AN EMPIRICAL TEST OF SOME POST-KEYNESIAN

INCOME DISTRIBUTION THEORIES

by

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ABSTRACT

An Empirical Test of Some Post-Keynesian Income
Distribution Theories

This thesis has two objectives; one, to introduce a
method of testing which is more fruitful than the conventional
approach and two, to test three post-Keynesian income
distribution theories.

An alternative approach to testing was introduced as a
solution for the following problem: given that there is no
inductive logic, what logical relationship between empirical
evidence and theories can be used as the basis for testing and
how can these tests be carried out? The proposed method of
testing uses the logical relationship between a theory and its
conclusions or predictions. More specifically, the falsity of
a theory's predictions or conclusions can be used to argue for
the falsity of the theory. The alternative method of testing
therefore involves looking for false predictions, i.e.
refuting evidence. This refuting evidence is sought by
constructing and looking for confirming instances of
counterexamples of the theory under examination. The
alternative approach to testing also involves examining the
empirical evidence to determine if it can also be considered
as a confirming instances of the theorems to which the
counterexample under examination correspond. This was done in
order to scrutinize the testing conventions.

The testing conventions which were used to test the three

above mentioned post-Keynesian income distribution theories
were taken from previous tests of one of the theories under
examination and from tests of similar theories. These testing
conventions were chosen so as to reflect conventional testing
procedures, empirical definitions and criteria for considering
empirical evidence as a confirming instance of a model or
theory.

Two of the three post-Keynesian income distribution
theories under consideration were outlined by Nicholas Kaldor,
(one in 1955 and the other in 1966); the third one was
outlined by A. Asimakopulos, (in 1975). All three are
macroeconomic distribution theories and include assumptions
which make them characteristically post-Keynesian in approach.
They were chosen for testing because: one, relatively little
empirical work has been carried out in the area of
post-Keynesian theory; two, post-Keynesian income distribution
theory represents an important part of post-Keynesian theory;
and three, only one of the three theories under examination
has been previously tested.

The three theories were tested by examining some of their
theorems. One theorem from Kaldor's 1955 theory was examined,
two from his 1966 theory and three from Asimakopulos' theory.
All six theorems take the form of predicted functional
relationships between certain macroeconomic aggregates, (e.g.
total corporate profits, the total wage bill, national income,
etc.). As mentioned, the objective of the tests was to find

refuting evidence. This refuting evidence was sought by constructing models of the counterexample of each theorem. These models took the form of functional relationships. The models of the counterexamples were constructed using the same variables which appear in the corresponding theorems and in such a way that the observation of a confirming instance of any one of them is ruled out by the truth of the theorems.

Generally the tests indicated that where the observations were interpreted as a confirming instance of one or more models of a counterexample, they were also interpreted as a confirming instance of the corresponding theorem, or if the observations were not interpreted as a confirming instance of one or more models of a counterexample, they were not also interpreted as a confirming instance of the corresponding theorem. This suggests that the testing conventions should be reexamined. There were, however, some exceptions. Relatively decisive results were obtained from tests of one of the theorems derived from Kaldor's 1966 theory and also from the tests of a theorem derived from Asimakopulos' theory. With respect to the latter, an evaluation of the tests results indicated that refuting evidence had been found.

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Chapter One - Introduction

This thesis has two objectives; one is to introduce a method of testing and the other is to present the results from tests of three post-Keynesian income distribution theories. The method of testing which will be introduced, involves looking for confirming instances of a theory's counterexamples. This method of testing was implemented to test the three above mentioned post-Keynesian income distrbution theories by constructing models of the counterexamples of six of the three theories' theorems.

. The proposed method of testing was used instead of the conventional approach, because of the following problem: The conventional method of testing, i.e., logical positivism, involves looking for confirming instances of the theory under examination. Because there is no inductive logic, these confirming instances cannot be used to argue for the truth of the theory being tested. Furthermore, if the tests fail to indicate that a confirming instance of the theory has been found, this does not imply that the theory is false. Logical positivism is, therefore, logically limited as a method for examining the truth or falsity of a theory.

On the other hand, if confirming instances are observed

of the counterexample, there is a logic by which this refuting evidence, (i.e., the confirming instances), can be used to argue for the falsity of the theory under examination.

The following post-Keynesian income distribution theories have been tested: a 'Keynesian' theory of income distribution first proposed by Nicholas Kaldor in a 1955 survey article of income distribution theories; another income distribution theory outlined by Kaldor in 1966, in which he introduced a securities market; and a more recent 'Kaleckian' theory proposed by A. Asimakopulos. Kaldor's 'First Theory' used some of the basic principles of Keynesian income determination theory to explain the distribution of income between profits and wages[1]. It is one of the original theories of its type, and is probably the best known of the three theories to be tested. His 'Second Theory' was included in the appendix of a reply to a criticism of Pasinetti's theory of income distribution and growth[2]. It was outlined to explain the distribution of income between the corporate and noncorporate sectors. Asimakopulos' theory is the most recent of the three and reflects some of the Kaleckian influences in post-Keynesian income distribution theory. It incorporates Kalecki's price mark-up method for explaining income distribution and some aspects of Kaldor's differential savings rate approach[3].

These three theories were chosen to be tested for several

reasons. Firstly, neither Kaldor's Second Theory, nor Asimakopulos' have been previously tested. Secondly, testing Kaldor's First Theory allows us to contrast the methodology of this thesis with tests done by others. Thirdly, these theories are, from amongst post-Keynesian income distribution theories, some of the most clearly laid out and amenable to testing. And fourthly, they are representative of post-Keynesian income distribution theories.

In Chapter Two each of the three theories will be discussed and axiomatized. This will allow us to identify the assumptions which are at stake, and to verify that the theorems follow logically from the theories. Expressing the theories in the logical form of a conjunction of a list of assumptions will also help to clarify the discussion of the role of models in testing.

The post-Keynesian income distribution literature in which the three theories can be found will be examined in Chapter Three. We will see that this literature can be divided into four areas. One area is made up of the macro-distribution theories and discussions following from Kaldor's First Theory. A second area comprises the theories and discussions which originate from Pasinetti's theory of income distribution and growth. A third area includes those theories and discussions which find their origins in Kaldor's Second Theory. And a fourth area of post-Keynesian income distribution theory is made up of the theories and discussions which utilize the

mark-up method of price determination as a mechanism for explaining income distribution. This fourth area of post-Keynesian income distribution theory includes Asimakopulos' theory.

Five empirical tests of Kaldor's First Theory, as well as several tests by Michal Kalecki, will be discussed in Chapter Four. Having these works for reference is valuable for two reasons. Firstly, they provide a contrast by which the differences between the the conventional and the proposed methods of testing can be emphasized. And secondly, they were a source of what will be called 'testing conventions'. Testing Conventions are 'empirical definitions', specifications of testing techniques, and criteria for determining when an observation statement can be accepted as a confirming instance of a theory or model. Since testing conventions were taken from sources other than prior tests, a discussion of the testing conventions will be left until Chapter Seven.

The methodology used to test the three theories will be outlined in Chapter Five. As mentioned, the tests of these theories involved looking for refuting evidence. This refuting evidence was sought by constructing and looking for confirming instances of models of the theory's counterexample(s). Models were constructed of the counterexamples for two reasons; firstly, so that confirming instances of the counterexample could be more easily observed or identified; and secondly, so that available testing conventions could be more readily used.

Seven theorems were derived from the three theories; one from Kaldor's First Theory, three from Kaldor's Second Theory, and three from Asimakopulos' theory. The six counterexamples, for which models were constructed, are counterexamples of these seven theorems, (in the case of Kaldor's Second Theory, two theorems are represented by one counterexample – see Chapter Six). The models of the counterexamples which were used in the empirical tests will be outlined in Chapter Six.

As mentioned above, the testing conventions will be discussed in Chapter Seven. The major problems to be resolved in this chapter were; firstly, how some of the relevant variables should be defined, and secondly, what criteria should be used to determine when an observation can be accepted as a confirming instance of a model.

The tests' results will be given in Chapter Eight. We will see that the testing conventions, commonly used to identify an observation as an confirming instance of a theory or model, will often also identify it as an confirming instance of a model of the theory's counterexample!

In the last chapter, Chapter Nine, a summary of the results and some concluding remarks will be presented.

Footnotes to Chapter One

1 N. Kaldor, "Alternative Theories of Distribution,"
    Review of Economic Studies 33 (1966): 83-100.

2 N. Kaldor, "Marginal Productivity and Macroeconomic
    Theories of Distribution," Review of Economic Studies
    33 (1966): 309-319, cited by G. Harcourt and N.F.
    Laing, Capital and Growth, (Harmondsworth, England:
    Penguin Books, 1971) pp. 295-310.

3 A. Asimakopulos, "A Kaleckian Theory of Income
    Distribution," Canadian Journal of Economics
    8(3) (August 1975): 313-333.

Chapter Two - Axiomatization of the Three Theories

In this chapter the theories to be tested will be discussed and axiomatized. As mentioned in the introduction, there are several reasons for wanting to express the theories logically as a conjunction of a set of assumptions. Firstly, it identifies the assumptions which are at stake; secondly it allows us to verify that the theorems to be tested do follow logically from a conjunction of the stated assumptions; thirdly, it allows us to check the assumptions for consistency; and fourthly, it helps to clarify the process of model building. Each of the theories will be discussed with the objective being first, to put the theory in the form of the conjunction of its assumptions, and second, to show how from this conjunction each of its principal assertions can be derived. The theories will be considered individually, starting with Kaldor's first theory of income distribution.

I. Kaldor's First Theory

Kaldor introduced his first theory of income distribution as the 'Keynesian' alternative in a survey article of income distribution theories[1]. The theory's principal assertion is that the wage and profit share can be expressed as a linear function of exogenously given levels of income and investment. The coefficients of this linear function are determined by the savings rates from wages and profits.

The theory shares two key assumptions with the simple Keynesian income determination model, (from which it originates), they are that investment is assumed to be; one, exogenously given; and two, equal to savings. In both theories these two assumptions are necessary so that the determinates of the level of savings must adjust in order to equilibrate savings and investment. Savings is a function of the level of income in the simple Keynesian income determination model and a function of the distribution of income in Kaldor's theory. Savings is therefore equated to investment by way of changes of the level of income in the former and the distribution of income in the latter. Kaldor had made the level of savings a function of the income distribution by assuming that the savings rates from wages and profits are not the same. Note that in order for savings to be a function only of the distribution of income it was necessary for Kaldor to assume that there is full employment.

If the full employment assumption were dropped from Kaldor's theory then savings would also be a function of the level of income, in which case the theory would not be sufficient to explain the income distribution. The full employment assumption is therefore necessary in order to deduce the theory's principal assertion.

Kaldor was aware that the full employment assumption represents a departure from the usual Keynesian approach; but he justified its usage by arguing that,

> these two uses of the multiplier principle are not as incompatible as would appear at first sight, the Keynesian technique, as I hope to show can be used for both purposes, provided one is conceived as a short-run theory and the other as a long-run theory - or rather, the one is used in the framework of a static model, and the other in the framework of a dynamic growth model.[2]

We are to understand from this argument that savings and investment will be equilibrated in the short-run by an adjustment in the level of income and in the long-run, by a redistribution of income.

The assertion that the level of income will adjust to changes in the level of investment in the short-run, and that the income distribution will eventually adjust in the long-run, rests on several implicit assumptions. They are as follows: Firstly, the level of income will change more quickly in response to changes in the level of investment than will the income distribution. Secondly, the level of income will return to the full employment level, as the income distribution adjusts to equate I and S. And thirdly, that the

inequality of savings and investment will cause income to be redistributed in such a way that savings will equal investment. Since Kaldor's theory assumes that income is at the full employment level, these implicit assumptions concerning the adjustment mechanism need not be listed, nor are they necessary for either the derivation of the principal assertion or the form of the principal assertion that was used in the tests.

Kaldor assumed that there is neither a government sector, nor foreign trade. Although this assumption ensures that government surpluses (deficits) and trade deficits (surpluses) will not unnecessarily complicate the analysis by becoming another source of savings, (or investment), it presents, as we will see later, some problems with respect to the testing conventions.

Kaldor also assumed that,

$$s_p > I/Y > s_w,$$

where $- s_p$ is the rate of savings from profits

and $- s_w$ is the rate of savings from wages.

This assumption ensures that there exists an income distribution where savings equals investment and that profits will move in the same direction as the level of investment.

The assumptions Kaldor used to derive the theorem that the level of profits, (or wages), is a linear function of income and investment, and a positive value, can be listed

below as follows:

(1.1) $Y = Y^*$, or income is equal to the level of income corresponding to the full employment of labour.

(and) (1.2) $I = I^*$, or investment is exogenously given.

(and) (1.3) $S_w = s_w W$, or savings from wages are some constant fraction of wages.

(and) (1.4) $S_p = s_p P$, or savings from profits are some constant fraction of profits.

(and) (1.5) $I = S = S_w + S_p$, or savings is equal to investment. Aggregate savings is made up of savings from wages and profits.

(and) (1.6) $Y = W + P$, or income is equal to wages plus rofits.

(and) (1.7) $s_p > I/Y > s_w$.

We can derive the theorem of interest by using these assumptions in the following steps. By assumptions (1.3), (1.4) and (1.5),

$$I = s_w W + s_p P.$$

and using assumption (1.6),

$$I = s_w(Y - P) + s_p P.$$

We can solve for P and P/Y as follows,

$$= s_w Y + (s_p - s_w)P$$

$$I - s_w Y = (s_p - s_w)P$$

$$P = (-s_w/(s_p - s_w))Y + (1/(s_p - s_w))I$$
$$P/Y = (-s_w/(s_p - s_w)) + (1/(s_p - s_w))(I/Y).$$

This theorem is the one derived by Kaldor, it is not however the form of the theorem that was tested. Instead the test was carried out on a variant of the theorem which specifies the relationship between wages and investment and income. Using assumption (1.6) we could have written,

$$I = s_w W + s_p(Y - W),$$

and derived that,

$$W = (s_p/(s_p - s_w))Y - (1/(s_p - s_w))I.$$

That is, the total wage bill is a linear function of income and investment, it is positively related to the former and negatively related to the latter.

Note that neither form of the theorem requires either assumptions (1.1), (1.2) or (1.7). With respect to Kaldor's principal assertion, the necessity of (1.7) has already been mentioned and (1.1) and (1.2) are necessary only to assert that the level and income shares of wages and profits are determined by the exogenously given levels of income and investment. It is worth bearing in mind however, that because the tests will be carried out on the above theorems, only assumptions (1.3),(1.4),(1.5) and (1.6) are at stake.

It may appear that assumption (1.1) conflicts with the implicit assumption, mentioned above, that changes in the level of income will equilibrate savings and investment in the short-run. The inconsistency could be overcome by restating

the assumption in a way which suggests that the level of income is close to the full employment level when measured over a long period of time. Kaldor does not do this, and as mentioned, this assumption is not used in the derivations.

II. Kaldor's Second Theory

In a reply to Samuelson and Modigliani's criticism of Pasinetti's theory of income distribution and growth[3], (discussed in the next chapter), Kaldor outlined another theory of income distribution[4]. The objective of this second theory was to explain the distribution of income between the corporate and noncorporate sectors. It closely resemblances his first income distribution theory discussed above, in that the following assumptions were retained; there is a full employment level of income, exogenously given investment, the equality of savings and investment, and differential savings rates. The major differences between the two theories are indicated by the following assumptions in the second theory; there exists a securities market, all noncorporate savings can be carried out only by way of the purchase of corporate equity, some fraction of capital gains is consumed[5], and a fraction 'i' of new investment is financed by the savings of the noncorporate sector. The fraction 'i' is determined by the corporate sector, (and is to be considered as exogenously given).

In the securities market of the second theory, it is

implicitly assumed that the price of securities will rise when desired noncorporate savings exceeds the value of the new shares sold to finance investment. The resulting capital gains increase the consumption of equity holders. Prices and the consumption of equity holders will continue to increase until net noncorporate savings has been lowered to an amount equal to the fraction of investment to be financed by the noncorporate sector. In this way the desired savings of the noncorporate sector is equated to the sector's investment opportunities. A similar process operates when the investment to be financed by the noncorporate sector exceeds desired savings.

The assumption that savings equals investment, in conjunction with the assertion that net noncorporate savings equals the noncorporate sector's investment opportunities, would suggest that corporate savings must equal the level of investment not financed by the noncorporate sector. Since the fraction 'i' of investment financed by the noncorporate sector is (exogenously) determined by the corporate sector, and corporations are assumed to save a fraction of their profits, savings and investment can be equilibrated only by a redistribution of income to or from profits. Note that this conclusion required the implicit assumption that the level of income is exogenously given. If it were not exogenously given then the level of savings would be a function of both the income distribution and the level of income. The theory would

not therefore be sufficient to explain the income distribution.

Kaldor's interpretation of capital gains suggests that he was implicitly assuming a long-run equilibrium in the securities market. Kaldor introduced a variable, v, the valuation ratio, which measures the ratio of the market value of corporate equity to the book value of corporate capital stock, K. Since the market value of corporate equity would therefore be vK, capital gains, G, can be expressed as,

$$G = Kdv + vdK + dvdK,$$

where 'd' indicates a marginal change of the variable which it precedes, (i.e. it is not a coefficient). A long-run equilibrium condition in a growing economy is that dv = 0, or rather that G = vdK. Kaldor has used G = vdK to solve for v. Without this assumption, v would be a function which solves a differential equation. As we will see, this assumption is not necessary to solve for the level of corporate profits. The predicted relationship between the level of profits and investment therefore holds in both the short and long-run.

The theory, expressed as the conjunction of a list of assumptions, is given below. Kaldor's notation has been changed only slightly by substituting I for gK.

(2.1) Y = Y*, where Y* is equal to the
full employment level of income.

(and)   (2.2) $I = I^* = gK$, or investment is equal to
the product of the exogenously given growth
rate of capital, g, and the quantity of
capital in book value terms.

(and)   (2.3) $I = S$, or savings equals investment.
All savings are from either wages or profits.

(and)   (2.4)(a)(i) the rate of consumption out of
capital gains, G, is some fraction c,

(ii) $S_W = s_W W$, the rate of savings
from wages is s_W,

(iii) the rate of savings out of
dividends, s_d, is zero.

(or) (b) the rate of savings from dividends
and wages is s_h, and the rate of
consumption from capital gains is $1 - s_h$.

(and)   (2.5) Savings from noncorporate income, that is
wages or dividends, are used only to
purchase securities, (demand for securities).

(and)   (2.6) Securities issued by the firms are some
constant fraction, 'i', of new investment,
(supply of securities).

(and)   (2.7) $G = I(v - i)$, or capital gains are equal
to the market value of the new investment,
vI, less that portion of investment
financed by the sale of new shares. v is
equal to the ratio of the securities market

value of firms to the supply price of their
capital (book value).

(and)   (2.8) The demand for securities equals the supply.

(and)   (2.9) A constant fraction, s_c, of corporate
profits is saved, the rest is paid
to shareholders as dividends.

(and)   (2.10) Y = W + P, income is equal to wages plus
profits, only the noncorporate sector
receives wages.

Two assumptions, (a) and (b), are given as assumption
(2.4) because Kaldor added in a footnote that:

> It would be possible to assume that there is only a
> single savings propensity for the household sector
> which applies equally to wages, dividends and capital
> gains[6].

He proceeded in the same footnote and worked out the theorems.
Both forms of the theory will be tested, since it will require
little extra effort.

The steps are given below for deriving the theorems of
interest from the above assumptions. P and v will be derived
first from the theory using assumption (2.4)(a).

By assumptions (2.4)(a),(2.5) and (2.9) net savings of
noncorporate income is equal to,

$$s_w W + s_d (1 - s_c)P - cG,$$

this can be interpreted as the demand for corporate
securities. By assumption (2.6), the supply of corporate
securities is, iI, and using assumption (2.9) we can say that,

$$iI = s_wW + s_d(1 - s_c)P - cG.$$

Using assumption (2.4)(a)(iii), $s_d = 0$, the above can be, expressed as:

$$\text{net noncorporate savings} = iI = s_wW - cG.$$

From assumptions (2.3),(2.9) and (2.4)(a), we obtain that,

$$I = s_cP + s_wW - cG.$$

Using the equation for iI,

$$s_wW - cI(v - i) = iI,$$

we can derive that,

$$s_wW = iI + cI(v - i).$$

Substituting this into $I = s_cP + s_wW - cG$

and using assumption (2.7) gives,

$$I = s_cP + iI + cI(v - i) - cI(v - i)$$
$$= s_cP + iI$$
$$(1 - i)I = s_cP$$
$$P = ((1 - i)/s_c)I$$

This solves for P as a function of I. Note however that it was not necessary to have expressed cG as $cI(v - i)$, (this was done above only because Kaldor used $cI(v - i)$ for cG in the steps of his derivations)[7]. As long as there is an equilibrium in the securities market, such that iI + cG can replace swW in the equation for I, it does not matter how cG is defined, since in any case it is cancelled out.

The next variable of interest is v. Its derivation is given below.

Again by assumptions (2.4)(a),(2.5),(2.6),(2.8),(2.9) and

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(2.10),

$$iI = s_w W + s_d(1 - s_c)P - cG,$$

and by (2.4)(a),

$$iI = s_w W - cG.$$

Using assumption (2.7),

$$iI = s_w W - cI(v - i).$$

Sustituting in, $W = Y - P$, from assumption (2.10) gives,

$$iI = s_w(Y - P) - cI(v - i),$$

and substituting into this the solution derived above for P
gives,

$$iI = s_w Y - s_w((1 - i)/s_c)I - cI(v - i),$$
$$= s_w Y - (s_w/s_c)I + (s_w/s_c)iI - cvI + ciI,$$

we can solve for v by way of the following steps,

$$cvI = s_w Y - (s_w/s_c)I + (s_w/s_c)iI + ciI - iI,$$
$$cv = s_w Y/I - (s_w/s_c) + (s_w/s_c)i + ci - i,$$
$$v = (1/c)[s_w Y/I - (s_w/s_c)(1 - i) - i(1 - c)].$$

This result requires the assumption that $G = vdK$, (expressed
as $G = I(v - i)$). If Kaldor had wished to consider the
short-run, and therefore assumed that $G = vdK + Kdv + dvdK$,
then v would be the solution of the following differential
equation,

$$v = (1/c)[s_w Y/I - (s_w/s_c)(1 - i) - i(1 - c)]$$
$$- [(K + I)/cI]dv.$$

This is a differential equation of the form:

$$v = a - bdv.$$

It will converge to the above solution for v in the long-run.

We will solve for v and P again, this time using assumption (2.4)(b). For brevity we can start at the steps of the above proofs where (2.4)(a) is used,

net noncorporate savings = $iI = s_wW + s_d(1 - s_c)P - cG$.

By assumption (2.4)(b),

$$s_w = s_h, \quad s_d = s_h, \quad \text{and } c = (1 - s_h)$$

so that the equation for net noncorporate savings can be rewritten as,

$$iI = s_hW + s_h(1 - s_c)P - (1 - s_h)G.$$

Using assumptions (2.3) and (2.10) and the above equation for iI,

$$I = s_cP + s_hW + s_h(1 - s_c)P - (1 - s_h)G.$$

The above equation for iI can be manipulated to give the following,

$$s_hW + s_h(1 - s_c)P = iI + (1 - s_h)cG.$$

Substituting the right-hand side of the above into the equation for I allows us to solve for P as follows,

$$I = s_cP + iI + (1 - s_h)cG - (1 - s_h)cG,$$

$$= s_cP + iI,$$

$$P = [(1 - i)/s_c]I.$$

Notice that his solution does not require an assumption of long-run equilibrium in the securities market.

To solve for v we start again at,

net noncorporate savings = $iI = s_wW + s_d(1 - s_c)P - cG$.

Using assumption (2.4) (b) this can be expressed as,

$$iI = s_h W + s_h(1 - s_c)P - (1 - s_h)G.$$

From Assumption (2.7), $G = I(v - i)$, and (2.10), $W = Y - P$, and substituting in,

$$P = [(1 - i)/s_c]I,$$

we get,

$$iI = s_h Y - s_h[(1 - i)/s_c]I + s_h(1 - s_c)[(1 - i)/s_c]I$$
$$- (1 - s_h)I(v - i)$$
$$= s_w Y - s_h(1 - i)I - (1 - s_h)vI + (1 - s_h)iI$$

and we solve for v by way of,

$$(1 - s_h)vI = s_h Y - s_h(1 - i)I + i(1 - s_h)I - iI,$$

$$v = (s_h Y/I)/(1 - s_h) - s_h(1 - i)/(1 - s_h) + i - i/(1 - s_h),$$

$$v = [(s_h Y/I) - s_h(1 - i) - i]/(1 - s_h + i$$

$$v = [s_h Y/I - s_h + s_h i - i + i - s_h i]/(1 - s_h)$$

$$v = (s_h Y/I - s_h)/(1 - s_h),$$

$$= 1 - (1 - s_h Y/I)/(1 - s_h).$$

Once again, this is the long-run equilibrium solution for v. In the short-run v would be obtained by solving a differential equation similar to the one derived using assumption (2.4)(a).

Since in this theory, corporations set the level of net noncorporate savings by way of 'i', it should not be surprising that a change of noncorporate savings propensities does not change the distribution of income between the corporate and noncorporate sectors. It is also worth noting that neither assumption (2.1) nor (2.2) were used. As was the case for similar assumptions in Kaldor's First Theory, they

are necessary only to assert that profits, and the profit

share, are determined by the level of income and investment.

The theorems derived above state only that a certain

relationships exist, firstly between profits and investment,

and secondly, between the valuation ratio and investment and

income. This was all that was necessary for the purposes of

testing.

III. Asimakopulos' 'Kaleckian' Theory

The third theory to be considered is Asimakopulos'. He

outlined his theory of employment, profits and profit share in

an article published in 1975[8]. Although a similar theory can

be found in another article by D.J. Harris[9], (to be discussed

in Chapter Three), Asimakopulos' theory was chosen for testing

because the theorems are more clearly laid out.

Asimakopulos outlined two theories of the distribution of

income between profits and wages. The second theory is a more

sophisticated version of the first, although most of the

article in which they are given is devoted to a discussion of,

and a derivation of theorems from, the first theory. He

introduced the second theory after commenting that "Some of

the assumptions made in setting up the model in the text were

introduced for the sake of simplicity in presentation"[10]. He

then went on to present the theorems that would follow from

assuming, firstly, that workers also save, and secondly, that

wages and distributed profits are saved at the same rate, (he did not give the derivations). It was decided to test the second theory for two reasons; one, the assumptions are probably more acceptable in the sense that they would be considered more realistic than the assumptions of the first theory; and two, Asimakopulos has stated that the first theory was outlined principally 'for the sake of simplicity in presentation'.

In many respects Asimakopulos' theory is much like Kaldor's. All three theories require the equality of savings and investment, and all three assume that investment is exogenously given such that adjustments must be made by way of savings. They differ in that the level of savings adjusts by way of a redistribution of income in Kaldor's theories and a change in the level of income in Asimakopulos'.

Asimakopulos introduced income distribution by assuming, firstly, that firms have fixed and variable costs in the form of 'overhead' and 'direct' labour respectively, and, secondly, that prices are a mark-up on variable costs. Overhead labour, the fixed cost, is defined as the labour input necessary to operate the plant (firm) at any nonzero level of production, while direct labour determines the level of output. Increases in the utilization of the latter increase output at a constant marginal rate. The average cost of the overhead and direct labour inputs is therefore declining as output increases. By assuming that prices are set by a fixed mark-up on variable

costs, Asimakopulos is able to assert that as output increases average costs in terms of the price level are falling. Profits per unit are therefore increasing with output.

The linkages of Asimakopulos' theory can be summarized as follows, (where H is overhead labour and G is direct labour); an increase (decrease) of I means an increase (decrease) of Y and L, since H is given, G also increases (decreases), this means that average costs decrease (increase), and because the price does not change with respect to average variable costs, P increases (decreases) as well.

Asimakopulos' theory can be expressed as the conjunction of the set of assumptions given below.

(3.1) J = J*, or investment is exogenously given
in physical units as J*.

(and) (3.2) S = sW + sbP + (1 - b)P,

where s - is the propensity to save
of individuals,

b - is the proportion of profits
distributed to the firms' owners,

P - profits in money terms,

W - is the total wage bill in
money terms.

(and) (3.3) pJ = S, or investment equals savings,

where p - is the price of the multipurpose
good, assumed to be the only

good produced,

(and)   (3.4) $Y = wL + P$

$= W + P$, income is equal to wages

plus profits.

(and)   (3.5) $p = (1 + u)(w/a)$

where u – is the mark-up,

w – is the wage rate,

a – is the rate of output per variable

labour input. The time period

over which a is measured

corresponds to the time period

over which the wage rate is

measured.

(and)   (3.6) $Y = paG$, income is equal to the value of

output,

where – G is the variable or direct labour

input to production.

(and)   (3.7) $L = G + H$, or all employed labour can

be put into one of two categories,

either direct or overhead labour,

where H – is the overhead labour,

(required to operate the plant

at any nonzero output).

Asimakopulos derived three theorems. They are the

following;

$$G = \frac{(1 + u)J^* + aH(1 - b + sb - s)}{a[u(1 - b + sb) + s]}$$

$$P = \frac{(1 + u)w(J^* - saH)}{a[u(1 - b + sb) + s]}$$

$$P/Y = \frac{J^* - saH}{(1 + u)J^* + aH(1 - b + sb - s)}$$

The derivation of these theorems will be given below, although because it would be long and tedious to go through every step of the proofs, some of the algebraic manipulations will be dropped. In any case, showing all of the steps is not necessary since the objective is only to indicate where and how the assumptions are used.

To obtain the first theorem we start by using assumptions (3.2) and (3.3) to derive that,

$$pJ = sW + (1 - b)P - sbP,$$

then using assumptions (3.4) and (3.7) we obtain that,

$$pJ = swH + swG + (1 - b)(Y - wL) + sb(Y - wL)$$

$$= swH + swG + (1 - b + sb)Y - (1 - b + sb)wL$$

Using assumptions (3.6) and (3.7) this can be rewritten as,

$$pJ = swH + swG + (1 - b + sb)paG$$

$$- (1 - b + sb)wH - (1 - b + sb)wG$$

By way of some algebraic manipulations, omitted for the sake of brevity, we can derive that,

$$pJ = wG[u(1 - b + sb) + s] - wH(1 - b + sb - s).$$

Using assumption (3.5) this can be rewritten as,

$$(1 + u)J = aG[u(1 - b + sb) + s] - aH(1 - b + sb - s).$$

Solving for G gives the following:

$$G = \frac{(1 + u)J + aH(1 - b + sb - s)}{a[u(1 - b + sb) + s]}$$

The theorem for profits can be derived by using the solution obtained above for the direct (variable) labour input. The right hand side of the above equation for G can be substituted into, (from assumptions (3.6) and (3.7)),

$$paG = wL + P,$$

and with some algebraic manipulations, profits can be solved to give the following:

$$P = \frac{(1 + u)w(uJ - saH)}{a[u(1 - b + sb) + s]}.$$

The other theorem of interest is the equation for P/Y. Using assumptions (3.5) and (3.6) we know that,

$$Y = (1 + u)wG.$$

G can be removed by substituting the right hand side of the above equation for G in its place. P/Y can be solved in terms of the exogenous variables by dividing the right hand side of the equation for P, by the right hand side of the above equation for Y, after the G has been replaced by the right hand side of the equation for G. This will give the following:

$$P/Y = \cfrac{\cfrac{(1 + u)w(uJ - saH)}{a[u(1 - b + sb) + s]}}{\cfrac{(1 + u)w[(1 + u)J + aH(1 - b + sb - s)]}{a[u(1 - b + sb) + s]}}$$

With the appropriate cancelations this yields,

$$P/Y = \frac{uJ - saH}{(1 + u)J + aH(1 - b + sb - s)}$$

The theorem for profits, P, and the profit share, P/Y, as they have been derived above, differ slight from Asimakopulos' results. He obtained the following:

$$P = \frac{(1 + u)w(J - saH)}{a[u(1 - b + sb) + s]}$$

and
$$P/Y = \frac{J - saH}{(1 + u)J + aH(1 - b + sb - s)}$$

It is difficult to see where the 'u' has been cancelled out. In any case it makes little difference to the empirical tests.

The level of investment in the above theorems has been expressed in real value terms. Investment could be more easily measured and the theorems therefore more easily tested if it were expressed as a money value. For all three of the above

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theorems this can be done without too much difficulty. It involves algebraic manipulations in the form of multiplying the numerator and denominator on the right-hand side by p, w/a or a.

With the appropriate algebraic manipulations the theorems become,

$$G = \frac{pJ + wH(1 - b + sb - s)}{w[u(1 - b) + sb) + s]}$$

$$P = \frac{upJ - spaH}{[u(1 - b + sb) + s]}$$

and

$$P/Y = \frac{upJ - spaH}{(1 + u)pJ + paH(1 - b + sb - s)}$$

Henceforth pJ will be written only as I, where I is investment in money terms. This need not be done for P and P/Y, since they are already expressed as money values.

By way of a note it should be pointed out that at this level of abstraction only one value of p is involved. It is not a price vector because Asimakopulos has assumed there exists only a single multipurpose good. This does not affect the tests since the assumption of a single multipurpose good is not used in the derivations and the variables are expressed as money values.

Note that assumption (3.1) has not been used. It is necessary only to assert that J* determines the level of profits, etc., (along with overhead labour which is also exogenously given). The theorems therefore only assert that certain functional relationships exist between the endogenous and exogenous variables.

IV. The Theorems

In the above, the six theorems to be tested have each been derived from the conjunction of the appropriate list of assumptions. In this section, each of these theorems will be discussed starting with Kaldor's First Theory.

Kaldor's First Theory – Theorem 1

The theorem for the total wage bill was deduced from Kaldor's First Theory as the following:
$$W = (s_p/(s_p - s_w))Y + (1/(s_p - s_w))I.$$
Ordinarily, in the context of this model, s_w and s_p would be considered as parameters, (although the theory does not contain an assertion to the effect that they cannot change). If s_w and s_p are interpreted in this way then the theorem is an assertion that the total wage bill can be expressed as a linear function of the exogenously given level of income, Y, and the level of investment, I.

The coefficient for Y is positive and the one for I is negative. Furthermore, the absolute value of both coefficients

is greater than one. With respect to Y, this would follow intuitively since income in this theory is distributed so as to equate savings and investment; an increase of income, because it will increase savings, will therefore necessitate a redistribution of income from profits, which has a high savings rate, to wages, which has a low savings rate, (in order to reduce savings to the level of investment). Wages will therefore increase not only because of the increase·of income, but also because of the latter's redistribution.

The coefficient of I will be less than negative one for much the same reason. If investment increases, unless s_p equals one and s_w, zero, then profits will have to increase by a greater amount in order to equate savings and investment.

Kaldor's Second Theory - Theorem 2

Two theorems for the valuation ratio have been deduced from two forms of Kaldor's Second Theory. The two theorems are:

$$v = (1/c)[s_w Y/I - (s_w/s_c)(1 - i) - i(1 - c)]$$

and $$v = 1 - (1 - s_h Y/I)/(1 - s_h).$$

In the context of the model, the following would ordinarily be considered as parameters: the savings rate of the noncorporate sector, s_w, the corporate retention rate, s_c, the proportion of investment financed by the noncorporate sector, i, the rate of consumption from capital gains, c, and the overall household savings rate

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s_h. If s_w, s_c, i, c and s_h are interpreted in this way then v could be expressed as a linear function of Y/I. The coefficient of Y/I is positive, (i.e. s_w/c and s_h are greater than 0). This means that, for a given level of income, as the level of investment increases the valuation ratio falls. This follows intuitively, since for higher levels of investment there is consequently a greater capital stock and therefore a lower ratio between the market value of capital and its book value. Similarly, for a given level of investment as the level of income increases so does the valuation ratio. This is because with an increased level of income there will be a higher level of savings. The higher valuation ratio which will be associated with this higher level of income provides the mechanism by which savings is brought into equilibrium with investment. More specifically, a higher valuation ratio means that there will be greater capital gains for any given level of investment. As an equilibrium condition, the valuation ratio will take on a value such that the resulting increase in consumption (from capital gains) will compensate for the increased savings of a higher level of income.

Theorem 3

The theorem for the level of profits in Kaldor's Second Theory has been derived as:

$$P = (1 + i)I/s_c.$$

i and

s_c would ordinarily be considered as parameters, (although the theory does not rule out the possbility that they can change). If i and s_c are interpreted in this way then the level of profits could be expressed as a linear function of the exogenously given level of investment I.

The above theorem can also be expressed as $s_c P = (1 + i)I$. That is, the savings of the corporate sector, (which receives all of the profits), must equal the level of investment, $(1 + i)I$, undertaken by this sector. In other words the level of profits, P, is determined by $(1 - i)I$, so as to equate corporate savings and investment.

Asimakopulos' Theory – Theorem 4

The theorem for the level of direct employment, G, has been derived from Asimakopulos' theory as follows (expressed in terms of the exogenous variables):

$$G = \frac{(1 + u)J + aH(1 - b + sb - s)}{a[u(1 - b + sb) + s]}.$$

The theorem is less complicated than it looks since in the context of the theory the following would ordinarily be understood to be parameters: the mark-up, u, average productivity, a, the proportion of profits distributed by the firms' owners, b, and the savings rate of individuals, s. The theory, however, does not rule out the possibility the these 'parameters' do not change. H might also be considered as a parameter, (depending upon the conventions which are used to

examine the theory). The level of direct employment can therefore be expressed as a linear function of the exogenously determined level of real investment, J, and possibly overhead labour, H. Their coefficients would be determined by a, u, b and s.

Theorem 5

The theorem for the profit share, P/Y, has been derived above as:

$$P/Y = \frac{uJ - saH}{(1 + u)J + aH(1 - b + sb - s)}.$$

Once again u, a, b, and s would ordinarily be considered as the parameters. However, unlike the other theorems, the relationship between the share of profits and the exogenous variables, real investment and overhead labour, is nonlinear.

The numerator of the right hand side is proportional with the level of profits and the denominator is proportional to the level of income. Note that the profit share decreases as the quantity of overhead labour utilized in production increases but increases as real investment increases.

Theorem 6

The theorem for the level of profits, P, has been derived as:

$$P = \frac{(1 + u)w(uJ - saH)}{a[u(1 - b + sb) + s]}.$$

Once again, in the context of the model, u, a, b and s would ordinarily be considered as parameters, as would the wage rate, w. If u, a, b, and s are interpreted in this way then this theorem expresses the profit level, P, as a linear function of real investment, J, and overhead labour, H. The coefficient of H is negative and the one for J is positive. The negative coefficient for H means that, all other things being equal, the economy with more overhead labour has a lower level of profits. This is because the revenues received by the firm after paying direct labour costs, i.e. uwG, are divided up between overhead labour costs, wH, and profits, P, so that if overhead labour costs increase it can only be at the expense of profits, (since u is given). The coefficient for real investment, J, is positive because an increase of real investment must be associated with an increase in the level of income and direct labour utilized in production, (in order to eqilibrate savings and investment). A consequence of the increase in the level of income and direct labour utilized in production is that profits must also increase.

The Theorems in the Tests

In order to have the theorems in a form which could be tested, it was necessary to make further derivations. The forms of the theorems which were tested are listed below, the 'variables' which would ordinarily be considered as parameters have been put into the coefficients: 'a', 'b', 'c', or 'e'. The theorems are as follows:

Theorem 1,

$$W = aI + bY$$

Theorem 2,

$$v = a(Y/I) + b$$

Theorem 3,

$$P = aI$$

Theorem 4,

$$(G/L)W = aI + b(H/G)Y$$

Theorem 5,

$$P/Y = \frac{aI + b(H/G)Y}{cI + e(H/G)Y}$$

Theorem 6,

$$P = aI + b(H/G)Y$$

The derivation of the above forms of the theorems will be outlined in Chapter Six.

Footnotes to Chapter Two

1 It is interesting to note that Kaldor put Kalecki's mark-up
theory of distribution under the heading of 'Neoclassical
Theories'.
Kaldor, "Alternative Theories of Distribution," 90.

2 Ibid., 94.

3 P.A. Samuelson and F. Modigliani, "The Pasinetti Paradox
     in Neo-Classical and More General Models,"
     Review of Economic Studies 33 (1966): 269-301.

4 Kaldor, "Marginal Productivity and Macroeconomic Theories
     of Distribution," pp. 295-310.

5 Kaldor stated that 'consumption out of capital ..... is some
fraction (c) of their capital gains'. To ensure that there is
always an equilibrium this must also be interpreted as a
decrease of consumption by 'c' in the case of a capital loss.
Kaldor, "Marginal Productivity and Macroeconomic Theories
     of Distribution," 317.

6 Ibid., 318.

7 Kaldor reduced the theory to a system of two equations with
two unknowns, i.e., v and P. He gave the theorems for v and P
as the solution of the system of two equations.
Ibid., 317.

8 Asimakopulos, "A Kaleckian Theory of Income Distribution."

9 Donald J. Harris "The Price Policy of Firms, the Level
     of Employment and Distribution of Income in the
     Short Run," Australian Economic Papers 13(2.2)
     (June 1974): 144-151.

10 Asimakopulos, "A Kaleckian Theory of Income Distribution,"
     331.

Chapter Three — A Review of the Literature

The objective of this chapter is to discuss the post-Keynesian income distribution literature and to examine the place in this literature of the three theories under examination. The discussion will be organized under the following headings: (1) Kaldor's First Theory of Income Distribution; (2) Pasinetti's Theory of Income Distribution and Growth; (3) Kaldor's Second Theory of Income Distribution; and (4) Kalecki's Price Mark-up Theory.

Post-Keynesian income distribution theories are characterized by their assumptions of institutional behaviour. More specifically, almost all post-Keynesian income distribution theories use at least one of the two following sets of institutional assumptions: (1) the mark-up method of price determination; or (2) the differential savings rate approach. Note, for example, that all three of the theories under examination use the differential savings rate approach and one, that is, Asimakopulos' theory, also uses the price mark-up method. In this respect the three theories that were tested are representative of post-Keynesian income distribution theories.

Differential Savings Rate Method

The differential savings rate approach is largely attributable to Nicholas Kaldor[1]. Theories which embody this approach ordinarily contain assumptions to the affect that income classes can be identified, and that at least one of the income classes has a different savings rate. More specifically, it is usually assumed that there are two income classes, either wages and profits[2], (the savings rate is a characteristic of the income source), or capitalists and workers, (the savings rate is a characteristic of the income recipients). It follows from these assumptions that the level of savings is a function of the distribution of income. The differential savings rate approach also makes use of the following 'Keynesian' assumptions: (1) savings is equal to investment, and (2) investment is exogenously given.

Price Mark-up Method

The usage of the mark-up method of price determination as a means of explaining income distribution is largely attributable to Michal Kalecki. This approach is characterized by the assumption that firms mechanically mark-up prices over costs. The income distribution is determined by the size of the mark-up. Kalecki, for example, expressed the relationship between prices and costs as follows;

$$p = mu + np^*$$

> where p - the price charged by the firm

under consideration,

u – unit prime costs,

m – the firm's mark-up (a measure of their 'degree of monopoly').

p* – average price in the industry,

n – degree of monopoly of the firm's position[3].

For Kalecki the size of the mark-up is determined by the 'degree of monopoly'. Not all post-Keynesians have been satisfied with this theory of the mark-up. Alfred Eichner, for instance, has outlined a theory in which the mark-up is determined by the equality of the demand for and supply of additional investment funds[4].

Keynesian Origins

John Maynard Keynes did not outline a theory of income distribution. The extension of Keynes' work to the area of income distribution was carried out by Kaldor, Joan Robinson, Richard Kahn and others. J.A. Kregel has stated the case for tracing the origins of Post-Keynesian income distribution theories to Keynes, as follows:

> The post-Keynesian approach to income distribution takes the central proposition of Keynes' theory of output and employment as its point of departure. This proposition can be summarized briefly in the statement that "given the psychology of the public, the level of output and employment as a whole depends on the amount of investment ......
> It is of course, well known that Keynes did not deal explicitly with the question of distribution in the The General Theory. Yet he made a number of

suggestions about the effects of the distribution of income on the level of employment and, in particular on the level and composition of aggregate demand....

Thus, when Keynes' pupils and followers, such as Joan Robinson, Richard Kahn and Nicholas Kaldor, went on to investigate the wider theoretical implications of Keynes' theory of employment..... it was perhaps natural that they should attempt to determine, in a more systematic manner, the implications of Keynes' theory of income determination for the analysis of income distribution[5].

Kaleckian Origins

At the same time that Keynes was producing his 'General Theory...', Kalecki was working on models and theories that bear close resemblance to some of the Keynesian models that became popular in the 1940's and 50's. His article, 'The Determination of Profits'[6], which contained some of what would now be called, Keynesian features, first appeared in 1933. Other articles such as 'The Determination of National Income and Consumption', which also used what would now be called a Keynesian approach, were published in the late 1930's[7]. It is therefore not surprising that a post-Keynesian income distribution theory such as Asimakopulos', should be referred to as 'Kaleckian'.

Kaldor's Contribution

The writings that have originated from Kaldor's first
theory of income distribution will be organized under three
headings: (1) Kaldor's First Theory; (2) Pasinetti's Theory of
Income Distribution and Growth; and (3) Kaldor's Second
Theory. Under the first heading, we will examine works where
the theory under consideration is either Kaldor's First Theory
or a variant of his First Theory. The theories which they
discussed or proposed are characterized by the following
assumptions: one, savings equals investment; two, there are
several income sources, each with its own savings rate; and
three, equilibrium need only be in the short-run, (although
some of the discussions involved an assumption of long-run
equilibrium). The writings discussed under the second heading
generally deal with Pasinetti's theory of income distribution
and growth. They differ from writings under the first heading
in that the rate of savings is assumed to be a characteristic
of the income recipients, not the income source, and that it
is ordinarily necessary to assume a long-run equilibrium. The
works under the third heading are related to Kaldor's second
theory of income distribution. The theories which they
discussed or proposed are characterized by the following
assumptions: one, the economy is in a long-run equilibrium;
and two, it is assumed that a financial market acts as an
intermediary between the savings of the noncorporate sector
and investment activity. With respect to the assumption of

long-run equilibrium, note that in Kaldor's Second Theory this assumption is not necessary to deduce the level of profits or the income distribution, it is necessary only to obtain the theorem for the valuation ratio.

I. Kaldor's First Theory

Kaldor outlined his first theory of income distribution in a survey article of income distribution theories[8], It was given as the 'Keynesian alternative'. This theory has been discussed in Chapter Two.

The above mentioned survey article, which contained Kaldor's First Theory, was followed shortly thereafter by another article[9] in which he amended his theory of distribution in order to obtain a theory of balanced growth. This theory of balanced growth concentrates more on the capital requirements of growth than on the distributional aspects. Although both theories are often discussed together and are sometimes treated as though they are one theory, these discussions usually emphasize the theory of growth. For this reason and because Kaldor's 'model of economic growth' deals with growth, neither the growth model nor the literature which follows from it will be discussed.

Empirical tests of Kaldor's first theory have been carried out by Melvin Reder, L.E. Gallaway, I.B. Kravis, B. Dholakia and, V. Bharadwaj and P. Dave. These tests will be

discussed separately, in the next Chapter, so that the
procedures and definitions they used can be examined more
closely.

Kaldor's first theory of income distribution is most
commonly discussed, or examined, by altering the theory's
assumptions or adding assumptions to those already present in
the theory. This procedure usually involves dropping
(altering) the full employment assumption. This approach of
altering and adding assumptions has been used by E. Schneider,
H. Atsumi, J. Tobin, G.C. Harcourt, K.W. Rothschild, B. Moore,
C.E. Ferguson and P. Pattenati. Their contributions will be
discussed in order to examine the trends in this area of
post-Keynesian income distribution theory. As we will see,
there is no one theme or debate which has dominated the
literature of this area.

Hiroshi Atsumi[10] introduced a production function to
replace Kaldor's full employment assumption, and assumed that
workers are paid their marginal product. The income
distribution in this modified form of the theory, is
determined by the exogenously given level of investment and
the nature of the production function. That is, for a given
level of investment, the income distribution is determined as
an equilibrium condition necessary for the equality of; the
wage rate and the marginal product of labour; and savings and

investment. Atsumi concluded that,

> In order to determine the equilibrium distribution of income both the principle of the Multiplier and the production function (in other words, the marginal principle) are indispensible. The latter principle should not be replaced by the given level of income.[11]

James Tobin introduced the assumption that workers and capitalists can each as a group, control their own savings rates. He also assumed that they will change their savings rate so as to increase their income shares[12]. With these two assumptions, in conjunction with Kaldor's theory, he conluded that "the whole theory of distribution will have to be surrendered to the game theorists."[13]He is, in other words, unable to deduce, from the new set of assumptions, Kaldor's theorem, or any other theorem which determines the distribution of income.

G. C. Harcourt, in his article "A Critique of Mr. Kaldor's Model of Income Distribution and Economic Growth"[14], deals at once with both Kaldor's income distribution theory and his theory of growth. Harcourt argued that; "For Kaldor's model of economic growth to work, the distributive mechanism must operate in the short period, despite his disclaimer to the contrary"[15]. Harcourt maintained that the distribution mechanism must work in the short-run because; "any change in planned investment at the beginning of a short period is also

accompanied by movements of resources, prices and the distribution of income, (so) that investment planned at the beginning of the period becomes actual investment by the end"[16], (i.e., ex-post savings must equal investment). With respect to the operation of the distribution mechanism he poses the following question: "What patterns of entrepreneurial behaviour with regard to pricing would allow the Kaldor mechanism to work in the short period"[17]. In order to determine what these patterns are, he then assumed the existence of a two sector economy, (i.e., a consumption and investment goods sector). He deduced four conditions that must hold if, in the short-run, planned investment is to become actual investment.

As a criticism of Kaldor's distribution theory, Harcourt's argument hinges on a rigid interpretation of the full employment assumption, i.e., that it must hold in both the long and short-runs. It is possible, in the case of Kaldor's distribution theory, to more liberally interpret the assumption as 'close to full employment' or 'roughly full employment over long periods of time'. This can be done without losing the ability to deduce a slightly modified version of the theory's principal assertion; i.e., that the savings rates and the investment income ratio, are the determinents of the income distribution over some 'long' period of time.

Paolo Pettenati[18] dealt at once with both of Kaldor's income distribution theories. Kaldor's Second Theory is converted into something similar to his First Theory by dropping the securities market, and assuming that some fraction of corporate retentions is consumed, (to account for the consumption of capital gains). Pettenati argued that if Kaldor's theories are to be called 'Keynesian' they should not contradict other relevant parts of Keynes' theory, notably the theory of interest and money.

Pettenati pointed out that Kaldor's theories assume that the capacity utilization of labour is the only effective constraint on the level of output. He then set out to show that "only the opposite assumption, (the level of income associated with capacity utilization of capital is less than the level of income associated with the capacity utilization of labour), makes the Cambridge theory of distribution perfectly consistent with Keynes's theory of the rate of interest (or better, given the assumptions made in this section, with the money-and-capital version of the latter theory)"[19].

Pettenati replaced the full employment assumption with the following: Firstly, there is a fixed coefficients production function. Secondly, if the level of income is at or below the level of income associated with the capacity utilization of capital then;

$$p = aw/(1 + m),$$

where a - is the coefficient of L in the

fixed coefficients production function,

w - is the wage rate,

and   1/(1 + m) - is the mark-up.

Thirdly, when the level of income is less than the full

employment level, the wage rate is given as w*. And fourthly,

the level of income is equal to either the full employment

level or the capacity utilization of capital level, whichever

is lower, (he assumes a fixed coefficients production

function). It follows from this modified version of Kaldor's

theory, that when the full employment level of income is

higher than the level associated with a capacity utilization

of capital, then it is possible to solve for the price level,

p, by way of $p = aw/(1 + m)$.

Pettenati also introduced a money and capital market. He

assumed that money demand is a function of the level of

interest and income, and equal to the exogenously given real

money supply. The money market uses three endogenous variables

Y, r and p. In the context of Pettenati's theory, if the level

of income where capital is fully utilized is below the full

employment level, then prices as well as income will be

determined in the real sector, leaving only the interest rate

to be determined by the money market. The system can be solved

for all of its unknowns. If however, the level of income

associated with full employment is less than the level

associated with capacity utilization of capital, then, since

there will be full employment, wages will not be fixed at w*. As a consequence, prices will no longer be determined in the real sector and the money market will have one too many unknowns. Pettenati pointed out that the system could be solved for all of its unknowns if one were to assume that investment is a function of the interest rate. But he also argued out that this assumption violates the spirit of a Kaldorian approach.

K.W. Rothschild[20] presented a theory proposed by Erich Schneider[21] as one which he would classify as Kaldorian. Schneider had dropped the assumption that income is at the full employment level and replaced it by $W = f(P)$. The assumption that $W = f(P)$ follows from an argument that the total wage bill, by way of the number of workers hired, is some function of the entrepreneurs intended profits, (represented by profits, P). Schneider made the assumption more specific by hypothesizing that,

$$W = aP,$$

so that the theorem of interest becomes,

$$P = \frac{1}{s_p + s_w a} I.$$

Note that the theory in this form does not require the full employment assumption in order to explain the income distribution. By assuming that $W = f(P)$, Schneider has made the level of income one of the endogenously determined

variables.

Rothschild, in another article, proposed the a version of Kaldor's First Theory in which the distribution of income places restrictions on the investment income ratio[22]. On the basis of his assertion that "in the short and medium run the trade unions will offer strong resistance against any reductions of their 'traditional' share by more than k percent"[23], he argued that; "the problem is no longer how investment behaviour affects the income distribution, but rather what limitations distribution behaviour sets to investment plans"[24]. Rothschild used the assumption that workers will resist any reductions by more than k percent of their traditional share of national income, to deduce theorems with respect to the range of possible investment-income ratios. That is, given an initial $(I/Y)*$ and its associated income distribution, $(W/Y)*$, there is an upper bound '$(I/Y)max$', above which it is not possible to have values of I/Y in the following time period. Values of the investment-income ratio above '$(I/Y)max$' are not possible because they would entail a fall of labour's share, $(W/Y)*$, by more than k percent.

In another section of the same ariticle he considered the effect of introducing the following assumption:

$$s_w = f(s_p).$$

The appropriateness of this assumption is based on an argument

that; "high consumption standards in the capitalist group will lead to higher consumption propensities among the workers"[25]. In the same section, he also assumed that,

$$s_p = F(W).$$

The usage of this assumption is based on the argument that, "If wages can always be set at a low level, this will probably encourage waste and care-free consumption among capitalists"[26] . s_w can therefore be expressed as,

$$s_w = f(F(W)) = g(W).$$

He then deduced a theorem in which the profit share is given as a linear function of I/Y, and the coefficients are functions of f(W) and g(W).

K.W. Rothschild[27] also discussed Ferguson's two sector model, produced, as Rothschild stated, "merely as a side-thought in connection with his intensive analysis of neoclassical distribution theory"[28]. Ferguson modified Kaldor's theory by dropping the assumptions that investment and the level of income are given. This left him with a theory which predicts only that there is a functional relationship between I/Y and W/P. Ferguson introduced assumptions such that W/P is determined by the labour-capital ratio, (L/K). Since a functional relationship exists between W/P and I/K, I/K is also determined by L/K. Rothschild noted that Ferguson's approach is,

"classical in reasoning and not Kaldorian. For in the above scheme income distribution (determined in the

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factor market) determines savings intentions and they
in turn determine investment expenditures. With KALDOR
it is the other way around; investment determines the
(flexible) income distribution.[29]

Rothschild in his article on Ferguson's 'side-thought'
also "made use of the structure of Ferguson's model in order
to compare in a very simple manner some basic approaches in
distribution theory"[30]. He did this by "cast(ing) some of the
general FERGUSON relationships into specific forms using
simplified assumptions;(b) apply(ing) numerical values in the
comparative static example"[31].

Milton Moore[32] examined Kaldor's First Theory by
introducing assumptions which bring into consideration
production, production periods and labour supply. He does this
by postulating "two models in which changes in income
distribution are described as playing crucial roles"[33]. He
then deduced the conditions (implicit assumptions) that would
be necessary in order that one could still deduce the
principal assertion of Kaldor's theory from the new set of
assumptions. He then proposed that these conditions should be
tested and suggested some of the tests that could be carried
out. He pointed out, for example, that "One would expect
profits to rise both absolutely and as a percentage of G.N.P.
when plant operating rates rise, and one would expect the
latter to occur at roughly the save time that investment
increased. And vice versa"[34].

B.T. McCallum[35] and R.G.D. Allen[36] examined Kaldor's theory of income distribution and growth. They were able to express the rate of change of the capital-output ratio as a differential equation by using the following assumpions in conjunction with Kaldor's first income distribution theory: One, there is a technological progress function which maps rates of change of per capita capital stock to rates of change of per capita levels of income. Two, there is an exogenously given rate of growth of labour. And three, there is a desired capital-labour ratio dependent on the rate of profit. By using the assumption of steady state growth, (i.e., a long-run equilibrium in which the rate of change of the capital-output ratio is zero) they were able to turn the differential equation into a quadratic. Allen found that using one of the roots of the quadratic as a solution for the capital-output ratio gives negative income shares[37] and McCallum asserted that using the other root gives an unstable equilibrium[38].

The above is probably not an exhaustive coverage of the comments, criticisms and developments that are a product of Kaldor's first income distribution theory, but the diversity of the discussion is indicative of the literature in this area. As mentioned, no one theme has dominated the discussion of Kaldorian macro-distribution theories.

II. Pasinetti's Theory of Income and Growth

Pasinetti's theory of income distribution and growth[39] could be considered as a part of the literature originating from Kaldor's First Theory. However, because there are some important differences between their explicit assumptions, Pasinetti's theory and the literature which follows from it will be considered as a separate area of post-Keynesian income distribution theory. Pasinetti's theory and related works are characterized firstly, by an assumption of long-run equilibrium, and secondly, by the association of savings rates with income recipients rather than with income sources.

Pasinetti intended that his theory solve what he considered as a problem with Kaldor's First Theory[40]. The latter involved using an assumption that wages are saved at a rate s_w and profits at a rate s_p. Pasinetti associated these rates of savings with workers and capitalists. He concluded that if workers save their income at a rate s_w and capitalists save theirs at a rate s_p, then if s_p is to be the rate of savings from profits, profits must be received only by capitalists. Presumably this would mean that workers either give their savings to capitalists or do not receive a return from their investments.

To solve this problem Pasinetti proposed a theory in which the assumption of long-run equilibrium plays a central role. He assumed that workers will use their savings to buy capital and that their rate of savings from profits and wages

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is the same. He also assumed that capitalists received a share of profits and that they saved this profit income at a higher rate than do workers. These assumptions are for the most part in the spirit of Kaldor's original theory, although the rates of savings are now associated with a class of income recipients, and not with an income source. The major departure from Kaldor's original approach is indicated by Pasinetti's assumption that the ratio of workers' savings to total savings is equal to the ratio of capital owned by workers to the total capital stock, i.e.,[41].

$$S_w/S = K_w K$$

An assumption of this type is ordinarily understood to mean that there is an implicit assumption of long-run equilibrium, since, in the context of the theory, there is no other appearant reason why K_w/K should equal S_w/S.

The assumption that $K_w/K = S_w/S$ allowed Pasinetti to deduce the following theorem; 'given a level of income and investment, the distribution of income between profits and wages is determined solely by the savings rate of capitalists, i.e.,

$$P/Y = (1/s_c)I/Y,$$

where s_c is the savings rate of capitalists.

Pasinetti also assumed that $s_c > I/Y > s_w$. This assumption is necessary in order to deduce that income shares will be positive and that savings will be sufficient to finance investment.

Paul Samuelson and Franco Modigliani[42] expanded on
Pasinetti's theory by deducing the restrictions that must be
placed on the savings rates so that, in the long-run, both
capitalists and workers will have positive capital shares.
They were able to show that if in the long-run capitalists are
to have a positive capital share, then the product of their
share of national income and their savings rate must be
greater than the savings rate of workers, i.e.,

$$s_W < as_c,$$

(where 'a' represents the share capitalists receive of
national income).

Samuelson and Modigliani also deduced what they called
the 'Dual Theorem', or the 'Anti-Pasinetti Dual Theorem', (it
has become known as the 'Anti-Pasinetti Theorem'). The theorem
states that, when the conditions for positive capital shares
do not exist,
i.e. $s_W < as_c$, the growth of capital, nK, will adjust such
that,

$$nK/Y = s_W.$$

When $s_W < as_c$, the rate of profits is therefore independent of
the savings behaviour of capitalists. Their derivation of
there results involved the assumption of a production
function.

They discussed other issues in their paper, one of which
was, for example, the stability of the Kaldor-Pasinetti model,
(the discussions of these issues ordinarily involved making

additional assumptions). These other issues, however, have been overshadowed by the attention given to the above mentioned condition for positive capital shares.

Quite a number of articles dealing with Pasinetti's theory or Samuelson and Modigliani's criticism have followed. The trends in this literature are noteworthy, primarily because this branch of post-Keynesian theory has attracted the most attention from economists. Some of the literature will be discussed below with the objective of identifying what these trends have been.

J.E. Meade commented on Samuelson and Modigliani's assumption of a production function by pointing out that under certain conditions an equilibrium may not be possible. That is, if $s_w > as_c$ and the production function is a fixed coefficients type, then there is no mechanism by which s_w, n or K/Y can adjust so as to equate s_w and nK/Y, (the equality of s_w and nK/Y is a necessary condition for a full employment equilibrium if $s_w > as_c$)[43]. In the context of the more general production function used by Samuelson and Modigliani, the equality of s_w and nK/Y was achieved by way of adjustments to the capital-labour ratio. However, as Meade pointed out, in the case of a fixed coefficients production function, K/Y, as well as s_w and n, is given exogenously so that the equality of s_w and nK/Y can be achieved only by chance.

If s_W does not equal nK/Y, Meade argued the the return to
capital must be such that,

$$s_W < as_c,$$

in order for there to be a full employment equilibrium.

Mauro Baranzini[44] showed that the assumption of a
production function was not necessary to obtain Samuelson and
Modigliani's results. He did so by using the assumptions of
Pasinetti's theory to deduce both the Pasinetti Paradox and
the anti-Pasinetti theorem. The derivation involved showing
that it is possible to derive a quadratic equation of the
profit rate, (i.e., P/K). The roots of P/K are; $P/K = n/s_c$,
(where n is the growth rate); and $P/K = nP/s_W Y$. The second
root can be rewritten as, $s_W Y = nK$, (note that nK = I). The
first root represents the Pasinetti theorem, and the second,
Samuelson and Modigliani's Anti-Pasinetti Theorem. Baranzini
pointed out that;

> "It is easy to deduce (as is explained in the
> Appendix) that where
> $$(s_c a > s_W)$$
> solution (10) - Pasinetti's - applies. Where,
> $$(s_c a < s_W)$$
> the economy cannot be in a steady state but, according
> to the Meade and Samuelson-Modigliani argument, it
> will asymptotically tend towards a steady state where,
> $$(s_W = s = s_c a)$$
> and their solution (11) applies."[45]

Changing the assumption that workers and capitalists
receive the same rate of return, constitutes a relatively

common theme for rewriting some of Pasinetti's results. Basil
Moore, N.F. Laing, P. Balestra and M. Baranzini, and K.L.
Gupta are some of the others who have changed this assumption,
and derived theorems for the more general case that changing
this assumption represents. They tended to place their
emphasis on establishing the conditions necessary for positive
capital and income shares.

Basil Moore[46] set out to show that Pasinetti's principal
assertion, that is, 'the rate of profits is determined by the
savings rate of capitalists and the level of investment', does
not require the following assumptions:

    (a) $s_w = 0$

    (b)   rate of interest = rate of profit

    (c)   capitalists and workers receive
           the same rate of return,

    (d)   workers save the same proportion out of
           wages and profits.

Moore asserted that in order to deduce Pasinetti's Theorem, it
is only necessary that the capitalists' savings rate be
greater than that of workers. He derived theorems, firstly,
for the case where the assumption that workers and capitalists
receive the same rate of return is dropped, and secondly, for
the case where workers are assumed to have a different rate of
savings from their capital and labour income. Moore also
briefly considered the adjustment mechanism for changes of

workers' and capitalists' savings rates.

N.F. Laing[47] and K.L. Gupta[48] worked within the framework of Pasinetti's theory but dropped the assumption that workers receive the same rate of return as capitalists. They were still able to derive the result that the savings rate of capitalists determines the profit share and the profit rate, subject to the conditions necessary for positive capital· shares.

Balestra and Baranzini[49] dropped not only the assumption that workers and capitalists receive the same rate of return for capital, but they also replaced the assumption of a fixed level of income by an assumption of a Cobb-Douglas production function. Moreover, they assumed that capital is paid its marginal product and that labour receives the residual. They were then able to deduce that the savings rate of workers determines in part, the profit share and rate. This result stands in contrast to the Pasinetti theorem, which states that the income shares and profit rate are determined only by the savings rate of capitalists.

To obtain Balestra and Baranzini's result, it is necessary to make all of the changes mentioned above, that is, it is necessary to assume: one, the existance of a production function; two, that either labour or capital, (or both), receives its marginal product; and three, that workers and

capitalists do not receive the same rate of return on capital. If it were assumed, for example, that there is a production function, but not also that capitalists and workers receive different rates of return, (i.e., Samuelson and Modigliani's assumptions), then the savings rate of workers does not affect the distribution of income. In the case of the latter assumptions, a change of the workers' savings rate will result only in a reallocation of the share of capital ownership between capitalists and workers[50].

Another popular theme, and one also taken up by Moore and Gupta as well as Alpha Chiang[51] and A. Maneschi[52], is to drop the assumption that the savings rate of workers from profits and wages are the same. Chiang summed up the four cases to be considered as follows:

$$\text{case 1: } s_{ww} < s_{pw} = s_{pc}$$
$$\text{case 2: } s_{ww} = s_{pw} = s_{pc}$$
$$\text{case 3: } s_{ww} = s_{pw} < s_{pc}$$
$$\text{case 4: } s_{ww} < s_{pw} < s_{pc},\text{[53]}$$

where the first subscript represents the source of income and the second is the class of income recipients for which the variable is the savings rate.

Chiang pointed out that case 1 has been considered by Kaldor, case 2 has been covered by Pasinetti, case 3 is where income classes are not characterized by different savings rates and consequently "no information on income distribution

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can emerge unless the model is duly amplified"[54] and case 4 has

not been given consideration. Case 4, he argued, if

substituted for case 2 in Pasinetti's theory, would give a

more general form of the theory, and one from which

Pasinetti's theorem could still be derived.

A. Maneschi[55] also examined case 4. He derived the

necessary conditions (implicit assumptions) for positive

capital shares, (Chiang looked only at the conditions for

positive income shares).

Maneschi also substituted into Pasinetti's theory the

assumptions associated with what Chiang called case 1, to show

that either,

$$s_w = 0 \text{ or } W = 0,$$

if the capitalist class is not to disappear. Gupta[56] however

asserted that this need not be the case, (i.e., that either s_w

or W must equal zero), if one drops the assumption that

capitalists and workers receive the same rate of return on

capital.

Although changing the assumptions concerning either the

rates of return or the savings rates have been the most

popular themes, at least one paper has examined the time spans

involved in achieving the long-run equilibrium discussed by

Pasinetti and, Samuelson and Modigliani.

Y. Farumo, in his article "Convergence Time in the

Samuelson-Modigliani Model"[57] set out to,

> investigate(d) the speed at which the equilibrium path
> of the Samuelson-Modigliani model converges towards
> either the Pasinetti or anti-Pasinetti
> equilibrium......(considered) the equilibrium path
> which consists of both the time path of the
> output-capital ratio and that of the capitalists'
> wealth share[58]

He obtained results such as the following;

> "Our calculations show that the time taken for a 90
> percent convergence is longer than five centuries if,

$$(s_w - as_c = .01),$$

> $(s_w = .08, s_c = .20, a = .35$ and the growth rate of
> labour
> $n = .015)$, and that it is longer than three centuries
> even if s_w increases to .1"[59].

As mentioned earlier, commenting on or discussing the
Pasinetti-Samuelson and Modigliani debate by altering the
assumptions concerning the rate of return or the rate of
savings is the most common theme found in this area of the
literature. However, all of those who have altered the
assumptions in this way, have retained the assumption of
long-run equilibrium. Because this assumption runs contrary to
the spirit of post-Keynesianism, neither Pasinetti's theory,
nor the variants of his theory, are likely to play a central
role in future post-Keynesian income distribution theories.

III. Kaldor's Second Theory

There have been no empirical tests of Pasinetti's theory or any of the related works. Samuelson and Modigliani's discussion of whether or not,

$$s_w < as_c,[60]$$ and Kaldor's reply to any

suggestion that $s_w > as_c[61]$ is the closest to an empirical test that one will find in the literature.

Kaldor's above mentioned reply is noteworthy for two reasons: Firstly, because Kaldor took issue with how he felt the variables were (implicitly) being measured. He suggested some other definitions of profits and investment, and the rate of savings from profits and wages, that he thought would be more appropriate. These definitions will be discussed in Chapter Seven. And secondly, because it is the first article of what can be considered as another area of post-Keynesian income distribution theory, (i.e., 'Kaldor's Second Theory and the related literature'). This area is characterized by the assumptions that; one, corporations and the noncorporate sector are the two income earning institutions; two, that the noncorporate sector can save only by way of some financial intermediary issued by the corporations; and three, it is ordinarily assumed that the economy, or at least the financial markets, are in long-run equilibrium.

The theory outlined by Kaldor in his reply to Samuelson and Modigliani has been discussed in Chapter Two as Kaldor's second theory of income distribution.

J. Kregel[62]expanded on Kaldor's assumption of corporate
equity as a financial intermediary to consider the case of
bond financing. Kregel also altered the mechanism, in the case
of bond financing, by which the level of investment to be
financed by the noncorporate sector is equilibrated with
noncorporate savings. He did this by assuming that the rate of
interest will decline when desired household savings (demand
for bonds) exceeds household investment opportunities (supply
of bonds). A fall of the interest rate will motivate firms to
finance more of their investment by way of bond financing and
households to save less[63]. Bond financing will increase, and
household saving decrease, until there is equilibrium in the
bond market. A similar process operates when the desired
household savings is exceeded by the bond supply, (that is,
the interest rate increases). Kregel did not use the
consumption effect of capital gains or losses to equate
noncorporate savings and investment.

Basil Moore expanded on the concept of a valuation ratio,
first introduced by Kaldor in his second theory of income
distribution, and explored "some implications of the
introduction of corporate equities and capital gains income in
macro-economic growth models"[64]. Moore rewrote Kaldor's theory
by merging the goods and securities markets. This meant
redefining income as capital gains, wages and returns to
capital. He referred to this definition of income as,

'comprehensive income'[65]. He derived theorems such as the rate of change of the profit rate with respect of the savings rate from profits and set out to show that "shareholders have the opportunity to 'undo' such saving (corporate retentions) should they so desire, by realizing and spending their capital gains for current consumption"[66].

Moore has also done some empirical work, although not in the form of an empirical test. He provided some estimates, for the U.S. and U.K., of the valuation ratio for the years 1947-1971. In addition to this, he provided estimates of the rate of consumption from capital gains. On the basis of the estimates of the latter he concluded that,

> Alternatively expressed, the propensity to save out of capital gain income is extremely high .... This suggests that changes in equity prices and in v must operate primarily through their effect on investment expenditures rather than consumption expenditures in order to restore equilibrium in the market for current output.[67]

Paolo Pettenati's article, mentioned earlier, dealt not only with Kaldor's first, but also with his second theory of income distribution. He has however dropped the securities market from the second theory and attempted to examine both theories by assuming, as a proxy for consumption from capital gains, that some fraction of retained profits is consumed. In so much as Pettenati's discussion is directed at the appropriateness of the full employment assumption, dropping

the securities market is a matter of convenience. It may
however be more consequential to Pettenati's principal
objective, which was to show that "Kaldor's theory of
distribution..(is).. inconsistent with Keynes's theory of
interest and of money"[68], (since the supply or demand of
securities would not ordinarily be assumed to be independent
of the interest rate established in the money market and vice
versa).

IV. Kaleckian Price Mark-up Theories

Kalecki outlined two approaches to income distribution,
one of which was to explain the level of profits, and the
other, the wage share. Kalecki did not attempt to integrate
the two theories to obtain one theory of the profit level and
share. This was not done until Asimakopulos and Harris took up
the task. Both of Kalecki's approaches will be outlined below.

Kalecki's Theory of Profits

Kalecki's theory of the profit level uses the following
assumptions: one, savings must equal investment; two,
investment is exogenously given; three, workers save a
constant amount $'S_W'$; four, some fraction of profits are
saved; and five, there is a stable (exogenous) component 'A'
of capitalists' consumption[69]. It follows from these
assumptions that

savings is equal to $S_W + qP - A$; where q is the savings rate of profit income. It also follows that the level of profits is;

$$P = (I^* - S_W - A)/q.$$

(where I^* is the exogenously given level of investment).

The above theory is very much like Kaldor's first theory of income distribution, without the full employment assumption. Note that while Kaldor assumed that workers' savings is a function of the total wage bill, (i.e., $s_W W$), Kalecki assumed instead that it was a constant S_W. By removing the possibility that a change of the total wage bill could affect the level of savings, Kalecki did not have to make the full employment assumption in order to explain the level of profits. On the other hand, because the level of income is neither given exogenously, nor determined endogenously, Kalecki's theory explains only the level of profits, but not the distribution of income.

Kalecki's Theory of the Level of Income

Kalecki determined the level of income by fusing his theory of the level of profits with an income distribution theory[70]. The 'income distribution theory' which he used is the following;

$$V/Y = a + B/Y,$$

where B is the stable (overhead) component of wages and salaries, and V is total wages and salaries. By itself this

theory is not sufficient to determine an income distribution because there are two unknowns, V and Y, and only one equation. The level of income and profits, and profit share can be obtained by adding Kalecki's theory of profits to the above, (i.e. adding P = bI + c), and introducing the assumption (definition) that Y - P = V. This gives a system of three equations and three unknowns[71].

Kalecki did not introduce the theory, 'V/Y = a + B/Y', with the objective of explaining the income distribution. He considered the above as a theory of the cyclical fluctuations of wages and salaries, (i.e., as Y increases in the business cycle, the share of wages and salaries falls)[72], and used it, in conjunction with his theory of profits, to explain the fluctuations in the level of income and consumption[73]. With respect to income distribution, Kalecki was interested in explaining the income share of wages - as opposed to wages and salaries - which he did by way of his mark-up theory of price determination. Kalecki considered salaries to be of an 'overhead' character[74].

Kalecki's Price Mark-up Theory

Kalecki's theory of income distribution originates from his mark-up theory of price determination, (mentioned earlier in this chapter)[75]. He expanded upon his theory of prices as a mark-up on costs, to express the relative share of wages in the value added of an industry as;

$$w = \frac{W}{W + (k - 1)(W + M)}$$

where – W is the aggregate wage bill

M is aggregate costs of materials,

k is the ratio of aggregate proceeds

to aggregate prime costs,

and w is the relative share of wages[76].

The principal explanatory variable is k; it is a measure of the extent to which firms can mark-up prices on prime costs. The share of wages also depends upon the ratio of raw material costs to wage costs. Although the above refers to the share of wages in the value added of an industry, Kalecki noted that; "It may be shown that this theorem can be generalized to cover the relative share of wages in the gross national income of the private sector"[77].

It would not be correct to say that Kalecki has integrated his mark-up theory of price determination and his differential savings rate approach, (represented by his theory of the level of profits). There are two reasons for this: Firstly, his income distribution theory which used the mark-up was intended to explain the share of wages, and not wages and salaries. Secondly, the above mentioned theory of income determination which can be used to find the wage and salary, and profit shares, does not use the mark-up.

Price Mark-up Theories

Proposals or discussions of theories which incorporate the mark-up method of price determination into a differential savings rate approach in order to explain income distribution can be considered as part of a separate area of post-Keynesian income distribution theory. This area includes the income distribution theories outlined by Joan Robinson, A. Asimakopulos (discussed in Chapter Two), Donald J. Harris and Alfred Eichner[78].

Robinson integrated the price mark-up theory and the differential savings rate approach by using a macro-distribution theory similar to the one outlined above as Kalecki's theory of the profit level[79]. As mentioned above, Kalecki's theory of profits is not sufficient to determine the distribution of income because it does not impose any constraints on the level of wages. As Robinson has in effect pointed out, this can be done by introducing a mark-up theory of price determination which imposes a fixed relationship between profits and wages of the form P = uW, (where u is the mark-up). Although Robinson's discussion is somewhat more involved, the basic approach of her theory of income distribution is not unlike the theory proposed by Erich Schneider, (discussed earlier in this Chapter). As mentioned when discussing Schneider's version of Kaldor's First Theory, an assumption of this type, (i.e., P = aW), makes the theory

sufficient to explain income shares without having to resort to the full employment assumption.

Harris' theory, or theories, (one could argue that there is more than one)[80]is similar to the one by Asimakopulos outlined in Chapter Two. He made the following assumptions: one, investment is equal to savings; two, there are different rates of saving from profits and wages; and three, the labour utilized in production can be divided into two groups; one representing fixed costs and the other representing variable costs. He assumed that one category of labour, variable labour, varies with the level of output[81]and that the other category, "is required for operating equipment as long as output is positive"[82].

Using these definitions and assumptions, Harris constructed a system of four equations with five unknowns, (the unknowns are the real level of income, the levels of variable and total labour utilization, profits and the price level). He then introduced four equations that could be used to determine the price level as possibilities for the fifth equation. Each equation represents a possible assumption that would make the theory sufficient to explain the five unknowns. He discussed and derived theorems for the case of each assumption used as the fifth equation. His case 1 bears the closest resemblance to Asimakopulos' theory. His case 2 is introduced as an "alternative basis for determining the

mark-up suggested by Joan Robinson"[83].

Asimakopulos' theory has already been discussed in Chapter Two. The major difference between Asimakopulos and Harris' theories is that Asimakopulos assumed, in his second version of the theory, that some fraction of profits is retained, (by businesses), and that the rate of savings is the same for wages and distributed profits.

Alfred Eichner has proposed a theory in which prices are determined as a mark-up on costs. The mark-up is determined by the firms' demand for and supply of additional investment funds. The supply side associates with a given level of additional investment funds a price in the form of "the possible subsequent decline in revenue from increasing the margin above costs in order to augment the current cash flow"[84]. The demand side is "simply the familiar marginal efficiency of investment curve"[85].

Eichner has not integrated this theory of price determination with a differential savings rate approach in such a way as to give a clearly defined theory. It is evident however that Eichner views the distribution of income as being determined in much the same way as do Asimakopulos and Harris. Eichner has argued that "Even in the oligopolistic sector, although the price level might not rise, profits could still be expected to increase as output expanded and average costs

simultaneously fell"[86]. This fall in average costs is precisely the mechanism by which income is redistributed in both Harris and Asimakopulos' theories. The difference is that Eichner does not, for the purposes of explaining the income distribution, consider the mark-up as given.[87]

Some Concluding Remarks

We have seen that Kaldor's first theory played a key role in the development of the post-Keynesian view of income distribution. It forms the foundations upon which a good deal of work has been elaborated.

Kaldor's second theory turns out to be a newer approach which has attracted less attention. Although it is not likely to become as prominent as Kaldor's first theory, one of its key assumptions, that is, the assumption of the existence of a securities market, may have a promising future. With respect to testing, his Second Theory is well laid out and puts forward some propositions that can be easily examined.

Asimakopulos' theory was also a good candidate for testing for much the same reasons; its theorems and assumptions are relatively well laid out and the approach of integrating Kalecki's price mark-up theory and Kaldor's macro-distribution theory, shows promise as the basis for future post-Keynesian income distribution theories.

Footnotes to Chapter Three

1 In the early 1950's Kenneth Boulding outlined a theory which
was similar to Kaldor's, in Chapt. 14, 'A Macroeconomic Theory
of Distribution', of his book A Reconstruction of Economics.
It aroused relatively little interest and only occasionally
receives mention along side Kaldor's theory. Also, J.A. Kregel
has mentioned Joan Robinson, Richard Kahn and others as
amongst those who have developed income distribution theories
from this Keynes' approach.
J.A. Kregel, "Post-Keynesian Theory: Income Distribution,"
        Challenge 21(4) (Sept.-Oct.): 78-92.

2 This is not always the case. Kaldor's Second Theory has four
income sources: corporate profits, dividends, capital gains,
and wages. In one version of his theory there is a different
savings rate associated with each of the above, (see Chapter
Two).

3 M. Kalecki, "Costs and Prices," Selected Essays on the
        Dynamics of the Capitalist Economy 1933-1970,
        (Cambridge: Cambridge University Press, 1971), p. 45

4 A.S. Eichner, "A Theory of the Determination of the
        Mark-up Under Oligopoly," Economic Journal 83(332)
        (December 1973): 1184-1200.

5 Kregel, "Post-Keynesian Theory: Income Distribution," 37-38.

6 Kalecki, "The Determinants of Profits," Selected Essays
        on the Dynamics of the Capitalist Economy 1933-1970,
        pp. 78-92.

7 M. Kalecki, "The Determination of National Income and
        Consumption," Selected Essays on the Dynamics of
        the Capitalist Economy 1933-1970, pp. 93-104.

8 Kaldor, "Alternative Theories of Distribution," 83-100.

9 N. Kaldor, "A Model of Economic Growth," Economic Journal
        67 (December 1957): 83-100.

10 H. Atsumi, "Mr. Kaldor's Theory of Income Distribution,"

Review of Economic Studies 27 (February 1960): 109-118.

11 Ibid., 118.

12 J. Tobin, "Towards a General Kaldorian Theory of
      Distribution," Review of Economic Studies 27
      (February 1960): 119-120.

13 Ibid., 119.

14 G.C. Harcourt, "A Critique of Mr. Kaldor's Model of
      Income and Distribution and Economic Growth,"
      Australian Economic Papers 2(1) (June 1963): 20-36.

15 Ibid., 25.

16 Ibid., 26.

17 Ibid.,

18 Paolo Pettenati, "Keynes' Monetary Theory and The
      Neo-Keynesian Theory of Distribution," Oxford
      Economic Papers 27(1) (March 1975): 1-9.

19 Ibid., 4.

20 K.W. Rothschild, "Some Recent Contributions to a
      Macro-economic Theory of Income Distribution,"
      Scottish Journal of Political Economy 8
      (October 1961): 173-179.

21 Rothschild gives as his source;
Erich Schneider, "Einkommen und Einkommensverteilung
      in der makro-okonomischen Theorie," L'Industria
      2 (1957) orInternational Economic Papers 8 (1958)
Ibid., 187.

22 K.W. Rothschild, "Themes and Variations – Remarks on
      the Kaldorian Distribution Formula," Kyklos
      28(4) (1965): 652-667.

23 Ibid., 656.

24 Ibid.,

25 Ibid., 662.

26 Ibid., 661.

27 K.W. Rothschild, "Different Approaches in Distribution
        Theory," Kyklos 24(1) (1971): 10-29.

28 The model was outlined by C. Ferguson in section 3.2 of
Chapter 15 of his book The Neoclassical Theory of Production
and Distribution, cited by Ibid., 12.

29 Ibid., 15.

30 Ibid., 16.

31 Ibid.,

32 A.M. Moore, "A Reformulation of the Kaldor Effect,"
        Economic Journal 77 (March 1967): 84-99.

33 Ibid., 85.

34 Ibid., 97.

35 B.T. McCallum, "The Instability of Kaldorian Models,"
        Oxford Economic Papers 21(1) (March 1969): 56-65.

36 R.G.D. Allen, "Chapter 16," Macro-Economic Theory
        (Toronto: Macmillan, 1968), pp. 306-310.

37 Ibid., p. 309.

38 McCallum, 59.

39 L. Pasinetti, "Rate of Profit and Income Distribution
        in Relation to the Rate of Economic Growth,"
        Review of Economic Studies 29 (October 1962): 267-279.

40 Ibid., 270.

41 Ibid., 271.

42 Samuelson and Modigliani, "The Pasinetti Paradox," 269-301.

43 J.E. Meade, "The Outcome of the Pasinetti-Process,"
        Capital and Growth, ed. G.C. Harcourt and N.F. Laing
        (Harmondsworth, England: Penguin Books, 1971): 289-294.

44 Mauro Baranzini, "The Pasinetti and Anti-Pasinetti
        Theorems: A Reconciliation," Oxford Economic
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45 Ibid., 471.

46 B.J. Moore, "The Pasinetti Paradox Revisited," Review of Economic Studies 41(2) (April 1974): 297-299.

47 N.F. Laing, "Two Notes on Pasinetti's Theorem," The Economic Record 45 (September 1969): 373-385.

48 K.L. Gupta, "Differential Interest Rates and Kaldor -Pasinetti Paradoxes," Kyklos 29(2) (1976): 310-314.

49 P. Balestra and M. Baranzini, "Some Optimal Aspects in a Two Class Model with Differential Interest Rates," Kyklos 24(2) (1971): 240-255.

50 Note that if the production function is linear homogenous then the distribution of income is determined by the production function. In this case only the determination of the profit rate would be affected by the above mentioned changes of the assumptions.

51 Alpha A. Chiang, "A Simple Generalization of the Kaldor -Pasinetti Theory of Profit Rate and Income Distribution," Economica 40 (August 1973): 311-313.

52 A. Maneschi, "The Existance of a Two-Class Economy in the Kaldor and Pasinetti Models of Growth and Distribution," Review of Economic Studies 41 (January 1974): 149-150.

53 Chiang, "A Simple Generalization," 311.

54 Ibid., 312.

55 Maneschi, "The Existance of a Two-Class Economy," 149-150.

56 Gupta, 310-314.

57 Y. Farumo, "Convergence Time in the Samuelson -Modigliani Model," Review of Economic Studies 37 (April 1970): 221-229

58 Ibid., 221.

59 Ibid.,

60 Samuelson and Modigliani, "The Pasinetti Paradox," 274-275.

61 Kaldor, "Marginal Productivity and Macroeconomic Theories of Distribution."

62 J.A. Kregel, Rate of Profit, Distribution and Growth
      (London: Macmillan, 1971), pp. 187-190

63 Ibid., pp. 188-189.

64 B.J. Moore, "Equities, Capital Gains, and the Role of
      Finance in Accumulation," American Economic Review
      65(5) (December 1975): 872.

65 B.J. Moore, "Some Macroeconomic Consequences of Corporate
      Equities," Canadian Journal of Economics
      6(4) (November 1973): 533.

66 Ibid., 531.

67 B.J. Moore, "Equities, Capital Gains, and the Role of
      Finance in Accumulation," 876.

68 P. Pettenati, "Keynes Monetary Theory and the
      Neo-Keynesian Theory of Distribution," Oxford
      Economic Papers 27(1) (March 1975): 1-9,

69 Kalecki, "Determinants of Profits," pp. 78-92.

70 Kalecki, "Determination of National Income and
      Consumption," pp. 93-104.

71 Kalecki has done this to obtain a theory of the level of
income in "Determination of National Income and Consumption,"
pp. 93-104.

72 M. Kalecki, "Distribution of National Income," Selected
      Essays on the Dynamics of the Capitalist Economy
      1933-1970, pp. 74-75.

73 M. Kalecki, "Determination of National Income and
      Consumption," pp. 93-104.

74 Ibid., 75.

75 Kalecki, "Distribution of National Income," pp. 62-77.

76 Ibid., p. 62.

77 Ibid., p. 62.

78 Rothschild pointed out, in a footnote, an earlier attempt
to bring together the price mark-up and differential savings
rate methods;

"A very interesting example in this direction is E. Preiser's Wachstrum und Einkommensverteilung (Heidelberg, 2nd ed., 1964), where he marries the Kaldorian method with a 'degree of monopoly' approach of KALECKI origin. The Kaldor equation is used to ensure the fulfilment of macro-economic flow-equilibrium. The degree of monopoly is introduced in order to bring out the essence of the distribution problem". K.W. Rothschild, "Themes and Variations - Remarks on the Kaldorian Distribution Formula," Kyklos 28(4) (1965): 652-667.

79 Joan Robinson, "The Theory of Distribution," Collected Economic Papers - Vol. II (Oxford, Basil Blackwell, 1964) pp. 145-158.

80 Harris, 144-151.

81 Ibid., 144.

82 Ibid., 144.

83 Ibid., 146.

84 A.S. Eichner, "A Theory of the Determination of the Mark-up Under Oligopoly," Economic Journal 83(332) (December 1973): 1190.

85 Ibid., 1190.

86 A.S. Eichner, The Megacorp and Oligopoly (Cambridge: Cambridge University Press, 1976), pp. 178.

87 See Chapters Five and Six of; Eichner, The Megacorp and Oligopoly pp. 144-223.

Chapter Four - Empirical Tests of Kaldor's and Related

Theories

Of the three theories under examination, only Kaldor's
First Theory has been previously tested. There have been
several tests of this theory and in this chapter, five of them
will be discussed. They are the tests by Melvin W. Reder,
Irving B. Kravis, L.E. Gallaway, V.P. Bharadwaj and P.K. Dave,
and Bakul Dholakia. In addition to these tests, some empirical
works by Michal Kalecki will also be discussed.

One of the principal objectives of this Chapter is to
present the tests in such a way that their testing conventions
are apparent. The discussion will therefore be directed
towards establishing: one, the methods that were used to test
the theory; two, the criterion, if any, used to determine if
the observations should be accepted as a 'confirming instance'
of the theory; and three, the definitions used to measure the
relevant variables.

Kalecki's Empirical Tests

Kalecki outlined a theory of the determination of the
level of profits, (discussed in Chapter Three)[1], from which he
deduced the following relationship between investment and
profits,

$$P = \frac{I - S_w + A}{q}$$

where S_w - is the savings of workers,

A - is the stable part of capitalists' consumption,

q - is the rate of savings by capitalists of profit income.

In order to simplify the tests Kalecki suggested that

$$P = \frac{I - S_w + A}{q}$$

could be replaced by a 'simpler although approximate formula'[2],

$$P = (I + A)/q.$$

He argued that the savings of the workers, 'S_w', are comparatively small and can be dropped from the above equation without affecting the tests[3]. The above equation can be rewritten as follows,

$$P = aI + b,$$

where $a = 1/q$ and $b = A/q$

The test took the form of estimating the extent to which investment explains, (predicts), profits.

The first step of Kalecki's test procedures was to find a number of period lags, denoted as i, where i is an integer > or = 0, such that the correlation of profits and lagged investment, i.e.,

$$r(P_t, I_{t-1}),$$

is the highest.

The next step was to estimate the values of a and b in the equation,

$$P = aI + b,$$

using profits and a measure of investment lagged i periods. The estimates were obtained using a regression technique by fitting the data to a linear function of the form,

$$P_t = aI_{t-1/4} + b + ct,$$

(where time 't' is measured in units of a year)[4].

The third step was to use the estimates of a, b and c to calculate 'estimated P_t's, (which we can denoted as; (est. P_t)'s). Kalecki then used the (est. P_t)'s to calculate the following correlation coefficient,

$$r(P_t, (\text{est. } P_t)). \quad .$$

Kalecki did not give a rule for determining when an observed value of 'r' can be interpreted to mean that the observations should be accepted as a confirming instance of the theory. He did however say of his test results that "The correlation is very close. The double correlation coefficient is .986"[5].

He also listed both the observed values and estimates of P_t in order that one can inspect the correlation between the two variables.

Kalecki carried out several other tests in much the same way. One of these tests examined the following assertion concerning cyclical changes in the relative share of wages[6].

$$V/Y = a + B/Y,$$

where   V - is the real wage and salary bill

            B - is a share of the wage bill that
                 is "a positive constant in the short
                 period although subject to long-run
                 changes"[7].

He used the same approach again to test the following theorem concerning the determination of national income[8].

$$Y = a'I + b'$$

(which follows from[9];

$$V/Y = c + B/Y$$

and $P = aI + b$

where $V = Y - P$).

Kalecki measured three variables of interest; income, Y; investment, I; and profits, P. He measured P as 'gross profits after taxes'[10], I as "gross private investment plus export surplus plus budget deficit plus brokerage fees"[11] and Y as 'consumption plus investment', (or wages plus profits), minus the income of government employees[12].

Kalecki's empirical tests are the only ones, of the type we would like to examine, by someone who might be considered as a post-Keynesian theorist. There is unfortunately not a

great deal of post-Keynesian empirical work in the area of income distribution theories.

Reder's Empirical Test

Melvin W. Reder, in his paper "Alternative Theories of Labor's Share"[13], set out "(1) to compare the more important theories of labor's share with one another and (2) to study the capacity of two of them to explain empirically the behavior of labor's share in the United States"[14]. One of the two theories he examined by way of an empirical test is Kaldor's First Theory. He tested this theory by examining the variation of predicted investment/income ratios from their corresponding observed values.

Reder evaluated the variations of observed from predicted values of the investment/income ratio by first defining a variable 'd' as follows;

$$d = I/Y - est.I/Y$$

$$\text{where} \quad est.I/Y = s_g + s_p(P/Y) + s_w(W/Y),$$

and s_g = "the ratio of 'Government Surplus on Income and Product Transactions to National Income'"[15].

Reder used the following (somewhat arbitrarly chosen[16]) values as estimates of the savings rates from wages and profits,

$$s_w = .04 \text{ and } s_p = .14.$$

These estimates were used to calculate values of d for the years 1904-14, 1923-29 and 1946-56. With respect to evaluating

the tests' results, he noted that,

> The test to be made is how well the annual levels of
> I/Y can be predicted, with the aid of equation (4a),
> from the annual levels of W/Y and P/Y. The success of
> the theory in meeting this test is indicated by the
> resulting size of d......".[17]

Reder evaluated the calculated values of d by saying that,

> For the period 1946-56, the average value of d was
> -.004; for 1923-29 it was +.005; for 1921-29 it was
> -.001; and for 1904-14 it was +.020. I interpret the
> values of d for either 1921-29 or 1923-29 and for
> 1946-56 as "small"; i.e., as being not inconsistent
> with the acceptance of Kaldor's theory. One reason for
> this interpretation is that the average values of d in
> each of these periods lies within one standard
> deviation of the annual values of d when these values
> are measured from zero. Another reason is that in
> 1949-56, the average value of d was only about 1/200
> of I/Y and in 1923-29, about 1/20 of I/Y ...... The
> data for 1909-14 (average d = .02) are not so easily
> reconciled with Kaldor's theory"[18].

Reder has in effect given two criteria of acceptance. One

criterion was based on the level of the average value of d

relative to the standard deviation of d and the other was

based on the level of the average value of d. His first

criterion is not very clearly stated.

Reder qualified any judgement about whether or not the

observations should be accepted as a confirming instance of

the theory by arguing that,

> to assert that a set of data are or are not reasonably
> consistent with a particular hypothesis requires that
> we also test their consistency with some alternative
> hypothesis. One obvious alternative to (the above
> equation for est.I/Y) is that (the rate of savings of
> workers equals that of capitalists).....
> we assume that $s_w = s_p = .08$.
> $$est.I/Y = s_g + .08 [19].$$

Denoting,

$$\text{(i)} \quad \text{est.} I/Y = s_g + .08 \quad \text{as} \quad \text{est.} I/Y^*$$

$$\text{and (ii)} \quad I/Y - \text{est.} I/Y^* \quad \text{as} \quad d^*,$$

Reder compared the d's and d*'s calculated in the same time periods and concluded that,

> it is difficult to choose between Kaldor's theory and our "dummy" alternative expressed by (5). However, while this does not preclude possibility that variations in the relative shares of national income "explain" variations in the savings ratio, it does mean that variations in the distribution of wage income among workers; of nonwage income among its recipients (especially the ratio of corporate to noncorporate profits); and of exogenous shifts in the savings functions of households, governments, and firms have so combined as to have had just about the same effect upon the savings ratio as shifts in relative shares.[20]

Kaldor's theory, in Reder's test, turns out to 'predict' the observed data no better, by Reder's criterion, than a simple alternative.

Reder's empirical test used estimates of I, P, W and Y. Y is national income, W is wage income and P is other (than wage) income. He did not indicate whether wage and profit income include any components of government spending, although including the income of government employees in wages would be consistent with national income as a measure of Y. I is referred to only as 'investment', Reder was not more specific and did not indicate whether it is gross or net investment. He took into consideration the effect of a government surplus or deficit by introducing the variable, sg.

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Kravis' Empirical Test

Irving Kravis gave a test of Kaldor's first income distribution theory in a lengthy footnote of his article "Relative Income Shares in Fact and Theory"[21]. The objective of Kravis' test was to calculate estimates of s_w and s_p[22]. He did this by way of solving the following two equations for s_w and s_p;

$$a = -s_w/(s_p - s_w) \text{ and } b = 1/(s_p - s_w),$$

where a and b are the parameters of the theorem,

$$P/Y = a + b(I/Y).$$

This required estimates of a and b which Kravis obtained by solving another system of two equations and two unknowns. The equations of the latter system were of the form,

$$P/Y = a + b(I/Y),$$

For I/Y Kravis used Kuznet's estimates[23]; .135 in 1899-1900 and .074 in 1949-55. For P/Y he used his own estimates; .28 in 1899-1900 and .193 in 1949-50[24]. The system of equations was therefore,

$$.28 = a + .135b$$

$$.193 = a + .074b$$

Solving the two systems of two equations for the two unknowns gives the following estimates for the savings rates,

$$s_p = .643 \text{ and } s_w = -.062$$

Kravis did not evaluate this result, nor did he suggest a criterion for deciding whether or not it could be interpreted as a confirming instance of the theory.

By way of a note, although one would not ordinarily expect to observe a negative savings rate such as -.062 as an estimate for s_w, an interpretation of this result as refuting evidence requires some qualifications. Firstly, a negative value for an estimate of s_w need not be interpreted as refuting evidence unless one or more of the following conditions hold: one, the theory contains an assumption that $s_w >$ or $= 0$, (this assumption is not necessary in order to deduce Kaldor's principal assertion); two, there is an independent estimate, considered as true, which indicates that $s_w > 0$ or $= 0$; or three, another theory, considered as true, predicts that $s_w >$ or $= 0$. Secondly, when the savings rates are calculated using the above method, a negative estimate is possible if the savings rates have changed over time. Kravis did not rule out this possibility and points out that "An increase in s_p or in

$$(s_p - s_w)$$

or a decrease in s_w, with I/Y constant, would also have lowered R/Y...... however we have no knowledge of the actual behavior of the propensities"[25]. And thirdly, even under the following conditions - (a): one, the theory includes an assumption that s_w is $>$ or $= 0$; or two, there is an independent estimate indicating that $s_w >$ or $= 0$; or three, there is another theory, considered as true, which indicates that $s_w >$ or $= 0$; and (b), there was no reason to believe that the savings rates have changed over time - there would still remain the problem of choosing a criterion for deciding

whether to accept the observation as a confirming instance of $s_w < 0$.

Kravis' test required the measurement of only three variables; P, I and Y. For I/Y he used Simon Kuznet's estimates for the U.S., where I is net capital formation and Y is net national product[26]. The estimates, also for the U.S., of R/Y were his own. In profits he included rent, interest and corporate profits, (i.e. property income)[27], and a share of entrepreneurial income equal to the share of property income in national income excluding the entrepreneurial sector[28]. Y in this case appears to have been measured as national income. [29]

Gallaways's Empirical Test

Kaldor's theory, by way of some algebraic manipulations, can be written as,
$$W/Y = s_w/(s_w - s_p) - [1/(s_w - s_p)]I/Y.$$
It can be further deduced from the above theorem that,
$$d(W/Y) = [1/(s_w - s_p)]d(I/Y),$$
(where 'd' means 'a change of W/Y or I/Y, and $1/(s_w - s_p)$ is less than zero). L.E. Gallaway tested the latter form of theorem[30]. He used the fraction of observations in which W/Y and I/Y have opposite signs as the basis for evaluating the empirical evidence.

Using American data for the years 1929 to 1960, Gallaway

calculated the sign of the yearly change of the wage share and the investment/income ratio. He observed that "In the period 1929-1960 the changes in the investment/income ratio correctly predict the direction of change in the wage share 74.2 per cent of the time (23 of 31 years)"[31].

Gallaway also tested a theory of his own. His theory involves making adjustments to the observed wage share to compensate for what he sees as an aggregation problem. He posed the problem as follows;

> "a theory of aggregate relative shares would be greatly facilitated if there were exact macro-counterparts of the variables which are crucial in determining micro-relative shares, viz. the relative price of labour and the elasticity of substitution between captial and labour. However, it is well known that these do not exist; one need only note the difficulties of aggregating production functions to demonstrate this."[32]

When testing his own theory, he found that a "change in the investment/income ratio correctly predicts the direction of change of the in wage share....83.9 per cent of the time (26 of 31 years) employing wage share data adjusted for interindustry shifts"[33].

Gallaway commented that this result and the 74.2 percent given above 'are significantly different from 50 percent at the .05 level'[34]. He then went on to argue that Kaldor's theory does not apply when there is full employment by saying that:

> In fact, if a maximal level of employment were reached, any further increases in the investment/income ratio would produce no change in the relative price of labour and no change in the wage

> share. This suggests that given our empirical findings
> concerning the behavior of sectoral wage shares
> Kaldor's full employment model really says very little
> about the distribution of income, for if the full
> employment assumption is truly satisfied, there can be
> no change in the relative price of labor and,
> consequently, in the wage share.[35]

When he dropped the six years in which there was full

employment from the data set, Gallaway found that Kaldor's

theory predicted the correct change of the wage share 83.3 per

cent of the time (20 of 24 years) and his own theory predicted

correctly 91.7 per cent of the time (22 of 24 years).

Gallaway concluded that (1) "Kaldor's full employment

model really says very little about the distribution of

income, for if the full employment assumption is truly

satisfied, there can be no change in the relative price of

labor and, consequently, in the wage share,"[36] and (2) "the

modified version of Kaldor's theory which has been suggested

in this paper is most applicable...."[37].

Gallaway's test required the measurement of three

variables; W, I and Y. For I he used "a definition of

investment embracing gross private, public (defined as

government purchases of goods and services), and net foreign

components is employed"[38]. For wages he used "wage share data

pertain(ing) to the share of compensation of employees out of

private income"[39]. This would imply that the Y in the ratio

W/Y is some measure of private income. The measure of Y in the

ratio I/Y was not described. Gallaway referred to I/Y only as

the investment/income ratio. Since he did not also refer to the Y in I/Y as 'private income', this may be taken as an indication that the two measures of Y are not the same.

Bharadwaj and Dave's Empirical Test

Bharadwaj and Dave gave the results of an emprical test of Kaldor's theory in their article "An Empirical Test of Kaldor's Macro Model of Income Distribution For Indian Economy"[40]. The test was based on an examination of the predicted linear relationship between P/Y and I/Y, (the theory predicts that P/Y = a + b(I/Y)). Using Indian data for the period 1950-51 to 1957-58, they estimated two correlation coefficients for P/Y and I/Y, i.e., one for each of their two sets of estimates of P/Y. One set of estimates of P/Y included the income of the self-employed sector. To estimate P in this case, the fraction of self-employed income which could be considered as profits was calculated. This fraction of self-employed income was added to profit income. The corresponding estimate of Y included self-employed income. Another estimate of P/Y was obtained by using estimates of P and Y which do not include self-employed income.

The estimate of the correlation coefficient between I/Y and the P/Y which included a component of self-employed income was .0324. Bharadwaj and Dave pointed out that this is not significantly different from zero. The correlation coefficient between I/Y and the other estimate of P/Y was .3779, which, as

they pointed out, is not significantly different from zero at the .1 level of significance.

Bharadwaj and Dave also listed the two sets of estimates of P/Y, the corresponding estimates W/Y and the estimates of I/Y. It is observed that, relative to the variation of I/Y, there was little variation of the other four variables, (if s_p > s_w and, $1 > s_p > s_w > 0$, then a given variation of I/Y should result in a greater variation of W/Y and P/Y).

Bharadwaj and Dave's test required the measurement of; W/Y, P/Y and I/Y. As mentioned, they provided two definitions of W/Y and P/Y: one set of definitions was based on a measure of profit and wage income which did not include components self-employed income. The other definiton involved assigning a fraction of self-employed income to profits, and the rest to wages, based on an estimate of the fraction of self-employed income attributable to either profits or wages in 1951. In order to calculate their estimates of W/Y and P/Y, they used estimates of wages, profits, and self-employed income given by R. Narayanan and B. Roy in their paper, "Movements of Distributive Shares in India". Narayanan and Roy's estimates of profits, wages and self-employed income include the public sector[41]. They did not however discuss the definition of the investment/income ratio.

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Dholakia's Empirical Test

Bakul Dholakia also used Indian data to test Kaldor's First Theory[42]. His method of testing was the same as Bharadwaj and Dave's, that is, he estimated a correlation coefficient between P/Y and I/Y. His estimate was .826, which he commented is highly significant. He interpreted his result as evidence which, "lends a support to Kaldor's hypothesis that a relative share of property income would be directly related to the proportion of total income that is invested"[43].

His test is of interest for two reasons; one, it contradicts Bharadwaj and Dave's results, (they found that, in much the same period of time, the correlation coefficient was not significantly different from zero); and two, he measured P/Y and I/Y as the profit share and investment-income ratio for the nonagricultural sector. He did not, however, say whether Y and I include components of government spending.

Testing Models and Models of the Counterexample

It may appear that Reder and Gallaway have used a method of testing similar to the one proposed in this thesis, however this is not the case. The method of testing outlined in the next Chapter involves looking for a confirming instance of a model of a counterexample of the theory under examination. More importantly, the objective of the test is not to determine whether the model of the theory's counterexample better predicts the data than does the theory. Instead the

objective is to determine whether the observations can be accepted as refuting evidence.

Reder and Gallaway did not set out to find confirming instances of a counterexample. With respect to Reder's test, the truth of $I = s_w W + s_p P$ does not rule out the possibility that $I = sY$. In fact it is quite likely that a confirming instance of the latter would be observed in a world where the former is true. Similarly, with respect to Gallaway's test, although it is not clear exactly what his alternative model is, it would appear that observing a confirming instance of this model is not ruled out by the truth of Kaldor's Theory.

Despite the fact that in both Reder and Gallaway's tests, on the basis of the testing conventions they have used, the alternative models better 'predict' the data, neither of the tests' results represent a refutation of Kaldor's theory, (since, as mentioned, the truth of Kaldor's theory does not rule out the possibility of observing confirming instances of their alternative models).

Footnotes to Chapter Four

1 Kalecki, "Determinents of Profits," pp. 78-92.

2 Kalecki made this simplification because, as he noted,
"virtually ... no statistical data about workers' savings, s,
are available".
Ibid., 89-90.

3 Ibid., 89.

4 Ibid., 90-92.

5 Ibid., 91.

6 Kalecki, "Distribution of National Income," pp. 62-77.

7 Ibid., 76.

8 Kalecki, "Determination of National Income and
        Consumption," pp. 93-104.

9 Ibid., 98-101.

10 Kalecki, "Determinents of Profits," pp. 90.

11 Ibid.

12 Kalecki, "Determination of National Income and
        Consumption," pp. 104.

13 Melvin W. Reder, "Alternative Theories of Labor's Share,"
        The Allocation of Economic Resources ed. M. Abromowitz
        (Stanford, Stanford University Press, 1964).

14 Ibid., p. 180.

15 Ibid., p. 188.

16 Reder said of these estimates; "For the logic of the
argument, the values assigned to s_w and s_p should be
considered to be arbitrary; however they were chosen from
among the possible pairs that make d roughly zero in the base

period".
Ibid., p. 189-190.

17 Ibid., p. 189.

18 Ibid., p. 190.

19 Ibid., p. 191.

20 Ibid.,

21 Irving B. Kravis, "Relative Income Shares in Fact and
        Theory," American Economic Review 49(5) (December
        1959): 917-949.

22 Kravis' test could be called an empirical inquiry since it
is not clear what, if anything, he is testing.

23 The estimates are from;
S. Kuznets, "Table III-8," Capital in the American Economy:
        Its Formation and Financing, Summary Volume
        (Princeton, N.J.: Princeton University Press,
        1961), pp. 92.

24 Kravis, p. 939.

25 Ibid.

26 Ibid.

27 Ibid., p. 918.

28 Ibid., p. 925.

29 Y is given at the top of the table I as 'National Income',
Ibid., p. 919.

30 L.E. Gallaway, "The Theory of Relative Shares,"
        Quarterly Journal of Economics 78(4) (November
        1964): 574-593.

31 Ibid., 587.

32 Ibid., 577.

33 Ibid., 587.

34 Ibid.

35 Ibid.

36 Ibid.

37 Ibid., 589.

38 Ibid., 585.

39 Ibid., 587.

40 R. Bharadwaj, and K. Dave, "An Empirical Test of
    Kaldor's Macro Model of Income Distribution
    For Indian Economy," Indian Journal of Economics
    20(3) (January-March 1973): 515-520.

41 R. Narayanan, and B. Roy, "Movements of Distributive
    Shares in India," in Papers on National Income
    and Allied Topics, Volume III, ed. N.S.R.
    Shastry, et. al. (Bombay: 1965), p. 103.

42 Bakul H. Dholakia, "Behaviour of Income Shares in
    a Developing Economy - The Indian Experience,"
    Indian Economic Journal 23(4) (April-June 1976):
    295-307.

43 Ibid., 307.

Chapter Five – Methodology

All of the tests discussed in Chapter Four, with the exception of Kravis', involved looking for confirming instances of a theory's predictions. This suggests that the authors are using one of the prevailing methodologies in· economics, and that accordingly, their objective was to find how well the theory they were examining predicts[1] or describes[2] observed reality. We have referred to this approach as logical positivism because it emphasizes the logical relationship between a theory and positive (i.e. confirming) evidence in its favour. As a means of arriving at true theories, logical positivism is logically limited. That is, there is no inductive logic by which to connect the theory with positive evidence and still provide the logical assurances of deductive logic[3]. Failure to establish a logical connection between theories and positive evidence is often called "the problem of induction".

The objective of this chapter is to introduce an alternative approach to testing. This alternative approach is not intended as a solution to the above mentioned problem of induction, (the proposed methodology takes as its starting point an assertion to the affect that this problem cannot be solved). Instead, the problem to be solved by the alternative

approach can be posed as follows; (given that the problem of induction cannot be solved), which logical relationship between empirical evidence and theories can be used as the basis for testing, how can these tests be carried out and what can be gained from this type of testing?

The method of testing proposed in this chapter, which is intended as a solution for this problem, is designed to determine if a given set of observations can be used to criticize a theory, i.e. argue for, (but not prove), its falsity. More specifically, this alternative method of testing involves constructing and looking for confirming instances of models of a theory's counterexample(s). The advantage of this procedure is that it is possible to logically argue for an assertion of the falsity of a theory from an assertion of the truth of refuting evidence. This approach to testing is based on the methodological viewpoint of Karl Popper[4].

This alternative approach has been used to test the three post-Keynesian income distribution theories discussed in Chapter Two.

This chapter is divided into three sections. In the first section there will be a discussion, with an example, of the structure of a model of a theory. More specifically, the example will feature a model of the type that would be used to test a theory by looking for confirming instances of its predictions. This example will include an assumption to

explain observed reality, an assumption to make the model observationally convenient, empirical definitions, and rules for determining when an observation can be considered as a confirming instance of the model. Although testing a theory by looking for confirming instances of its models is logically limited as a means for establishing the theory's truth, there are several reasons for examining models of this type: Firstly, it will help clarify what is meant by a model of a theory designed for the purposes of testing. Secondly, in the alternative approach, model building is still an important part of testing. And thirdly, since testing conventions will be necessary even in the alternative methodology, it allows us to examine their role in model building.

The second section will contain a discussion of the limitations of logical positivism as a method for establishing the truth of theories. The purpose of this second section is to explain why an alternative approach is desirable if one wishes to examine the truth or falsity of theories.

The alternative approach is outlined in the third section. This alternative approach is based on a mode of argument referred to as 'modus tollens', that is, one can argue logically for the falsity of a theory on the basis of the falsity of one or more of its conclusions. The third section is divided into two parts. In the first part it will be argued that the falsity of a theory cannot be established by refuting its models. In the second part it will be argued

that refuting evidence can be more successfully sought by constructing models of the theory's counterexample(s).

I. A Model of a Theory

To test a theory by way of looking for confirming instances of its predictions, it is necessary to construct a model of the theory. In addition to the theory, this model must contain empirical definitions, rules of evidence, and at least implicitly, an assumption to the affect that there are no other relevant factors influencing observed reality, (note: 'rules of evidence' is defined to be the procedural specifications of a test and criteria for determining when an observation can be considered as a confirming instance of the model). The model may also include assumptions to make the theory more observationally convenient or assumptions to account for other influencing factors on observed reality, (these two roles for the additional assumptions are not mutually exclusive, an additional assumption can do both). The theory by itself, if it is assumed to be sufficient to explain observed reality, or in conjunction with observationally convenient assumptions and assumptions designed to explain other factors influencing observed reality, will be referred to as an observational model. An observational model in conjunction with rules of evidence and empirical definitions will be referred to as a testing model.

A specific observational and testing model will be constructed as an example. These models will be constructed from the following theory;

'for a set of commodities Y, the quantity of a
commodity demanded by consumers is a function
of its price.'

or in mathematical notation;

'q = f(p) for every member of the set Y'.

An observational model of this theory can be constructed by assuming that the relationship between p and q is linear, i.e.;

q = a + bp.

This assumption is observationally convenient because it introduces the possibility that a regression technique can be used to identify a confirming instance of the theory.

For the purposes of having a simple notation, we could say that this kind of model has the following structure:

$$a_1$$
and a_2
and a_3
.
.
.
and an
and b_1
.
.
.
and b_m,

where 'a_1' to 'an' are the original assumptions of the theory,
and b_1 to b_m are the additional assumptions designed to make
the predictions observable or more specific, or to explain
observed reality. They will be referred to as type 'a' and 'b'
assumptions respectively. Note that the assumptions are joined
by the conjunction 'and'. Consequently, if any one of a_1 to a_n,
or b_1 to b_m, is false, then so is the model, (that is, their
conjunction would be false even though all of the assumptions
except one were true).

The other class of statements mentioned above as
necessary for a testing model, that is, the empirical
definitions, the procedural specifications and the criteria by
which it can be decided if the observation statements can be
considered as confirming instances of a theory or a model, can
be denoted as:

$$\text{and } \begin{matrix} c_1 \\ c_2 \\ \bullet \\ \bullet \\ \bullet \end{matrix}$$

and c_k.

They will be referred to as type 'c' statements, (and will be discussed below).

The model, given as an example above, can be expanded to include empirical definitions, procedural specifications, and criteria that can be used to identify confirming instances of the model, i.e. type c statements. This has been done below, the letters in brackets indicate the type of assumption or rule:

(a) 1/ $q = f(p)$

and (b) 2/ the relationship between q and p is linear, with an intercept of a, and a coefficient of b.

and (b) 3/ the observed q is equal to a + bp + e, and e has a normal distribution, with a mean of zero and some finite standard deviation.

and (c) 4/ q is defined and measured as ...... at time t or over time period t.

p is defined and measured as ...... at time t or over time period t.

and (c) 5/ If the R squared is greater than .95, then the observations are accepted as a confirming instance of the model.

The above model contains the necessary ingredients for an attempt to test a theory by looking for confirming instances of its predictions: Assumption (2) makes the theory, ($q = f(p)$), observationally more convenient, that is, a regression technique could be used to estimate the coefficients. Assumption (3) explains why real world observations will differ from the predictions of assumptions (1) and (2). Statement (4) provides 'empirical definitions' so that the relevant variables can be measured in terms of real world observations. And rule (5) provides a criterion for deciding which observations can be accepted as a confirming instance of the model, (and implicitly contains the procedural specification that an R squared should be calculated). This is the type of model one would construct in order to look for 'positive evidence'.

Note that with assumption (3) as an explanation of the deviations of the observed q's from the a + bp's, no possible combination of p and q is ruled out by the truth of the model since e can have any value. The model does, however, say that some combinations are more unlikely to be observed than others, (because of the assumed probability distribution of e). When a model is constructed to have this type of prediction, the usual testing procedure is to say that if unlikely values of x and y are observed, the model is to be considered as false. Any procedure of this type, including

rule (5), is somewhat arbitrary and its appropriateness is not beyond question, (that is, in some cases it may not be appropriate).

Several other statements or assumptions might also have been included in the example. For instance, if the model were being used to evaluate data taken from a period of time in which incomes were increasing, the model should be designed to take this into consideration, (that is, if the quantity demanded is also a function of income). This could be done by including in the model, assumptions to explain how the quantity demanded will change as incomes increase. The additional assumption(s) may be for example;

$$q = m + ny, \qquad \text{(where y is income)}.$$

A model to explain observed reality could therefore be the following;

$$q = c + bp + ny,$$

(rule (5) would be applied to this observational model).

The model could also have included a procedural specification or rule for dealing with a problem such as autocorrelation. A specification of this type could be exemplified by the following: if the Durban-Watson Statistic is less than 1.2 or greater than 2.8 then use a Hildreth-Lu technique to calculate the R squared.

It is important to note with respect to testing, that the testing model is designed only to examine the truth, falsity or predictive powers of the type a and b assumptions. This does not mean however that the type c statements are beyond question. Their appropriateness is as much an issue as is the truth, falsity or predictive power of the observational model.

With respect to examining the theory's truth or falsity, testing the theory by way of the above model suffers from certain limitations. More specifically, there is no inductive logic by which any finite number of confirming instances of q = a + bp can be used to argue for the truth of q = f(p), (or for that matter, nor can it be used to argue for the truth of q = a + bp).

II. Three Aspects of the Problem of Induction

Since a theory is the conjunction of its assumptions, any method for establishing its truth entails establishing the truth of every one of its assumptions. The problem of induction arises because every theory contains as an assumption at least one 'universal statement', that is, a statement of the form 'all x's have property y'. Theories cannot be verified because it is not possible to verify statements of this type[5]. As an example consider the assertion that, 'all demand curves are downward sloping'. For this statement to be true, every demand curve, past, present and

future, must be downward sloping. A single exception would mean that the statement is false. A verification of the truth of this statement would therefore entail establishing that every demand curve, past present and future, has the desired characteristic. Obviously this cannot be done[6].

The problem of induction is that a finite number of observations cannot be used to argue for the truth of a statement such as, 'all demand curves are downward sloping', with the logical assurances of deductive logic. With respect to testing by way of looking for positive evidence, there are three aspects to this problem. The first is that there is no logic by which it is possible to use a finite number of true observation statements to establish the truth of a theory or more specifically, the theory's universal statements. The second is that observation statements cannot be proven to be true beyond question. And the third is that even with conventions for evaluating the truth of observation statements, there is no way to prove that an observation statement which is accepted as true, is or is not a confirming instance of a theory. These three aspects of the problem of induction will be discussed below.

Note that the counterexample of a universal statement is an assertion to the effect that at least one member of the class under examination does not have the characteristic of interest. Statements of this type are referred to as

existential statements and can be said to be of the form, 'at least one x has (or does not have) the property y'. This type of statement can be verified, at least conceptually, by establishing that one or more x's have (or do not have) property y.

The First Aspect - Reverse Modus Ponens

It is possible to argue for the truth of a model or theory's conclusions on the basis of the truth of the model or theory's assumptions. This mode of argument is referred to as modus ponens. The first aspect of the problem of induction arises because there is no valid 'reverse modus ponens', that is, there is no logic by which one can argue from the truth of a finite number of a model or theory's conclusions to the truth of its assumptions[7]. A finite number of true observation statements cannot therefore be used to argue logically for the truth of the theories or models from which they logically follow.

The Second Aspect - The Contingency Problem

As mentioned, the second aspect of the problem of induction is that observation statements cannot be proven to be true. This aspect will be referred to as the contingency problem because any purported proof of the truth of an observation statement is necessarily contingent on the truth of at least one theory. The contingency problem is twofold:

firstly, there are the limitations imposed by the fact that there is no valid reverse modus ponens; and secondly, there is what we will call the problem of infinite regress. With respect to both problems, a noncontingent proof of the truth of an observation statement is not possible because an assertion of the truth of any observation statement depends upon, (follows logically from), the assertion of the truth of at least one theory.

It is a manifestation of the first aspect of the problem of induction because the truth of the theories, upon which a proof of the truth of an observation statement is contingent, cannot be established (proven) without a logically valid reverse modus ponens, (see the above).

This problem however would not be solved by a reverse modus ponens since even if one were available only contingent proofs of the truth of observation statements would be possible. That is, it can be shown that these contingent proofs lead to an infinite regress such that a noncontingent proof of the truth of either an observation statement or a theory is not possible. This can be shown as follows: label a theory under examination as T1 and the observation statement that one would use to argue for its truth as O1. If there were a valid reverse modus ponens with the logical assurances of deductive logic, and if one wished to argue for the truth of T1 on the basis of O1, then it would be necessary to prove the truth of O1. A proof of O1 would require at least one theory

that has been proven to be true. The theory or theories which are necessary to argue for the truth of O1 can be labelled as T2. The observation statements which would be used to argue for (prove) the truth of T2, can be denoted O2. Observation statements O2 must be proven to be true, if they are to be used to prove the truth of T2. The proof of the truth of these observation statements would require that at least one theory, denoted as T3, has been proven to be true. The proof of the truth of T3 would in turn require that observation statements O3 have been proven to be true. There is no Tn or On at which this process stops. A proof of the truth of On will always be contingent upon the truth of some theory T(n + 1).

The Third Aspect — The Limits of Observation

The third aspect of the problem of induction concerns the limitations of observation. Even if there are conventions for determining when observations can be considered as true, so as to circumvent the contingency problem discussed above, it would still not be possible to prove that observation statements are, or are not, confirming instances of a theory or model. This is because there are other factors influencing observed reality and it is not always possible to construct observational models which can take all of them into account.

There are two sides to this problem: Firstly, it is not possible to prove that the discrepancy between the observational model's predictions and observed reality was not

due to some factor not considered by the theory or model, (where the observational model fails to predict observed reality). Secondly, it would not be possible to prove, for the same reasons, that an observation statement was accepted as a confirming instance of a theory or model's prediction because the prediction is true, (where the observational model accurately predicts observed reality). That is, it could be that the prediction is false, but that observations were accepted as confirming instances of the model or theory because of other influencing factors, (this is not as likely as the case where the prediction is true but the observation statements are not accepted as a confirming instance of the prediction). This problem cannot be solved by building better models since it is not usually possible to construct a model which will always account for every relevant influencing factor in the real world[8].

Demand theory can be used to exemplify this problem. Demand theory predicts that if a commodity is not an inferior good then the quantity demanded will decrease as the price increases, all other things being equal. Unfortunately from the point of view of testing, in the real world all other things are not equal, (even under laboratory conditions). Although the theory as stated may be true, falling prices may not be associated with increasing demand for any number of reasons having to do with the fact that 'other things are not equal'. An observational model should be designed to take

these 'other things' into account[9].

.

At this point the following note with respect to observational models may be appropriate, (because it is associated with the above problem). As mentioned, an observational model implicity contains an assumption that there are no other relevant factors influencing observed reality, (other than those in the model). Consequently, if the model does not accurately predict observed reality then it is false. It is possible therefore that if the theory is used as an observational model, that the model may be false, but the theory, true, (because as mentioned, an observational model implicitly contains, in addition to the theory, an assumption that all other things are equal).

Rules of Evidence

In the absence of the complete accuracy of a model's predictions and in light of our inability to prove the truth of observation statements, the problem with respect to testing is therefore to develop some type c statements for determining when an observation can be interpreted as a confirming instance of the theory or model under examination. These type c statements should, as much as possible, take into consideration what is known about why the predicted values of the relevent variables deviate from their observed values, and make some allowance for unexplained deviations. There is,

however, no mechanical method for developing statements of this type which will always correctly determine whether an observation is a confirming instance of a model or theory.

The type b assumptions and type c rules, specifications and definitions will also be referred to as 'testing conventions'. In other words this term will be used to refer to any set of additional assumptions, procedures, empirical definitions and criteria of acceptance employed in testing a theory. Testing conventions can also be seen as the means by which we deal with the latter two aspects of the problem of induction. More specifically, they are used to determine which observation statements should be considered as true, and which may be considered as confirming instances of the theory or model under examination.

Random Deviations

A common approach for dealing with the problem that models do not predict with complete accuracy is to assume that deviations from the predicted values are the product of a random error term. This assumption is often associated with the use of an hypothesis test as a means of determining if an observation should be considered as a confirming instance of a model. Gallaway, Dholakia and, Bharadwaj and Dave have used this approach. They have set up their tests such that the observations were accepted as a confirming instance of the

model if the hypothesis was rejected. This convention for
testing models has been incorporated into the tests carried
out for this thesis.

III. An Alternative Approach

The limitations imposed by the problem of induction have
caused many economists to turn to instrumentalism and
conventionalism which presumably do not require an inductive
logic, (namely, through model building they look for theories
which predict or describe observed reality acceptably well).
The problem is not with these conventional approaches, but
with the fact that many economists see them as a second best
alternative to induction. This thesis argues that this
position overlooks an alternative approach suggested by the
work of Karl Popper.

The Popperian approach is based on the fact that, if one
accepts observation statements as empirical evidence, one can
argue for the falsity of a theory on the basis of the falsity
of its conclusions. Since at least one assumption of any
theory must be a universal statement, at least one of these
conclusions must also be a universal statement. There is
therefore at least one conceivable counterexample which can be
expressed in the form of an existential statement. With
respect to testing, this means that, on the basis of empirical
evidence, a contingent proof of the falsity of a theory is
possible, (note that a contingent proof of the truth of a

theory is not possible, on the basis of empirical evidence, because there is no inductive logic). That is, one can argue for the falsity of a theory by arguing for the truth of the existential statement which represents a counterexample of the theory. Conceptually at least, an existential statement can be shown to be true by finding a single confirming instance of its assertion.

The alternative approach involves testing a theory by constructing models of its counterexamples. More specifically, the models are built from counterexamples in the form of existential statements. Existential statements are chosen as the basis for testing because it is logically possible to argue for the truth of the counterexample, (i.e. the existential statements), and therefore the falsity of the theory, on the basis of a finite number of confirming instances.

The test procedures would also involve applying the same empirical definitions and rules of evidence, (i.e. procedural specifications, empirical definitions and criteria for accepting the observations as a confirming instance of the model), to an observational model of the theory, (that is, if doing so is possible). This is done so as to identify rules of evidence which too readily accept an observation statement as a confirming instance of the counterexample. If the rules of evidence indicate that an observation is a confirming instance of both the theory and the counterexample, the testing

conventions should be reexamined.

The alternative approach is superior to testing procedures designed to find confirming instances of the theory, (i.e. the implementation of inductivism, instrumentalism or conventionalism), for the reason given above: that is, it is logically possible to use a confirming instance of the counterexample to argue for, (but not prove), the falsity of the theory, (with the assurances of deductive logic), while on the other hand, it is not logically possible to use a confirming instance of the theory's prediction to argue for the truth of the theory.

The methodology is also superior because, in comparison with the case where failing to find a confirming instance of an observational model of the theory is treated as negative evidence, (i.e. as a basis for criticizing a theory), inappropriate testing conventions are not as likely to lead to deceptive results. It is more likely that a confirming instance of a model of the theory will not be found because of inappropriate testing conventions, than for the same reason, a confirming instance of a model of the counterexample will be found. In particular, this is the case if inappropriate testing conventions are weeded out by attempting to apply the same conventions to an 'observational model' of the theory.

The superiority of the alternative approach requires a qualification however. Confirming instances of models of a theory's counterexample(s) can only be used to criticize a theory, (by way of a contingent proof of its falsity). It is not possible to prove that a theory is false because the problem of induction cannot be overcome. With respect to the above method of testing, there remain two (unsolvable) aspects of the problem of induction. They are as follows: firstly, there is still no method for establishing the truth of an observation statement, (to prove that the counterexample is true, it is first necessary to prove that the observation statement, which is a confirming instance of the counterexample, is true). And secondly, as is the case when testing models of a theory, (discussed in section I), it is not possible to prove that an observation statement should, or should not, be considered as a confirming instance of a model of a counterexample, even if the universal statement to which the counterexample corresponds is false and the real world is such that refuting evidence is there to be observed. Model building and testing conventions, and in particular rules of evidence, are therefore no less important for this alternative approach.

Models and Counterexamples

There are two reasons why models of the type discussed in section I cannot be used when applying the proposed methodology. One reason is that the rules of evidence would have to be changed. This would have to be done because rules of evidence designed to find a confirming instance of a model cannot necessarily be used to identify confirming instances of the model's counterexample(s). This is because there is not an 'excluded middle' between the status of being a confirming instance of a model, and that of being a confirming instance of its counterexample. Namely, an observation which is not identified as a confirming instance of a model, need not be considered as refuting evidence.

The necessity of changing the rules of evidence can be demonstrated by way of the example discussed in section I. Rule (5) states that an observation is to be interpreted as a confirming instance of the model if the R squared is > .95. This does not mean however that an observation having an R squared < .95 must be considered as a counterexample since an R squared less than .95 is consistent with the truth of the theory under certain conditions. For instance if x and y change very little then the deviations of y from its observed mean that can be explained by similar deviations of x, will be small relative to that part of the deviation of y which is a product of a random error term. In a situation where x and y change very little, (relative to the standard error of

regression), the observed R squared will be relatively close to zero. The observations are not therefore likely be accepted as a confirming instance of the above model, even if the model were true.

In order to show that the model is false, new testing conventions would have to be developed to look for refuting evidence. In other words the new rules of evidence would have to be designed to look for confirming instances of the model's counterexample(s). This would involve a fundamental change of the testing model.

The second reason that models of the theory cannot be used to test the theory by way of the above approach is that it is not possible to show that a theory is false by establishing the falsity of a finite number of its models[10]. This is because showing that a model is false, by establishing the falsity of one of its conclusions, is not sufficient to determine which ones or how many of its assumptions are false since it could be any one of them. With respect to testing, being able to establish the falsity of a finite number of a theory's models may mean only that at least one of every model's type b assumptions is false.

A Model of the Counterexample

Because a theory contains at least one universal statement, it has at least one counterexample. The counterexample can be expressed in the form of an existential statement, which will be denoted as 'not p_j'. The existential statement, 'not p_j', is the denial of a universal statement which can be denoted as pj, and which is either one of 'a_1 to an' or can be deduced from 'a_1 and a_2 and ..... an'

The model of the counterexample will be a testing model designed to find confirming instances of 'not p_j'. It will therefore require type c statements. These type 'c' statements must be designed to identify confirming instances of 'not p_j'. The basic testing model can therefore be expressed as;

$$'not\ p_j'$$
$$and\ c_1$$
$$and\ c_2$$
$$\cdot$$
$$\cdot$$
$$\cdot$$
$$and\ c_k.$$

Constructing a model of this type may not, however, always be the most practical approach since it is possible that the model is not be sufficient to explain observed reality or the theory's counterexamples are not easily observed. Instead, as a general rule, constructing models of the theory's counterexamples which include 'b' type assumptions, will be a more fruitful method of looking for refuting evidence.

A model of the counterexample, with type 'b' assumptions,

can be expressed as;

$$\text{'not } p_j\text{'}$$
$$\text{and } b_1$$
$$\text{and } b_2^1$$
$$\cdot$$
$$\cdot$$
$$\cdot$$
$$\text{and } b_m$$
$$\text{and } c_1^1$$
$$\text{and } c_2^1$$
$$\cdot$$
$$\cdot$$
$$\cdot$$
$$\text{and } c_k$$

The model ' 'not p_j' and b_1 .... and c_k' must be constructed such that, what the researcher identifies as a confirming instance of the model, is an instance of 'not p_j'.

In terms of the above example, 'not p_j' would be:

'q does not always equal f(p)',

(where f is a well-defined function[11], and what we mean by 'equal' would be established by the testing conventions, that is, by the type 'c' statements). It may be easier or more practical to establish that an observation is a confirming instance of 'q does not always equal f(p)' by showing that it is a confirming instance of one of its observational models. One possible model of the above counterexample is:

$$-(q - b)^2 + a = p$$

The model can be shown graphically as:

q

b

a   p
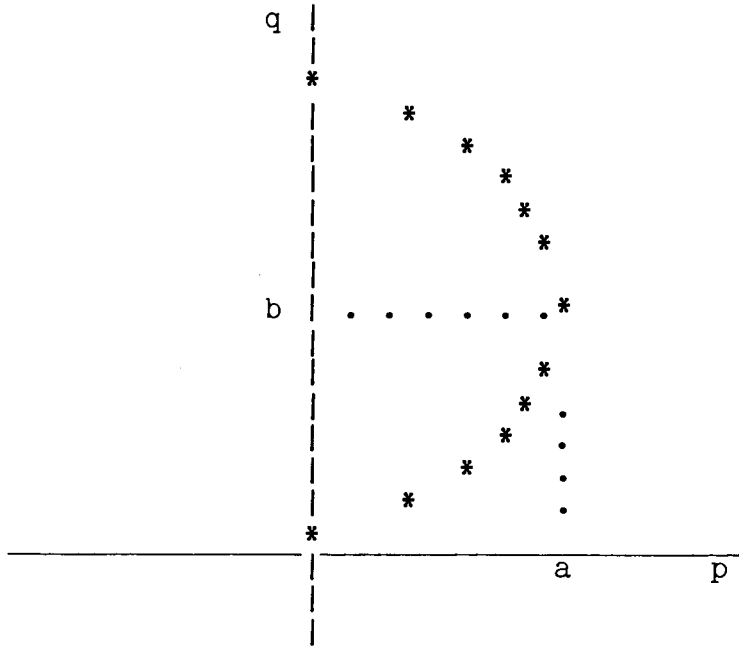
This observational model describes a parabola, the existence
of which is ruled out by the truth of the theorem. More
specifically, the theorem q = f(p) predicts that each value of
p is associated with only one value of q. In contrast, if the
above model were true then there would be two values of q
associated with some values of p. In fact the above model
asserts that price is a function of quantity.

The observation of a single confirming instance of,

$$-(q - b)^2 + a = p$$

would be considered as refuting evidence. This is where the
testing conventions become important. Observations forming a
segment of the parabola for p between o and a, may be
considered as a confirming instance of the model of the
counterexample, but they could also be considered as a

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confirming instance of the theory, (or some model of the theory) if values of q only between o and b are observed, (i.e. one value of q is associated with each value of p). This situation can be shown graphically as:

```
q |
  |
  |
  |
  |
b |  .  .  .  .  .  .*
  |                *
  |              *
  |             *   .
  |            *    .
  |          *      .
  |        *        .
  |      *          .
  |  *
_____|_____
  |                   a        p
  |
  |
```
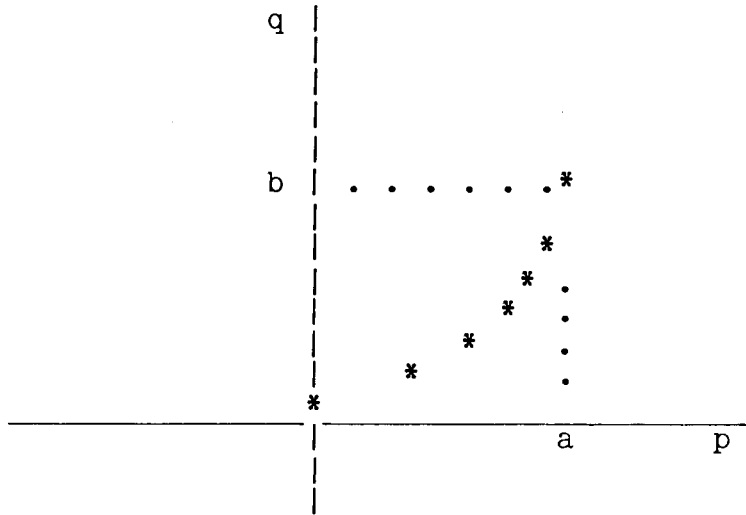
The testing conventions would have to be designed to identify as a confirming instance of the counterexample, only those observations that could not also be an accepted as a confirming instance of the theory, (i.e. cases where each value of p is associated with two values of q).

In general, testing conventions will be required such that observations which are interpreted as refuting evidence will not also be interpreted as a confirming instance of the theory, (if the same testing conventions are used to construct a similar model of the theory). Consider for example the case of a theory having the following prediction;

$$y = a + bx.$$

Even if the theory were true, because of the inevitable discrepency between the observed and predicted values of y, some observations may be considered as a confirming instance of both $y = a + bx$ and the following model of the counterexample:

$$y = a + bx^q.$$

If the latter were used to test the theory, some testing conventions would be required for deciding when an observation can be considered as a confirming instance of this model in a way which is ruled out by the truth of the theory, (that is, testing conventions are necessary to specify the meaning of 'equal' and 'not equal'). This problem appeared in the tests to be discussed in Chapters Six to Nine, and it was solved by the 'two standard deviation rule'. The rule states that to be an instance of the counterexample, the exponent, q, must be more than two standard deviations from one.

The Tests

The approach taken in this thesis was to test the theories by way of constructing models of their counterexamples. The theorems chosen for testing were mostly of the form,

$$y = bx + cz,$$

for which refuting evidence is a confirming instance of the following counterexample,

'y does not always equal bx + cz'.
The models constructed of this counterexample were functional
relationships such as,

$$y = g(x,z),$$

(where, y = g(x,z), was ruled out by the truth of y = bx +
cz).

The need for testing conventions is one of the reasons
why models of this type were used. Most of the tests cited in
chapter Four were designed to identify confirming instances of
a theorem of the form, y = f(x,z). Testing conventions were
therefore more readily available to test models in the form of
a functional relationship.

Several models of the type, y = g(x,z), were constructed
of each of the theorems' counterexamples. They are outlined in
the next Chapter.

Footnotes to Chapter Five

1 Milton Friedman for example, in his well known essay "The
Methodology of Positive Economics", makes an argument for
using theories as tools, and more specifically as predictors.
The test by Bharadwaj and Dave is an application of this
approach, they evaluate Kaldor's theory as a model for
predicting the profit share. Presumably the truth of the
theory was not an issue.

2 We say that a theory 'describes reality' when it predicts
well and its assumptions meet certain other conventional
criteria, usually with respect to their ability to approximate
or categorize (presumed) reality. The absolute truth or
falsity of the theory is not usually an issue. This approach
is indicative of what we call Conventionalism.

3 L.A. Boland, "A Critique of Friedman's Critics," Journal
of Economic Literature 17 (June 1979): 503-522.

4 Karl R. Kopper, Conjectures and Refutations ('New York:
Basic Books, 1965).

5 The only universal statements that can be verified, at least
conceptually, are limited universal statements. Statements of
this type limit (in time and space) the class of x's to a
finite size.

6 The problem with respect to establishing the truth or
falsity of theories, posed by the fact that a universal
statement such as, 'all demand curves are downward sloping',
cannot be empirically verified, cannot be circumvented by
showing that the universal statement follows logically from
the conjunction of a set of assumptions. Any attempt to prove
the truth of a statement in this way, if it were possible,
would first involve proving the truth of all of the
assumptions. This cannot be done because any set of
assumptions from which a universal statement can be derived,
must also contain at least one universal statement. This
universal statement can no more be empirically verified than
can the original universal statement or theory under
consideration. Any attempt to establish the truth of a theory
in this way would therefore only make the problem of empirical

verification one step removed.

7 This is because false theories and models can have true conclusions.

8 The impossibility of always being able to account for every relevant factor is discussed by Joseph Agassi in:
J. Agassi, "Tristram Shandy, Pierre Menard, and All That," Inquiry 4: 152-181.

9 Cliff Lloyd discussed this problem with respect to testing demand theory in:
Cliff Lloyd, "On the Falsification of Traditional Demand Theory," Metroeconomica, 17(1-2) (July-August 1965): 17-23.

10 L.A. Boland, "Testability in Economic Science," South African Journal of Economics 45(1) (March 1977): 93-105.

11 Well-defined means that the function is a one to one mapping from the domain of p into the domain of q.

Chapter Six - The Models of the Counterexamples

The theories were tested by constructing and looking for confirming instances of models of their counterexamples. More specifically, these counterexamples are the statements, which if true, would refute the theorems derived in Chapter Two. The models of the counterexamples will be outlined in this Chapter. They will be listed below with the theorems to which they correspond.

In this chapter the theorems that were outlined in Chapter Two will be expressed in the following form, using theorem 1 as an example:

$$W = aI + bY \qquad \text{where} \quad a = 1/(s_p - s_w)$$
$$b = s_p/(s_p - s_w)$$

This form of the theorem was a convenient starting point for constructing models of the counterexample for two reasons: Firstly the arguments of the coefficients 'a' and 'b' are difficult to measure. And secondly, even if they could be measured, there are no convenient testing conventions for determining when 'a does not always equal $1/(s_p - s_w)$' or 'b does not always equal $s_p/(s_p - s_w)$'. Only Kravis carried out an empirical test based on estimates of a and b,

(i.e., estimates of s_w and s_p), and he did not give a testing convention for evaluating the results[1].

I. Kaldor's First Theory - Theorem 1

The counterexample of the theorem given above as,

$$(10) \quad W = aY + bI,$$

is as follows:

'W does not always equal aY + bI'.

A model of this counterexample is:

$$(11) \quad W = ay + bI + c \qquad \text{where } c > \text{ or } < 0.$$

Confirming instances of this model were sought as refuting evidence of theorem 1. Several other models of the counterexample were constructed and tested as well. They are the following:

$$(12) \quad W = a(Y - I)^q \qquad q > \text{ or } < 1$$

$$(13) \quad W = (I/Y)^q$$

$$(14) \quad W/Y = a(I/Y)^q \qquad q > \text{ or } < 1$$

$$(14.5) \quad W/Y = a(Y/I) + b$$

A confirming instance of any of these models would be a confirming instance of 'W does not always equal aY + bI'.

The theorem was also tested in the first differential form, i.e.:

$$(15) \quad (dW) = a(dY) + b(dI)$$

(where 'd' preceeding a variable means a measure of the change of the variable from one time period to the next).

Two models of the counterexample were constructed of this form of the theorem. They are:

$$(16) \quad (dW) = a(dY) + b(dI) + c \qquad c > or < 0$$

$$(17) \quad d(W/Y) = ad(I/Y) + c$$

II. Kaldor's Second Theory – Theorem 2

In Chapter Two, three theorems from two versions of Kaldor's Second Theory were outlined for testing. One theorem specified the level, (or rate), of profits and the other two determined the valuation ratio. Two of the three theorems can be deduced from each version of the theory, in the case of both versions one of these two theorems was for the level, (or rate), of profits and the other was for the valuation ratio. The two theorems for the valuation ratio are as follows: from one version of the theory we can deduce that;

$$v = (1/c)[(s_w I/Y) - (s_w/s_c)(1 - i) - i(1 - c)]:$$

and from the other version it follows that;

$$v = 1 - 1/(1 - s_h) + s_h Y/(1 - s_h)I.$$

Both can be reduced to an equation of the form,

$$(20) \quad v = a(Y/I) + b$$

where, for the theorem corresponding to one version of the theory;

$$a = s_w/c$$

$$b = -s_w(1 - i)/s_c c - i(1 - c)/c$$

and for the theorem corresponding to the other version;

$$a = s_h/(1 - s_h)$$
$$b = -s_h/(1 - s_h)$$

Since the models of the counterexample are based only on a denial of the assertion that the variables have the relationship indicated by the theorem, in this case,

$$v = a(Y/I) + b \qquad b < 0,$$

both theories can be tested by seeking confirming instances of the same models of the counterexample, (i.e., both would·be refuted by an instance of 'v does not always equal $a(Y/I) + b'$).

Confirming instances were sought of the following models of the counterexample:

(21) $v = a(Y/I) + 1$

(22). $v = aY + bI + c$

(23) $v = a(Y/I)^q \qquad q < \text{or} > 1$

(24) $v = a(I/Y) + b$

The theorem was also tested in the first differential form. In this form the theorem is as follows:

(25) $(dv) = ad(Y/I)$

The models of the counterexample were:

(26) $(dv) = ad(Y/I) + b \qquad b > \text{or} < 0$

(27) $(dv) = a(dY) + b(dI) + c$

(28) $(dv) = ad(I/Y) + b$

Theorem <u>3</u>

The theorem common to both versions of Kaldor's second theory is:

$$P = I(1 - i)/s_c$$

This theorem was tested in the following form;

(30) P = aI.

The models of the counterexample, for which confirming instances were sought, are:

(31) P = aI + b   b > or < 0

(32) P = aI^q q > or < 1.

The following form of the theorem was also tested:

(35) (dP) = (dI).

The models of the counterexample which were tested are:

(36) (dP) = a(dI) + b.   b > or < 0

(37) |dP| = a|dI|^q q < or > 1.

III. Asimakopulos' Theory - Theorem 4

Three theorems from Asimakopulos' theory were tested. They are the following:

$$G = \frac{I + wH(1 - b + sb - s)}{w[u(1 - b + sb) + s]}$$

$$P/Y = \frac{uI + spaH}{(1 + u)I + paL (1 - b + sb - s)}$$

$$P = \frac{uI - spaH}{a[u(1 - b + sb) + s]}$$

A problem with testing these theorems is that some of the

variables are difficult to measure. The worst difficulties are
encountered with u, a, w and p. Fortunately, with respect to
a, w and p, the problem posed by the fact that these variables
do not have 'empirical definitions' can be avoided. The
solution is to set up the tests such that they do not have to
be measured. This can be done by manipulating the assumptions
so that a, w and p, are removed from the theorems. Using the
theorem for G as an example, this can be done as follows: w in
the numerator of the right hand side of the equation for G can
be replaced by p(1 + u)a, (since by assumption (35) of Chapter
Two, p = (1 + u)w/a). With some algebraic manipulations this
yields;

$$G = \frac{(1+u)I + apH(1 - b + sb - s)}{(1 + u)w(u(1 - b + sb) + s))}$$

·The assumption, apG = Y, can be altered to give, apH = (H/G)Y.
'a' and 'p' can be removed from the theorem by subsituting in
'Y(H/G)' for 'apH'.

By substituting in Y(H/G) for paH the theorem becomes:

$$G = \frac{(1 + u)I + (H/G)Y(1 - b + sb - s)}{(1 + u)w[u(1 - b + sb) + s]}$$

'w' can be removed from the theorem by using the
assumption that w times L, (the total labour input) equals
total labour income, (or the total wage bill). Dividing both
sides of the equation by L gives:

$$G/L = \frac{aI + b(H/G)Y}{cW}$$

where $a = 1 + u$

$b = 1 - b + sb - s$

$c = (1 + u)[u(1 - b + sb) + s]$

The coefficients of a nonlinear equation such as the above cannot be estimated using a least squares regression procedure. The theorem was therefore altered to give the following:

(40) $(G/L)W = a'I + b'(H/G)Y$

where $a' = a/c$

$b' = b/c.$

Confirming instances were sought of the theorem in this form. They were also sought of the following models of the counterexample:

(41) $G/L = aI + b(H/G)Y + cW$

(42) $GW/L = aI + bHY/G + c$ $c >$ or < 0

(43) $GW/L = a(I + HY/G)^q$ $q >$ or < 1

(44) $G/L = aI/(H/G)Y + bW/(H/G)Y + c.$

The first difference form of the theorem was also tested. The theorem in this form is:

(45) $d(G/L) = a[d(I/W)] + b[d(HY/GW)]$

Confirming instances were sought of this theorem and of the following models of the counterexample:

(46) $d(G/L) = a(dI) + b[d(HY/G)] + c(dW)$

(47) $d(G/L) = a(d[I/(H/G)Y]) + b(d[W/(H/G)Y]).$

Theorem 5

The theorem for P/Y has been given above as:

$$P/Y = \frac{uI + spaH}{(1 + u)I + paH(1 - b + sb - s)}$$

By the same argument that was used when discussing the theorem for G, this theorem can be rewritten as:

$$(50) \quad P/Y = \frac{aI + b(H/G)Y}{cI + e(H/G)Y}$$

It is not possible to estimate the coefficients of this type of functional relationship using an ordinary least squares regression technique. Confirming instances were therefore not sought of this theorem.

This does not however prevent one from constructing models of the counterexample. The following models of the counterexample were used in the tests:

$$(51) \quad P/Y = aI + b(H/G)Y + c$$

$$(52) \quad P/Y = a[(I - (H/G)Y)/(I + (H/G)Y)] + c$$

$$(53) \quad P/Y = aI/Y + bH/G + c$$

$$(54) \quad P/Y = aI/(H/G)Y + c.$$

The theorem was also tested in the first differential form given below;

$$(55) \quad d(P/Y) = \frac{a(I + dI) - b(HY/G + d(HY/G))}{c(I + dI) + e(HY/G + d(HY/G))} - \frac{aI - bHY/G}{cI + e(HY/G)}$$

The least squares method cannot be used to estimate the coefficients of this functional form either, but again, models of the counterexample can be constructed. Confirming instances

were sought of the following models of the counterexample:

(56) $d(P/Y) = a(dI) + b(d(H/G)Y) + c$

(57) $d(P/Y) = a(d[(I - (H/G)Y)/(I + (H/G)Y)]) + c$

(58) $d(P/Y) = ad(I/Y) + bd(H/G) + c$

Theorem 6

The last theorem to be considered from Asimakopulos'
theory is:

$$P = \frac{uI - spaH}{a[u(1 - b + sb) + s]}$$

By the same argument that was used when discussing the theorem
for G, this theorem can be rewritten as:

(60) $P = aI + b(H/G)Y$

where $a = u/[u(1 - b + sb) + s]a$

$b = -s/[u(1 - b + sb) + s]a$

To test the theorem, confirming instances were sought of this
functional relationship and of the following models of the
counterexample:

(61) $P = aI + b(H/G)Y + c$ $c < 0$ or > 0

(62) $P = a(I + (H/G)Y)^q$ $q <$ or > 1

(63) $P = a(I + (H/G)Y) + c$

(Note: (63) is a model of the counterexample because the
theory predicts that the coefficient of I and HY/G will have
opposite signs).

The theorem was also tested in the first differential
form given below:

$$(65) \quad (dP) = a(dI) + b[d(HY/G)]$$

This involved looking for confirming instances of the above form of the theorem as well as confirming instances of the following models of its counterexample:

$$(66) \quad (dP) = a(dI) + b(d(H/G)Y) + c$$

$$(67) \quad (dP) = a(dI) + b[d(HY/G)] + c$$

$$(68) \quad (dP) = ad(I + HY/G)$$

Summary

If the procedures and testing conventions are thought to be correct, the observation of a confirming instance of a model of the counterexample would ordinarily be considered as refuting evidence. Confirming instances of the theorems were also sought because doing so helps to avoid the problem of: one, looking for counterexamples, in the wrong place, with incorrect definitions, and using the wrong procedures; and two, creating 'loose testing conventions', i.e., testing conventions by which observations are too readily accepted as refuting evidence.

Footnotes to Chapter Six

1 Kravis, 939.

Chapter Seven - Test Procedures and Conventions

In this chapter the testing conventions used to examine the three post-Keynesian income distribution theories will be discussed. The discussion will be organized under two headings: firstly, the 'definitions of the variables' and secondly, the 'criteria of acceptance'. Under the first heading we will see that the problem was, in some cases, to find a measurable definition, and in others, to decide which of the available definitions should be used. Under the second heading the problem was to find some criteria by which it could be decided whether the observations should be considered as a confirming instance of the model under examination. The test procedures will also be discussed under this second heading.

The definitions, procedures and criteria of acceptance were drawn largely from the tests discussed in Chapter Four. This was done so that the testing conventions would incorporate definitions, procedures and criteria of acceptance that have been established in the past. The objective was to avoid having the test results rejected on the basis of the testing conventions used to obtain them. Because a wide variety of testing conventions were used in the tests discussed in Chapter Four, several sets of testing conventions

were used to carry out the tests for this thesis.

I. Definitions of the Variables

A List of the Variables

      To test the models and theorems outlined in Chapter Six, it was necessary to measure the variables listed below. They are, grouped by theory:

(1) Kaldor's first theory;

        W – the total wage bill

        Y – the level of income

        I – the level of investment

(2) Kaldor's second theory;

        P – corporate profits

        Y – the level of income

        I – the level of investment

        v – the valuation ratio.

(3) Asimakopulos' theory;

        P – corporate profits

        W – the total wage bill

        I – the level of investment

        G – 'direct labour',(variable labour input)

        H – 'overhead labour'

        L – the the level of total employment

        Y – the level of national income.

Note that 'profits' from Asimakopulos' theory has been
interpreted as corporate profits. This was done because
profits in Asimakopulos' theory are received by businesses and
'distributed profits' are received by individuals[1]. Corporate
profits is a measurable definition of profits which has this
characteristics.

The Selection Procedure

In addition to the above, there were several other
variables to be defined. These variables were required for the
'selection procedure'. The selection procedure was used to
correct for the following problem: Consider the case of a
theorem which predicts that a linear relationship exists
between certain variables. If the coefficients of the linear
relationship had changed over the period of time from which a
set of observations was drawn, these observations may not
appear to indicate that a linear relationship exists, (the
same argument holds for a nonlinear relationship such as
Theorem 5). A selection procedure was therefore developed to
deal with the possibility that the coefficients may not have
had the same values in each of the time periods from which the
data were drawn. The objective of the selection procedures was
to select time periods in which the values of the coefficients
were similar.

It was possible to develop a 'selection procedure'
because the arguments of the coefficients can be identified.

The coefficients are functions of the savings rates, the mark-up and the share of investment financed by corporations. The selection procedure involved choosing data on the following basis: each argument was assigned a range of values; then years, (i.e., data), were selected in which all of the arguments of the coefficients fell in their respective ranges.

By way of a note, in order to deduce the principal assertions of the theories, it is not necessary to assume that the coefficients do not change. It is necessary only that the arguments of the coefficients, i.e., the savings rates, etc., are not functions of any other variables defined in the theory.

The coefficients of the theorems derived from the three theories under examination, are functions of the following variables:

(1) Kaldor's First Theory;

s_w - savings rate from wages,

s_p - savings rate from profits,

(2) Kaldor's Second Theory;

s_c - the savings (retention) rate of corporate profits,

s_h - the savings rate from household incomes,

i - the fraction of investment financed by corporations,

s_d - the savings rate from dividend income,

c - the rate of consumption from

capital gains,

(3) Asimakopulos' Theory;

u - the mark-up of prices over costs,

s - the savings rate of wage income,

b - the proportion of profits distributed

to the firms' owners, (i.e. 1 - b

is the corporate retention rate).

The savings rates in Kaldor's first theory can only be measured with some difficulty and using questionable assumptions about what should and should not be considered as profit or wage income. For the two savings rates involved, the personal savings rate was used as a proxy[2].

With respect to the other variables 'c, s, s_h, s_d, s_w, (in Kaldor's Second Theory), they can be interpreted as, or represented by, the personal savings rate mentioned above. 's_c' and '1 - b' can be defined as the ratio of: the profits corporations retain after paying dividends, to corporate profits, and 'i' can be defined as one minus the ratio of: the profits corporations retain after paying dividends, to investment.

Asimakopulos' mark-up, 'u', is the mark-up of a fully integrated firm. Estimates of this variable are therefore not available because the economy is not characterized by firms of this type. It is not feasible to use the mark-up of firms that

are not fully integrated, as a proxy, for the following reasons: Firstly, the mark-up of individual firms will vary from product to product and from firm to firm so that some weighting scheme would be necessary in order to calculate the movements of a mark-up for the entire economy. And secondly, estimates would be difficult to obtain since the mark-up pertains to 'direct labour' costs. Since it is not clear which labour inputs should be included in a measure of 'direct. labour', an estimate of 'direct labour' costs would be difficult to obtain. In face of these difficulties it was decided to ignore this variable.

The list of variables that were to be defined has now been extended to include personal savings and dividends. The list is now:

S – personal savings

Y – aggregate level of income

I – total investment

D – corporate dividend payments

R – corporate profits

W – total wage bill

L – total labour force

G – overhead labour

H – direct labour (variable labour)

v – valuation ratio

The Definitions

Kaldor and Asimakopulos, when outlining their respective theories, did not give empirical definitions of their theories' variables, (i.e., definitions that could be used in an empirical test). In fact Kaldor did not outline the empirical definitions of some of the variables he used in his First Theory, until he replied to Samuelson and Modigliani's critique of Pasinetti's work. It is therefore not surprising that the authors of the empirical tests of Kaldor's First Theory took some liberty when defining the relevant variables. It is not clear that any of the empirical definitions they used reflect either Kaldor's or a Post-Keynesian point of view.

Kalecki's tests and Kaldor's reply to Samuelson and Modigliani provide a better indication of what would be the post-Keynesian empirical definitions of some of the relevant variables. Their definitions tended to differ from those used in the tests of Kaldor's First Theory.

It was decided to use two sets of definitions. One set, drawn largely from four of the empirical tests of Kaldor's First Theory[3], will be referred to as the neoclassical definitions. The other set, drawn largely from Kalecki's empirical tests and Kaldor's reply to Samuelson and Modigliani's critique of Pasinetti, will be referred to as the post-Keynesian definitions. This latter set of definitions, we will see, includes two definitions of investment, profits and

income. Consequently there were from two to five
post-Keynesian definitions used to test each of the models and
theorems.

Two sets of definitions were used because; one, it was
felt that some mix of Kalecki's and Kaldor's definitions would
best represent a post-Keynesian perspective; two, the
definitions from the empirical tests of Kaldor's First Theory
represent a common interpretation of the relevant variables
and should not therefore be ignored; and three, using two sets
of definitions, representing two points of view, allows us to
compare the results.

I - Investment

Kaldor, in his reply to Samuelson and Modigliani,
defined investment as 'gross investment'[4]. Kalecki used an
'empirical definition' of investment which included not only
gross investment, but also the trade surplus, the government
deficit and what he calls 'brokerage fees'. His empirical
definition did not, however, include government investment
expenditures[5]. If Kaldor had carried out an empirical test,
there is no reason to believe that he would not have measured
this variable in much the same way as Kalecki. Kalecki's
definition, without the brokerage fees, was used as the basis
for the Post-Keynesian measures of investment[6].

One of the post-Keynesian definitions of investment was
obtained by adding an estimate of the trade surplus and the

overall government deficit, (this covered deficits for governments at all levels), to a figure for 'gross private investment'.

A second definition of investment was obtained by subtracting investment expenditures for residential housing from the first definition given above. This was done because of Kaldor's argument concerning the measurement of the savings rates. He argued that for the purposes of explaining income distribution, expenditures for consumer durables, including residential housing, should not be counted as savings[7]. By this same argument residential housing should not therefore be included in investment, (i.e., savings equals investment)[8]. Furthermore Alfred Eichner has argued, in the context of a discussion of post-Keynesian macro theories, that expenditures for residential housing should not be considered as a part of investment expenditures[9].

The definitions used by Reder, Gallaway and Kravis in their tests of Kaldor's First Theory, and a comment by Tibor Scitovsky were used as the basis for a neoclassical empirical definition of investment. Reder used net investment and Kravis used Kuznets' estimates of I/Y. Kuznets defined I/Y as the ratio of "net capital formation to net national product"[10]. Scitovsky cited evidence in favour of Kaldor's First Theory by noting that there is a correlation between net investment, upturns of the business cycle and the wage share of national

income[11]. Gallaway in his calculation of investment used "a definition of investment embracing gross public, (public defined as government purchases of goods and services), and net foreign components is employed"[12]. This is very likely closer than the others to Kalecki's definition, but unfortunately Gallaway is not more explicit.

As the neoclassical definition it was decided to use; gross investment minus the capital consumption allowance. This is taken as a measure of net investment.

Y - Income

Kaldor did not discuss total income, Y, in his response to Samuelson and Modigliani's criticism of Pasinetti. In outlining his first theory he said only that income is at the full employment level, and that it is equal to the sum of wages and profits. We can presume, at least from his discussion of savings, investment and profits, that by whatever means he would measure income, he would measure it in 'gross' terms.

It was decided to use Kalecki's definition of income because it was more clearly intended for use in an empirical test and because it can be taken as representative of a post-Keynesian point of view. He defined income as "'gross national income' minus public investment plus the budget deficit minus income of government employees"[13] and he defined 'gross national income' as either 'gross profits + wage bill'

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or equivalently 'consumption + investment'[14]. It was decided
to use the second definition of 'gross national income'
because figures for consumption were readily available.
Investment was interpreted as meaning the post-Keynesian
definitions of investment given above, (so that there were two
definitions of income).

Since the income of government employees is subtracted
from Kalecki's definition of 'gross national income', a
measurable definition of the income of government employees
was necessary. An empirical definition can be inferred from
Kalecki's empirical works and Kaldor's reply to Samuelson and
Modigliani. Kalecki measured profits and wages after taxes,
but including government transfers to the private sector[15].
Kaldor stated that profits should be measured as gross
profits, after taxes. The argument is that only 'transfers and
after tax income' can be saved, or alternatively spent on
consumption. To be consistent with this argument, wages and
salaries, and more specifically the wages and salaries of
government employees, should be measured after taxes and
including transfers. The latter definition was therefore used
to measure the income of government employees.

Measuring the income of government employees by way of
the above definition was complicated by the fact that
estimates of neither the transfers received, nor the direct
taxes paid, by government employees were available. In order
to approximate the taxes paid, and transfers received, by

government employees, total personal taxes and transfers to persons were weighted by the share of government employees income in total personal income. The weighted direct taxes was subtracted from the income of government employees and weighted transfers was added on.

The mainstream or neoclassical definition of income was less complicated. Tibor Scitovsky and Reder used national income[16] and Kravis used net national product[17]. Gallaway appears to have used two definitions of income; as the denominator of W/Y he used 'private income' and for the denominator of I/Y he used something he calls 'income'[18]. Judging from this rough description, by the latter he could have meant national income. When Hans Brems measured income for similar tests of neoclassical theory, he measured it as G.N.P.[19]. For what is called the neoclassical definition, it was decided to define Y as national income.

W - The Total Wage Bill

The post-Keynesian measurement of aggregate wages, has to some extent already been discussed. That is, the question of whether or not direct taxes and transfers should be included in a measure of income has been mentioned above, albeit with respect to the income of government employees. Furthermore, because the income of government employees has not been included in income, it should not be included in the

measurement of wages. The post-Keynesian definition of wages was therefore measured as the wages and salaries of the private sector after taxes, but including the wage and salary share of transfers to the private sector.

As mentioned, a breakdown is not available to indicate which part of transfers should be counted as wages and salaries. Nor is a similar breakdown available for personal income tax. Therefore, in order to estimate the total wage bill of the private sector, taxes and transfers were weighted by the fraction of total income represented by total private sector wages and salaries, (this is described in more detail in the appendix of this Chapter). These weighted values of taxes and transfers were subtracted and added respectively to total wages and salaries.

From amongst the empirical tests of Kaldor's theory, only Reder and Gallaway's tests used a measure of wages. Reder used 'total employee compensation'[20], and Gallaway used 'the share of employee compenstation from private income'[21]. It would be inappropriate to use Gallaway's definition of wages because it is not consistent with 'national income'. Since total employee compensation is compatable with 'national income' it was used as the neoclassical definition of the total wage bill[22].

Total employee compensation does not equal total wages and salaries. The latter, (minus the wages and salaries of

government employees), was used in constructing the
post-Keynesian definition, instead of the former, because it
does not include payments by the employer, on behalf of their
employees, to pension funds, social security, etc. Many of
these payments might be considered as a form of taxation. They
are in any case nondiscretionary income, that is they are not
forms of income which workers can either save or consume. The
difference between total wages and salaries, and total
employee compensation, is not great, it would make up only a
few percentage points of the latter.

R - Corporate Profits

Kaldor argued that in so much as post-Keynesian income
distribution theory is concerned, the relevant measure of
profits is gross profits after taxes[23]. Kalecki stated, with
respect to his theory of the determination of profits, that
"By gross real profits, P, we understand the aggregate real
income of capitalists including depreciation per unit of time"
[24]. Their argument is that, after paying wages, taxes and
other costs, depreciation and profits are what remain for the
capitalist (corporation) to invest or consume[25]. Despite this
argument, in order to make a comparison, two post-Keynesian
definitions were used. One definition of profits is 'corporate
profits after taxes' and the other is 'corporate profits after
taxes, plus depreciation'.

Kravis, in his test, measured profits as; 'profits before taxes', (although he was measuring total, not just corporate profits). Furthermore, Kaldor suggested that Samuelson and Modigliani were referring to net profits before taxes when they gave estimates of the savings rate from profits[26]. It was therefore decided to use corporate profits before taxes as the neoclassical definition.

S - Total Personal Savings

Some of the test procedures required estimates of the personal savings rate. The calculation of this variable required estimates of total savings. The measurement of total savings does not pose any particular problems, but some comments by Kaldor suggest that two defintions can be used. He argued that purhases of consumer durables should not be included in savings[27]. The post-Keynesian definition did not therefore include the purchases of consumer durables.

A neoclassical definition can be taken from Kaldor's argument that:

> The value s_w = 1/12 is probably a realistic one for the net savings of wage and salary earners ...... it is not, however, an indication of the savings available for the acquisition of business capital or for lending to the business sector, since a large part goes to finance personal investment in consumer durables.[28]

Taken in context, Kaldor was arguing that an estimate of total savings which included consumer durables, was what Samuelson and Modigliani had in mind when they gave what they thought

were reasonable estimates of the savings rate of workers. Furthermore, a definition of total savings which includes consumer durables is more consistent with the neoclassical definition of investment than a definition of savings which does not include consumer durables. For these reasons, and for the purposes of having contrasting definitions, it was decided to include the purchases of consumer durables in the neoclassical definition of savings.

In the case of both definitions, to calculate the savings rate, total savings was divided by the appropriate definition of income.

G,H and L – Direct Labour, Overhead Labour, and The Level of Total Employment

Asimakopulos defined G as the "level of employment of direct labour"[29]. It might just as accurately be referred to as variable labour, since output increases by a constant amount 'a' per additional unit of G. He decribed H as the labour necessary to "operate a plant at any non-zero degree of utilization"[30]. An additional unit of H does not make a marginal contribution to output. L was defined as the level of total employment and is equal to, H + G.

It is doubtful than many firms could divide the labour they use into an overhead or variable classification. We could not, therefore, expect to find estimates of these variables based on Asimakopulos' definitions. With respect to testing

his theory, the problem was to find estimates whose empirical descriptions approximated the variables' definitions.

Estimates for H, G and L, were found in the form of figures for 'production and nonsupervisory workers'[31]. L, the level of total employment, was estimated as: 'Employees on Nonagricrutural Payrolls' minus 'Employees on Government Payrolls'. G, 'direct labour', was estimated as 'Production or Nonsupervisory workers on Private Nonagricultural Payrolls, by Industry Division'. H, 'overhead labour' was estimated as 'L − G'.

These approximations are not entirely satisfactory. Firstly, the fact that agricultural payrolls have been excluded means that a segment of the economy has been left out. Fortunately only the ratios H/G and G/Y are required, so this problem is not as serious as it would be if estimates of H and G were also necessary. Secondly, Asimakopulos may not have intended that G could be approximated by a statistic such as 'Production and nonsupervisory workers'. Thirdly, the estimates of L, G and H refer only to the private sector. This is not consistent with the neoclassical definition of the wage bill or total income. Despite these three points, the above estimates were used in the tests to represent both the post-Keynesian and neoclassical definitions since nothing better was available.

D - Corporate Dividend Payments

Total dividends was measured as the total dividend payments of corporations. Dividends payments were not discussed in any of the empirical works, there is therefore little basis for establishing two definitions.

v - The Valuation Ratio

Kaldor described 'v', the valuation ratio, as the "the relation of the market value of shares to the capital employed by the corporations (or the 'book value' of assets)"[32]. This definition is relatively uncomplicated and was not a source of difficulties. Instead the problem was to find suitable yearly estimates. Fortunately some exist. They were constructed using U.S. data for the period 1947 to 1971, and are given by B.J. Moore in his article "Equities, Capital Gains and the Role of Finance in Accumulation'[33]. He cited them as being unpublished estimates by C.W. Bischoff. Moore stated that they represent "empirical estimates of the market value to book or replacement value of corporate equity"[34].

Since no empirical work has been done for Kaldor's second theory there is little basis for asserting that Post-Keynesians and mainstream economists would not use the same definition. Bischoff's estimates were therefore used for both sets of tests.

United States Data

American Data was used because the United States could be considered as almost a closed economy in the period 1947-1970. The volume of foreign trade was in the order of only 5 to 10 percent of the G.N.P. This can be taken as an indication that nonresidents received only a small part of American profits and wages. By using American data we were able to avoid the problem of having to find or develop the additional testing conventions that would be required if a substantial part of income were received by nonresidents, (e.g., should the income of nonresidents be considered as savings – assuming that it is spent outside of the country, or since earnings leaving the country can be seen as a negative exogenous contribution to demand, should these earnings be subtracted from investment, etc.).

II. Test Procedures and Acceptance Criteria

Test Procedures

In most of the tests an ordinary least squares regression technique was used to estimate the coefficients. There were a few tests however where a procedure was used to correct for autocorrelation, (in some tests the Durbin-Watson statistic was less than .5). In the case of the latter, the coefficients were estimated using a modified Hildreth-Lu

estimator.

In his empirical tests, Kalecki lagged the independent variable[35]. The procedure he used to determine the number of periods by which the independent variable should be lagged is as follows: The independent variable was lagged i periods, i = 1, ... n, (Kalecki did not give an n). For each i a correlation coefficient was calculated between the first difference forms of the independent and dependent variables. The lag i which gave the highest correlation was used in the tests. This procedure has been adapted for some of the tests. In some cases the lag with the highest correlation was as much as 12 years[36]. Theorems that were not tested using this procedure, represent cases where the highest correlation was observed with no lag at all.

Period of Measurement

With the exception of Kravis and Kalecki all of the tests used yearly data. Although Kalecki used a one quarter lag in one of his tests[37], he gave his resulting estimates of profits and income as yearly figures. Because most of the tests are in yearly terms, and because of the problem of obtaining other than annual estimates, yearly data were used for all of the tests.

Criteria of Acceptance

It was originally intended that there would be two criteria of acceptance, one labelled neoclassical and the other post-Keynesian, (to complement the two sets of definitions). It turned out that this was not feasible. Instead three criteria were developed, they are largely independent of the post-Keynesian or neoclassical labels, (i.e. the criteria could not be clearly identified with either post-Keynesian or mainstream economists).

Kalecki's Acceptance Criterion

Kalecki used a measure of the correlation between the observed and predicted values of the dependent variable as a basis for his criterion of acceptance. There is a problem with attempting to apply this approach to the tests outlined above. Kalecki used a regression technique to obtain estimated coefficients for equations having one or two independent variables and a constant term[38]. Unfortunately when the constant term is dropped, a high correlation between the predicted and observed dependent variable does not mean that the two variables are close to one another. It means only that they have a linear relationship. Since many of the theorems have a zero intercept, and consequently many of the tests involved looking for an instance of a model with a nonzero constant term, a criterion of acceptance based on a correlation between the predicted and observed values cannot

be used. That is, if the theorem were of the form y = bx and a model of the counterexample was y = a + bx, it would not be possible, using a criterion based on correlations, to accept the data as a confirming instance of the model of the counterexample and not also of the theorem.

Instead it was decided to use a criterion based on the R squared. The R squared, in cases where the regression line is estimated with a constant term, is equivalent to the correlation between the predicted and observed values of the dependent variable. It has the advantage that when a constant term is not used, an R squared can still be calculated that measures the extent to which the estimated value of dependent variable is close to the observed value. The R squared will not be referred to as a post-Keynesian acceptance criterion since it is so widely used.

An R squared was not always calculated because the programmes which were used to carry out the tests having a selection procedure, gave unreliable estimates of R squared when the intercept was forced through zero.

When the intercept is set equal to zero, calculations using the various definitions of R squared will no longer yield the same result. In the case of a zero intercept the R squared's were calculated on the basis of the residuals. That is, the R squared was said to be equal to the sum of the squared residuals divided by the sum of the squared deviations

of dependent variable, subtracted from one.

Reder's Acceptance Criterion

A criterion of acceptance is not available from Kravis' test of Kaldor's first theory. Kravis calculated estimates of the savings rates from profit and wage income, by way of solving two systems of two equations, (see Chapter Four). But he did not say whether the estimates should, or should not, be accepted as a confirming instance of Kaldor's theory.

Bharadwaj and Dave's test was based on an hypothesis test of the correlation coefficient between P/Y and I/Y[39]. They calculated two estimates of the correlation coefficient, one for each of the two definitions of P/Y, to test the hypothesis that the correlation coefficient(s) equal zero. One of the estimates was close to zero and the other was .3779. As they pointed out, on the basis of the latter estimate, the hypothesis could not be rejected at a .1 level of significance.

This criterion of acceptance, (i.e., a hypothesis test evaluated at a .1 level of significance), is not directly applicable to the tests of the models outlined in Chapter Four. However an hypothesis test approach proved to be useful for evaluating some of the models of the counterexamples. These models of the counterexample had the same functional form as the theorem, except that their intercept or exponent

did not equal zero or one respectively. Some criterion was therefore necessary to determine when the observations could be interpreted as a confirming instance of a model with an intercept not equal to zero or an exponent not equal to one. This criterion of acceptance was established as though; (i) the intercepts and exponents had been hypothsized to equal zero and one respectively; (ii) the distribution of the estimates was approximately normal; and (iii) the level of significance was approximately .05. Consequently, an intercept or exponent more than two standard deviations from its predicted value was considered as not equal to zero or one respectively.

By Gallaway's criterion, Kaldor's first theory successfully predicted observed reality whenever changes of the level of investment and wages had the opposite sign significantly more than one half of the time[40]. Gallway's criterion of acceptance was not used because it would be too 'loose' for our purposes, i.e., it would not be an appropriate criterion for determining if an observation should be accepted as a confirming instance of a functional relationship. More specifically, if the observations were taken from a period of time in which wages, profits, income and investment were increasing, a large number of functional forms, some representing models of the counterexample, could predict the positive changes of the dependent variable. Even if the

variables are not increasing, it is conceivable that many models of the counterexample would give accurate predictions. These accurate predictions could not be taken as an indication that the observations conform to the functional relationship which was used to obtain these same predictions.

Reder's criterion of acceptance was based on the average deviation of the predicted from the observed values. Two variants of this approach were used to evaluate the test results. One criterion of acceptance was based on a measure of the average absolute value of the deviations. In most cases the absolute deviations were weighted by the corresponding observed value of the dependent variable, (the weighting procedure is outlined in the appendix at the end of this Chapter). The data were said to be a confirming instance of the model if the (weighted) average absolute value of the deviations was less than .05, (the test criterion was also tried for 'less than .1'). The other criterion of acceptance was based on an estimate of the standard deviation of the predicted from the observed value. This estimate of the standard deviation was in most cases divided by the average of the observed dependent variable, (again, see the appendix). If this (weighted) value was less than .07 the data were interpreted as a confirming instance of the the theory, (the test was also done with a criterion of 'less than .15').

This gives three criteria of acceptance; one based on the R squared and two based on the deviations of the predicted from the observed values of the dependent variable. One of the latter two criteria is based on the (weighted) average absolute deviation and the other is based on the (weighted) standard deviation.

Comment

Although over 300 sets of coefficients have been estimated in the search for confirming instances of the models of the counterexamples and the theorems, the tests used data from only one country and for one period of time. There were only six sets of definitions, and coefficients have been estimated using only ordinary least squares and an autocorrelation correction procedure. Neither the predicted coefficients nor the predicted causal relationship between the exogenous and endogenous variables was examined. There is still considerable scope for more tests.

Footnotes to Chapter Seven

1 Asimakopulos, "A Keleckian Theory of Income Distribution,"
       331..

2 One problem with using the personal savings rate as a proxy
for s_w and s_p is a possibility that a change of the
coefficients would not be indicated by a change of the
personal savings rate. s_p could increase (decrease) and s_w
decrease (increase), in a way that would change a and b of
equation (10) but leave the personal savings rate unchanged.
By using the personal savings rate as a proxy, it is assumed
that this phenomenon is unlikely to have occurred.

3 B.H. Dholakia's test was not used as source for neoclassical
definitions. Other than to point out that profits and income
have been measured only for the nonagricultural sector, he
does not give any 'empirical definitions'.

4 Kaldor, "Marginal Productivity and Macroeconomic Theories
       of Distribution," p. 301.

5 Kalecki, "Determinents of Profits," p. 104.

6 Brokerage fees were not included because it was not clear
from Kalecki's test how they should be measured. In any case
they are probably a small fraction of total investment.

7 Kaldor, "Marginal Productivity and Macroeconomic Theories
       of Distribution," p. 301.

8 A post-Keynesian definition of investment which included
residential housing, (i.e., the first definition), was also
used because an argument could be made that purchasing a house
is an investment decision separated from the act of saving.

9 Eichner, The Megacorp and Oligopoly p. 215.

10 Kravis, 939.

11 Tibor Scitovsky, "A Survey of Theories of Income
       Distribution," in The Behavior of Income Shares,
       ed. National Bureau of Economic Research,

(Princeton N.J.: Princeton University Press, 1964), p. 19.

12 L.E. Gallaway, "The Theory of Relative Shares," 585.

13 Kalecki, "Determination of National Income and Consumption," p. 104.

14 M. Kalecki, Selected Essays on the Dynamics of the Capitalist Economy 1933-1970, (Cambridge: Cambridge University Press, 1971), p. 195.

15 Ibid., 81.

16 As mentioned, Scitovsky noted that there is a correlation between the level of net investment, upturns of the business cycle and the wage share of national income. He saw this as evidence supporting Kaldor's Theory. Scitovsky, p. 19. and Reder, p. 188.

17 Kravis, 917-949.

18 Gallaway, 585.

19 Hans Brems, "Reality and Neoclassical Theory," Journal of Economic Literature 15 (1977): 72-83.

20 Reder, p. 204.

21 L.E. Gallaway, "Theory of Relative Shares," 585.

22 Hans Brems, in similar tests of neoclassical theory, quotes Kravis as saying that a measure of wages which excludes the income of government employees may be preferable, (for the purposes of examining changes of labour's share). As mentioned, however, to be consistent with the measure of 'income', total employee compensation will be used as a measure of wages. Brems, "Reality and Neoclassical Theory," 79.

23 Kaldor, "Marginal Productivity and Macroeconomic Theories of Distribution," 301.

24 M. Kalecki, "Outline of a Theory of the Business Cycle," Selected Essays on the Dynamics of the Capitalist Economy 1933-1970, (Cambridge: Cambridge University Press, 1971), p. 1.

25 This definition of profits is reiterated by A. Asimakopulos and J. Burbidge, and again by Burbidge, in;
A. Asimakopulos and J. Burbidge, "The Short-period Incidence
     of Taxation," Economic Journal 84 (June 1974): 273.
and
J. Burbidge, "The Incidence of Profit Taxes - A Summary,"
     The Proceedings of the Sixty-Eighth Annual
     Conference on Taxation Columbus, Ohio: National
     Tax Association - Tax Institute of America (November
     1975), 191-198.

26 Kaldor, "Marginal Productivity and Macroeconomic
     Theories of Distribution," 301.

27 Ibid., 301.

28 Ibid.

29 Asimakopulos, "A Kaleckian Theory of Income Distribution,"
     323.

30 Ibid., 324.

31 U.S., Bureau of the Census, The Statistical History
     of the United States (Washington, D.C.: U.S. Govt.
     Print. Off., 1975), p. 138.

32 As Kaldor used the variable he must also be assuming that the book values of assets equals the replacement cost of the assets.
Kaldor, "Marginal Productivity and Macroeconomic Theories
     of Distribution," 317.

33 B.J. Moore, "Equities, Capital Gains, and the Role of
     Finance in Accumulation," 872-886.

34 Ibid., 877.

35 see for example,
Kalecki, "Determinants of Profits," p. 90-92.

36 This was found when examining the correlations between G/L and lagged values of W.

37 Kalecki, M., "Determinants of Profits," p. 90-92.

38 see for example, Ibid.

39 Bharadwaj and Dave, 515-520.

40 Gallaway, "Theory of Relative Shares," 587.

III. Appendix to Chapter Seven

This appendix contains the raw data and their sources. It also contains the formulas by which the variables used in the tests were calculated from the raw data, and the weighting scheme used to assess the test results.

The raw data is given in nominal values.

Raw Data

	A	B	C	D	E
1947	161.8	34.0	11.1	-14.4	128.9
1948	175.1	46.0	14.4	-8.5	141.1
1949	178.7	35.7	13.7	3.2	141.0
1950	193.4	54.1	19.4	-7.9	154.6
1951	208.9	59.3	17.2	-5.8	180.7
1952	219.8	51.9	17.2	3.8	195.3
1953	233.8	52.6	18.0	6.9	209.1
1954	240.5	51.7	19.7	7.0	208.0
1955	259.0	67.4	23.3	-2.7	224.5
1956	272.0	70.0	21.6	-4.9	243.1
1957	287.2	67.9	20.2	-.7	256.0
1958	296.0	60.9	20.8	12.5	257.8
1959	317.7	75.3	25.5	2.1	279.1
1960	332.5	74.8	22.8	-3.7	294.2

1961	342.8	71.7	22.6	4.3	302.6
1962	363.2	83.0	25.3	2.9	323.6
1963	384.1	87.1	27.0	-1.8	341.0
1964	411.3	94.0	27.1	1.4	365.7
1965	444.1	108.1	27.2	-2.2	393.8
1966	478.7	121.4	25.0	-1.1	435.5
1967	505.3	116.6	25.1	13.9	467.2
1968	550.4	126.0	30.1	6.8	514.6
1969	595.3	139.0	32.6	-8.8	566.0
1970	634.5	136.3	31.2	10.1	603.9

A - Consumption, Historical Statistics, p. 242

B - Gross Private Domestic Investment, Historical
    Statistics, p. 229

C - Residential Structures, Historical Statistics, p. 229

D - Budget Deficit (all governments), Historical
    Statistics, p. 263

E - Total Compensation of Employees, Historical
    Statistics, p. 235

	F	G	H	I
1947	105.6	123.0	2.3	199.0
1948	116.5	135.4	2.7	244.2
1949	113.9	134.5	3.0	217.2
1950	124.4	146.8	3.8	241.2
1951	142.1	171.1	4.8	278.0
1952	151.9	185.1	5.3	291.4

1953	164.2	198.3	6.0	304.7
1954	161.9	196.5	6.3	303.1
1955	175.1	211.3	7.3	331.0
1956	189.6	227.8	8.5	350.8
1957	198.2	238.7	9.5	366.1
1958	196.4	239.9	9.9	367.8
1959	212.5	258.2	11.3	400.0
1960	222.1	270.8	12.0	414.5
1961	225.9	278.1	12.7	427.3
1962	240.1	296.1	13.9	457.7
1963	251.6	311.1	14.9	481.9
1964	269.4	333.7	16.6	518.1
1965	289.6	358.9	18.7	564.3
1966	316.8	394.5	20.7	620.6
1967	337.3	423.1	22.3	653.6
1968	369.2	464.9	25.4	711.1
1969	405.2	509.7	28.4	766.0
1970	426.9	542.0	32.2	800.5

F - Private Wages and Salaries, Historical Statistics, p. 235

G - Total Wages and Salaries, Historical Statistics, p. 235

H - Other Labor Income, Historical Statistics, p. 235

I - National Income, Historical Statistics, p. 236

	J	K	L	M
1947	31.5	20.2	6.3	6.4
1948	35.2	22.7	7.0	7.9
1949	28.9	18.5	7.2	8.5
1950	42.6	24.9	8.8	9.5
1951	43.9	21.6	8.6	11.1
1952	38.9	19.6	8.6	12.4
1953	40.6	20.4	8.9	14.2
1954	38.3	20.6	9.3	15.7
1955	48.6	27.0	10.5	18.6
1956	48.8	27.2	11.3	20.5
1957	47.2	26.0	11.7	22.8
1958	41.4	22.3	11.6	23.8
1959	52.1	28.5	12.6	25.3
1960	49.7	26.7	13.4	26.9
1961	50.3	27.2	13.8	28.2
1962	55.7	31.2	15.2	32.0
1963	58.9	33.1	16.5	34.1
1964	66.3	38.4	17.8	36.5
1965	76.1	46.5	19.8	39.2
1966	82.4	49.9	20.8	42.8
1967	78.7	46.6	21.4	46.6
1968	84.3	47.8	23.6	50.7
1969	79.8	44.8	24.3	55.5
1970	69.2	39.3	24.7	59.3

J - Corporate Profits before Taxes, Historical

Statistics, p. 236

K – Corporate Profits after Taxes, Historical
     Statistics, p. 236

L – Dividend Payments, Historical Statistics, p. 236

M – Depreciation, Depletion and Amortization,
     Historical Statistics, p. 924

	N	O	P	Q	R
1947	191.3	11.7	21.4	11.6	12.2
1948	210.3	11.2	21.1	6.5	14.5
1949	207.2	12.4	18.6	6.2	16.6
1950	227.6	15.1	20.7	1.9	18.3
1951	255.6	12.5	29.0	3.8	21.2
1952	272.5	13.0	34.1	2.4	23.2
1953	288.2	14.0	35.6	.5	25.7
1954	290.1	16.0	32.7	2.0	28.2
1955	310.9	17.3	35.5	2.2	31.5
1956	333.0	18.5	39.8	4.1	34.1
1957	351.1	21.4	42.6	5.9	37.1
1958	361.2	25.7	42.3	2.4	38.9
1959	383.5	26.6	46.6	.3	41.4
1960	401.0	28.5	50.9	4.1	43.4
1961	416.8	32.4	52.4	5.6	45.2
1962	442.6	33.3	57.4	5.1	50.0
1963	465.5	35.3	60.9	6.0	52.6
1964	497.5	36.7	59.4	8.6	56.1

1965	538.9	39.9	65.7	7.1	59.8
1966	587.2	44.1	75.4	5.2	63.9
1967	629.3	51.8	83.0	5.1	68.9
1968	688.9	59.6	97.9	2.4	74.5
1969	750.9	65.8	116.5	1.9	81.6
1970	808.3	79.1	116.6	3.6	87.3

N – Personal Income before taxes, Historical
  Statistics, p. 241

O – Transfer Payments to Persons, Historical
  Statistics, p. 242

P – Personal Tax and Nontax Payments, Historical
  Statistics, p. 242

Q – Export Surplus, Historical Statistics, p. 864

R – Capital Consumption Allowance, Historical
  Statistics, p. 234

	S	T
1947	7.3	.72
1948	13.4	.60
1949	9.4	.57
1950	13.1	.61
1951	17.3	.59
1952	18.1	.63
1953	18.3	.60
1954	16.4	.75
1955	15.8	.81

1956	20.6	.77
1957	20.7	.68
1958	22.3	.81
1959	19.1	.92
1960	17.0	.90
1961	21.2	1.07
1962	21.6	1.01
1963	19.9	1.17
1964	26.2	1.20
1965	28.4	1.29
1966	32.5	1.00
1967	40.4	1.07
1968	39.8	1.17
1969	38.2	1.00
1970	56.2	.87

S – Personal Savings, Historical Statistics, p. 234

T – Valuation Ratio, from Moore, B.J., "Equities,
Capital Gains and the Role of Finance in Accumulation",
American Economic Review
65 (5), Dec. 1975: 878

	U	V	W
1947	33,747	43,881	5,474
1948	34,489	44,891	5,650
1949	33,159	43,778	5,856
1950	34,349	45,222	6,026
1951	36,225	47,849	6,389
1952	36,643	48,825	6,609
1953	37,694	50,232	6,645
1954	36,274	49,022	6,751
1955	37,500	50,675	6,914
1956	38,495	52,408	7,277
1957	38,384	52,894	7,616
1958	36,608	51,363	7,839
1959	38,080	53,313	8,083
1960	38,156	54,234	8,353
1961	37,989	54,042	8,594
1962	38,979	55,596	8,890
1963	39,553	56,702	9,225
1964	40,589	58,331	9,296
1965	42,309	60,815	10,074
1966	44,281	63,955	10,792
1967	45,169	65,857	11,398
1968	46,475	67,915	11,845
1969	48,105	70,284	12,202
1970	47,950	70,616	12,535

U – Production or Nonsupervisory workers on Private

Nonagrucultural Payrolls.

V – Employees on Nonagrucultural Payrolls.

W – Employees on Government Payrolls.

U,V and W are from The Statistical History of the United States, p. 138.

Definitions – Post-Keynesian

The post-Keynesian definitions by which the raw data were used to calculate investment, profits, wages, income and the savings rate, are given below.

Investment:

Definition 1 = Gross Private Domestic Investment

- Residential Housing + the Export Surplus

+ the Budget Deficit.

Definition 2 = Gross Private Domestic Investment

+ the Export Surplus

+ the Budget Deficit.

Corporate Profits:

Definition 1 = Corporate profits after taxes.

Definition 2 = Corporate profits after taxes +

Depreciation, Depletion and Amortization.

The Total Wage Bill = Wages and Salaries (of the private

sector)

+ Other labor Income (weighted)

- Personal Taxes (weighted)

+ Transfers (to persons), (weighted).

Other Labor Income (weighted) =

     Other Labor Income x (wages and salaries

     of the private sector/Personal Income).

Personal Taxes (weighted) =

     Personal Taxes x (wages and salaries

     of the private sector/Personal Income).

Transfers to persons (weighted) =

     Transfers to persons x (wages and salaries

     of the private sector/Personal Income).

Income:

Definition 1 = Consumption + Gross Private Domestic Investment

     - Residential Housing

     + Budget Deficit - Income of Government Employees

     + Personal Taxes of government employees

     - Transfers to government employees

    Personal Taxes of government employees =

        Personal Taxes x (wages and salaries

        of government employees/Personal Income)

    Transfers to government employees =

        Transfers to persons x (wages and salaries

        of government employees/Personal Income).

Definition 2 = Consumption + Gross Private Domestic Investment

      + Export Surplus + Budget Deficit

     - Income of Government Employees

     + Personal Taxes of government employees

     - Transfers to government employees

Personal Taxes of government employees =

      Personal Taxes x (wages and salaries

      of government employees/Personal Income)

Transfers to government employees =

      Transfers to persons x (wages and salaries

      of government employees/Personal Income).

Savings Rate = Personal Savings/Personal Income.

Definitions - Neoclassical

The neoclassical definitions by which the raw data were used to calculate investment, profits, wages, income and the savings rate, are given below.

Income = National Income

Corporate Profits = Corporate Profits before Taxes

The Total Wage Bill = Total Employee Compensation

Investment = Gross Private Domestic Investment

      - Capital Consumption Allowance.

Savings Rate = (Personal Savings + Purchases of Consumer

      Durables)/ Personal Income.

Definitions - General

There is no difference between the post-Keynesian and neoclassical definitions of 'direct' and 'overhead' labour. The method used to calculate these two variables is given below, along with the formulas used to calculate the 'fraction of investment from noncorporate sources' and the corporate

savings rate. The formulas for calculating the latter are given in terms of 'corporate profits' and 'investment'. To obtain a post-Keynesian or neoclassical corporate savings rate or 'fraction of investment financed by noncorporate sources', one can substitute in for 'corporate profits' and 'investment' whichever definition is appropriate, (e.g., for a neoclassical corporate savings rate, substitute in the neoclassical definition of corporate profits and investment).

Overhead Labour/Direct Labour = (Employees on Nonagrucultural Payrolls

- Employees on Government Payrolls

- Production or Nonsupervisory workers on Private Nonagrucultural Payrolls)

(divided by) /Production or Nonsupervisory workers on Private Nonagrucultural Payrolls.

Direct Labour/Total Labour = Production of Nonsupervisory workers on Private Nonagrucultural Payrolls

(divided by) /(Employees on Nonagrucultural Payrolls

- Employees on Government Payrolls).

Fraction of Investment not Financed by Corporations (i) =

1 - (corporate profits - dividends)/investment

Corporate Savings Rate =

(corporate profits - dividents)/corporate profits.

Weighting Scheme

To calculate the 'average absolute deviation' and the 'standard deviation', the absolute and standard deviations were sometimes weighted. Whether or not they were weighted, and by how much, depended upon the dependent variable. Generally if the dependent variable was a fraction between 0 and 1 it was not weighted. The absolute deviations were weighted by their corresponding observed dependent variable, and the standard deviations were weighted by the average of the observed dependent variables. The absolute and standard deviations of the first difference form were weighted by the absolute values, and average absolute value of the dependent variable respectively.

The dependent variables are listed below, along with the values by which the absolute deviations and standard deviations were weighted. A '-' means that the deviation, indicated by the column in under it appears, was not weighted.

Variable	Absolute deviation weighted by	Standard deviation weighted by
W	observed W	average W
log W	observed log W	average log W
(dW)	observed (dW)	average (dW)
v	–	–
log v	observed log v	average log v
(dv)	observed abs(dv)	average abs(dv)
R	observed R	average R
log R	observed log R	average log R
(dR)	observed abs(dR)	average abs(dR)
(H/G)W	observed (H/G)W	average (H/G)W
log (H/G)W	observed log (H/G)W	average log (H/G)W
d[(H/G)W]	observed abs(d[(H/G)W])	average abs(d[(H/G)W])
H/G	–	–
log(H/G)	observed log(H/G)	average log(H/G)
d(H/G)	observed d(H/G)	average d(H/G)
R/Y	–	–
log(R/Y)	observed log(R/Y)	average log(R/Y)
d(R/Y)	observed abs[d(R/Y)]	average abs[d(R/Y)]

Chapter Eight — The Test Results

The test results will be given in this chapter. They will
be presented in a series of tables. Each cell of the tables
will contain figures for the test results grouped on the basis
of the equation type, definitions and procedures. For each
group of tests, (in each cell of the tables), a figure will be
given indicating the number of tests which fall in the group,
the number of these tests in which the observations were
accepted as a confirming instance of the theorems or model(s)
of the counterexample under examination, and the proportion
the latter is of the former. Individual test results will not
be given in this chapter. Since there were over three hundred
tests, it would be impractical to give detailed results for
each one, (for individual test results, the reader is referred
to the appendix).

The results will be presented in seven sets of tables:
Set of tables A gives the test results grouped only by
equation type. Set of tables B presents the results grouped by
definition as well as equation type. Set of tables C gives the
results grouped by equation type and selection procedure. Sets
of tables D and E compare the lag and autocorrelation
correction procedures respectively with corresponding tests in

which these procedures were not used. And Sets of Tables F and G were obtained by reevaluating some of the test results on the basis of new criteria of acceptance. Table F was produced by replacing the 'two standard deviation rule' used to evaluate intercepts and exponents, with a 'one' or 'three standard deviation rule'. And Set of Tables G was the result of by changing the 'cut-off levels' for acceptance to evaluate tests where the variables were measured in the first difference form.

Note that data from only one country and time period, (U.S., 1947 - 1970), were used to carry out all of the tests. The number of tests in each group therefore represents a difference only of equation types, definitions or procedures. Consequently, care should be taken with the evaluation of the results. For example if only one of a group of tests is interpreted as a confirming instance of an equation(s), it may not be correct to say that the results indicate that few confirming instances of the equation(s) are to be found. The one test where the data was interpreted as a confirming instance of the theorem or model, may be the one case in which the test was carried out using the appropriate testing conventions; that is, using the correct equation type, criteria of acceptance, empirical definition and procedures.

Test Result Layouts

Most of the results will be presented in much the same format as the table shown below.

Rsq > .95	absdev < .05	stddev < .07	
a,b,c	h,d,e	h,f,g	10
a,b,c	h,d,e	h,f,g	11
a,b,c	h,d,e	h,f,g	12
a,b,c	h,d,e	h,f,g	13
a,b,c	h,d,e	h,f,g	14
.	.	.	
.	.	.	
.	.	.	
.	.	.	
.	.	.	

The number on the right side of each row, outside of the table, is the number of the equation to which the test results given in the row correspond. The number, indicated by the letter 'a', in the left column cells, is the number of tests of the theorem or model, in the group of tests being considered, for which an R squared was calculated. The numbers referred to above by the letters 'b' and 'c' are the number and fraction respectively of tests 'a', in which, by a

criterion of acceptance based on the Rsq, (e.g. R squared >
.95), the data is accepted as a confirming instance of the
equation, (or rather, a confirming instance of the statement
the equation represents).

The number indicated by the letter h, in the centre and
right columns, is the number of tests in which the (weighted)
average absolute and (weighted) standard deviation were
calculated. The numbers referred to by the letters 'd' and 'e'
are the number and fraction respectively of tests 'h', where,
on the basis of the (weighted) average absolute deviation of
the predicted from the observed dependent variable, (e.g.
absdev < .05), the data has been interpreted as a confirming
instance of the equation. Lastly, the numbers referred to
above as 'f' and 'g' are the number and fraction respectively
of tests 'h' in which the data is interpreted as a confirming
instance of the equation, on the basis of the (weighted)
standard deviation of the predicted from the observed
dependent variables.

As a matter of notation, in all of the tables; 'absdev'
stands for the '(weighted) average absolute deviation of the
predicted from the observed value of the dependent variable',
'stddev' stands for the '(weighted) standard deviation of the
predicted from the observed value of the dependent variable'
and 'Rsq' stands for the 'R squared'.

The reader should note that there is a method for identifying theorems and models of the counterexample on the basis of the numbering system used to identify the equations. If the two digit number ends in a zero (0) or five (5), it is a theorem, if it ends in a digit between or including 1 to 4.5 or 6 to 8, it is a model of the counterexample. If the last digit is between or includes, 5 to 8, it is a model or theorem where the variables have been measured in the first difference form. The first digit is the number of the theorem to which the equation refers, (e.g., 10 is theorem 1, and 11 is the first model of its counterexample).

The equations to which the two digit codes correspond have been outlined in Chapter Six. For quick reference they are also given in the appendix of this Chapter.

Also for quick reference the numbering system can be outlined as follows:

First digit - theorem number

    1 - Kaldor's First Theory

    2 - Kaldor's Second Theory, the valuation ratio

    3 - Kaldor's Second Theory, the profit level

    4 - Asimakopulos' Theory, direct labour

    5 - Asimakopulos' Theory, the profit share

    6 - Asimakopulos' Theory, the profit level

Second digit –

	regular	first difference form
theorem	0	5
model of the counterexample	1 – 4.5	6 – 8

Set of Tables A

The first set of tables will give the results for all of the tests, grouped by model or theorem, (i.e., equation type). The results will be presented as described above, with one modification. The values given in brackets refer to the test results reconsidered using the criteria of acceptance given in the brackets at the top of each column. For example, the values in brackets in the cells below the heading 'Rsq > .95', are for the criterion of acceptance Rsq > .9. The criterion, Rsq > .9, is indicated by the '(> .9)', which appears below 'Rsq > .95'.

Set of Tables A

Theorem 1 - Kaldor's First Theory

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
8, 8, <u>1.0</u> (8, 8, <u>1.0</u>)	11, 11, <u>1.0</u> (11, 11, <u>1.0</u>)	11, 11, <u>1.0</u> (11, 11, <u>1.0</u>)	10
8, 6, <u>.75</u> (8, 6, <u>.75</u>)	11, 8, <u>.73</u> (11, 8, <u>.73</u>)	11, 8, <u>.73</u> (11, 8, <u>.73</u>)	11
6, 5, <u>.83</u> (6, 5, <u>.83</u>)	9, 8, <u>.89</u> (9, 8, <u>.89</u>)	9, 8, <u>.89</u> (9, 8, <u>.89</u>)	12
4, 0, <u>.0</u> (4, 0, <u>.0</u>)	7, 0, <u>.0</u> (7, 0, <u>.0</u>)	7, 7, <u>1.0</u> (7, 7, <u>1.0</u>)	13
2, 0, <u>.0</u> (2, 0, <u>.0</u>)	6, 6, <u>1.0</u> (6, 6, <u>1.0</u>)	6, 4, <u>.67</u> (6, 6, <u>1.0</u>)	14
2, 0, <u>.0</u> (2, 0, <u>.0</u>)	2, 2, <u>1.0</u> (2, 2, <u>1.0</u>)	2, 2, <u>1.0</u> (2, 2, <u>1.0</u>)	14.5

	Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	15
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	16
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	17

Theorem 2 - Kaldor's Second Theory

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
7, 0, .0 (7, 0, .0)	10, 0, .0 (10, 0, .0)	10, 0, .0 (10, 0, .0)	20
5, 0, .0 (5, 0, .0)	8, 0, .0 (8, 0, .0)	8, 0, .0 (8, 0, .0)	21
7, 0, .0 (7, 0, .0)	10, 3, .3 (10, 5, .5)	10, 1, .1 (10, 8, .8)	22
4, 0, .0 (4, 0, .0)	7, 0, .0 (7, 0, .0)	7, 0, .0 (7, 0, .0)	23
2, 0, .0 (2, 0, .0)	5, 0, .0 (5, 0, .0)	5, 0, .0 (5, 0, .0)	24

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	25
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	26
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	27
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	28

Theorem 3 - Kaldor's Second Theory

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
11, 4, .36 (11, 5, .45)	19, 7, .37 (19, 15, .79)	19, 8, .42 (19, 16, .84)	30
11, 3, .27 (11, 3, .27)	22, 2, .09 (22, 4, .18)	22, 2, .09 (22, 4, .18)	31
9, 2, .22 (9, 2, .22)	17, 3, .18 (17, 4, .23)	17, 5, .29 (17, 5, .29)	32

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
3, 0, .0 (3, 0, .0)	13, 0, .0 (13, 0, .0)	13, 0, .0 (13, 0, .0)	35
5, 0, .0 (5, 0, .0)	13, 0, .0 (13, 0, .0)	13, 0, .0 (13, 0, .0)	36
5, 0, .0 (5, 0, .0)	5, 0, .0 (5, 0, .0)	5, 0, .0 (5, 0, .0)	37

Theorem 4 – Asimakopulos' Theory

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
5, 2, <u>.4</u> (5, 5, <u>1.0</u>)	5, 1, <u>.2</u> (5, 4, <u>.8</u>)	5, 2, <u>.4</u> (5, 5, <u>1.0</u>)	40
3, 0, <u>.0</u> (3, 0, <u>.0</u>)	5, 0, <u>.0</u> (5, 2, <u>.4</u>)	5, 0, <u>.0</u> (5, 2, <u>.4</u>)	41
5, 5, <u>1.0</u> (5, 5, <u>1.0</u>)	5, 5, <u>1.0</u> (5, 5, <u>1.0</u>)	5, 5, <u>1.0</u> (5, 5, <u>1.0</u>)	42
5, 4, <u>.8</u> (5, 4, <u>.8</u>)	5, 4, <u>.8</u> (5, 4, <u>.8</u>)	5, 4, <u>.8</u> (5, 4, <u>.8</u>)	43
3, 3, <u>1.0</u> (3, 3, <u>1.0</u>)	3, 3, <u>1.0</u> (3, 3, <u>1.0</u>)	3, 3, <u>1.0</u> (3, 3, <u>1.0</u>)	44

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Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	45
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 1, .25)	4, 0, .0 (4, 0, .0)	46
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	47

Theorem 5 - Asimakopulos' Theory

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
6, 2, .33 (6, 2, .33)	7, 7, 1.0 (7, 7, 1.0)	7, 7, 1.0 (7, 7, 1.0)	51
5, 2, .4 (5, 2, .4)	6, 6, 1.0 (6, 6, 1.0)	6, 6, 1.0 (6, 6, 1.0)	52
4, 2, .5 (4, 2, .5)	4, 4, 1.0 (4, 4, 1.0)	4, 4, 1.0 (4, 4, 1.0)	53
3, 2, .67 (3, 2, .67)	5, 5, 1.0 (5, 5, 1.0)	5, 5, 1.0 (5, 5, 1.0)	54

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
3, 0, .0 (3, 0, .0)	6, 0, .0 (6, 0, .0)	6, 0, .0 (6, 0, .0)	56
3, 0, .0 (3, 0, .0)	6, 0, .0 (6, 0, .0)	6, 0, .0 (6, 0, .0)	57
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	58

Theorem 6 - Asimakopulos' Theory

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
8, 4, <u>.5</u> (8, 7, <u>.88</u>)	12, 6, <u>.5</u> (12, 11, <u>.92</u>)	12, 5, <u>.42</u> (12, 11, <u>.92</u>)	60
8, 4, <u>.4</u> (8, 5, <u>.63</u>)	12, 3, <u>.25</u> (12, 6, <u>.5</u>)	12, 2, <u>.17</u> (12, 7, <u>.58</u>)	61
4, 1, <u>.25</u> (4, 1, <u>.25</u>)	10, 2, <u>.2</u> (10, 6, <u>.6</u>)	10, 4, <u>.4</u> (10, 7, <u>.7</u>)	62
1, 1, <u>1.0</u> (1, 1, <u>1.0</u>)	1, 0, <u>.0</u> (1, 1, <u>1.0</u>)	1, 1, <u>1.0</u> (1, 1, <u>1.0</u>)	63
4, 3, <u>.75</u> (4, 3, <u>.75</u>)	4, 2, <u>.5</u> (4, 4, <u>1.0</u>)	4, 4, <u>1.0</u> (4, 4, <u>1.0</u>)	64

Rsq > .95 (> .9)	absdev < .05 (< .10)	stddev < .07 (< .15)	
3, 0, .0 (3, 0, .0)	6, 0, .0 (6, 0, .0)	6, 0, .0 (6, 0, .0)	65
3, 0, .0 (3, 0, .0)	6, 0, .0 (6, 0, .0)	6, 0, .0 (6, 0, .0)	66
1, 0, .0 (1, 0, .0)	2, 0, .0 (2, 0, .0)	2, 0, .0 (2, 0, .0)	67
2, 0, .0 (2, 0, .0)	4, 0, .0 (4, 0, .0)	4, 0, .0 (4, 0, .0)	68

The test results are for the most part inconclusive. The general pattern appears to be that confirming instances were found of theorems in approximately the same proportion that they were found of the models of the counterexample[1]. Closer examination of the results, (see the appendix), indicates than when a confirming instance of at least one of the models of the counterexample was observed then, using the same procedures and definitions, it was often the case that a confirming instance of the theorem was also observed. Contrapositively, when a confirming instance of the theorem was not observed, it was often the case that one was also not observed of the models of its counterexample.

Theorems 1 and 2 are clearly examples of this pattern. In every test of theorem 1, the observations were judged to be a confirming instance of the theorem. However, of the eleven combinations of procedures and definitions that were used to test this theorem, only two of them did not also turn up at least one confirming instance of a model of the counterexample. In particular, the observations were accepted as a confirming instance of models 11 and 12 in tests using most combinations of definitions and procedures.

With respect to the tests of Theorem 2, on the basis of all three criteria of acceptance, the observations were not

interpreted as a confirming instance of this theorem, in a single test. Nor, in a single test, was the data judged to be a confirming instance of the following models of the counterexample; 21, 23, 24. The observations were accepted as a confirming instance of model 22 in only a few tests and only when the criteria of acceptance was based on the average deviations. (Note however, that when the criteria of acceptance are loosened, one half of the tests of equation 22 indicated that the observations should be accepted as a confirming instance of this model).

Only for theorem 3 can it be said that the observations were interpreted as confirming instances of the theorem in a somewhat greater proportion of the tests than was the case for any models of its counterexample. As we will see later, this is attributable mainly to tests using two of the post-Keynesian definitions and the selection procedure.

The results of the tests of Theorems 4 and 6 are mixed. An analysis of these results would be simplified by introducing a classification system. We will say that, for any of the combinations of procedures and definitions used to test a theorem and the models of its counterexample, the test results can be put into one of the following four categories:

type A - the observations were accepted as

a confirming instance of the theorem and at

least one of the models of its counterexample.

type B - the observations were accepted as

a confirming instance of the theorem but

not of any of the models of its counterexample.

type C – the observations were not accepted

as a confirming instance of the theorem, but

they were accepted as a confirming instance of

at least one of the models of its counterexample.

type D – the observations were not accepted as a

confirming instance of either the theorem

or any model of its counterexample.

For the purposes of classifying the test results, an observation was said to be a confirming instance if two of the three criteria of acceptance indicated an acceptance, or if only two of the criteria were available, one of the two criteria indicate an acceptance. The following cut-off levels will be used as the basis for determining the status of an observation: R squared > .95; absdev < .05; stddev < .07.

For quick reference, the test results classification system can be represented as:

```
                    models of the counterexample,
                          at least one,

                    accepted          not accepted
             ┌──────────────┬──────────────┐
             │              │              │
   accepted  │      A       │      B       │
             │              │              │
 theorem     │              │              │
             ├──────────────┼──────────────┤
             │              │              │
not accepted │      C       │      D       │
             │              │              │
             └──────────────┴──────────────┘
```

Note that type A and D results are indicative of the
general pattern mentioned above. Theorem 1 is characterized by
type A results and theorem 2, by type D, (unless of course the
criteria of acceptance are loosened, in which case one half of
the combinations of theorem 2 tests give type C results). Type
A results are considered as inconclusive because it is not
clear, on the basis of the testing conventions, whether the
observations should be considered as a confirming instance of
the theorem or its counterexample. Type D results are also
considered as inconclusive because, on the basis of the
testing conventions, the observations cannot be considered as
a confirming instance of the theorem, let alone of the
counterexample, (type D results should not be considered as
refuting evidence).

    Type B and C results are considered as relatively
conclusive only because the test results do not suggest that
there is reason to doubt the appropriateness of the testing

conventions. They do not, however, prove that the observations are a confirming instance of the theorem or counterexample, respectively. Furthermore, type C results can be considered as more conclusive than type B results because, to the extent that the testing conventions are accepted as correct, it is logically possible to use confirming instances of the models of the counterexample to argue for the falsity of the theory under examination.

Five combinations of procedures and definitions were used to test theorem 4. Three of them gave type C results, (i.e., a confirming instance was observed of at least one model of the counterexample but not of the theorem), and two of them gave type A results, (i.e., a confirming instance was observed of the theorem and at least one model of its counterexample). All three of the type C results were obtained using post-Keynesian definitions.

Twelve combinations of procedures and definitions were used to test theorem 6. Five of the combinations turned up type A results, four yielded type D results and three turned up type C results. In general it could be said that theorem 6 followed the pattern of inconclusive results, although it was not, as in the case of theorems 1 and 2, either almost all type A's or D's.

Because theorem 5 was not tested in the same way as the others, it is not possible to classify the results using the

categories outlined above.

The tests which sought to find confirming instances of the predicted relationships in the first difference form almost all failed in their objective. The observations were accepted as a confirming instance a model of the counterexample in only one of the tests, (model 46 - using a neoclassical definition, no selection procedure and the criteria 'absdev < .1'). and no confirming instances were found of the theorems. Generally, for the tests measuring the variables in the first difference form, the deviations of the predicted from the observed values of the dependent variables were relatively high, and the R squared's were low. The criteria of acceptance would have had to be relaxed considerably before many of the test results would have indicated that the observations were a confirming instance of the predicted relationships, (see table G below).

There is reason to believe that the three criteria of acceptance will not evaluate all of the test results in much the same way. There is firstly a fundamental difference between the R squared and the criteria based on the average deviations, (both 'absolute' and 'standard'). An R squared measures the proportion of the deviation of the dependent variable from its observed mean, which is 'explained' (predicted) by deviations of the independent variable. If the

variables are measured over a period of time in which the dependent and independent variables changed very little, (relative to the standard error of the regression estimate), the deviations that are observed may be due largely to random error, in which case the R squared will be relatively low. It is therefore the case that if the dependent variable changes very little, it is probable that the observations will not be accepted as a confirming instance of the model or theorem under examination on the basis of the R squared criteria.

On the other hand the average deviations criteria only measures the size of the deviations of the observed from the predicted values of the dependent variable. If the dependent variable changes little, relative to 1 if it is unweighted or relative to its weighting factor if it is, then the regression estimate is likely to be considered as a good predictor on the basis of the average deviations criteria. Most of the dependent variables for which a weighting factor was used, showed considerable variation. However, some of the dependent variables whose values were between 0 and 1, tended to change very little. It follows from the above discussion that with respect to evaluating the latter, the R squared and average deviations criteria should show a tendency to give opposite results. This was observed to be the case.

In particular, this was observed to be the case for theorem 5. R/Y was the dependent variable and it changed relatively little, (for all definitions), over the 24 year

period considered in the tests. Many of the R squareds were less than .9. On the basis of the R squared criterion, a little less than one half of the tests indicated that the observations should not be accepted as a confirming instance of the model of the counterexample under examination. On the other hand, the 'absdev' and 'stddev', which measure only the deviations of the predicted from the observed values, were generally low. As a consequence, in every one of the tests, on the basis of 'absdev' and 'stddev' criteria, the observations were accepted as a confirming instance of the model or theorem under examination. To some extent this was also the case for the model 14, (where the dependent variable was W/Y), and model 41, (where the dependent variable was G/L).

There were also some differences between the results obtained using criteria of acceptance based on the absolute and standard deviations. The differences were observed primarily in cases where the coefficients were estimated using a regression model in log linear form. For models of this type, the (weighted) average absolute deviation was measured after the predicted and observed values were converted back from log form, while the (weighted) standard deviation was measured in the log form. If the dependent variable is greater than 1, then the usage of the above procedure should result in a (weighted) average absolute deviation which is greater than the (weighted) standard deviation. In the case of some tests

this difference was sufficiently large that observations were interpreted as a confirming instance of the equation on the basis of the 'stddev', but not on the basis of the 'absdev'. This was the case for equation 13. In not a single test were the data judged to be a confirming instance of this equation on the basis of the 'absdev', yet for every test it was judged to be a confirming instance of this equation on the basis of the 'stddev'. To a lesser extent this was also the case for equations; 32, 43, and 64.

The above results were evaluated using the three criteria of acceptance at two cut-off levels for each criteria. A change of the cut-off level for acceptance from; .95 to .9, .05 to .10 and .07 to .15, for the R squared, 'absdev' and 'stddev' respectively, significantly affected the overall test results of only 7 of the 48 equations, or eliminating the first difference form, only 7 of 21. The cases where it did make a difference were for tests of equations; 22, 30, 40, 41, 60, 61, 62.

Set of Tables B

Several definitions were used to measure the variables. The results, grouped by equation type(s) and definitions, are given below in the Set of Tables B. The format for giving the results, in this case, will feature from two to six sets of figures in each cell. The first set of figures in each cell,

starting from the top, will be the results from tests using the neoclassical definition. They will be indicated by the notation '(NC)'. The other sets of figures are for tests using post-Keynesian definitions. They will be denoted as '(PK1)' to '(PK5)'. The five post-Keynesian definitions were constructed from some of the possible combinations of the two available definitions for each of investment, profits and income. The definitions of investment, profits and income used in each of (PK1) to (PK5) are given in the appendix of this Chapter.

With respect to the numbers of the equations, note once again that if the second digit is equal to zero or five, this indicates that the equation is a theorem, otherwise it is a model of the counterexample.

Set of Tables B

Theorem 1 - Kaldor's First Theory

Rsq > .95	absdev < .05	stddev < .07	
(NC) 3,3,<u>1.0</u>	(NC) 4,4,<u>1.0</u>	(NC) 4,4,<u>1.0</u>	10
(PK1) 3,3,<u>1.0</u>	(PK1) 5,5,<u>1.0</u>	(PK1) 5,5,<u>1.0</u>	
(PK3) 2,2,<u>1.0</u>	(PK3) 2,2,<u>1.0</u>	(PK3) 2,2,<u>1.0</u>	
(NC) 8,5,<u>.63</u>	(NC) 13,9,<u>.69</u>	(NC) 13,10,<u>.77</u>	11-14
(PK1) 9,4,<u>.45</u>	(PK1) 17,12,<u>.71</u>	(PK1) 17,16,<u>.94</u>	
(PK3) 5,2,<u>.4</u>	(PK3) 5,3,<u>.6</u>	(PK3) 5,3,<u>.6</u>	

Rsq > .90	absdev < .10	stddev < .15	
(NC) 1,0,<u>.0</u>	(NC) 2,0,<u>.0</u>	(NC) 2,0,<u>.0</u>	15
(PK1) 1,0,<u>.0</u>	(PK1) 2,0,<u>.0</u>	(PK1) 2,0,<u>.0</u>	
(NC) 2,0,<u>.0</u>	(NC) 4,0,<u>.0</u>	(NC) 4,0,<u>.0</u>	16-17
(PK1) 2,0,<u>.0</u>	(PK1) 4,0,<u>.0</u>	(PK1) 4,0,<u>.0</u>	

Theorem 2 - Kaldor's Second Theory

Rsq > .95	absdev < .05	stddev < .07	
(NC) 3,0,.0	(NC) 3,0,.0	(NC) 3,0,.0	20
(PK1) 3,0,.0	(PK1) 6,0,.0	(PK1) 6,0,.0	
(PK3) 1,0,.0	(PK3) 1,0,.0	(PK3) 1,0,.0	
(NC) 8,0,.0	(NC) 9,0,.0	(NC) 9,0,.0	21-24
(PK1) 8,0,.0	(PK1) 19,3,.16	(PK1) 19,1,.05	
(PK3) 2,0,.0	(PK3) 2,0,.0	(PK3) 2,0,.0	

Rsq > .90	absdev < .10	stddev < .15	
(NC) 1,0,.0	(NC) 2,0,.0	(NC) 2,0,.0	25
(PK1) 1,0,.0	(PK1) 2,0,.0	(PK1) 2,0,.0	
(NC) 3,0,.0	(NC) 6,0,.0	(NC) 6,0,.0	26-28
(PK1) 3,0,.0	(PK1) 6,0,.0	(PK1) 6,0,.0	

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Theorem 3 - Kaldor's Second Theory

Rsq > .95	absdev < .05	stddev < .07	
(NC) 3,0,.0	(NC) 4,0,.0	(NC) 4,0,.0	30
(PK1) 3,1,.33	(PK1) 8,5,.63	(PK1) 8,5,.63	
(PK2) 1,1,1.0	(PK2) 3,1,.33	(PK2) 3,2,.67	
(PK4) 2,1,.50	(PK4) 2,1,.50	(PK4) 2,1,.5	
(PK5) 2,1,.50	(PK5) 2,0,.0	(PK5) 2,0,.0	
(NC) 5,0,.0	(NC) 8,0,.0	(NC) 8,0,.0	31-32
(PK1) 5,0,.0	(PK1) 17,0,.0	(PK1) 17,2,.12	
(PK2) 2,0,.0	(PK2) 6,0,.0	(PK2) 6,0,.0	
(PK4) 4,2,.5	(PK4) 4,2,.5	(PK4) 4,3,.75	
(PK5) 4,3,.75	(PK5) 4,3,.75	(PK5) 4,2,.5	

	Rsq > .90	absdev < .10	stddev < .15	
(NC)	1,0,.0	(NC) 5,0,.0	(NC) 5,0,.0	35
(PK1)	1,0,.0	(PK1) 5,0,.0	(PK1) 5,0,.0	
(PK2)	1,0,.0	(PK2) 3,0,.0	(PK2) 3,0,.0	
(NC)	3,0,.0	(NC) 6,0,.0	(NC) 6,0,.0	36–37
(PK1)	4,0,.0	(PK1) 7,0,.0	(PK1) 7,0,.0	
(PK2)	3,0,.0	(PK2) 5,0,.0	(PK2) 5,0,.0	

Theorem 4 – Asimakopulos' Theory

	Rsq > .95	absdev < .05	stddev < .07	
(NC)	2,2,1.0	(NC) 2,1,.5	(NC) 2,2,1.0	40
(PK1)	2,0,.0	(PK1) 2,0,.0	(PK1) 2,0,.0	
(PK3)	1,0,.0	(PK3) 1,0,.0	(PK3) 1,0,.0	
(NC)	6,4,.83	(NC) 7,4,.57	(NC) 7,4,.57	41–44
(PK1)	6,5,.83	(PK1) 7,5,.71	(PK1) 7,5,.71	
(PK3)	4,3,.75	(PK3) 4,3,.75	(PK3) 4,3,.75	

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	Rsq > .90	absdev < .10	stddev < .15	
(NC)	1,0,.0	(NC) 2,0,.0	(NC) 2,0,.0	45
(PK1)	1,0,.0	(PK1) 2,0,.0	(PK1) 2,0,.0	
(NC)	2,0,.0	(NC) 4,1,.25	(NC) 4,0,.0	46
(PK1)	2,0,.0	(PK1) 4,0,.0	(PK1) 4,0,.0	

Theorem 5 - Asimakopulos' Theory

	Rsq > .95	absdev < .05	stddev < .07	
(NC)	7,4,.57	(NC) 8,8,1.0	(NC) 8,8,1.0	51-54
(PK1)	7,4,.57	(PK1) 8,8,1.0	(PK1) 8,8,1.0	
(PK2)	2,0,.0	(PK2) 4,4,1.0	(PK2) 4,4,1.0	
(PK3)	2,0,.0	(PK3) 2,2,1.0	(PK3) 2,2,1.0	

	Rsq > .90	absdev < .10	stddev < .15	
(NC)	3,0,.0	(NC) 6,0,.0	(NC) 6,0,.0	56-58
(PK1)	3,0,.0	(PK1) 6,0,.0	(PK1) 6,0,.0	
(PK2)	2,0,.0	(PK2) 4,0,.0	(PK2) 4,0,.0	

Theorem 6 - Asimakopulos' Theory

Rsq > .95	absdev < .05	stddev < .07	
(NC) 3,1,<u>.33</u>	(NC) 3,1,<u>.33</u>	(NC) 3,1,<u>.33</u>	60
(PK1) 2,0,<u>.0</u>	(PK1) 5,3,<u>.6</u>	(PK1) 5,2,<u>.4</u>	
(PK2) 1,1,<u>1.0</u>	(PK2) 2,1,<u>.5</u>	(PK2) 2,1,<u>.5</u>	
(PK3) 2,2,<u>1.0</u>	(PK3) 2,1,<u>.5</u>	(PK3) 2,1,<u>.5</u>	
(NC) 5,1,<u>.2</u>	(NC) 6,2,<u>.33</u>	(NC) 6,2,<u>.33</u>	61-64
(PK1) 4,0,<u>.0</u>	(PK1) 11,2,<u>.18</u>	(PK1) 11,2,<u>.18</u>	
(PK2) 3,3,<u>1.0</u>	(PK2) 5,1,<u>.2</u>	(PK2) 5,3,<u>.6</u>	
(PK3) 5,5,<u>1.0</u>	(PK3) 5,2,<u>.4</u>	(PK3) 5,4,<u>.8</u>	

Rsq > .90	absdev < .10	stddev < .15	
(NC) 1,0,<u>.0</u>	(NC) 2,0,<u>.0</u>	(NC) 2,0,<u>.0</u>	65
(PK1) 1,0,<u>.0</u>	(PK1) 2,0,<u>.0</u>	(PK1) 2,0,<u>.0</u>	
(PK2) 1,0,<u>.0</u>	(PK2) 2,0,<u>.0</u>	(PK2) 2,0,<u>.0</u>	
(NC) 2,0,<u>.0</u>	(NC) 4,0,<u>.0</u>	(NC) 4,0,<u>.0</u>	66-68
(PK1) 2,0,<u>.0</u>	(PK1) 4,0,<u>.0</u>	(PK1) 4,0,<u>.0</u>	
(PK2) 2,0,<u>.0</u>	(PK2) 4,0,<u>.0</u>	(PK2) 4,0,<u>.0</u>	

Set of Tables B - Comments

   In the case of theorems 1, 2 and 5, the results were
much the same for all the definitions. With respect to the
tests of Theorem 1, for every one of the three definitions
used to test this theorem, at least one of the combinations of
procedures resulted in the observations being interpreted as a
confirming instance of the theorem and at least one model of
the counterexample, (i.e., type A results). For theorem 5, on
the basis of the deviations criteria, the results were the
same for all four definitions used to test this theorem, the
observations were accepted as a confirming instance in every
test. However, when only the criterion of acceptance based on
the R squared was applied to tests using post-Keynesian
definition 1 and the neoclassical definition, only four of the
seven tests using each definition indicated that the
observations should be accepted as confirming instances of the
models of the counterexample. Furthermore, on the basis of the
R squared criterion, none of the tests using post-Keynesian
definitions 2 and 3, indicated that the observations should be
accepted as confirming instances of these models.

   With respect to the tests of theorem 2, a confirming
instance was not found of this theorem, nor of any models of
its counterexample, with the exception of model 22.
Furthermore, using the deviations criteria and the cut-offs;
absdev < .05 and stddev < .07, the only tests of model 22 that
indicated that the observations should be accepted as a

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confirming instance of this model, were tests using post-Keynesian definition 1. However, when the criteria of acceptance were relaxed to the following; absdev < .1 and stddev < .15, one of the three tests using the neoclassical definition indicated that the observations should be accepted as a confirming instance of this model, (it was a test in which the selection procedure was used).

Confirming instances of theorem 3 were not found as a result of tests using the neoclassical defintions, nor were any confirming instances found of models of its counterexample, (i.e., type D results). On the other hand using post-Keynesian definition 1, (PK1), confirming instances were found of the theorem and almost none of the models of its counterexample, (i.e., type B and D results were obtained). No type C and only one type A result was obtained from tests using this definition. The one type A result was from a group of tests in which the observations were interpreted to be a confirming instance only of model 32, and only on the basis of the 'stddev' criterion, (i.e., the observations were not also accepted as a confirming instance of the model on the basis of the 'absdev' criterion and an R squared was not calculated). Furthermore, the tests which gave a type A result were not carried out using a selection procedure.

Similarly, using post-Keynesian definition 2, (PK2), confirming instances were found of the theorem, but none were found of the models of the counterexample, (i.e., type B

results).

These results are of interest because theorem 3 is similar to one of the theorems tested by Kalecki. Kalecki's test was discussed in Chapter Four.

Some of the post-Keynesian definitions of investment did not include expenditures for residential housing. Two of them, post-Keynesian definitions 1 and 2, were mentioned above with respect to the test results of theorem 3. Using these definitions, only one type A result was obtained, while the other results were type B. On the other hand, using post-Keynesian definitions 4 and 5, which did include residential housing, the results were less conclusive. The two procedures used with definition 4 produced the following results: a type C result without a selection procedure, and a type A result with a selection procedure. Similarly, the tests using definition 5, gave type C results with and without a selection procedure. These results are of interest in light of the fact that Kaldor insisted that residential housing should not be included in the post-Keynesian definition of saving, and therefore investment[2].

Although it is not appearant from the set of tables B, the tests of theorem 3 using post-Keynesian definitions 1 and 2, which turned up confirming instances of the theorem, (that is, they gave type B results), were tests where a selection procedure was used. The theory predicts that if the fraction

of investment financed by corporations, or the corporate savings rate changes over time, then the predicted value of P, for any given level of investment, will also change. Consequently, if the coefficients of the predicted relationship are to be calculated using observations from different time periods then data should be used only from periods of time in which the values of 'i' and 'sc' are the same. This was the objective of the selection procedure. Since i and sc did change over time, one might interpret the fact that confirming instances of the theorem were observed only when the selection procedure was used, as itself a confirming instance of the theorem. This confirming instance cannot be used to argue for the truth of the theory, nor can it be taken as an indication that the testing procedures are correct. Failure, however, to have observed this confirming instance would have put the testing conventions in doubt.

With respect to the tests of theorem 4, the two test procedures using the neoclassical definition turned up confirming instances of both the theorem and models of the counterexample, (i.e. type A results). On the other hand, the three tests using the post-Keynesian definitions turned up only confirming instances of models of the counterexample, (i.e. type C results).

A duplication of theorem 3's results might have been expected for theorem 6 since the latter differs from the former only in that HY/G has been added as an explanatory variable. This does not appear to have been the case. More specifically, a high proportion of type B results were not obtained when post-Keynesian definitions 1 and 2, and a selection procedure were used. Adding HY/G seems to have decreased the number of combinations in which type B results were obtained by increasing the number of cases in which confirming instances were observed of the models of the counterexample.

Set of Tables C

For some of the tests the data were selected by what has been referred to as a 'selection procedure'. More specifically, the data were selected on the basis of three variables: personal savings rate, the rate of corporate retentions, and the fraction of investment financed by corporations. This selection procedure involved chosing years in which the observed values of the above mentioned variables, fell in prescribed ranges.

The results will be grouped on the basis of whether or not a selection procedure was used. This will be done, as opposed to giving results for each selection procedure, because: firstly, for each variable several sets of ranges

were used; and secondly, some of the selection procedures involved choosing years of data on the basis of two of the three variables. If the results were presented for each range, or combination of ranges, some of the tables could contain more cells than tests. For individual results of each selection procedure the reader is referred to the appendix.

As mentioned, in some cases more than one savings rate selection procedure was used, or as in the case of theorems 2 and 3, a procedure to select data based on the fraction of investment financed by corporations was also used. There were therefore cases in which the ranges of savings rates, etc., to be selected was so narrow that very few observations were chosen. In cases where fewer than five observations were selected, the test results were ignored.

Two sets of figures will appear in each cell of the tables in Set of Tables C. The first set of results, that is the results preceded by the letter S in brackets, are for tests in which a selection procedure was applied. The second set of figures in the each cell, the ones not preceded by an (S), are for similar tests without a selection procedure.

Set of Tables C

Theorem 1 - Kaldor's First Theory

Rsq > .95	absdev < .05	stddev < .07	

(S)   2,2,<u>1.0</u>
 	
      6,6,<u>1.0</u>
	(S) 5,5,<u>1.0</u>
	
	      6,6,<u>1.0</u>
		(S) 5,5,<u>1.0</u>
		
		      6,6,<u>1.0</u>
			10

(S)   8,6,<u>.75</u>
 	
     14,5,<u>.36</u>
	(S) 21,15,<u>.68</u>
	
	     14,9,<u>.64</u>
		(S) 21,18,<u>.84</u>
		
		     14,11,<u>.79</u>
			11-14

Rsq > .90	absdev < .10	stddev < .15	

(S)   0,0,-
 	
      2,0,<u>.0</u>
	(S) 2,0,<u>.0</u>
	
	      2,0,<u>.0</u>
		(S) 2,0,<u>.0</u>
		
		      2,0,<u>.0</u>
			15

(S)   0,0,-
 	
      4,0,<u>.0</u>
	(S) 4,0,<u>.0</u>
	
	      4,0,<u>.0</u>
		(S) 4,0,<u>.0</u>
		
		      4,0,<u>.0</u>
			16-17

Theorem 2 – Kaldor's Second Theory

Rsq > .95	absdev < .05	stddev < .07	
(S) 2,0,.0 5,0,.0	(S) 4,0,.0 6,0,.0	(S) 4,0,.0 6,0,.0	20
(S) 6,0,.0 12,0,.0	(S) 15,2,.13 15,1,.07	(S) 15,1,.07 15,0,.0	21-24

Rsq > .90	absdev < .10	stddev < .15	
(S) 0,0,- 2,0,.0	(S) 2,0,.0 2,0,.0	(S) 2,0,.0 2,0,.0	25
(S) 0,0,- 6,0,.0	(S) 6,0,.0 6,0,.0	(S) 6,0,.0 6,0,.0	26-28

Theorem 3 - Kaldor's Second Theory

Rsq > .95	absdev < .05	stddev < .07	
(S) 4,2,.5	(S) 11,7,.64	(S) 11,8,.73	30
7,2,.29	8,0,.0	8,0,.0	
(S) 8,4,.5	(S) 25,4,.16	(S) 25,4,.16	31-32
12,1,.08	14,1,.07	14,3,.21	

Rsq > .90	absdev < .10	stddev < .15	
(S) 0,0,-	(S) 10,0,.0	(S) 10,0,.0	35
3,0,.0	3,0,.0	3,0,.0	
(S) 4,0,.0	(S) 12,0,.0	(S) 12,0,.0	36-37
6,0,.0	6,0,.0	6,0,.0	

Theorem 4 - Asimakopulos' Theory

Rsq > .95	absdev < .05	stddev < .07	
(S) 2,1,<u>.5</u> 3,1,<u>.33</u>	(S) 2,0,<u>.0</u> 3,1,<u>.33</u>	(S) 2,1,<u>.5</u> 3,1,<u>.33</u>	40
(S) 4,4,<u>1.0</u> 12,8,<u>.67</u>	(S) 6,4,<u>.67</u> 12,8,<u>.67</u>	(S) 6,4,<u>.67</u> 12,8,<u>.67</u>	41-44

Rsq > .90	absdev < .10	stddev < .15	
(S) 0,0,- 2,0,<u>.0</u>	(S) 2,0,<u>.0</u> 2,0,<u>.0</u>	(S) 2,0,<u>.0</u> 2,0,<u>.0</u>	45
(S) 0,0,- 4,0,<u>.0</u>	(S) 4,0,<u>.0</u> 4,1,<u>.25</u>	(S) 4,0,<u>.0</u> 4,0,<u>.0</u>	46-48

Theorem 5 - Asimakopulos' Theory

Rsq > .95	absdev < .05	stddev < .07	
(S) 6,6,<u>1.0</u> 12,2,<u>.17</u>	(S) 10,10,<u>1.0</u> 12,12,<u>1.0</u>	(S) 10,10,<u>1.0</u> 12,12,<u>1.0</u>	51-54

Rsq > .90	absdev < .10	stddev < .15	

(S)   0,0,-
     8,0,$\underline{.0}$
	(S) 8,0,$\underline{.0}$
	     8,0,$\underline{.0}$
		(S) 8,0,$\underline{.0}$
		     8,0,$\underline{.0}$
			56-58

Theorem 6 - Asimakopulos' Theory

Rsq > .95	absdev < .05	stddev < .07	

(S)   3,2,$\underline{.67}$
     5,2,$\underline{.4}$
	(S) 6,6,$\underline{1.0}$
	     6,0,$\underline{.0}$
		(S) 6,5,$\underline{.83}$
		     6,0,$\underline{.0}$
			60

(S)   4,3,$\underline{.75}$
     13,6,$\underline{.46}$
	(S) 12,5,$\underline{.42}$
	     15,2,$\underline{.13}$
		(S) 12,6,$\underline{.5}$
		     15,5,$\underline{.33}$
			61-64

Rsq > .90	absdev < .10	stddev < .15	

(S)   0,0,-
     3,0,$\underline{.0}$
	(S) 3,0,$\underline{.0}$
	     3,0,$\underline{.0}$
		(S) 3,0,$\underline{.0}$
		     3,0,$\underline{.0}$
			65

(S)   0,0,-
     6,0,$\underline{.0}$
	(S) 6,0,$\underline{.0}$
	     6,0,$\underline{.0}$
		(S) 6,0,$\underline{.0}$
		     6,0,$\underline{.0}$
			66-68

Generally the usage of a selection procedure does not
appear to have made much difference. The exceptions were the

tests of models 30 and 60. When a selection procedure was not used, none of the test results for these equations indicated, on the basis of the 'stddev' and 'absdev' criteria, that the data should be accepted as a confirming instance of either theorem. On the other hand, for each of these two theorems, more than one half of the corresponding tests in which a selection procedure was used, indicated that the observations should be accepted as a confirming instance of the theorem. As mentioned, if the theories were true, one would expect the observations to be more readily identified as a confirming instance of the theorem if a selection procedure were used.

Set of Tables D

The Durbin-Watson statistics indicated that for many of the tests, under the conditions ordinarily assumed for the Durbin-Watson test, there is evidence of autocorrelation. The validity of the argument that the Durbin-Watson statistic indicates a correlation between the error terms rests on, amongst other assumptions, an assumption of the existance of a random error term. Because the R squared, 'absdev' and 'stddev' also rest on the assumption of random deviations and because correcting for autocorrelation is a common procedure, we should be interested in the affect of correcting for what is taken as an indication of this problem. It is worth noting however that a Durbin-Watson statistic indicating autocorrelation may also be the product of having used a

misspecified functional form.

The results preceded by the letter A in brackets are results for tests in which an autocorrelation procedure was implemented. The second set of figures, are the results for corresponding tests without a correction procedure.

Set of Tables D

Theorem 1

Rsq > .95   absdev <.05

(A) 2,2,<u>1.0</u> 2,2,<u>1.0</u>	(A) 2,2,<u>1.0</u> 2,2,<u>1.0</u>	10
(A) 2,1,<u>.5</u> 2,2,<u>1.0</u>	(A) 2,1,<u>.5</u> 2,2,<u>1.0</u>	11

Theorem 2

Rsq > .95   absdev <.05

(A) 2,0,.0	(A) 2,0,.0	20
2,0,.0	2,0,.0	
(A) 2,0,.0	(A) 2,0,.0	22
2,0,.0	2,0,.0	

Theorem 3

Rsq > .95   absdev <.05

(A) 2,0,.0	(A) 2,0,.0	30
2,0,.0	2,0,.0	
(A) 2,0,.0	(A) 2,0,.0	31
2,0,.0	2,0,.0	

Theorem 6

Rsq > .95   absdev <.05

(A) 1,0,<u>.0</u>
 	
      1,0,<u>.0</u>
	(A) 1,0,<u>.0</u>
	
	      1,0,.0
		60

(A) 1,0,<u>.0</u>
 	
      1,0,<u>.0</u>
	(A) 1,0,<u>.0</u>
	
	      1,0,.0
		61

(A) 1,0,<u>.0</u>
 	
      1,0,<u>.0</u>
	(A) 1,0,<u>.0</u>
	
	      1,0,.0
		62

Correcting for autocorrelation does not appears to have made much difference. Only for a test of model 11, using post-Keynesian definition one, was there a change in the status of the observation. The observations were not considered as a confirming instance of model 11 when an autocorrelation correction procedure was used, and were when the correction procedure was not used.

Because the autocorrelation correction procedure in effect introduces another explanatory variable, the estimated R squareds and average deviations obtained using this technique should be higher and lower respectively than the corresponding estimates obtained using ordinary least squares. In every case, however, the difference between the estimates

obtained using the autocorrelation correction procedure and those obtained using ordinary least squares was sufficiently small that the former did not result in the observations being more frequently accepted as a confirming instance of the models under examination.

As mentioned, there was one case in which the observations were interpreted as a confirming instance of a model of the counterexample on the basis of a test using ordinary least squares but were not considered as the same on the basis of a test using an autocorrelation correction correction procedure. This seemingly anomalous result was obtained because the test under consideration contained a procedure for evaluating an intercept or exponent. The intercept was considered significantly different from zero in the test using ordinary least squares but was not in the test using an autocorrelation correction procedure.

Set of Tables E

Kalecki, in some of his tests, lagged the independent variables by a number of time periods. The number of periods lagged was the number of period lags which gave the highest correlation between the independent and dependent variables. In order to examine the affect of this testing convention, the results will be given for tests in which this procedure has been used, and for corresponding tests in which the procedure was not used. The results for the tests in which the

independent variables were lagged will be preceded by the letter L in brackets. Results will not be given for every theorem since for theorem 1, the highest correlations were observed with a zero period lag.

Set of Tables E

Theorem 2

absdev <.05   stddev <.07

(L) 2,0,.0	(L) 2,0,.0	20
2,0,.0	2,0,.0	
(L) 6,2,.33	(L) 6,1,.17	21-24
6,0,.0	6,0,.0	

Theorem 3

absdev <.05   stddev <.07

(L) 3,2,.67	(L) 3,2,.67	30
3,2,.67	3,2,.67	
(L) 6,0,.0	(L) 6,1,.17	31-32
6,0,.0	6,1,.17	

Theorem 6

absdev <.05   stddev <.07

(L) 2,1,.5	(L) 2,1,.5	60
2,1,.5	2,0,.0	
(L) 4,1,.25	(L) 4,1,.25	61-64
4,1,.25	4,0,.0	

Tests using the lag procedure should turn up more confirming instances of the equations than would tests not using the procedure. We can see from the above that they did. It tended to increase the proportion of tests where the observations were judged to be a confirming instances of both the theorems and models of the counterexample.

It could be argued that lagging the independent variables is a questionable practise because it does not agree with a strict interpretation of the theory; i.e., that 'S = I' means 'S at time t equals I at time t'. On the other hand it could be argued that the lag procedure better reflects the intent of post-Keynesian theorists, and that this assumption should be read as 'S at time t equals I at time t-i'. This latter interpretation could be supported by taking the post-Keynesian

argument that investment determines the level of savings one step further, and asserting that some time lag is involved. However, even if one does follow this line of argument there is still another issue; it is not clear that Kalecki's method of establishing the lag is correct, (i.e., it may not be possible to induce the true lag from the observations).

Table F

With respect to testing some of the models of the counterexample, a confirming instance of the model was said to have been observed only if an exponent did not equal one or a constant term did not equal zero. In order to test these models, some criteria were therefore required to determine when the exponent or intercept under consideration did not have the value predicted for it by the theory. It was decided that the required testing convention would be as follows: the intercept would be considered as not equal to zero and the exponent not equal to one, if they were more than two standard deviations from zero and one respectively, (see Chapter Five). In Table F below the test results will be reconsidered by changing this 'two standard deviations rule' to a 'one' or 'three standard deviation rule'. The number at the top of each column indicates the number of standard deviations used to evaluate the intercepts and exponents. Test results will be given in Table F only for the models to which this decision rule applies.

Table F

For absdev <.10,

levels of significance=

	1	2	3	
	11, 9, <u>.82</u>	11, 8, <u>.73</u>	11, 8, <u>.73</u>	11
	9, 8, <u>.89</u>	9, 8, <u>.89</u>	9, 7, <u>.77</u>	12
	6, 6, <u>1.0</u>	6, 6, <u>1.0</u>	6, 6, <u>1.0</u>	14
	4, 0, <u>.0</u>	4, 0, <u>.0</u>	4, 0, <u>.0</u>	16
	7, 0, <u>.0</u>	7, 0, <u>.0</u>	7, 0, <u>.0</u>	23
	4, 0, <u>.0</u>	4, 0, <u>.0</u>	4, 0, <u>.0</u>	26
	23, 6, <u>.26</u>	22, 4, <u>.18</u>	22, 2, <u>.09</u>	31
	17, 7, <u>.41</u>	17, 4, <u>.23</u>	17, 3, <u>.18</u>	32
	13, 0, <u>.0</u>	13, 0, <u>.0</u>	13, 0, <u>.0</u>	36
	5, 5, <u>1.0</u>	5, 5, <u>1.0</u>	5, 5, <u>1.0</u>	42
	6, 6, <u>1.0</u>	6, 6, <u>1.0</u>	6, 6, <u>1.0</u>	52
	12, 6, <u>.5</u>	12, 6, <u>.5</u>	12, 1, <u>.08</u>	61
	6, 0, <u>.0</u>	6, 0, <u>.0</u>	6, 0, <u>.0</u>	66

As the cut-off level is increased from one through to three, there were of course fewer tests in which the observations were accepted as a confirming instance of the model under examination. For most models, however, the decrease was not dramatic. In fact, for four of the nine tests which did not use the first difference form, there was no change at all. It is probably fair to say that setting the cut-off point at two was not a crucial decision. With the exception of the tests for equations 31, 32 and 61, any other number in a reasonable range around two would have given much the same results.

As mentioned, two of the exceptions were models 31 and 32. The cut-off level was particularly important for the tests of these two models where post-Keynesian definitions 1, 2 and 3 were used. In tests using these three definitions, the observations could frequently be interpreted as a confirming instance of the functional form, but the estimated intercept, in the case of model 31, or the estimated exponent in the case of model 32, could not be judged to differ from zero or one respectively.

Set of Tables G

Looking over the results of Sets of Tables A, B and C, it is apparent that very few tests indicated that the observations should be accepted as confirming instances of equations 15 - 17, 25 -28, 35 - 37, 45 - 48, 56 - 58 and 65 -

68. It could be argued that this result was obtained because the criteria of acceptance were too stringent. In order to examine this line of argument, and because it would be interesting to see what differences would result if the acceptance levels were lowered, the test results were reconsiderd using the following criteria of acceptance: R squared > .75 and a (weighted) standard deviation < .5. The results are given below in the Set of Tables G.

Set of Tables G

Theorem 1

Rsq > .75	stddev < .5	
(NC) 1,1,<u>1.0</u>	(NC) 2,2,<u>1.0</u>	15
(PK) 1,1,<u>1.0</u>	(PK) 2,2,<u>1.0</u>	
(NC) 2,0,<u>.0</u>	(NC) 4,1,<u>.25</u>	16-17
(PK) 2,0,<u>.0</u>	(PK) 4,2,<u>.5</u>	

Theorem 2

	Rsq > .75	stddev < .5	
	(NC) 1,0,<u>.0</u>	(NC) 2,0,<u>.0</u>	25
	(PK) 1,0,<u>.0</u>	(PK) 2,0,<u>.0</u>	
	(NC) 3,0,<u>.0</u>	(NC) 6,0,<u>.0</u>	26–28
	(PK) 3,0,<u>.0</u>	(PK) 6,0,<u>.0</u>	

Theorem 3

	Rsq > .75	stddev < .5	
	(NC) 1,0,<u>.0</u>	(NC) 5,3,<u>.6</u>	35
	(PK) 2,0,<u>.0</u>	(PK) 8,0,<u>.0</u>	
	(NC) 3,0,<u>.0</u>	(NC) 6,2,<u>.33</u>	36–37
	(PK) 7,0,<u>.0</u>	(PK) 12,0,<u>.0</u>	

Theorem 4

	Rsq > .75		stddev < .5	
(NC)	1,0,.0	(NC)	2,1,.5	45
(PK)	1,0,.0	(PK)	2,1,.5	
(NC)	2,0,.0	(NC)	4,1,.25	46-48
(PK)	2,0,.0	(PK)	4,1,.25	

Theorem 5

	Rsq > .75		stddev < .5	
(NC)	3,0,.0	(NC)	6,1,.16	56-58
(PK)	5,0,.0	(PK)	10,0,.0	

Theorem 6

	Rsq > .75		stddev < .5	
(NC)	1,1,1.0	(NC)	2,1,.5	65
(PK)	2,0,.0	(PK)	4,0,.0	
(NC)	2,1,.5	(NC)	4,0,.0	66-68
(PK)	4,0,.0	(PK)	8,0,.0	

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With these loosened criteria, only a few of the tests indicated that the observations should be considered as confirming instances of the models and theorems under examination. Furthermore, even in these few cases where there was 'acceptance', the results were inconclusive. Tests using most combinations of procedures and definitions produced type A or D results when reevaluated according to the above criteria. On the basis of 'stddev' criterion, there were 21 type D results, 7 type A's, 3 type B's and no type C's. On the basis of the R squared criterion, the results were all type D and A's, with the exception of the tests of theorem 1, which produced type B results. In fact, not even theorem 3 stands out as an exception, where type D results were obtained using the post-Keynesian definitions. Only the results of theorem 1 suggest a case where observations were more readily interpreted as a confirming instance of the theorem than of the models of the counterexample.

Conclusions

From the point of view of testing, the single most important point to come out of the tests is highlighted by the test results of theorems 1 and 2. By the criteria we have used, and these are criteria that reflect common practise, the following pattern emerges: a set of observations which can be interpreted as a confirming instance of a theorem, can also be interpreted as a confirming instance of at least one model of

the theorem's counterexample, if not a confirming instance of several, (e.g., theorem 1). Or contrapositively, when the observations cannot be considered as a confirming instance of any models of the counterexample, they also cannot be interpreted as a confirming instance of the theorem, (e.g., theorem 2).

This pattern suggests that for some of the above tests, the testing conventions may not have been appropriate. The problem could have been a result of the criteria of acceptance, the definitions or the procedures, (using a regression technique, the selection procedure, etc.). In any case it is not clear that the testing conventions that have been used are capable of determining if the observations are, or are not, confirming instances of the theorems or models under examination.

These comments should be qualified by noting that in the case of theorem three, using post-Keynesian definitions 1 and 2, and a selection procedure, the above method of testing gave some relatively decisive results. Relatively decisive results were also obtained from tests of theorem 4 using post-Keynesian definitions 1 and 3.

Footnotes to Chapter Eight

1 Although the objective of testing is to refute the theory,
finding confirming instances of the theorem is not
undesirable. The failure to find a confirming instance of the
theory would suggest that one is looking for a confirming
instance of the counterexample in the wrong place, or with
incorrect definitions and procedures. A confirming instance is
not, however, 'confirming evidence' of the theory.

2 Kaldor, "Marginal Productivity and Macroeconomic Theories
       of Distribution," p. 301.

I. Appendix to Chapter Eight

For quick reference, the equations corresponding to the two digit code are given below:

Theorem 1

$$10 \quad W = aY + bI \quad \text{or} \quad W/Y = a(I/Y) + b$$

$$11 \quad W = aY - bI + c$$

$$12 \quad W = k(Y - I)^q$$

$$13 \quad W = a(I/Y)^q$$

$$14 \quad W/Y = a(I/Y)^q$$

$$14.5 \quad W/Y = a(Y/I) + b$$

$$15 \quad dW = a(dY) + b(dI)$$

$$16 \quad dW = a(dY) + b(dI) + c$$

$$17 \quad d(W/Y) = ad(I/Y) + c$$

Theorem 2

$$20 \quad v = a(Y/I) + b$$

$$21 \quad v = a(Y/I) + 1$$

$$22 \quad v = bY + bI + c$$

$$23 \quad v = a(Y/I)^q$$

$$24 \quad v = a(I/Y) + b$$

$$25 \quad dv = ad(Y/I)$$

$$26 \quad dv = ad(Y/I) + c$$

$$27 \quad dv = a(dY) + b(dI) + c$$

$$28 \quad dv = ad(I/Y) + b$$

Theorem 3

$$30 \quad P = aI$$

$$31 \quad P = aI + b$$

$$32 \quad P = aI^q$$

$$35 \quad dP = a(dI)$$

$$36 \quad dP = a(dI) + b$$

$$37 \quad |dP| = a|dI|^q$$

Theorem 4

$$40 \quad GW/L = aI + b(HY/G)$$

$$41 \quad G/L = aI + b(HY/G) + cW$$

$$42 \quad GW/L = aI + b(HY/G) + c$$

$$43 \quad GW/L = a(I + HY/G)^q$$

$$44 \quad G/L = a(IG/HY) + b(WH/GY) + c$$

$$45 \quad d(G/L) = a(d(I/W)) + bd(HY/GW)$$

$$46 \quad d(G/L) = a(dI) + bd(HY/G) + c(dW)$$

$$47 \quad d(G/L) = ad(IG/HY) + bd(WH/GY) + c$$

Theorem 5

$$51 \quad P/Y = aI + b(HY/G) + c$$

$$52 \quad P/Y = a[(I - HY/G)/(I + HY/G)] + c$$

$$53 \quad P/Y = aI/Y + bH/G + c$$

$$54 \quad P/Y = a(IG/HY) + c$$

$$56 \quad d(P/Y) = a(dI) + bd(HY/G) + c$$

$$57 \quad d(P/Y) = ad[(I - HY/G)/(I + HY/G)] + c$$

$$58 \quad d(P/Y) = ad(I/Y) + bd(H/G) + c$$

Theorem 6

$$60 \quad P = aI + bHY/G$$

$$61 \quad P = aI + bHY/G + c$$

$$62 \quad P = a(I + HY/G)$$

$$63 \quad P = a(I + HY/G) + c$$

$$64 \quad P = a(I + HY/G)^q$$

$$65 \quad dP = a(dI) + bd(HY/G)$$

$$66 \quad dP = a(dI) + bd(HY/G) + c$$

$$67 \quad dP = ad(I + HY/G) + c$$

$$68 \quad dP = ad(I + HY/G)$$

Definitions

The components of each of the five post-Keynesian definitions are given below in terms of the definitions of profits, investment and income.

(PK1) — definition 1 of investment
   — definition 1 of profits
   — definition 1 of income

(PK2) — definition 1 of investment
   — definition 2 of profits
   — definition 1 of income

(PK3) — definition 1 of investment
   — definition 2 of profits
   — definition 2 of income

(PK4) — definition 2 of investment
   — definition 1 of profits

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(PK5) – definition 2 of investment

   – definition 2 of profits

The post-Keynesian definitions of profits, investment and income, are given in the appendix of Chapter 7.

Chapter Nine - Summary and Conclusions

In this chapter the tests' results will be summarized and there will be some concluding remarks. This will be done by examining each theorem in turn, starting with Kaldor's first theory.

Kaldor's First Theory

Theorem 1 - Tests of this theorem and models of its counterexample gave type A results for almost all of the combinations of definitions and procedures. As mentioned in Chapter Eight, this is an indication that there may be something wrong with the testing conventions, in which case the 'confirming instances' of the counterexample should not necessarily be considered as refuting evidence.

The type A results could be a product of the steady upward trend of wages, income and investment from 1947 to 1970, where all three of these variables increased by approximately the same order of magnitude. Using, for example, post-Keynesian definition 1, the wage bill, investment and income went from 102.3 to 433.6 billion, 20.1 to 118.8 billion and 153.2 to 641.4 billion dollars, respectively. Similar changes were observed for the same variables using the other definitions. Relative to this substantial upward trend, the

variation of the predicted from the observed values of W appeared to be small, when W was calculated using equations 10, 11 and 12.

There were three reasons why this could have lead to the observations being readily accepted as a confirming instance of equations 10, 11 and 12 for all combinations of definitions and procedures. Firstly, it meant that the R squared's from these functional forms were close to one. That is, the upward trend of investment and income was a good predictor of the upward trend of wages. Secondly, because the upward trend resulted in a large average value of the dependent variable, relative to its deviations from this trend, the weighted average deviations were observed to be small. Thirdly, the large trend variation, relative to the deviation of the predicted from observed values of W, resulted in a small estimated standard deviation of the estimated coefficients. Since the rule for accepting an observation as a confirming instance of a model with an intercept or exponent, was based in part on this estimated standard deviation, the large trend variation increased the liklihood that the observations would be accepted as a confirming instance of this type of model, (depending on the R squared, etc.).

The ease with which confirming instances were found of models 14 and 14.5, using the deviation criteria, can be explained by the fact that W/Y varied little over the 24 year period, (for example, using post-Keynesian definition 1 it

varied only from .628 to .676). Note that confirming instances were not observed of these two models using the R squared criterion. The deviations of W/Y from its mean were not predicted well by deviations of I/Y.

Because of the above mentioned characteristics, i.e., the trend variation of W, I and Y, and the stability of W/Y, it is not likely that convincing 'refuting evidence' will be found by way of testing for the functional relationship, (that is, a test where confirming instances are observed of a model of the counterexample but not also of the theorem). If the test results are to be more decisive, that is, they can be used to more convincingly criticize the theory, then either testing conventions will have to be developed for examining other types of models of this theorem's counterexample, (that is, conventions for determining when 'W does not equal aI + bY'), or else some other theorem will have to be tested. With respect to the latter, one could attempt to examine, for example, the predicted causal relationship between the total wage bill and investment. One could also have tested the coefficients - almost all of which, in the above tests, had the correct sign, (the exceptions were tests using post-Keynesian definition 3 - the coefficients are given in the appendix).

As a note of caution, with respect to identifying evidence that can be used to argue for the falsity of a theory, choosing the model which best predicts the observations is not a satisfactory method for obtaining decisive results. This procedure could easily result in true theories being refuted. A more satisfactory approach is to say that the empirical evidence can be used to argue for the falsity of a theory only when it is believed that the testing conventions have correctly identified it as a confirming instance of a model of the counterexample. If an observation turns out to be accepted as a confirming instance of several models, including models of the theory, then the testing conventions should be reexamined.

Kaldor's Second Theory

Theorem 2 - Most of the combinations of definitions and procedures used to test this theorem yielded type D results. However, type C results were obtained for three combinations of procedures using post-Keynesian definition 1. In these three groups of tests, the observations were interpreted as a confirming instance only of model 22 and, with one exception, only on the basis of the 'absdev' criterion. All of the confirming instances of model 22 were for tests in which either a lag or selection procedure was used, (the test in which the two procedures were used together was the one test in which the observations were also accepted as a confirming

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instance of the model, on the basis of the 'stddev' criterion). Nevertheless, if post-Keynesian definition 1 is accepted as the correct set of empirical definitions then, to the extent that the other testing conventions are considered as appropriate, one could argue that refuting evidence has been found.

Note that it is always possible to explain type C and D results by questioning the testing conventions. For example, in order to explain why confirming instances were not observed of theorem 2, one could argue that the observational model (of the theorem), but not the theorem, is false. An argument of this type would have to based on an assertion that other influencing factors affected observed reality. For instance, in the case of this theorem it could be argued that some other influencing factor caused an upward trend of v, I and Y, and that as a consequence the observations were not accepted as a confirming instance of the theorem, but were instead accepted as a confirming instance of model 22, (model 22 expressed the valuation ratio as a linear function of I and Y). If there were an influencing factor of this type then the models of the counterexample should have taken it into consideration, (with as a possible consequence, the observations being accepted only as a confirming instance of an observational model of the theorem).

Although it is likely that this theorem is false, a widespread acceptance of its falsity would not be very damaging for post-Keynesian theory. The theorem is of little importance and its derivation requires the assumption of long-run equilibrium, (see Chapter Two).

Theorem 3 - this theorem was also deduced from Kaldor's second theory and closely resembles a theorem tested by Kalecki[1]. Its refutation would be more damaging for post-Keynesian income distribution theory than would a refutation of theorem 2.

Using a neoclassical definition of investment and profits, confirming instances were not found for either the theorem, or a model of the counterexample, (i.e., type D results were obtained). Using post-Keynesian definitions 1 and 2, and a selection procedure, confirming instances were found of the theorem but none were found of the models of the counterexample, (i.e., type B results). The other two post-Keynesian definitions gave a mix of type C and A results.

With respect to the post-Keynesian definitions, in tests where investment was defined so as not to include residential housing, refuting evidence was not found when a selection procedure was used. The results became less conclusive when the definition of investment was changed to include residential housing, (post-Keynesian definitions 4 and 5).

This seems to support Kaldor's assertion, which can be taken as representative of the post-Keynesian position, that residential housing should not be considered as a part of savings - therefore investment[2],

Post-Keynesian definitions 2 and 5 included depreciation in corporate profits and post-Keynesian definitions 1 and 4 did not. If we contrast the results of tests using post-Keynesian definitions 1 and 4 with the results of tests using post-Keynesian definitions 2 and 5, including depreciation in corporate profits does not appear to have made much difference.

If investment is defined so as not to include residential housing, then from a post-Keynesian point of view there is no basis for asserting that this theorem is false.

Confirming instances of the theorem were observed only when the selection procedure was used. This could be considered as a confirming instance of an observational model of what would happen when a selection procedure is used to carry out the tests. This model predicts that confirming instances are more likely to be observed with the usage of a selection procedure than without. As mentioned in Chapter Eight, this confirming instance cannot be used to argue for the truth of the theory. It is, however, encouraging, since if it were believed that the coefficients had changed, the absence of this confirming instance could be used as the basis

for arguing that the testing conventions are not appropriate.

Asimakopulos' Theory

Theorem 4 - The form of this theorem, for which
confirming instances were sought, resembles theorem 1. The
differences are that in theorem 4, W and Y are weighted by G/L
and H/G respectively. The test results of these theorems
should therefore be comparable. The tests showed that
confirming instances of theorem 4 did not turn up as readily.
The data was accepted as a confirming instance of the theorem
in only two of the five tests. The two confirming instances
were from tests using the neoclassical definition. The results
were more like those of theorem 1 when the criteria of
acceptance were loosened.

Confirming instances were more readily found of models of
the counterexample, 42 and 43, in which WG/L was the dependent
variable. The observations were accepted as a confirming
instance of these two models using all five combinations of
definitions and procedures.

Two models of the counterexample were examined in which
G/L was the dependent variable. Tests of one of them, model
41, did not turn up any confirming instances of the model.
This model must have been a particularly poor predictor since
the range of values for G/L was relatively small, (.83 to
.88). Model 44 also used G/L as the dependent variable,
however, in every test of this model the observations were

accepted as a confirming instance. The poor predictive power of model 41 relative to model 44 is most likely attributable to the fact that the former did not use a constant term and the latter did.

On the basis of the confirming instances of models 42, 43 and 44, the test results can be considered as relatively decisive for the post-Keynesian definitions. That is, if the post-Keynesian definitions are accepted as appropriate, it can be argued that refuting evidence has been found.

The theorem could also have been tested by examining the signs of its coefficients. The theory predicts that the coefficients of both I and HY/G will be positive. All of the coefficients were observed to have the correct sign. Depending upon the testing conventions this could be interpreted as a confirming instance of the theory.

Theorem 5 - Because of the theorem's functional form, it was not possible to estimate its coefficients using a least squares regression technique. It was, however, possible to construct and estimate coefficients for models of the counterexample. Since we only have results for these models, the efficiency of the testing conventions cannot be checked by doing a comparison with results from tests of the theorem.

The models of the counterexample were constructed with R/Y as the dependent variable. Over the period of measurement,

for all definitions, R/Y changed very little. Consequently, using the criteria of acceptance based on a measure of the average deviations, the observations were accepted as a confirming instance of every model of the counterexample, for every combination of definitions and procedures. Not surprisingly the R squared criterion turned up fewer confirming instances, these were mostly from tests in which a selection procedure was used. On the basis of the R squared criterion, confirming instances were not observed of any models of the counterexample for tests using post-Keynesian definitions 2 and 3.

Theorem 6 – the test results for this theorem should be comparable to those of theorem 3. The only difference between the two theorems is that HY/G has been added in theorem 6 as an explanatory variable.

The most decisive results of Theorem 3 were from tests using post-Keynesian definitions 1 and 2, the results were type B which indicates that refuting evidence was not found. In the case of theorem 6, the results from tests using post-Keynesian definitions 1 and 2 were as follows: there were type A results with a selection procedure and, type C and D results, without. Since the type C results were the product only of tests not using a selection procedure, we may wish to consider the results of these tests as inconclusive.

For all definitions, confirming instances were observed of the theorem only when a selection procedure was used. This could be interpreted as another confirming instance of (a model of) the theory's predictions.

Theorem 6 could also be tested by examining the signs of the coefficients. The theory predicts that the coefficient of I will be positive, and that the one for HY/G will be negative. It was observed that only tests using post-Keynesian definition 1, without a lag procedure, gave coefficients with the correct signs. Depending upon the testing conventions, this could be interpreted as refuting evidence, (except in the case of post-Keynesian definition 1).

The Definitions of Direct and Overhead Labour

As mentioned, theorems 4 and 6 can be obtained by modifying theorems 1 and 3. These modifications involved using a measure of overhead and variable labour inputs, i.e., H and G, Therefore, the extent to which the test results of theorems 4 and 6 differed from those of theorems 1 and 3, depended in part upon the empirical definitions of H and G, (using the post-Keynesian definitions, tests of theorems 4 and 6 gave more type C and D results). These empirical definitions have been outlined in Chapter Seven. The sought after characterisitics were that H and G represent fixed and variable labour (costs) respectively, and that output

increases with G but is unaffected by changes of H. There are two points to be made with respect to the empirical definitions that have been used in this chapter: Firstly, it is always possible to argue that they are not correct or do not reflect the intent of Asimakopulos' theory, especially since Asimakopulos did not outline an empirical definition. And secondly, it is doubtful that there are any real world variables which have the sought after characteristics. With respect to the former, if the the definitions which have been used are not thought to be appropiate then: one, the test results of theorems 4 and 6 become questionable on the basis of the empirical definitions; and two, some clarification as to what these variables are supposed to represent in measurable terms will be necessary in order to more decisively test Asimakopulos' theory, (i.e., some conventional definitions will be required). And with respect to the latter point, if there are no real world variables which have the desired characteristics, then it will be necessary to reformulate Asimakopulos' Theory, (i.e., the theory is false).

As a note, Asimakopulos' theory could be reformulated in a way which preserves its basic approach. This basic approach requires only that average costs are declining and that the mark-up is applied to average variable costs. However, revising the theory in a way which preserves its basic approach, may not make it any less difficult to test, (because of the difficulties of measuring fixed and variable costs at

the macro level).

Tests Using the First Difference Form

In Tables A to F of Chapter Eight, confirming instances were not found of the theorems or any of the models of the counterexample as a result of tests using variables measured in the first difference form. This is perhaps not surprising since they were evaluated using the same acceptance criteria which were used to evaluate the other tests. More surprising was the fact that so few confirming instances turned up when the criteria were loosened to give the results shown on table G, (see Chapter Eight).

There are several possible reasons why so few confirming instances were found of any of the functional relationships for variables measured in the first difference form. One possibility is that the random or unexplained variation of the observed dependent variable from its predicted value is large relative to its predicted change from one time period to the next. If this were the case then the predicted changes would have been overwhelmed by random variations. One possible source of random error large enough to have this effect is the estimation procedures used to obtain the national accounts estimates[3].

A second possible reason why few confirming instances were found is that the theorems are false. That is, the predicted relationships simply were not there to be observed.

The results from tests using variables measured in the first difference form do not however imply that this must be the case.

Substantial deviations of the observed from the predicted values of the dependent variables might also be explained by something similar to the modification of Kaldor's First Theory, proposed by K.W. Rothchild[4]. Rothchild argued that the resistance of income earners to changes in their level and share of total income will impose constraints on the possible values of investment and income. An observational model of this type could be constructed to explain the difference between observed reality and the theory's prediction of the short-run response of the dependent variable to a change in the level of investment or income.

The Assumptions

If the objective were only to establish the truth or falsity of the three theories under consideration, there is no reason why the assumptions could not have been directly examined. This was not done above because the thesis also had a methodological objective. A method of testing was introduced which in part deals with the problem that directly examining the assumptions can sometimes be difficult or impossible to do [5]. The problem has been solved by examining a testable theorem, the refutation of which would indicate that at least one of the assumptions is false.

In the three theories that were tested a few assumptions
stand out as being questionable. One of them, from
Asimakopulos' theory, is that firms are fully integrated.
Another, from the same theory, is that labour can be
classified as either overhead or direct, and that the marginal
contribution to production of direct labour is some constant
'a'. The assumption of long-run equilibrium in Kaldor's Second
Theory is also questionable, (although it is not necessary to
derive the theory's income distribution theorem).

Footnotes to Chapter Nine

1 Kalecki, "Determinents of Profits," p. 86-92.

2 Kaldor, "Marginal Productivity and Macroeconomic
        Theories of Distribution," p. 301.

3 Oskar Morgenstern can be quoted as saying, in his book On
the Accuracy of Economic Observation, that "(Simon) Kuznets
infers that an average margin of error for national income
estimates of about 10 percent would be reasonable." The
predicted change, over a one year period, of the dependent
variable could easily be overwhelmed by an error term this
large.
O. Morgenstern, On the Accuracy of Economic Observation
        2nd edition (Princeton: Princeton University
        Press, 1965), p. 255.

4 K.W. Rothschild, "Themes and Variations - Remarks on
        the Kaldorian Distribution Formula," Kyklos
        28(4) (1965): 652-667.

5 As an example consider consumer theory. The assumption of
consumer maximization cannot be directly refuted, but the
theory's theorem, the slutsky equation, can be. A test which
is based on the logical relationship between the slutsky
equation and consumer theory has been proposed by Cliff Lloyd
in "On the falsification of Traditional Demand Theory," 17-23.

Appendix

The results for each of the tests are given in this appendix. For the sake of brevity these results have been condensed by coding much of the information. Codes will be used to indicate the equation type, definition and selection procedure. The coding systems for the equations types and definitions are the same as the ones used in Chapters Six and Eight, and the coding system for the selection procedure is outlined below. A Reference Number is also given so that the test results can be traced to the test output.

The 'standardized intercept or exponent' is given with the results of tests in which it was necessary, in order to determine the status of the observations, to first determine if an intercept or exponent differed from zero or one respectively. To calculate the standardized intercept, the absolute value of the estimated intercept was divided by the estimate of its standard deviation. Similarly, to calculate the standardized exponent, the absolute value of the difference between the estimated exponent and one, was divided by its estimated standard deviation. For most of the tests' results given in Chapter Eight, this value had to be greater than 2 if an observation was to be accepted as a confirming instance of the model.

The coding system for the selection procedures is given below. Each code has two digits, the first and second digits are each codes for specific selection procedures. The selection procedure indicated by the first digit was used in conjunction with the selection procedure indicated by the second digit. The selection procedures referred to by the first digit are:

1   Years were selected in which the overall
     personal savings rate was between .04 and .06,
     - post-Keynesian definitions, (post-Keynesian
     definitions 1 of investment, profits and
     income, will be referred to as 'post-Keynesian
     definitions', unless otherwise specified).

2   Years were selected in which the overall
     personal savings rate was between .042 and .058,
     - post-Keynesian definitions.

3   Years were selected in which the overall
     personal savings rate was between .049 and .056,
     - post-Keynesian definitions.

4   Years were selected in which the rate of
     corporate retentions was between .735 and .770,
     and the fraction of investment financed by
     corporations was between .6 and .8,
     - post-Keynesian definition 2 of corporate profits.

5   Years were selected in which the overall
     personal savings rate was between .16 and .18,

- neoclassical definitions.

6   Years were selected in which the overall

personal savings rate was between .17 and .18,

- neoclassical definitions.

7   Years were selected in which the corporate

rate of retentions was between .735 and .770,

and the overall personal savings rate was

between .04 and .06, - post-Keynesian definition 2·

of corporate profits.

8   Years were selected in which the proportion

of investment financed by corporations was between

.699 and .72, - post-Keynesian definitions.

9   Years were selected in which the proportion

of investment financed by corporations was between

.493 and .580, - neoclassical definitions.

0   A selection procedure is not refered

to by this digit.

The selection procedures indicated by the second digit are:

1   Years were selected in which the proportion

of investment financed by corporations was

between .699 and .76, - post-Keynesian definitions.

2   Years were selected in which the proportion

of investment financed by corporations was

between .72 and .75, - post-Keynesian definitions.

3   Years were selected in which the rate of

corporate retentions was between .5 and .6,

- post-Keynesian definitions.

4   Years were selected in which the rate of
    corporate retentions was between .535
    .565, - post-Keynesian definitions.

5   Years were selected in which the rate of
    corporate retentions was between .535
    and .585, - post-Keynesian definitions.

6   Years were selected in which the proportion
    of investment financed by corporations was between
    .493 and .580, - neoclassical definitions.

7   Years were selected in which the proportion
    of investment financed by corporations was between .515
    and .575, - neoclassical definitions.

8   Years were selected in which the rate of
    retentions by corporations was between .72 and .75,
    - neoclassical definitions.

9   Years were selected in the rate of retentions
    by corporations was between .72 and .77,
    - neoclassical definitions.

0   A selection procedure is not refered to by
    this digit.

If a code for a selection procedure is not given, a selection
procedure was not used.

Unless otherwise indicated, an ordinary least squares
regression technique was used to estimate the coefficients.

Kaldor's First Theory

Theorem 1 - Model 10

Test No. 1   Reference Number = 1   Definition = PK1
Equation type = 10   Number of Observations = 24
Absdev < .05   Stddev = 0.026
R Squared = .996
The coefficient of I = -.281, Standard Deviation = .211
The coefficient of Y = .702, Standard Deviation = .038

Test No. 2   Reference Number = 304   Definition = PK1
Equation type = 10   Number of Observations = 24
Absdev < .05   Stddev = 0.023
R Squared = .996
An Autocorrelation Correction Procedure was used.
The coefficient of I = -.236, Standard Deviation = .290
The coefficient of Y = .630, Standard Deviation = .526

Test No. 3   Reference Number = 41   Definition = PK1
Equation type = 10   Number of Observations = 15
Absdev < .05   Stddev = 0.024
R Squared = .996
Selection Procedure = 10
The coefficient of I = -.398, Standard Deviation = .260
The coefficient of Y = .721, Standard Deviation = .046

Test No. 4   Reference Number = 61   Definition = PK1
Equation type = 10   Number of Observations = 11
Absdev < .05   Stddev = 0.024
Selection Procedure = 20
The coefficient of I = -.684, Standard Deviation = .306
The coefficient of Y = .770, Standard Deviation = .054

Test No. 5   Reference Number = 78   Definition = PK1
Equation type = 10   Number of Observations = 7
Absdev < .05   Stddev = 0.026
Selection Procedure = 30
The coefficient of I = -.820, Standard Deviation = .342
The coefficient of Y = .798, Standard Deviation = .061

Test No. 6   Reference Number = 345   Definition = PK3
Equation type = 10   Number of Observations = 24
Absdev < .05   Stddev = 0.044
R Squared = .990
The coefficient of I = .240, Standard Deviation = .334
The coefficient of Y = .515, Standard Deviation = .051

Test No. 7   Reference Number = 380   Definition = PK3
Equation type = 10   Number of Observations = 15
Absdev = .025   Stddev = 0.030
R Squared = .991
Selection Procedure = 10
The coefficient of I = .065, Standard Deviation = .365
The coefficient of Y = .595, Standard Deviation = .060

Test No. 8   Reference Number = 21   Definition = NC
Equation type = 10   Number of Observations = 24
Absdev < .05   Stddev = 0.029
R Squared = .999
The coefficient of I = -1.38, Standard Deviation = .227
The coefficient of Y = .820, Standard Deviation = .018

Test No. 9   Reference Number = 305   Definition = NC
Equation type = 10   Number of Observations = 24
Absdev < .05   Stddev = 0.027
R Squared = .996
An Autocorrelation Correction Procedure was used.
The coefficient of I = -1.382, Standard Deviation = .227
The coefficient of Y = .820, Standard Deviation = .018

Test No. 10   Reference Number = 98   Definition = NC
Equation type = 10   Number of Observations = 10
Absdev < .05   Stddev = 0.029
Selection Procedure = 60
The coefficient of I = -1.984, Standard Deviation = .440
The Coefficient of Y = .876, Standard Deviation = .038

Test No. 11   Reference Number = 118   Definition = NC
Equation type = 10   Number of Observations = 15
Absdev < .05   Stddev = 0.031
R Squared = .996
Selection Procedure = 50
The Coefficient of I = -1.452, Standard Deviation = .421
The Coefficient of Y = .824, Standard Deviation = .036

Theorem 1 - Models of the Counterexample: 11-14

Model 11

Test No. 12   Reference Number = 2   Definition = PK1
Equation type = 11   Number of Observations = 24
Absdev < .05   Stddev = 0.017
R Squared = .998
The Standardized Intercept or Exponent = 5.08

Test No. 13   Reference Number = 290   Definition = PK1
Equation type = 11   Number of Observations = 24
Absdev < .05   Stddev = 0.010
R Squared = .998
The Standardized Intercept or Exponent = 0.17
An Autocorrelation Correction Procedure was used.

Test No. 14   Reference Number = 42   Definition = PK1
Equation type = 11   Number of Observations = 15
Absdev < .05   Stddev = 0.013
R Squared = .999
The Standardized Intercept or Exponent = 5.32
Selection Procedure = 10

Test No. 15   Reference Number = 62   Definition = PK1
Equation type = 11   Number of Observations = 11
Absdev < .05   Stddev = 0.010
The Standardized Intercept or Exponent = 6.37
Selection Procedure = 20

Test No. 16   Reference Number = 79   Definition = PK1
Equation type = 11   Number of Observations = 7
Absdev < .05   Stddev = 0.011
The Standardized Intercept or Exponent = 4.89
Selection Procedure = 30

Test No. 17   Reference Number = 359   Definition = PK3
Equation type = 11   Number of Observations = 24
Absdev < .05   Stddev = 0.042
R Squared = .989
The Standardized Intercept or Exponent = 0.17

Test No. 18   Reference Number = 381   Definition = PK3
Equation type = 11   Number of Observations = 15
Absdev = .020   Stddev = 0.020
R Squared = .997
The Standardized Intercept or Exponent = 6.12
Selection Procedure = 10

Test No. 19   Reference Number = 22   Definition = NC
Equation type = 11   Number of Observations = 24
Absdev < .05   Stddev = 0.020
R Squared = .998
The Standardized Intercept or Exponent = 5.07

Test No. 20   Reference Number = 286   Definition = NC
Equation type = 11   Number of Observations = 24
Absdev < .05   Stddev = 0.027
R Squared = .998
The Standardized Intercept or Exponent = 5.07
An Autocorrelation Correction Procedure was used.

Test No. 21   Reference Number = 119   Definition = NC
Equation type = 11   Number of Observations = 15
Absdev < .05   Stddev = 0.020
R Squared = .999
The Standardized Intercept or Exponent = 4.58
Selection Procedure = 50

Test No. 22   Reference Number = 99   Definition = NC
Equation type = 11   Number of Observations = 10
Absdev < .05   Stddev = 0.025
The Standardized Intercept or Exponent = 1.90
Selection Procedure = 60

Model 12

Test No. 23   Reference Number = 3   Definition = PK1
Equation type = 12   Number of Observations = 24
Absdev < .05   Stddev = 0.003
R Squared = .998
The Standardized Intercept or Exponent = 6.35

Test No. 24   Reference Number = 43   Definition = PK1
Equation type = 12   Number of Observations = 15
Absdev < .05   Stddev = 0.003
R Squared = .999
The Standardized Intercept or Exponent = 6.27
Selection Procedure = 10

Test No. 25   Reference Number = 63   Definition = PK1
Equation type = 12   Number of Observations = 11
Absdev < .05   Stddev = 0.002
The Standardized Intercept or Exponent = 8.70
Selection Procedure = 20

Test No. 26   Reference Number = 80   Definition = PK1
Equation type = 12   Number of Observations = 7
Absdev < .05   Stddev = 0.002
The Standardized Intercept or Exponent = 5.00
Selection Procedure = 30

Test No. 27   Reference Number = 346   Definition = PK3
Equation type = 12   Number of Observations = 24
Absdev < .05   Stddev = 0.001
R Squared = .983
The Standardized Intercept or Exponent = 0.59

Test No. 28   Reference Number = 382   Definition = PK3
Equation type = 12   Number of Observations = 15
Absdev = .011   Stddev = 0.002
R Squared = .998
The Standardized Intercept or Exponent = 9.08
Selection Procedure = 10

Test No. 29   Reference Number = 23   Definition = NC
Equation type = 12   Number of Observations = 24
Absdev < .05   Stddev = 0.005
R Squared = .996
The Standardized Intercept or Exponent = 5.31

Test No. 30   Reference Number = 120   Definition = NC
Equation type = 12   Number of Observations = 15
Absdev < .05   Stddev = 0.005
R Squared = .999
The Standardized Intercept or Exponent = 4.21
Selection Procedure = 50

Test No. 31   Reference Number = 100   Definition = NC
Equation type = 12   Number of Observations = 10
Absdev < .05   Stddev = 0.006
The Standardized Intercept or Exponent = 2.90
Selection Procedure = 60

Model 13

Test No. 32   Reference Number = 4   Definition = PK1
Equation type = 13   Number of Observations = 24
Absdev = .257   Stddev = 0.066
R Squared = .347

Test No. 33   Reference Number = 64   Definition = PK1
Equation type = 13   Number of Observations = 11
Absdev = .215   Stddev = 0.066
Selection Procedure = 20

Test No. 34   Reference Number = 44   Definition = PK1
Equation type = 13   Number of Observations = 15
Absdev = .211   Stddev = 0.060
R Squared = .336
Selection Procedure = 10

Test No. 35   Reference Number = 81   Definition = PK1
Equation type = 13   Number of Observations = 7
Absdev = .140   Stddev = 0.055
Selection Procedure = 30

Test No. 36   Reference Number = 24   Definition = NC
Equation type = 13   Number of Observations = 24
Absdev > .10   Stddev = 0.061
R Squared = .466

Test No. 37   Reference Number = 121   Definition = NC
Equation type = 13   Number of Observations = 15
Absdev = .268   Stddev = 0.066
R Squared = .226
Selection Procedure = 50

Test No. 38   Reference Number = 101   Definition = NC
Equation type = 13   Number of Observations = 10
Absdev = .224   Stddev = 0.054
Selection Procedure = 60

Model 14

Test No. 39   Reference Number = 253   Definition = PK1
Equation type = 14   Number of Observations = 24
Absdev < .05   Stddev = 0.053
R Squared = .035
The Standardized Intercept or Exponent = 28.80

Test No. 41   Reference Number = 256   Definition = PK1
Equation type = 14   Number of Observations = 15
Absdev < .05   Stddev = 0.053
The Standardized Intercept or Exponent = 14.29
Selection Procedure = 10

Test No. 42   Reference Number = 250   Definition = PK1
Equation type = 14   Number of Observations = 11
Absdev < .05   Stddev = 0.023
The Standardized Intercept or Exponent = 11.00
Selection Procedure = 20

Test No. 44   Reference Number = 261   Definition = NC
Equation type = 14   Number of Observations = 24
Absdev = .024   Stddev = 0.035
R Squared = .629
The Standardized Intercept or Exponent = 274.00

Test No. 45   Reference Number = 264   Definition = NC
Equation type = 14   Number of Observations = 10
Absdev = .026   Stddev = 0.103
The Standardized Intercept or Exponent = 18.86
Selection Procedure = 60

Test No. 46   Reference Number = 258   Definition = NC
Equation type = 14   Number of Observations = 15
Absdev = .030   Stddev = 0.112
The Standardized Intercept or Exponent = 20.17
Selection Procedure = 50

Model 14.5

Test No. 40   Reference Number = 358   Definition = PK1
Equation type = 14.5   Number of Observations = 24
Absdev < .05   Stddev = 0.014
R Squared = .035

Test No. 43   Reference Number = 357   Definition = PK3
Equation type = 14.5   Number of Observations = 24
Absdev < .05   Stddev = 0.033
R Squared = .181

Theorem 1 — Model 15

Test No. 47   Reference Number = 195   Definition = PK1
Equation type = 15   Number of Observations = 23
Absdev > .10   Stddev = 0.235
R Squared = .879

Test No. 48   Reference Number = 231   Definition = PK1
Equation type = 15   Number of Observations = 15
Absdev > .10   Stddev = 0.267
Selection Procedure = 10

Test No. 49   Reference Number = 177   Definition = NC
Equation type = 15   Number of Observations = 23
Absdev > .10   Stddev = 0.307
R Squared = .814

Test No. 50   Reference Number = 213   Definition = NC
Equation type = 15   Number of Observations = 15
Absdev > .10   Stddev = 0.246
Selection Procedure = 50

Theorem 1 — Models of the Counterexample: 16-17

Model 16

Test No. 51   Reference Number = 196   Definition = PK1
Equation type = 16   Number of Observations = 23
Absdev > .10   Stddev = 0.236
R Squared = .884
The Standardized Intercept or Exponent = 0.91

Test No. 52   Reference Number = 232   Definition = PK1
Equation type = 16   Number of Observations = 15
Absdev > .10   Stddev = 0.278
The Standardized Intercept or Exponent = 0.13
Selection Procedure = 10

Test No. 53   Reference Number = 178   Definition = NC
Equation type = 16   Number of Observations = 23
Absdev > .10   Stddev = 0.311
R Squared = .818
The Standardized Intercept or Exponent = 0.65

Test No. 54   Reference Number = 214   Definition = NC
Equation type = 16   Number of Observations = 15
Absdev > .10   Stddev = 0.225
The Standardized Intercept or Exponent = 1.87
Selection Procedure = 50

Model 17

Test No. 55   Reference Number = 197   Definition = PK1
Equation type = 17   Number of Observations = 23
Absdev > .10   Stddev = 0.383
R Squared = .331

Test No. 56   Reference Number = 233   Definition = PK1
Equation type = 17   Number of Observations = 15
Absdev > .10   Stddev = 0.362
Selection Procedure = 10

Test No. 57   Reference Number = 179   Definition = NC
Equation type = 17   Number of Observations = 23
Absdev > .10   Stddev = 0.533
R Squared = .315

Test No. 58   Reference Number = 215   Definition = NC
Equation type = 17   Number of Observations = 15
Absdev > .10   Stddev = 0.422
Selection Procedure = 50

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   Theorem 2 - Model 20

Test No. 59   Reference Number = 5   Definition = PK1
Equation type = 20   Number of Observations = 24
Absdev > .10   Stddev = 0.215
R Squared = .133

Test No. 60   Reference Number = 302   Definition = PK1
Equation type = 20   Number of Observations = 24
Absdev > .10   Stddev = 0.185
R Squared = .293
An Autocorrelation Correction Procedure was used.

Test No. 61   Reference Number = 138   Definition = PK1
Equation type = 20   Number of Observations = 18
Absdev > .10   Stddev = 0.204
A Lag Procedure was used.

Test No. 62   Reference Number = 65   Definition = PK1
Equation type = 20   Number of Observations = 5
Absdev = .135   Stddev = 0.225
Selection Procedure = 21

Test No. 63   Reference Number = 45   Definition = PK1
Equation type = 20   Number of Observations = 7
Absdev = .143   Stddev = 0.228
R Squared = .130
Selection Procedure = 11

Test No. 64   Reference Number = 151   Definition = PK1
Equation type = 20   Number of Observations = 6
Absdev > .10   Stddev = 0.198
Selection Procedure = 11
A Lag Procedure was used.

Test No. 65   Reference Number = 347   Definition = PK3
Equation type = 20   Number of Observations = 24
Absdev > .10   Stddev = 0.222
R Squared = .458

Test No. 66   Reference Number = 25   Definition = NC
Equation type = 20   Number of Observations = 24
Absdev > .10   Stddev = 0.188
R Squared = .335

Test No. 67   Reference Number = 301   Definition = NC
Equation type = 20   Number of Observations = 24
Absdev > .10   Stddev = .1729
R Squared = .365
An Autocorrelation Correction Procedure was used.

Test No. 68   Reference Number = 122   Definition = NC
Equation type = 20   Number of Observations = 10
Absdev > .10   Stddev = 0.155
R Squared = .340
Selection Procedure = 56

Theorem 2 - Models of the Counterexample: 21-24

Model 21

Test No. 69   Reference Number = 6   Definition = PK1
Equation type = 21   Number of Observations = 24
Absdev > .10   Stddev = 0.221
R Squared < 0.0

Test No. 70   Reference Number = 139   Definition = PK1
Equation type = 21   Number of Observations = 18
Absdev > .10   Stddev = 0.204
A Lag Procedure was used.

Test No. 71   Reference Number = 66   Definition = PK1
Equation type = 21   Number of Observations = 5
Absdev > .10   Stddev = 0.200
Selection Procedure = 21

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Test No. 72   Reference Number = 46   Definition = PK1
Equation type = 21   Number of Observations = 7
Absdev > .10   Stddev = 0.211
R Squared = .055
Selection Procedure = 11

Test No. 73   Reference Number = 152   Definition = PK1
Equation type = 21   Number of Observations = 6
Absdev > .10   Stddev = 0.230
Selection Procedure = 11
A Lag Procedure was used.

Test No. 74   Reference Number = 26   Definition = NC
Equation type = 21   Number of Observations = 24
Absdev > .10   Stddev = 0.243
R Squared < 0.0

Test No. 75   Reference Number = 262   Definition = NC
Equation type = 21   Number of Observations = 24
Absdev > .10   Stddev = 0.184
R Squared = .363

Test No. 76   Reference Number = 123   Definition = NC
Equation type = 21   Number of Observations = 10
Absdev > .10   Stddev = 0.176
R Squared = .592
Selection Procedure = 56

Model 22

Test No. 77   Reference Number = 7   Definition = PK1
Equation type = 22   Number of Observations = 24
Absdev = .112   Stddev = 0.159
R Squared = .546

Test No. 78   Reference Number = 309   Definition = PK1
Equation type = 22   Number of Observations = 24
Absdev > .10   Stddev = 0.132
R Squared = .638
An Autocorrelation Correction Procedure was used.

Test No. 79   Reference Number = 140   Definition = PK1
Equation type = 22   Number of Observations = 18
Absdev = .048   Stddev = 0.070
A Lag Procedure was used.

Test No. 80   Reference Number = 67   Definition = PK1
Equation type = 22   Number of Observations = 5
Absdev = .044   Stddev = 0.099
Selection Procedure = 21

Test No. 81   Reference Number = 47   Definition = PK1
Equation type = 22   Number of Observations = 7
Absdev = .083   Stddev = 0.131
R Squared = .746
Selection Procedure = 11

Test No. 82   Reference Number = 153   Definition = PK1
Equation type = 22   Number of Observations = 6
Absdev < .05   Stddev = 0.055
Selection Procedure = 11
A Lag Procedure was used.

Test No. 83   Reference Number = 360   Definition = PK3
Equation type = 22   Number of Observations = 24
Absdev > .10   Stddev = 0.142
R Squared = .573

Test No. 84   Reference Number = 27   Definition = NC
Equation type = 22   Number of Observations = 24
Absdev = .112   Stddev = 0.160
R Squared = .539

Test No. 85   Reference Number = 303   Definition = NC
Equation type = 22   Number of Observations = 24
Absdev > .10   Stddev = 0.147
R Squared = .539
An Autocorrelation Correction Procedure was used.

Test No. 86   Reference Number = 124   Definition = NC
Equation type = 22   Number of Observations = 10
Absdev = .063   Stddev = 0.094
R Squared = .714
Selection Procedure = 56

Model 23

Test No. 87   Reference Number = 8   Definition = PK1
Equation type = 23   Number of Observations = 24
Absdev > .10   Stddev = 1.010
R Squared = .127
The Standardized Intercept or Exponent = 3.66

Test No. 88   Reference Number = 141   Definition = PK1
Equation type = 23   Number of Observations = 18
Absdev > .10   Stddev = 1.000
The Standardized Intercept or Exponent = 2.81
A Lag Procedure was used.

Test No. 89   Reference Number = 68   Definition = PK1
Equation type = 23   Number of Observations = 5
Absdev > .10   · Stddev = 0.938
The Standardized Intercept or Exponent = 1.18
Selection Procedure = 21

Test No. 90   Reference Number = 48   Definition = PK1
Equation type = 23   Number of Observations = 7
Absdev > .10   Stddev = 1.000
R Squared = .118
The Standardized Intercept or Exponent = 1.27
Selection Procedure = 11

Test No. 91   Reference Number = 154   Definition = PK1
Equation type = 23   Number of Observations = 6
Absdev = .152   Stddev = 0.867
The Standardized Intercept or Exponent = 0.37
Selection Procedure = 11
A Lag Procedure was used.

Test No. 92   Reference Number = 28   Definition = NC
Equation type = 23   Number of Observations = 24
Absdev > .10   Stddev = 0.839
R Squared = .399
The Standardized Intercept or Exponent = 1.95

Test No. 93   Reference Number = 125   Definition = NC
Equation type = 23   Number of Observations = 10
Absdev > .10   Stddev = 0.774
R Squared = .707
The Standardized Intercept or Exponent = 2.36
Selection Procedure = 56

Model 24

Test No. 94   Reference Number = 254   Definition = PK1
Equation type = 24   Number of Observations = 24
Absdev > .10   Stddev = 0.214
R Squared = .146

Test No. 95   Reference Number = 257   Definition = PK1
Equation type = 24   Number of Observations = 7
Absdev > .10   Stddev = 0.228
Selection Procedure = 11

Test No. 96   Reference Number = 251   Definition = PK1
Equation type = 24   Number of Observations = 5
Absdev = .134   Stddev = 0.226
Selection Procedure = 21

Test No. 97   Reference Number = 348   Definition = PK3
Equation type = 24   Number of Observations = 24
Absdev > .10   Stddev = 0.223
R Squared = .288

Test No. 98   Reference Number = 259   Definition = NC
Equation type = 24   Number of Observations = 10
Absdev > .10   Stddev = 0.151
Selection Procedure = 56

Theorem <u>2</u> – Model <u>25</u>

Test No. 99   Reference Number = 199   Definition = PKl
Equation type = 25   Number of Observations = 23
Absdev > .10   Stddev = 1.215
R Squared = .016

Test No. 100   Reference Number = 235   Definition = PKl
Equation type = 25   Number of Observations = 7
Absdev > .10   Stddev = 1.366
Selection Procedure = 11

Test No. 101   Reference Number = 181   Definition = NC
Equation type = 25   Number of Observations = 23
Absdev > .10   Stddev = 1.270
R Squared = .0

Test No. 102   Reference Number = 217   Definition = NC
Equation type = 25   Number of Observations = 10
Absdev > .10   Stddev = 1.172
Selection Procedure = 56

·Theorem <u>1</u> – <u>Models</u> <u>of</u> the <u>Counterexample</u>: <u>26-28</u>

<u>Model 26</u>

Test No. 103   Reference Number = 198   Definition = PKl
Equation type = 26   Number of Observations = 23
Absdev > .10   Stddev = 1.237
R Squared = .099
The Standardized Intercept or Exponent = 0.52

Test No. 104   Reference Number = 234   Definition = PKl
Equation type = 26   Number of Observations = 7
Absdev > .10   Stddev = 0.646
The Standardized Intercept or Exponent = 4.65
Selection Procedure = 11

Test No. 105   Reference Number = 180   Definition = NC
Equation type = 26   Number of Observations = 23
Absdev > .10   Stddev = 1.301
R Squared = .003
The Standardized Intercept or Exponent = 0.23

Test No. 106   Reference Number = 216   Definition = NC
Equation type = 26   Number of Observations = 10
Absdev > .10   Stddev = 1.054
The Standardized Intercept or Exponent = 1.78
Selection Procedure = 56

Model 27

Test No. 107   Reference Number = 200   Definition = PK1
Equation type = 27   Number of Observations = 23
Absdev > .10   Stddev = 1.151
R Squared = .250

Test No. 108   Reference Number = 236   Definition = PK1
Equation type = 27   Number of Observations = 7
Absdev > .10   Stddev = 0.518
Selection Procedure = 11

Test No. 109   Reference Number = 182   Definition = NC
Equation type = 27   Number of Observations = 23
Absdev > .10   Stddev = 1.237
R Squared = .137

Test No. 110   Reference Number = 218   Definition = NC
Equation type = 27   Number of Observations = 10
Absdev > .10   Stddev = 1.108
Selection Procedure = 56

Model 28

Test No. 111   Reference Number = 201   Definition = PK1
Equation type = 28   Number of Observations = 23
Absdev > .10   Stddev = 1.226
R Squared = .106

Test No. 112   Reference Number = 237   Definition = PK1
Equation type = 28   Number of Observations = 7
Absdev > .10   Stddev = 0.629
Selection Procedure = 11

Test No. 113   Reference Number = 183   Definition = NC
Equation type = 28   Number of Observations = 23
Absdev > .10   Stddev = 1.301
R Squared = .0

Test No. 114   Reference Number = 219   Definition = NC
Equation type = 28   Number of Observations = 10
Absdev > .10   Stddev = 1.017
Selection Procedure = 56

Theorem <u>3</u> – <u>Model</u> <u>30</u>

Test No. 115   Reference Number = 9   Definition = PK1
Equation type = 30   Number of Observations = 24
Absdev = .143   Stddev = 0.199
R Squared = .664
The Coefficient of I = .470, Standard Deviation = .018

Test No. 116   Reference Number = 287   Definition = PK1
Equation type = 30   Number of Observations = 24
Absdev = .125   Stddev = 0.167
R Squared = .743
An Autocorrelation Correction Procedure was used.
The Coefficient of I = .396, Standard Deviation = .039

Test No. 117   Reference Number = 142   Definition = PK1
Equation type = 30   Number of Observations = 23
Absdev = .085   Stddev = 0.138
A Lag Procedure was used.
The Coefficient of I = .460, Standard Deviation = .013

Test No. 118   Reference Number = 291   Definition = PK1
Equation type = 30   Number of Observations = 8
Absdev < .05   Stddev = 0.027
Selection Procedure = 81
The Coefficient of I = .495, Standard Deviation = .004

Test No. 119   Reference Number = 86   Definition = PK1
Equation type = 30   Number of Observations = 7
Absdev < .05   Stddev = 0.023
Selection Procedure = 02
The Coefficient of I = .500, Standard Deviation = .004

Test No. 120   Reference Number = 49   Definition = PK1
Equation type = 30   Number of Observations = 9
Absdev < .05   Stddev = 0.027
R Squared = .994
Selection Procedure = 01
The Coefficient of I = .496, Standard Deviation = .004

Test No. 121   Reference Number = 155   Definition = PK1
Equation type = 30   Number of Observations = 6
Absdev = .031   Stddev = 0.044
Selection Procedure = 11
A Lag Procedure was used.
The Coefficient of I = .454, Standard Deviation = .006

Test No. 122   Reference Number = 168   Definition = PK1
Equation type = 30   Number of Observations = 5
Absdev = .026   Stddev = 0.053
Selection Procedure = 21
A Lag Procedure was used.
The Coefficient of I = .452, Standard Deviation = .008

Test No. 123   Reference Number = 310   Definition = PK2
Equation type = 30   Number of Observations = 24
Absdev = .084   Stddev = 0.090
R Squared = .951
The Coefficient of I = .930, Standard Deviation = .017

Test No. 124   Reference Number = 318   Definition = PK2
Equation type = 30   Number of Observations = 7
Absdev = .046 .   Stddev = 0.057
Selection Procedure = 11
The Coefficient of I = .960, Standard Deviation = .019

Test No. 125   Reference Number = 340   Definition = PK2
Equation type = 30   Number of Observations = 15
Absdev = .059   Stddev = 0.052
Selection Procedure = 70
The Coefficient of I = 1.01, Standard Deviation = .046

Test No. 126   Reference Number = 371   Definition = PK4
Equation type = 30   Number of Observations = 24
Absdev = .110   Stddev = 0.150
R Squared = .784
The Coefficient of I = .354, Standard Deviation = .011

Test No. 127   Reference Number = 377   Definition = PK4
Equation type = 30   Number of Observations = 8
Absdev = .040   Stddev = 0.060
R Squared = .960
Selection Procedure = 71
The Coefficient of I = .367, Standard Deviation = .008

Test No. 128   Reference Number = 368   Definition = PK5
Equation type = 30   Number of Observations = 24
Absdev = .070   Stddev = 0.075
R Squared = .964
The Coefficient of I = .697, Standard Deviation = .011

Test No. 129   Reference Number = 374   Definition = PK5
Equation type = 30   Number of Observations = 7
Absdev = .087   Stddev = 0.071
R Squared = .921
Selection Procedure = 98
The Coefficient of I = .690, Standard Deviation = .020

Test No. 130   Reference Number = 29   Definition = NC
Equation type = 30   Number of Observations = 24
Absdev = .138   Stddev = 0.130
R Squared = .835
The Coefficient of I = 1.49, Standard Deviation = .040

Test No. 131   Reference Number = 288   Definition = NC
Equation type = 30   Number of Observations = 24
Absdev = .094   Stddev = 0.106
R Squared = .877
An Autocorrelation Correction Procedure was used.
The Coefficient of I = 1.239, Standard Deviation = .124

Test No. 132   Reference Number = 106   Definition = NC
Equation type = 30   Number of Observations = 9
Absdev = .076   Stddev = 0.119
Selection Procedure = 07
The Coefficient of I = 1.50, Standard Deviation = .057

Test No. 133   Reference Number = 126   Definition = NC
Equation type = 30   Number of Observations = 15
Absdev = .095   Stddev = 0.134
R Squared = .859
Selection Procedure = 06
The Coefficient of I = 1.51, Standard Deviation = .051

Theorem 3 - Models of the Counterexample: 31-32

Model 31

Test No. 134   Reference Number = 10   Definition = PK1
Equation type = 31   Number of Observations = 24
Absdev = .112   Stddev = 0.139
R Squared = .843
The Standardized Intercept or Exponent = 5.10

Test No. 135   Reference Number = 308   Definition = PK1
Equation type = 31   Number of Observations = 24
Absdev = .116   Stddev = 0.131
R Squared = .843
The Standardized Intercept or Exponent = 5.10
An Autocorrelation Correction Procedure was used.

Test No. 136   Reference Number = 143   Definition = PK1
Equation type = 31   Number of Observations = 23
Absdev = .083   Stddev = 0.095
The Standardized Intercept or Exponent = 5.05
A Lag Procedure was used.

Test No. 137   Reference Number = 249   Definition = PK1
Equation type = 31   Number of Observations = 7
Absdev < .05   Stddev = 0.031
The Standardized Intercept or Exponent = 0.30
Selection Procedure = 11

Test No. 138   Reference Number = 50   Definition = PK1
Equation type = 31   Number of Observations = 9
Absdev < .05   Stddev = 0.028
R Squared = .999
The Standardized Intercept or Exponent = 0.36
Selection Procedure = 01

Test No. 139   Reference Number = 292   Definition = PK1
Equation type = 31   Number of Observations = 8
Absdev < .05   Stddev = 0.028
The Standardized Intercept or Exponent = 0.59
Selection Procedure = 81

Test No. 140   Reference Number = 87   Definition = PK1
Equation type = 31   Number of Observations = 7
Absdev < .05   Stddev = 0.022
The Standardized Intercept or Exponent = 1.25
Selection Procedure = 02

Test No. 141   Reference Number = 252   Definition = PK1
Equation type = 31   Number of Observations = 5
Absdev < .05   Stddev = 0.040
The Standardized Intercept or Exponent = 0.15
Selection Procedure = 21

Test No. 142   Reference Number = 156   Definition = PK1
Equation type = 31   Number of Observations = 6
Absdev < .05   Stddev = 0.042
The Standardized Intercept or Exponent = 1.27
Selection Procedure = 11
A Lag Procedure was used.

Test No. 143   Reference Number = 169   Definition = PK1
Equation type = 31   Number of Observations = 5
Absdev < .05   Stddev = 0.054
The Standardized Intercept or Exponent = 0.87
Selection Procedure = 21
A Lag Procedure was used.

Test No. 144   Reference Number = 311   Definition = PK2
Equation type = 31   Number of Observations = 24
Absdev = .075   Stddev = 0.087
R Squared = .955
The Standardized Intercept or Exponent = 1.60

Test No. 145   Reference Number = 341   Definition = PK2
Equation type = 31   Number of Observations = 15
Absdev = .059   Stddev = 0.052
The Standardized Intercept or Exponent = 0.99
Selection Procedure = 70

Test No. 146   Reference Number = 319   Definition = PK2
Equation type = 31   Number of Observations = 7
Absdev = .048   Stddev = 0.062
The Standardized Intercept or Exponent = 0.41
Selection Procedure = 11

Test No. 147   Reference Number = 372   Definition = PK4
Equation type = 31   Number of Observations = 24
Absdev = .090   Stddev = 0.133
R Squared = .846
The Standardized Intercept or Exponent = 2.96

Test No. 148   Reference Number = 378   Definition = PK4
Equation type = 31   Number of Observations = 8
Absdev = .025   Stddev = 0.040
R Squared = .987
The Standardized Intercept or Exponent = 3.30
Selection Procedure = 71

Test No. 149   Reference Number = 369   Definition = PK5
Equation type = 31   Number of Observations = 24
Absdev = .060   Stddev = 0.073
R Squared = .969
The Standardized Intercept or Exponent = 2.01

Test No. 150   Reference Number = 375   Definition = PK5
Equation type = 31   Number of Observations = 7
Absdev = .030   Stddev = 0.035
R Squared = .982
The Standardized Intercept or Exponent = 4.16
Selection Procedure = 98

Test No. 151   Reference Number = 30   Definition = NC
Equation type = 31   Number of Observations = 24
Absdev = .110   Stddev = 0.132
R Squared = .838
The Standardized Intercept or Exponent = 0.67

Test No. 152   Reference Number = 307   Definition = NC
Equation type = 31   Number of Observations = 24
Absdev = .116   Stddev = 0.124
R Squared = .839
The Standardized Intercept or Exponent = 0.68
An Autocorrelation Correction Procedure was used.

Test No. 153   Reference Number = 127   Definition = NC
Equation type = 31   Number of Observations = 15
Absdev = .106   Stddev = 0.135
R Squared = .985
The Standardized Intercept or Exponent = 0.89
Selection Procedure = 06

Test No. 154   Reference Number = 260   Definition = NC
Equation type = 31   Number of Observations = 10
Absdev = .091   Stddev = 0.114
The Standardized Intercept or Exponent = 1.20
Selection Procedure = 56

Test No. 155   Reference Number = 107   Definition = NC
Equation type = 31   Number of Observations = 9
Absdev = .096   Stddev = 0.125
The Standardized Intercept or Exponent = 0.38
Selection Procedure = 07

Model 32

Test No. 156   Reference Number = 11   Definition = PK1
Equation type = 32   Number of Observations = 24
Absdev = .123   Stddev = 0.045
R Squared = .793
The Standardized Intercept or Exponent = 5.98

Test No. 157   Reference Number = 144   Definition = PK1
Equation type = 32   Number of Observations = 23
Absdev = .090   Stddev = 0.032
The Standardized Intercept or Exponent = 5.57
A Lag Procedure was used.

Test No. 158   Reference Number = 293   Definition = PK1
Equation type = 32   Number of Observations = 8
Absdev < .05   Stddev = 0.008
The Standardized Intercept or Exponent = 0.66
Selection Procedure = 81

Test No. 159   Reference Number = 51   Definition = PK1
Equation type = 32   Number of Observations = 9
Absdev < .05   Stddev = 0.009
R Squared = .999
The Standardized Intercept or Exponent = 0.53
Selection Procedure = 01

Test No. 160   Reference Number = 88   Definition = PK1
Equation type = 32   Number of Observations = 7
Absdev < .05   Stddev = 0.008
The Standardized Intercept or Exponent = 1.42
Selection Procedure = 02

Test No. 161   Reference Number = 157   Definition = PK1
Equation type = 32   Number of Observations = 6
Absdev < .05   Stddev = 0.012
The Standardized Intercept or Exponent = 1.51
Selection Procedure = 11
A Lag Procedure was used.

Test No. 162   Reference Number = 170   Definition = PK1
Equation type = 32   Number of Observations = 5
Absdev < .05   Stddev = 0.015
The Standardized Intercept or Exponent = 1.15
Selection Procedure = 21
A Lag Procedure was used.

Test No. 163   Reference Number = 312   Definition = PK2
Equation type = 32   Number of Observations = 24
Absdev = .095   Stddev = 0.029
R Squared = .931
The Standardized Intercept or Exponent = 1.81

Test No. 164   Reference Number = 342   Definition = PK2
Equation type = 32   Number of Observations = 15
Absdev = .057   Stddev = 0.020
The Standardized Intercept or Exponent = 1.49
Selection Procedure = 70

Test No. 165   Reference Number = 320   Definition = PK2
Equation type = 32   Number of Observations = 7
Absdev = .045   Stddev = 0.017
The Standardized Intercept or Exponent = 0.36
Selection Procedure = 11

Test No. 166   Reference Number = 373   Definition = PK4
Equation type = 32   Number of Observations = 24
Absdev = .011   Stddev = 0.040
R Squared = .806
The Standardized Intercept or Exponent = 4.01

Test No. 167   Reference Number = 379   Definition = PK4
Equation type = 32   Number of Observations = 8
Absdev = .015   Stddev = 0.006
R Squared = .992
The Standardized Intercept or Exponent = 3.87
Selection Procedure = 71

Test No. 168   Reference Number = 370   Definition = PK5
Equation type = 32   Number of Observations = 24
Absdev = .060   Stddev = 0.025
R Squared = .947
The Standardized Intercept or Exponent = 1.02

Test No. 169   Reference Number = 376   Definition = PK5
Equation type = 32   Number of Observations = 7
Absdev = .030   Stddev = 0.020
R Squared = .977
The Standardized Intercept or Exponent = 4.19
Selection Procedure = 98

Test No. 170   Reference Number = 31   Definition = NC
Equation type = 32   Number of Observations = 24
Absdev < .05   Stddev = 0.036
R Squared = .807
The Standardized Intercept or Exponent = 0.89

Test No. 171   Reference Number = 128   Definition = NC
Equation type = 32   Number of Observations = 15
Absdev = .109   Stddev = 0.038
R Squared = .998
The Standardized Intercept or Exponent = 1.28
Selection Procedure = 06

Test No. 172   Reference Number = 108   Definition = NC
Equation type = 32   Number of Observations = 9
Absdev = .089   Stddev = 0.033
The Standardized Intercept or Exponent = 0.27
Selection Procedure = 07

Theorem 3 - Model 35

Test No. 173   Reference Number = 269   Definition = PK1
Equation type = 35   Number of Observations = 23
Absdev > .10   Stddev = 1.256
R Squared < 0.0

Test No. 174   Reference Number = 299   Definition = PK1
Equation type = 35   Number of Observations = 8
Absdev > .10   Stddev = 1.398
Selection Procedure = 81

Test No. 175   Reference Number = 202   Definition = PK1
Equation type = 35   Number of Observations = 15
Absdev > .10   Stddev = 1.424
Selection Procedure = 10

Test No. 176   Reference Number = 238   Definition = PK1
Equation type = 35   Number of Observations = 9
Absdev > .10   Stddev = 1.308
Selection Procedure = 01

Test No. 177   Reference Number = 273   Definition = PK1
Equation type = 35   Number of Observations = 7
Absdev > .10   Stddev = 1.536
Selection Procedure = 11

Test No. 178   Reference Number = 326   Definition = PK2
Equation type = 35   Number of Observations = 23
Absdev > .10   Stddev = 1.000
R Squared = .001

Test No. 179   Reference Number = 343   Definition = PK2
Equation type = 35   Number of Observations = 15
Absdev > .10   Stddev = 1.000
Selection Procedure = 70

Test No. 180   Reference Number = 333   Definition = PK2
Equation type = 35   Number of Observations = 7
Absdev > .10   Stddev = 1.000
Selection Procedure = 11

Test No. 181   Reference Number = 267   Definition = NC
Equation type = 35   Number of Observations = 23
Absdev > .10   Stddev = 0.598
R Squared < 0.0

Test No. 182   Reference Number = 297   Definition = NC
Equation type = 35   Number of Observations = 8
Absdev > .10   Stddev = 0.457
Selection Procedure = 99

Test No. 183   Reference Number = 184   Definition = NC
Equation type = 35   Number of Observations = 15
Absdev = .950   Stddev = 0.436
Selection Procedure = 50

Test No. 184   Reference Number = 220   Definition = NC
Equation type = 35   Number of Observations = 15
Absdev > .10   Stddev = 0.624
Selection Procedure = 06

Test No. 185   Reference Number = 271   Definition = NC
Equation type = 35   Number of Observations = 10
Absdev > .10   Stddev = 0.376
Selection Procedure = 56

Theorem 3 - Models of the Counterexample: 36-37

Model 36

Test No. 186   Reference Number = 270   Definition = PK1
Equation type = 36   Number of Observations = 23
Absdev > .10   Stddev = 1.254
R Squared = .007
The Standardized Intercept or Exponent = 1.05

Test No. 187   Reference Number = 300   Definition = PK1
Equation type = 36   Number of Observations = 8
Absdev > .10   Stddev = 1.482
The Standardized Intercept or Exponent = 0.48
Selection Procedure = 81

Test No. 188   Reference Number = 203   Definition = PK1
Equation type = 36   Number of Observations = 15
Absdev > .10   Stddev = 1.433
R Squared = .070
The Standardized Intercept or Exponent = 0.92
Selection Procedure = 10

Test No. 189   Reference Number = 239   Definition = PK1
Equation type = 36   Number of Observations = 9
Absdev > .10   Stddev = 1.378
The Standardized Intercept or Exponent = 0.44
Selection Procedure = 01

Test No. 190   Reference Number = 274   Definition = PK1
Equation type = 36   Number of Observations = 7
Absdev > .10   Stddev = 1.659
The Standardized Intercept or Exponent = 0.38
Selection Procedure = 11

Test No. 191   Reference Number = 327   Definition = PK2
Equation type = 36   Number of Observations = 23
Absdev > .10   Stddev = 1.000
R Squared = .0
The Standardized Intercept or Exponent = 3.06

Test No. 192   Reference Number = 344   Definition = PK2
Equation type = 36   Number of Observations = 15
Absdev > .10   Stddev = 1.000
The Standardized Intercept or Exponent = 1.84
Selection Procedure = 70

Test No. 193   Reference Number = 334   Definition = PK2
Equation type = 36   Number of Observations = 7
Absdev > .10   Stddev = 1.000
The Standardized Intercept or Exponent = 0.93
Selection Procedure = 11

Test No. 194   Reference Number = 268   Definition = NC
Equation type = 36   Number of Observations = 23
Absdev > .10   Stddev = 0.589
R Squared = .778
The Standardized Intercept or Exponent = 1.30

Test No. 195   Reference Number = 298   Definition = NC
Equation type = 36   Number of Observations = 8
Absdev > .10   Stddev = 0.322
The Standardized Intercept or Exponent = 2.88
Selection Procedure = 99

Test No. 196   Reference Number = 185   Definition = NC
Equation type = 36   Number of Observations = 15
Absdev = .950   Stddev = 0.396
R Squared = .778
The Standardized Intercept or Exponent = 1.98
Selection Procedure = 50

Test No. 197   Reference Number = 221   Definition = NC
Equation type = 36   Number of Observations = 15
Absdev > .10   Stddev = 0.616
The Standardized Intercept or Exponent = 1.17
Selection Procedure = 06

Test No. 198   Reference Number = 272   Definition = NC
Equation type = 36   Number of Observations = 10
Absdev > .10   Stddev = 0.266
The Standardized Intercept or Exponent = 3.16
Selection Procedure = 56

Model 37

Test No. 199   Reference Number = 400   Definition = PK1
Equation type = 37   Number of Observations = 24
Absdev = .999   Stddev = .970
R Squared = .093
The Standardized Intercept or Exponent = 3.6

Test No. 200   Reference Number = 401   Definition = PK1
Equation type = 37   Number of Observations = 9
Absdev = .72   Stddev = .598
R Squared = .245
The Standardized Intercept or Exponent = 4.5
Selection Procedure = 01

Test No. 201   Reference Number = 402   Definition = PK2
Equation type = 37   Number of Observations = 24
Absdev = .999   Stddev = .912
R Squared = .162
The Standardized Intercept or Exponent = 3.5

Test No. 202   Reference Number = 403   Definition = PK2
Equation type = 37   Number of Observations = 9
Absdev = .999   Stddev = .865
R Squared = .057
The Standardized Intercept or Exponent = 4.0
Selection Procedure = 01

Test No. 203   Reference Number = 404   Definition = NC
Equation type = 37   Number of Observations = 24
Absdev = .490   Stddev = .662
R Squared = .548
The Standardized Intercept or Exponent = .18

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Theorem 4 - Model 40

Test No. 204   Reference Number = 12   Definition = PK1
Equation type = 40   Number of Observations = 24
Absdev = .101   Stddev = 0.099
R Squared = .924
The coefficient of I = 1.676, Standard Deviation = .576
The coefficient of HY/G = 1.225, Standard Deviation = .530

Test No. 205   Reference Number = 52   Definition = PK1
Equation type = 40   Number of Observations = 9
Absdev = .058   Stddev = 0.080
R Squared = .936
Selection Procedure = 13
The coefficient of I = .625, Standard Deviation = 1.06
The coefficient of HY/G = 2.127, Standard Deviation = .977

Test No. 206   Reference Number = 349   Definition = PK3
Equation type = 40   Number of Observations = 24
Absdev = .094   Stddev = 0.093
R Squared = .944
The coefficient of I = 1.674, Standard Deviation = .568
The coefficient of HY/G = 1.04, Standard Deviation = .441

Test No. 207   Reference Number = 32   Definition = NC
Equation type = 40   Number of Observations = 24
Absdev < .05   Stddev = 0.055
R Squared = .985
The coefficient of I = 1.67, Standard Deviation = .262
The coefficient of HY/G = 2.36, Standard Deviation = .108

Test No. 208   Reference Number = 129   Definition = NC
Equation type = 40   Number of Observations = 9
Absdev = .051   Stddev = 0.064
R Squared = .971
Selection Procedure = 59
The coefficient of I = 2.58, Standard Deviation = .413
The coefficient of HY/G = 1.90, Standard Deviation = .944

Theorem 4 – Models of the Counterexample: 41-44

Model 41

Test No. 209   Reference Number = 13   Definition = PK1
Equation type = 41   Number of Observations = 24
Absdev = .111   Stddev = 0.150
R Squared < 0.0

Test No. 211   Reference Number = 53   Definition = PK1
Equation type = 41   Number of Observations = 9
Absdev = .065   Stddev = 0.119
Selection Procedure = 13

Test No. 212   Reference Number = 361   Definition = PK3
Equation type = 41   Number of Observations = 24
Absdev > .10   Stddev = 0.152
R Squared < .0

Test No. 213   Reference Number = 33   Definition = NC
Equation type = 41   Number of Observations = 24
Absdev > .10   Stddev = 0.183
R Squared < 0.0

Test No. 214   Reference Number = 130   Definition = NC
Equation type = 41   Number of Observations = 9
Absdev = .055   Stddev = 0.095
Selection Procedure = 59

Model 42

Test No. 215   Reference Number = 388   Definition = PK1
Equation type = 42   Number of Observations = 24
Absdev = .030   Stddev = 0.037
R Squared = .991
The Standardized Intercept or Exponent = 10.62

Test No. 216   Reference Number = 390   Definition = PK1
Equation type = 42   Number of Observations = 9
Absdev = .002   Stddev = 0.002
R Squared = .994
The Standardized Intercept or Exponent = 9.78
Selection Procedure = 13

Test No. 217   Reference Number = 391   Definition = PK3
Equation type = 42   Number of Observations = 24
Absdev = .002   Stddev = 0.002
R Squared = .999
The Standardized Intercept or Exponent = 6.42

Test No. 218   Reference Number = 392   Definition = NC
Equation type = 42   Number of Observations = 24
Absdev = .030   Stddev = 0.035
R Squared = .993
The Standardized Intercept or Exponent = 4.85

Test No. 219   Reference Number = 393   Definition = NC
Equation type = 42   Number of Observations = 9
Absdev = .015   Stddev = 0.015
R Squared = .997
The Standardized Intercept or Exponent = 8.9
Selection Procedure = 59

Model 43

Test No. 220   Reference Number = 394   Definition = PK1
Equation type = 43   Number of Observations = 24
Absdev = .030   Stddev = 0.01
R Squared = .985
The Standardized Intercept or Exponent = 11.5

Test No. 221   Reference Number = 396   Definition = PK1
Equation type = 43   Number of Observations = 12
Absdev < .05   Stddev = 0.002
R Squared = .999
The Standardized Intercept or Exponent = 11.6
Selection Procedure = 13

Test No. 222   Reference Number = 397   Definition = PK3

Equation type = 43   Number of Observations = 24
Absdev = .030   Stddev = 0.01
R Squared = .986
The Standardized Intercept or Exponent = 12.0

Test No. 223   Reference Number = 398   Definition = NC
Equation type = 43   Number of Observations = 24
Absdev = .065   Stddev = 0.012
R Squared = .975
The Standardized Intercept or Exponent = 1.26

Test No. 224   Reference Number = 399   Definition = NC·
Equation type = 43   Number of Observations = 9
Absdev < .05   Stddev = 0.003
R Squared = .997
The Standardized Intercept or Exponent = 8.5
Selection Procedure = 59

Model 44

Test No. 225   Reference Number = 275   Definition = PK1
Equation type = 44   Number of Observations = 24
Absdev < .05   Stddev = 0.013
R Squared = .983

Test No. 226   Reference Number = 350   Definition = PK3
Equation type = 44   Number of Observations = 24
Absdev < .05   Stddev = 0.026
R Squared = .981

Test No. 227   Reference Number = 276   Definition = NC
Equation type = 44   Number of Observations = 24
Absdev < .05   Stddev = 0.056
R Squared = .964

Theorem 4 - Model 45

Test No. 228   Reference Number = 204   Definition = PK1
Equation type = 45   Number of Observations = 23
Absdev > .10   Stddev = 1.04
R Squared = .00

Test No. 229   Reference Number = 240   Definition = PK1
Equation type = 45   Number of Observations = 9
Absdev = .265   Stddev = 1.09
Selection Procedure = 13

Test No. 230   Reference Number = 186   Definition = NC
Equation type = 45   Number of Observations = 23
Absdev > .10   Stddev = 0.280
R Squared = .00

Test No. 231   Reference Number = 222   Definition = NC
Equation type = 45   Number of Observations = 9
Absdev = .265   Stddev = 0.258
Selection Procedure = 59

Theorem 4 - Models of the Counterexample: 46-47

Model 46

Test No. 232   Reference Number = 205   Definition = PK1
Equation type = 46   Number of Observations = 23
Absdev > .10   Stddev = 0.595
R Squared = .739

Test No. 233   Reference Number = 241   Definition = PK1
Equation type = 46   Number of Observations = 9
Absdev > .10   Stddev = 0.356
Selection Procedure = 13

Test No. 234   Reference Number = 187   Definition = NC
Equation type = 46   Number of Observations = 23
Absdev > .10   Stddev = 0.659
R Squared = .650

Test No. 235   Reference Number = 223   Definition = NC
Equation type = 46   Number of Observations = 9
Absdev = .078   Stddev = 0.160
Selection Procedure = 59

Model 47

Test No. 236   Reference Number = 206   Definition = PK1
Equation type = 47   Number of Observations = 23
Absdev > .10   Stddev = 0.761
R Squared = .551

Test No. 237   Reference Number = 242   Definition = PK1
Equation type = 47   Number of Observations = 9
Absdev > .10   Stddev = 0.536
Selection Procedure = 13

Test No. 238   Reference Number = 188   Definition = NC
Equation type = 47   Number of Observations = 23
Absdev > .10   Stddev = 0.703
R Squared = .618

Test No. 239   Reference Number = 224   Definition = NC
Equation type = 47   Number of Observations = 9
Absdev > .10   Stddev = 0.615
Selection Procedure = 59

Theorem 5 – Models of the Counterexample: 51-54

Model 51

Test No. 240   Reference Number = 15   Definition = PK1
Equation type = 51   Number of Observations = 24
Absdev = .011   Stddev = 0.014
R Squared = .379

Test No. 241   Reference Number = 55   Definition = PK1
Equation type = 51   Number of Observations = 9
Absdev < .05   Stddev = 0.006
R Squared = .997
Selection Procedure = 13

Test No. 242   Reference Number = 313   Definition = PK2
Equation type = 51   Number of Observations = 24
Absdev < .05   Stddev = 0.013
R Squared = .156

Test No. 243   Reference Number = 321   Definition = PK2
Equation type = 51   Number of Observations = 13
Absdev < .05   Stddev = 0.009
Selection Procedure = 40

Test No. 244   Reference Number = 362   Definition = PK3
Equation type = 51   Number of Observations = 24
Absdev < .05   Stddev = 0.010
R Squared = .121

Test No. 245   Reference Number = 35   Definition = NC
Equation type = 51   Number of Observations = 24
Absdev < .05   Stddev = 0.008
R Squared = .841

Test No. 246   Reference Number = 132   Definition = NC
Equation type = 51   Number of Observations = 9
Absdev < .05   Stddev = 0.004
R Squared = .999
Selection Procedure = 59

Model 52

Test No. 247   Reference Number = 16   Definition = PK1
Equation type = 52   Number of Observations = 24
Absdev = .011   Stddev = 0.016
R Squared = .204
The Standardized Intercept or Exponent = 29.41

Test No. 248   Reference Number = 56   Definition = PK1
Equation type = 52   Number of Observations = 9
Absdev < .05   Stddev = 0.007
R Squared = .995
The Standardized Intercept or Exponent = 25.61
Selection Procedure = 13

Test No. 249   Reference Number = 314   Definition = PK2
Equation type = 52   Number of Observations = 24
Absdev < .05   Stddev = 0.013
R Squared = .150
The Standardized Intercept or Exponent = 6.31

Test No. 250   Reference Number = 322   Definition = PK2
Equation type = 52   Number of Observations = 13
Absdev < .05   Stddev = 0.010
The Standardized Intercept or Exponent = 24.14
Selection Procedure = 40

Test No. 251   Reference Number = 36   Definition = NC
Equation type = 52   Number of Observations = 24
Absdev < .05   Stddev = 0.009
R Squared = .783
The Standardized Intercept or Exponent = 3.98

Test No. 252   Reference Number = 133   Definition = NC
Equation type = 52   Number of Observations = 9
Absdev < .05   Stddev = 0.004
R Squared = .999
The Standardized Intercept or Exponent = 20.86
Selection Procedure = 59

Model <u>53</u>

Test No. 253   Reference Number = 17   Definition = PK1
Equation type = 53   Number of Observations = 24
Absdev = .010   Stddev = 0.013
R Squared = .492

Test No. 254   Reference Number = 57   Definition = PK1
Equation type = 53   Number of Observations = 9
Absdev < .05   Stddev = 0.006
R Squared = .997
Selection Procedure = 13

Test No. 255   Reference Number = 37   Definition = NC
Equation type = 53   Number of Observations = 24
Absdev < .05   Stddev = 0.009
R Squared = .806

Test No. 256   Reference Number = 134   Definition = NC
Equation type = 53   Number of Observations = 9
Absdev < .05   Stddev = 0.003
R Squared = .999
Selection Procedure = 59

Model <u>54</u>

Test No. 257   Reference Number = 277   Definition = PK1
Equation type = 54   Number of Observations = 24
Absdev < .05   Stddev = 0.016
R Squared = .974

Test No. 258   Reference Number = 281   Definition = PK1
Equation type = 54   Number of Observations = 9
Absdev < .05   Stddev = 0.007
Selection Procedure = 13

Test No. 259   Reference Number = 351   Definition = PK3
Equation type = 54   Number of Observations = 24
Absdev < .05   Stddev = 0.011
R Squared = .588

311

Test No. 260   Reference Number = 278   Definition = NC
Equation type = 54   Number of Observations = 24
Absdev < .05   Stddev = 0.009
R Squared = .995

Test No. 261   Reference Number = 282   Definition = NC
Equation type = 54   Number of Observations = 9
Absdev < .05   Stddev = 0.004
Selection Procedure = 59

Theorem 5 - Models of the Counterexample: 51-54

Model 56

Test No. 262   Reference Number = 207   Definition = PK1
Equation type = 56   Number of Observations = 23
Absdev > .10   Stddev = 1.303
R Squared = .059

Test No. 263   Reference Number = 243   Definition = PK1
Equation type = 56   Number of Observations = 9
Absdev > .10   Stddev = 1.061
Selection Procedure = 13

Test No. 264   Reference Number = 328   Definition = PK2
Equation type = 56   Number of Observations = 23
Absdev > .10   Stddev = 1.000
R Squared = .063

Test No. 265   Reference Number = 335   Definition = PK2
Equation type = 56   Number of Observations = 13
Absdev > .10   Stddev = 1.000
Selection Procedure = 40

Test No. 266   Reference Number = 189   Definition = NC
Equation type = 56   Number of Observations = 23
Absdev > .10   Stddev = 0.855
R Squared = .621

Test No. 267   Reference Number = 225   Definition = NC
Equation type = 56   Number of Observations = 9
Absdev > .10   Stddev = 0.789
Selection Procedure = 59

Model 57

Test No. 268   Reference Number = 208   Definition = PK1
Equation type = 57   Number of Observations = 23
Absdev > .10   Stddev = 1.232
R Squared = .113
The Standardized Intercept or Exponent = 1.29

Test No. 269   Reference Number = 244   Definition = PK1
Equation type = 57   Number of Observations = 9
Absdev > .10   Stddev = 1.127
The Standardized Intercept or Exponent = 0.02
Selection Procedure = 13

Test No. 270   Reference Number = 329   Definition = PK2
Equation type = 57   Number of Observations = 23
Absdev > .10   Stddev = 1.000
R Squared = .086
The Standardized Intercept or Exponent = 1.87

Test No. 271   Reference Number = 336   Definition = PK2
Equation type = 57   Number of Observations = 13
Absdev > .10   Stddev = 0.988
The Standardized Intercept or Exponent = 1.96
Selection Procedure = 40

Test No. 272   Reference Number = 190   Definition = NC
Equation type = 57   Number of Observations = 23
Absdev > .10   Stddev = 0.765
R Squared = .686
The Standardized Intercept or Exponent = 0.53

Test No. 273   Reference Number = 226   Definition = NC
Equation type = 57   Number of Observations = 9
Absdev > .10   Stddev = 0.427
The Standardized Intercept or Exponent = 0.81
Selection Procedure = 59

Model <u>58</u>

Test No. 274   Reference Number = 209   Definition = PK1
Equation type = 58   Number of Observations = 23
Absdev > .10   Stddev = 1.144
R Squared = .404

Test No. 275   Reference Number = 245   Definition = PK1
Equation type = 58   Number of Observations = 9
Absdev > .10   Stddev = 1.128
Selection Procedure = 13

Test No. 276   Reference Number = 191   Definition = NC
Equation type = 58   Number of Observations = 23
Absdev > .10   Stddev = 0.767
R Squared = .700

Test No. 277   Reference Number = 227   Definition = NC
Equation type = 58   Number of Observations = 9
Absdev = .171   Stddev = 0.317
Selection Procedure = 59

Theorem 6 – Model 60

Test No. 278   Reference Number = 18   Definition = PK1
Equation type = 60   Number of Observations = 24
Absdev = .143   Stddev = 0.196
R Squared = .689
The coefficient of I = .714, Standard Deviation = .184
The coefficient of HY/G = -.225, Standard Deviation = .169

Test No. 279   Reference Number = 148   Definition = PK1
Equation type = 60   Number of Observations = 23
Absdev = .097   Stddev = 0.115
A Lag Procedure was used.
The coefficient of I = .631, Standard Deviation = .107
The coefficient of HY/G = -.136, Standard Deviation = .092

Test No. 280   Reference Number = 58   Definition = PK1
Equation type = 60   Number of Observations = 9
Absdev < .05   Stddev = 0.088
R Squared = .949
Selection Procedure = 13
The coefficient of I = .489, Standard Deviation = .188
The coefficient of HY/G = -.007, Standard Deviation = .173

Test No. 281   Reference Number = 161   Definition = PK1
Equation type = 60   Number of Observations = 9
Absdev = .037   Stddev = 0.063
Selection Procedure = 13
A Lag Procedure was used.
The coefficient of I = .336, Standard Deviation = .076
The coefficient of HY/G = .110, Standard Deviation = .064

Test No. 282   Reference Number = 174   Definition = PK1
Equation type = 60   Number of Observations = 5
Absdev = .035   Stddev = 0.069
Selection Procedure = 25
A Lag Procedure was used.
The coefficient of I = .186, Standard Deviation = .160
The coefficient of HY/G = .249, Standard Deviation = .144

Test No. 283   Reference Number = 315   Definition = PK2
Equation type = 60   Number of Observations = 24
Absdev = .076   Stddev = 0.083
R Squared = .959
The coefficient of I = .571, Standard Deviation = .164
The coefficient of HY/G = .332, Standard Deviation = .151

Test No. 284   Reference Number = 323   Definition = PK2
Equation type = 60   Number of Observations = 13
Absdev < .05   Stddev = 0.048
Selection Procedure = 40
The coefficient of I = .433, Standard Deviation = .175
The coefficient of HY/G = .488, Standard Deviation = .161

Test No. 285   Reference Number = 352   Definition = PK3
Equation type = 60   Number of Observations = 24
Absdev = .075   Stddev = 0.081
R Squared = .959
The coefficient of I = .569, Standard Deviation = .161
The coefficient of HY/G = .282, Standard Deviation = .125

Test No. 286   Reference Number = 383   Definition = PK3
Equation type = 60   Number of Observations = 9
Absdev = .023   Stddev = 0.028
R Squared = .990
Selection Procedure = 10
The coefficient of I = .446, Standard Deviation = .153
The coefficient of HY/G = .444, Standard Deviation = .132

Test No. 287   Reference Number = 38   Definition = NC
Equation type = 60   Number of Observations = 24
Absdev = .074   Stddev = 0.098
R Squared = .911
The coefficient of I = 1.08, Standard Deviation = .099
The coefficient of HY/G = .176, Standard Deviation = .041

Test No. 288   Reference Number = 306   Definition = NC
Equation type = 60   Number of Observations = 23
Absdev = .062   Stddev = 0.084
R Squared = .923
An Autocorrelation Correction Procedure was used.
The coefficient of I = .913, Standard Deviation = .463
The coefficient of HY/G = .115, Standard Deviation = .189

Test No. 289   Reference Number = 135   Definition = NC
Equation type = 60   Number of Observations = 9
Absdev < .05   Stddev = 0.048
R Squared = .982
Selection Procedure = 59
The coefficient of I = .841, Standard Deviation = .150
The coefficient of HY/G = .309, Standard Deviation = .066

Theorem 6 – Models of the Counterexample: 61-64

Model 61

Test No. 290   Reference Number = 19   Definition = PK1
Equation type = 61   Number of Observations = 24
Absdev = .112   Stddev = 0.143
R Squared = .843
The Standardized Intercept or Exponent = 4.64

Test No. 291   Reference Number = 149   Definition = PK1
Equation type = 61   Number of Observations = 23
Absdev = .080   Stddev = 0.086
The Standardized Intercept or Exponent = 4.01
A Lag Procedure was used.

Test No. 292   Reference Number = 59   Definition = PK1
Equation type = 61   Number of Observations = 9
Absdev < .05   Stddev = 0.089
R Squared = .996
The Standardized Intercept or Exponent = 0.94
Selection Procedure = 13

Test No. 293   Reference Number = 162   Definition = PK1
Equation type = 61   Number of Observations = 9
Absdev = .033   Stddev = 0.063
The Standardized Intercept or Exponent = 1.10
Selection Procedure = 13
A Lag Procedure was used.

317

Test No. 294   Reference Number = 175   Definition = PK1
Equation type = 61   Number of Observations = 5
Absdev < .05   Stddev = 0.077
The Standardized Intercept or Exponent = 0.63
Selection Procedure = 25
A Lag Procedure was used.

Test No. 295   Reference Number = 316   Definition = PK2
Equation type = 61   Number of Observations = 24
Absdev = .067   Stddev = 0.070
R Squared = .972
The Standardized Intercept or Exponent = 3.14

Test No. 296   Reference Number = 324   Definition = PK2
Equation type = 61   Number of Observations = 13
Absdev < .05   Stddev = 0.048
The Standardized Intercept or Exponent = 1.66
Selection Procedure = 40

Test No. 297   Reference Number = 386   Definition = PK3
Equation type = 61   Number of Observations = 24
Absdev = .064   Stddev = 0.071
R Squared = .973
The Standardized Intercept or Exponent = 2.88

Test No. 298   Reference Number = 384   Definition = PK3
Equation type = 61   Number of Observations = 9
Absdev = .023   Stddev = 0.028
R Squared = .990
The Standardized Intercept or Exponent = 3.00
Selection Procedure = 10

Test No. 299   Reference Number = 39   Definition = NC
Equation type = 61   Number of Observations = 24
Absdev < .05   Stddev = 0.084
R Squared = .937
The Standardized Intercept or Exponent = 3.00

Test No. 300   Reference Number = 289   Definition = NC
Equation type = 61   Number of Observations = 24
Absdev = .055   Stddev = 0.077
R Squared = .935
The Standardized Intercept or Exponent = 0.32
An Autocorrelation Correction Procedure was used.

Test No. 301   Reference Number = 136   Definition = NC
Equation type = 61   Number of Observations = 9
Absdev < .05   Stddev = 0.024
R Squared = .999
The Standardized Intercept or Exponent = 4.61
Selection Procedure = 59

Model 62

Test No. 302   Reference Number = 20   Definition = PK1
Equation type = 62   Number of Observations = 24
Absdev = .178   Stddev = 0.221
R Squared = .588

Test No. 303   Reference Number = 150   Definition = PK1
Equation type = 62   Number of Observations = 23
Absdev > .10   Stddev = 0.148
A Lag Procedure was used.

Test No. 304   Reference Number = 60   Definition = PK1
Equation type = 62   Number of Observations = 9
Absdev = .053   Stddev = 0.092
Selection Procedure = 13

Test No. 305   Reference Number = 163   Definition = PK1
Equation type = 62   Number of Observations = 9
Absdev = .052   Stddev = 0.070
Selection Procedure = 13
A Lag Procedure was used.

Test No. 306   Reference Number = 176   Definition = PK1
Equation type = 62   Number of Observations = 5
Absdev = .035   Stddev = 0.061
Selection Procedure = 25
A Lag Procedure was used.

Test No. 307   Reference Number = 317   Definition = PK2
Equation type = 62   Number of Observations = 24
Absdev = .070   Stddev = 0.069
R Squared = .971

Test No. 308   Reference Number = 325   Definition = PK2
Equation type = 62   Number of Observations = 13
Absdev < .05   Stddev = 0.048
Selection Procedure = 40

Test No. 309   Reference Number = 40   Definition = NC
Equation type = 62   Number of Observations = 24
Absdev > .10   Stddev = 0.164
R Squared < 0.0

Test No. 310   Reference Number = 285   Definition = NC
Equation type = 62   Number of Observations = 24
Absdev > .10   Stddev = 0.157
R Squared = .738
An Autocorrelation Correction Procedure was used.

Test No. 311   Reference Number = 137   Definition = NC
Equation type = 62   Number of Observations = 9
Absdev = .059   Stddev = 0.062
Selection Procedure = 59

Model 63

Test No. 312   Reference Number = 354   Definition = PK3
Equation type = 63   Number of Observations = 24
Absdev = .068   Stddev = 0.068
R Squared = .972

Model 64

Test No. 313   Reference Number = 355   Definition = PK1
Equation type = 64   Number of Observations = 24
Absdev = .036   Stddev = 0.043
R Squared = .800

Test No. 314   Reference Number = 356   Definition = PK2
Equation type = 64   Number of Observations = 24
Absdev = .086   Stddev = 0.022
R Squared = .958

Test No. 315   Reference Number = 353   Definition = PK3
Equation type = 64   Number of Observations = 24
Absdev = .060   Stddev = 0.022
R Squared = .961

Test No. 316   Reference Number = 385   Definition = PK3
Equation type = 64   Number of Observations = 9
Absdev = .022   Stddev = 0.006
R Squared = .992
Selection Procedure = 10

Theorem 6 - Model 65

Test No. 317   Reference Number = 210   Definition = PK1
Equation type = 65   Number of Observations = 23
Absdev > .10   Stddev = 1.280
R Squared < 0.0

Test No. 318   Reference Number = 246   Definition = PK1
Equation type = 65   Number of Observations = 9
Absdev > .10   Stddev = 1.378
Selection Procedure = 13

Test No. 319   Reference Number = 330   Definition = PK2
Equation type = 65   Number of Observations = 23
Absdev > .10   Stddev = 1.000
R Squared = .0

Test No. 320   Reference Number = 337   Definition = PK2
Equation type = 65   Number of Observations = 13
Absdev > .10   Stddev = 1.000
Selection Procedure = 40

Test No. 321   Reference Number = 192   Definition = NC
Equation type = 65   Number of Observations = 23
Absdev > .10   Stddev = 0.610
R Squared = .761

Test No. 322   Reference Number = 228   Definition = NC
Equation type = 65   Number of Observations = 9
Absdev > .10   Stddev = 0.332
Selection Procedure = 59

Theorem 6 - Models of the Counterexample: 66-68

Model 66

Test No. 323   Reference Number = 211   Definition = PK1
Equation type = 66   Number of Observations = 23
Absdev > .10   Stddev = 1.262
R Squared = .041
The Standardized Intercept or Exponent = 1.30

Test No. 324   Reference Number = 247   Definition = PK1
Equation type = 66   Number of Observations = 9
Absdev > .10   Stddev = 1.218
The Standardized Intercept or Exponent = 1.73
Selection Procedure = 13

Test No. 325   Reference Number = 331   Definition = PK2
Equation type = 66   Number of Observations = 23
Absdev > .10   Stddev = 1.000
R Squared = .001
The Standardized Intercept or Exponent = 1.67

Test No. 326   Reference Number = 338   Definition = PK2
Equation type = 66   Number of Observations = 13
Absdev > .10   Stddev = 1.000
The Standardized Intercept or Exponent = 1.81
Selection Procedure = 40

Test No. 327   Reference Number = 193   Definition = NC
Equation type = 66   Number of Observations = 23
Absdev > .10   Stddev = 0.563
R Squared = .805
The Standardized Intercept or Exponent = 2.14

Test No. 328   Reference Number = 229   Definition = NC
Equation type = 66   Number of Observations = 9
Absdev = .144   Stddev = 0.280
The Standardized Intercept or Exponent = 1.93
Selection Procedure = 59

Model 67

Test No. 329   Reference Number = 332   Definition = PK2
Equation type = 67   Number of Observations = 23
Absdev > .10   Stddev = 1.000
R Squared = .0

Test No. 330   Reference Number = 339   Definition = PK2
Equation type = 67   Number of Observations = 13
Absdev > .10   Stddev = 1.000
Selection Procedure = 40

Model 68

Test No. 331   Reference Number = 212   Definition = PK1
Equation type = 68   Number of Observations = 23
Absdev > .10   Stddev = 1.253
R Squared < 0.0

Test No. 332   Reference Number = 248   Definition = PK1
Equation type = 68   Number of Observations = 9
Absdev > .10   Stddev = 1.414
Selection Procedure = 13

Test No. 333   Reference Number = 194   Definition = NC
Equation type = 68   Number of Observations = 23
Absdev > .10   Stddev = 0.857
R Squared = .506

Test No. 334   Reference Number = 230   Definition = NC
Equation type = 68   Number of Observations = 9
Absdev > .10   Stddev = 0.706
Selection Procedure = 59

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