Competition as gravitation

Evidence from the UK

Julian Wells
School of Economics
Faculty of Arts and Social Sciences
Kingston University
Penrhyn Road
Kingston-upon-Thames
KT1 2EE
j.wells@kingston.ac.uk

1 Introduction

In this paper we address the conception of capitalist competition as the gravitation of profit rates about a norm, as developed by Mark Glick (1985). This has been seminal in reviving both non-neo-classical ideas about the competitive process and their empirical investigation (see, for example, Christodoulopoulos, 1996, Glick, 1985, Glick and Erbar, 1988, 1990, Glick and Campbell, 1995, Lianos and Droucopoulos, 1993, Maldonado-Filho, 1998, Tsaliki, 1998, Wolff and Dollar, 1992). It has also been warmly endorsed as a conceptual and methodological advance:

> Up until a few years ago Stigler's and Brozen's work on [competition and concentration] represented the orthodox opinion, but it was based on limited datasets and primitive econometrics. This opened the door to a more systematic attack on the problem by Mark Glick, Hans Ehrbar and others starting from the Classical point of view of equalization of profit rates using more sophisticated econometrics and uniform, comprehensive data sets.
>
> Foley (1989)

Glick argues that the process of capitalist competition has two qualitatively opposite effects. On the one hand, the struggle of individual firms for competitive advantage creates persistent inequality of profit rates *within* industries ('hierarchies' of profit rates, in Glick's terminology). On the other hand, capital flows from industries where the average profit rate is low to those where it is higher, creating a *tendency* for industry average profit rates to equalise over time ('gravitation' of profit rates, in Glick's terminology). However, the gravitational process is constantly counteracted by the ebb and flow of supply and demand for particular commodities and the resulting variations in prices in, and profits of, the industries producing them.

Thus the wide differences between the profit rates of different companies in a given year, and the violent swings from one year to another in the profitability of given firms and industries, hide a more fundamental fact: that the amount by which each industry's profit rate deviates from the economy-wide average in each year should, when averaged over time, be small, and thus that the total of such average deviations be small.

Our argument will be that neither the data nor the methods used in Glick's 1985 thesis permit a genuine test of his theoretical position. It happens to be the case that we have more fundamental methodological and interpretative differences with Glick, elaborated in Wells (2007). However, objections grounded in even the most fundamental principle do not have great force in the eyes of those yet to be convinced of that principle's importance – unless they can also be shown that disregard of the principle has substantive consequences. Thus our aim here is two-fold: first, to show that his methods are indeed problematic (an *internal* critique), and then to apply our own and demonstrate that they provide better insight into the gravitation of industry profit rates (an *external* critique).

The present paper therefore has seven sections following this one: in Section 2 we review Glick's thesis (1985), and in Section 3 we present our critique of this. In Section 4 we use a very large set of company accounts data (from the Financial Analysis Made Easy (FAME) database published by Bureau van Dijk) to carry out tests comparable to Glick's work on the US manufacturing sector, and extend them to two-digit industries covering the whole UK economy. This addresses the point that the theory of competition to which Glick appeals only has meaning in the context of the whole economy, and that it is therefore not useful to confine investigation to manufacturing industry alone.

In Section 5 we test Glick's methods at different levels of aggregation and confirm that his measure of profit-rate gravitation produces the expected results when extended to higher and lower levels of aggregation than the two-digit level. Section 6 tests a proposed modification of his gravitation measure; the result is that difficulties found in Section 4 are relieved, but at the cost of introducing a perverse correlation between level of aggregation and degree of gravitation.

Section 7 concludes our internal critique by calculating both modified and original gravitation measures for a range of profit rate measures, including ones which we find theoretically preferable to those favoured by Glick. Unlike the latter, our preferred measures not only display the expected correlation between aggregation and gravitation, when tested with our modified version of Glick's test, but produce *greater* evidence of gravitation.

In Section 8 we move to an external critique of Glick using random-sized random sampling and *L*-moment ratio analysis to show why Glick's own gravitation measure produces different results to our modified version of it, and then demonstrate that his implicit assumption that within-industry distributions are similar cannot be taken for granted, and in fact turns out to be particularly unreliable in the case of Glick's preferred profit rate measures.

In what follows, all citations of Glick not otherwise identified are to his thesis (Glick, 1985).

2 Glick on gravitation of profit rates

The aim of Glick's thesis is to substantiate a theory of the competitive process which he attributes to classical political economy – that is, to Smith, Ricardo and Marx.

According to this profit rates within an industry (*intra*-industry profit rates) will be widely dispersed. Firms in the same line of business will employ techniques with varying proportions of fixed to variable capital. Although it is variable capital (that is, labour-power) which creates value, competition enforces a uniform price for identical use-values and thus firms employing more capital-intensive techniques will be more profitable. Moreover this hierarchy of profit rates will show no long-run tendency to gravitation, thanks to the continual search by all firms for ever-more-capital-intensive techniques that will allow them to increase their profit-rate at the expense of their rivals (pages 13–14).

But competition also tends to bring about prices of production which 'correspond to an equal rate of profit for the *average conditions of production* in each industry' (page 13, emphasis in original). This occurs because capital will tend to move from low-profit to high-profit sectors, diminishing the supply and increasing the price of the use-values produced in the former, and vice versa in the latter. Clearly this will not be an instantaneous process, and moreover the demand for given use values will also change as both technology and social needs change, introducing 'perturbation' in the structure of industry profit rates and transforming a tendency towards equalisation of rates into one of 'gravitation around equal centers of gravity' (page 21).

Thus we should not expect to see *inter*-industry profit rates equalise in the short run: Glick specifically criticises previous studies for failing to consider sufficiently long runs of data (pages 106–113). Rather, the aggregate rate of profit across all industries (the general rate of profit) will be an attractor for each individual industry's aggregate profit rate — it will be the overall 'centre of gravity' around which industry centres of gravity (profit rates) 'orbit', in Glick's phrase.[1]

This conception is explicitly contrasted to the neo-classical concern with whether industrial concentration allows individual *firms* to achieve persistently above-average profit rates. In the classical scheme, as described by Glick, firms may or may not benefit from persistent advantages but this is irrelevant, as it is simply a particular case of the persistent hierarchy in intra-industry profit rates. What *would* demonstrate impairment of the competitive process would be evidence that individual *industries* enjoyed persistent advantage.

Testing gravitation therefore involves accepting inter-industry differentiation of profit rates in any given year – indeed, in every year. Meanwhile intra-industry profit rates 'will *most likely* also *be unequal* because of the stratification of cost structures due to different technologies, economies of scale, etc.' (page 20, emphasis added).

[1] We will examine this phrase in our critique in section 2 below.

To measure the degree of gravitation Glick follows Levy (Levy, 1984) in defining three measures of dispersion, $V = V_1 + V_2$, where:

V is the total variance of the industry rates of profit around the yearly means over the complete set of years

V_1 is the total dispersion of the industry long-run average deviations, and

V_2 is the sum, over industries and years, of the total variance of each industry around its own centre of gravity.

Formally, these are defined as follows:

$$V = \frac{1}{T}\sum_i \sum_t k_t^i (r_t^i - \bar{r}_t)^2$$

where k_t^i, r_t^i are the capital and rate of profit of industry i in year t, and $\bar{r}_t$ is the average rate of profit across all industries in year t. Thus V is the average annual sum of (capital-weighted) squared deviations.

$$V_1 = \sum_i \bar{k}^i (\bar{d}^i)^2 \text{ with } \bar{k}^i = \frac{1}{T}\sum_i k_t^i \text{ and } \bar{d}^i = \sum_i k_t^i (\bar{r}_t^i - r_t)^2 \Big/ \sum_t k_t^i$$

where $\bar{k}^i$ is the average share of capital for one industry over the complete period, and $\bar{d}^i$ is the weighted average deviation from the mean in each industry. Finally

$$V_2 = \frac{1}{T}\sum_i \sum_t k_t^i (r_t^i - \bar{r}_t - \bar{d}^i)^2$$

In his Appendix A Glick raises, without definitively answering, the question of in what way these statistics should be normalised – by scale or by level. Consider the three samples (5, 6, 7), (25, 30, 35) and (5, 10, 15): does the first pair have the same dispersion, because one is five times the other (implying normalisation by scale), or the second pair, because the absolute deviations are ±5 (implying normalisation by level)?

Glick regards V_1 as 'the best criterion for a measure of classical gravitation' (page 99): in the case of equal centres of gravity, this term would be zero, since industry centres of gravity would be equal to the average.

> Thus, a comparison of the case of equal centers of gravity with large fluctuations with the case of unequal centers with small fluctuations may result in equal *V*s, but the first case would produce a small V_1 and a large V_2, while the second case would record a large V_2, and a small V_1.
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> (page 86, *sic*: presumably the last phrase is a slip for 'large V_1, and a small V_2').

Testing any proposition about profitability obviously entails specifying which of a wide range of possible profit rate measures.

Glick points out that '[t]he logic of a rate of profit is a logic of private investment' (page 87) and argues that those profit rate measures are to be preferred which include financial assets in their measure of capital, on the basis that these represent 'the total cost advanced in order to generate the income of the firm' (page 88). He specifically deprecates 'the "marxist" ratio of total surplus value divided by fixed capital' (page 91).

Glick's tests use two different data sets. One is a composite series of industry profit rates for 1969-1982, compiled by the Value Line organisation from the accounts of 1,637 U.S. corporations in such a way as to take account of missing values, and of births and deaths of firms.

Eight profit rate measures are calculated from this, normalised by scale (Table 5 outlines these and a number of other measures, some of which will be tested below).[2]

[2] Glick in fact computes a further 40 profit rates are computed and the effects of normalisation by scale and level are compared. The extra profit rate measures are constructed simply by considering every possible combination of eight

The other dataset is taken from the U.S. National Income and Product Accounts (NIPA), and four measures are calculated from it. The NIPA data is only available at the two-digit level of aggregation, and thus for comparability the Value Line series is also aggregated to this level, although the original is at the three-digit level.

An important feature is that the analysis is only carried out in respect of 18 manufacturing industries (see Table 4 for details). Glick states (page 59) that this is '*because of the unsatisfactory initial results we obtain for this data base* [NIPA] *on the basis of total industries*. Clearly some questionable adjustments would have been necessary to include non-manufacturing industries in the study' (our emphasis). He does not say here (or, as far as we have been able to discover, anywhere else) in what way the initial results are unsatisfactory, or what the 'questionable adjustments' would have to be.

The results obtained from the Value Line data are most nearly comparable with what can be done with our own FAME data set. Table 1 shows the values Glick finds for each of his statistics for the eight principal profit rate measures.

Table 1: Glick's Value Line statistics

Profit rate measures estimated from Value Line data		**V**	**V_1**	**V_2**
Glick 1 ≈ ROCE	(profit + net interest)/total assets	0.04243	0.02302	0.01940
Glick 2	(profit + net interest)/(net plant + inventories + cash)	0.10231	0.06495	0.03736
Glick 3	profit/total assets	0.08428	0.04359	0.04070
Glick 4	profit/(net plant + inventories + cash)	0.09395	0.05406	0.03989
Glick 5	(profit + depreciation)/total assets	0.03601	0.02313	0.01288
Glick 6 ≈ ORE	profit/equity	0.07205	0.03021	0.04184
Glick 7 ≈ NPM	profit/sales	0.12573	0.08726	0.03847
Glick 8	(profit + net interest + taxes)/net plant	0.11887	0.08022	0.03866

measures of profit and six measures of capital, without regard to economic or accounting logic. See Appendix A in Glick (1985).

Recall that Glick regards V_1 as the best measure of gravitation, and Glick 1 as the most appropriate measure of the profit rate. Table 2 shows the value of this for each profit rate measure in rank order; as can be seen, Glick 1 indeed ranks first in degree of gravitation: its V_1 score of 0.02302 indicates the absence of persistent long run deviations of industry profit rates from their centre of gravity. In contrast, the 'marxist' measure Glick 8, regarded as the least likely candidate to exhibit gravitation, comes seventh, a little way ahead of Glick 7 (the profit margin).

Table 2: rank order of Glick's Value Line results by V_1

Profit rate measures estimated from Value Line data		V_1
Glick 1 ≈ ROCE	(profit + net interest)/total assets	0.02302
Glick 5	(profit + depreciation)/total assets	0.02313
Glick 6 ≈ ORE	profit/equity	0.03021
Glick 3	profit/total assets	0.04359
Glick 4	profit/(net plant + inventories + cash)	0.05406
Glick 2	(profit + net interest)/(net plant + inventories + cash)	0.06495
Glick 8	(profit + net interest + taxes)/net plant	0.08022
Glick 7 ≈ NPM	profit/sales	0.08726

Glick thus finds good accord between his theoretical views and the results produced by his methodology: 'the measure chosen has an important influence on the degree of dispersion of industry long-run centers of gravity' (page 126).

However, it must be noted that the V_1 score for Glick 1 is virtually identical to that of Glick 5; this measure is a variant of Glick 3 (conceptually equivalent to the operating return on equity, ORE), described by Glick as 'a very traditional' measure which he includes for comparison with 'more theoretically specified' ones.

Glick 3 itself comes some way behind Glick 6 (conceptually equivalent to the operating return on capital employed, ROCE), the measure most frequently used in the empirical literature reviewed by Glick, and regarded by some as the measure most likely to exhibit strong gravitation.

3 Critique of Glick

A number of reservations must be made to Glick's claim to have satisfactorily tested his hypothesis about profit-rate gravitation.[3] Our critique here is directed at the use Glick makes of data derived from company accounts; we do not address that part of his work, using national accounts data, aimed at discovering the period over which gravitation might be expected to be observed. The points we make are as follows.

3.1 Inappropriate measures of the profit rate

As numerous authors point out, uncontroversially, the profit rate concept one uses should be the one relevant to the task at hand. Likewise, it is both true and uncontroversial that the concepts of net income and capital are logically related.

Authors whose main interest is ultimately the surplus created in production, and moreover at the level of the capitalist economy as a whole, pay attention to measures which are gross of interest and taxes and other

[3] A point which we will not attempt to develop here is whether or not Glick's conception of industry profits 'orbiting' the centre of a supposed gravitational system is, as he believes, derived from the full tradition of classical political economy, including Marx. Debating whether Marx's views are a development of, or a break with, the outlook of Smith and Ricardo would take us outside the aims of the current paper. However, the word 'orbit' is not found in any relevant context in any of Glick's three classical sources, and the extent to which any of them employed metaphors of gravitational processes in a way consonant with Glick is highly questionable. Ricardo uses 'gravitation' just once, in Chapter Six of his *Principles*: 'The natural tendency of profits then is to fall; … This tendency, this gravitation as it were of profits, is happily checked at repeated intervals by the improvements in machinery, connected with the production of necessaries'. Although the overall train of thought is clearly that followed by Glick, in Ricardo 'gravitation' refers *only* to the tendency of profits to suffer a secular decline, which is 'checked' by innovation. In other words gravitation is a one-way tendency in Ricardo, whereas it is a two-way one in Glick. For a recent assessment of the metaphor of profits orbiting a centre of gravity, see Freeman (2006).

deductions from the surplus value created in production (sometimes referred to as ‘broad’ measures of the profit rate). The pioneering study of Gillman (1957) is an example of this school.

Glick (1985) aims to substantiate a theory of the competitive process which requires attention to ‘[t]he logic of a rate of profit [a]s a logic of private investment’ (page 87). He argues that those profit rate measures are to be preferred which include financial assets in their measure of capital, on the basis that these represent ‘the total cost advanced in order to generate the income of the firm’ (page 88). Accounting logic then requires that net interest payable be deducted from the numerator. Glick specifically deprecates ‘the “marxist” ratio of total surplus value divided by fixed capital’ (page 91).

The numerator of the rate of profit is net income, the denominator is the capital advanced to achieve the income, and ‘net income’ means whatever is left over from gross revenue once provision is made for preserving the capital stock. Thus any definition of the numerator logically implies a particular definition of the denominator, and *vice versa*. For example, if I plant corn, the net physical income is the quantity of corn eventually harvested, less an amount equal to that planted in the first place. If I call my profit the amount for which I sell the surplus corn, less the interest on the £10,000 I borrowed to buy a combine harvester, the net assets should include not only the value of the machine but also a debit in respect of the £10,000 I owe the bank.[4]

But as the previous paragraph’s point about physical and financial assets shows, this still leaves open the question of what – or rather, whose – capital is to be counted, and hence whose income. If we are concerned only with the interests of the capitalist class as a whole then a full and correct accounting for financial assets should net out in both numerator and denominator, leaving the choice irrelevant for the purpose of computing a general rate of profit. On the other hand, if we are interested in some particular aspect of the process of

[4] We neglect wages and circulating capital, as well as the complications of depreciation.

capitalist production – for example, the capitalists' success in extracting surplus labour from productive workers – then we will want to include in the numerator the entire net sales revenue attributed to the product (a broad measure).

Our own perspective is that of Farjoun and Machover (1983), whose project is essentially to vindicate Marx's work in Volume I of *Capital* as against the traditional reading of Volume III, through considering the (capital-weighted) distribution of company profit rates. But if we propose to investigate the rate of profit enterprise by enterprise, then the question of which enterprise any particular assets should attributed to becomes important. Also, a broad measure as just described may be justified. Whether or not it equalises, in the sense of having some particular small degree of dispersion, is irrelevant, and therefore there is no need to consider whether the profit rate concept is one that is, or could conceivably be, the object of capitalists' investment decisions.

For authors such as Glick, who are precisely interested in such decisions, the choice is more momentous. We have serious reservations about his choices here. According to a passage which he quotes (page 10) from Ricardo:

> When the demand for silks increases, and that for cloth diminishes, the clothier does not remove with his capital to the silk trade, but he dismisses some of his workmen, he discontinues his demand for the loan from bankers and monied men; while the case of the silk manufacturer is the reverse; he wishes to employ more workmen, and thus his motive for borrowing is increased: he borrows more, and thus capital is transferred from one employment to another, without the necessity of a manufacturer discontinuing his usual occupation.
>
> Ricardo (1951: 89)

Glick's discussion of the 'logic of private investment' suggests that he thinks it is the logic of the 'bankers and monied men' which is relevant. But the passage from Ricardo on which he relies clearly refers to changes in productive capitalists' demand for means of production: it is the silk manufacturer's employment of workmen which is his motive for borrowing.

It implies that the proper measure of capital is not his net assets but instead the total value of means of production which the manufacturer mobilises ('net plant', as Glick calls it). If he borrows £100 from 'bankers or monied men' his net assets do not change: the £100 increase in the manufacturer's current account is exactly counter-balanced by his new debt of £100, and this position does not change if he then draws 100 gold sovereigns from the bank, nor even if he then exchanges the 100 sovereigns for £100-worth of means of production, whether these are bales of cotton or hours of labour-time.

Of course, the manufacturer who finances production with a loan of £100 then has to appropriate a profit at least sufficient to cover the interest on the loan; thus the numerator of the profit rate must be profit before deduction of interest and taxes. But this gives us Glick 8, the marxist measure which Glick says is not a good candidate for equalisation.

Glick prefaces his Ricardo quotation by saying that 'Ricardo argues that much of the movement of capital in the competitive process occurs through the financial system'. We have just argued that while it may well be that the financial system is the medium by which the capital flows from one industry to another, on the face of the quotation it is the logic of the manufacturer, not the banker, which is the motive force. But if the contrary is maintained, that implies the use of Glick 6 (profit/equity), which Glick notes (page 89) to be the one 'most frequently used in the empirical literature', 'lauded as the most accurate guide to investment' and thus the rate which should be equalised most strongly.

As he says, this view 'flows from the vision of the firm as the passive agent of stock holders attempting to maximise the return to equity' or, put another way, it follows the logic of investment by 'bankers and monied men' as opposed to that of manufacturers.

On the other hand, if the logic of 'manufacturers' is what counts, then since financial assets not only have transparent rates of return but are readily tradeable, then the only rate of profit that is important is that on the capital advanced for production, as suggested by the quotation from Ricardo.

Glick argues in favour of total net assets on the grounds that they represent the total cost advanced to generate the income of the firm, and since total net assets include total debt consistency demands that net interest should be included in the numerator.

There would seem to be various problems with this:

(i) suppose net interest for a given firm is positive (presumably reflecting positive net assets over and above the value of means of production); this suggests that the firm's activities include banking or investment as well as manufacturing.

(ii) suppose net interest is negative; this implies net debt to be offset against the value of plant and inventory. Indeed, a firm's means of production may be entirely financed by borrowing: but then its net assets are zero (there are several cases of this in our own data) and hence its profit rate is either undefined ('infinite') or strictly zero.

(iii) in either of these cases, changes in the measure of capital (that is, including financial assets and liabilities) do not capture changes in the quantity of means of production employed.

(iv) since capitalists are supposed to look only at price rates of profit, not value ones, then the competition which is supposed to produce a tendency to profit-rate equalisation must be that among all industries – not just among those in which surplus value is created but including those which appropriate surplus value from the productive sector.

3.2 Analysis is at too high a level of aggregation

Although this criticism is made by Glick himself (page 60), it is a passing remark in his description of his NIPA data set and its possible import requires some effort to extract from his discussion.

In describing his methodology (pages 83–105) he does not provide a detailed discussion of what level of aggregation would be desirable, or in what way the level of aggregation used might bias his results. However, in his discussion of previous studies of industrial concentration (pages 29–53) he reviews a study by (Gale and Branch, 1982) which used information from 200 large companies reporting on 2,000 separate businesses, and remarks that '[d]ata at the business level allows a very precise study of the product-line level, a concept very close to that of theoretical market.' (page 51, *sic*: 'the theoretical market'? 'theoretical markets'?). Moreover, a subsequent publication of Glick's which compares gravitation in the U.S. and several European countries using two-digit data for 13 industries states: 'Our study of profitability differentials will be restricted to a set of rather aggregated industries. Indeed, it would be more desirable to use *an economically more adequate definition* of industry. But this *would require greater disaggregation*.' (Glick and Erbar, 1988: 182, emphasis added).

The data used by Gale and Branch was not the Line of Business data set compiled by the Bureau of Economics of the US Federal Trade Commission but the PIMS dataset.[5] However, it is worth noting the Bureau's comments (in its Report on the 1974 Line of Business data) on the question of aggregation. On the one hand, it points out, the Bureau of the Census extends the SIC system to five-digit product classes and seven-digit products (Bureau of Economics, 1981: 3, footnote 2), and '[m]any economists accept the four-digit SIC or five-digit Census of Manufactures as the general levels that most closely correspond to economically meaningful markets'. On the other hand, the average number of four-digit SIC industries in which the largest 200 manufacturing firms was engaged in 1950 was 12.6, while 10 of these firms were engaged in more than 30 industries (for 1968 the diversification is even greater: 39 of the top 200 were engaged in more than 30 industries) (page 2).[6]

Glick's favourable reference to the product-line data suggests he might find even four-digit industry data insufficiently disaggregated for tests of gravitation. On the other hand, they will presumably be preferable to

[5] PIMS (Profit Impact of Market Strategy) is a decision-support system originally developed at the General Electric company and later at the Harvard Business School, and now the core product of a network of management consultancies.

[6] Ravenscraft (1983) is a traditional structure-performance study using FTC Line of Business data.

those at a higher level of aggregation (because they more closely correspond to the markets for individual commodities). Indeed, even company-level data has to be regarded as aggregate data, and moreover at an unknown and varying level of aggregation from firm to firm. The FTC's comments also suggest that data produced by aggregation from company accounts will be an imperfect substitute for that aggregated from line-of-business surveys (because of the preponderance of large companies, and those companies' extensive diversification).

In fact, the difficulty is shown by the following example (to take just one reason for inter-industry profit differentials): at any given point in time the existence of novel products on the one hand and obsolescent ones on the other will mean industries with respectively higher- and lower-than-average rates of profit. Even within a single period, aggregating numerous high- and low-profit product lines into a smaller number of more widely-drawn industries will reduce the measured inter-industry dispersion. As obsolete products disappear entirely, and transfer of capital undermines the higher profitability of novelties, the dispersion of product-line profit rates will fall, and the more so the longer the period examined – but whatever dispersion remains will still be reduced by aggregation.

Since Glick's test of gravitation is the size of the average annual dispersion between industries, testing at a higher level of aggregation must tend to increase the perceived degree of gravitation.[7] Hence an apparent demonstration of gravitation at the two-digit level is always open to being undermined by a demonstration that it is weaker at the four-digit level. Thus testing at the lowest feasible and theoretically-relevant level of

[7] To make the point most forcefully, consider testing at the 0-digit level – in other words, calculate the deviation of the general rate of profit of the whole economy from itself. Since this is zero one must necessarily find perfect 'gravitation'.

aggregation is necessary, since testing at any higher level is vulnerable to the complaint that any gravitation demonstrated is a mere artefact of aggregation.[8]

If the foregoing holds it is hard to resist the conclusion that working at the 2-digit level cannot show anything of any real relevance to the theory, and arguably even the 4-digit level is still some way off a reasonable approximation. At all events it is clearly important to investigate the effects of performing Glick-type analysis at different levels of aggregation.

3.3 The preferred statistic for measuring gravitation is questionable

Although Glick asserts (page 86, page 99) that the absolute size of his statistic V_1 is the best measure of long-run gravitation, it can be argued that a better one is the statistic $\hat{V} = V_1/V$, the *proportion* of V which is accounted for by V_1. This is on two related grounds: (i) his reasoning in favour of V_1 is arguably incomplete and (ii) it does not provide a criterion for judging whether the degree of dispersion exhibited in a single case in fact demonstrates gravitation.

First, recall his justification for V_1: ‘comparison of the case of equal centers of gravity with large fluctuations with the case of unequal centers with small fluctuations may result in equal V s, but the first case would produce a small V_1 and a large V_2 ‘ and *vice versa*.

[8] For more on the possible difficulties of aggregation, see the recent controversy on this topic between Cockshott and Cotterell, collaborators who share the Farjoun and Machover perspective, and Kliman (Cockshott and Cottrell, 2003, Kliman, 2002, 2003).

Now suppose the contrary situation: two cases with equal V_1 but unequal V and V_2. If $V_1^{x} = V_1^{y} = 0$ then on any interpretation we have equally perfect gravitation in both cases and further comparison is redundant. But what if $V_1^{x} = V_1^{y} \neq 0$?

The two best instances of gravitation, according to Glick's results, are just such a case: he finds $V_1^{Glick\ 1} = V_1^{Glick\ 5} = 0.023$, while $V^{Glick\ 1} = 0.042$ and $V^{Glick\ 5} = 0.036$ (and thus $V_2^{Glick\ 1} = 0.019$ and $V_2^{Glick\ 5} = 0.036$). If we take absolute size of V_1 as the criterion then we again have to say that these are cases of equal gravitation. Yet for Glick 1 the average dispersion of industry profit rates accounts for a little over half (54 per cent) of the total variation, yet for Glick 5 it is nearly two-thirds (64 per cent) of the total and – put like this – it seems odd to say that Glick 5 is as good an example of gravitation as Glick 1.

This brings us to the second point: V_1 measures the average annual deviation of industry profit rates. $V_1 = 0$ implies perfect gravitation; if V_1 accounted for 100 per cent of the total deviations V one would presumably say that there was no evidence of gravitation. The question thus arises, how big can V_1 be in relation to V and still constitute evidence for gravitation? It would be desirable to have a criterion based on argument from first principles, but even in the absence of such an argument it seems incongruous to suggest that average industry deviations which account for more than half the total count as such evidence.

Taking $\hat{V}$ as our measure of gravitation allows us to declare Glick 1 to demonstrate more gravitation than Glick 5, a conclusion which Glick might welcome, given that Glick 1 is the measure he prefers on theoretical grounds, whereas Glick 5 is merely a variant of a measure (Glick 3) which he regards as theoretically inadequate.

However, use of $\hat{V}$ suggests a radically revised overall ranking, as shown in Table 3 below:

Table 3: Glick Value Line results ranked by relative gravitation

Profit rate measure	estimated from Value Line data	V_I/V
Glick 6 ≈ ORE	profit/equity	0.4193
Glick 3	profit/total assets	0.5172
Glick 1 ≈ ROCE	(profit + net interest)/total assets	0.5425
Glick 4	profit/(net plant + inventories + cash)	0.5754
Glick 2	(profit + net interest)/(net plant + inventories + cash)	0.6348
Glick 5	(profit + depreciation)/total assets	0.6423
Glick 8	(profit + net interest + taxes)/net plant	0.6749
Glick 7 ≈ NPM	profit/sales	0.6940

Now the measures which do best are those akin to traditional accounting ratios: Glick 6 (equivalent to the operating return on equity, ORE) and Glick 1 (equivalent to the operating return on equity, ROCE). Moreover, use of $\hat{V}$ together with our proposed quantitative criterion suggests that Glick 6 is the only one that provides reasonably convincing evidence for gravitation (although Glick 3 also does fairly well).

The only conclusions which are unaffected concern the relatively poor results from the 'marxist' measure Glick 8 and the profit margin, Glick 7; however, it can now be added that these measures, even considered in isolation from others, provide only weak evidence of gravitation.

3.4 The full implications of the hypothesis are not tested

Glick's approach at least implies that intra-industry profit-rate dispersions (in the sense of the variance of firms' rates of profit about their industry's average) should be greater than inter-industry dispersions (in the sense of the variance of industry rates about some overall average).

Admittedly, his only specific comment (page 20) is that the intra-industry profit-rates will 'most likely' be 'unequal', whereas the inter-industry ones are certainly expected to be. But elsewhere he lays great stress on the expectation of 'hierarchy', of 'stratification', of intra-industry profit rates – and furthermore on its persistence through time, unlike that of inter-industry profit rates – and it seems reasonable to suppose that the tendency should be for the former to be greater than the latter. However, Glick's data does not allow him to investigate this.

3.5 No attention is paid to the *shape* of profit rate distributions

Although Glick pays passing attention to the question of higher moments of profit rate distributions his remarks are not only extremely cursory but opaque (page 71 ff). In a five-page section titled 'Statistical moments in the pattern of industry rates of profit' he presents a chart showing the frequency of industry mean rates of profit over the entire period covered by his Value Line study (Figure 4.4 on page 75, reproduced as Figure 1 below).

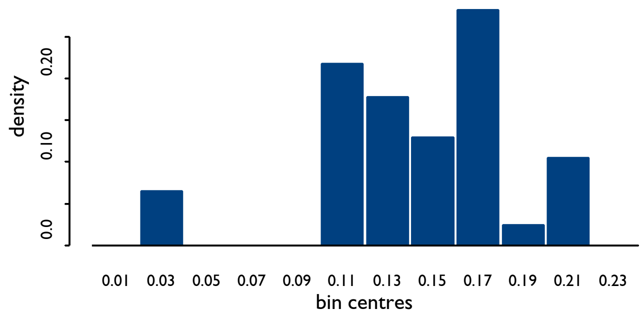

Figure 1: histogram of industry average rates of profit, after Figure 4.4 in Glick (1985)

Taking the underlying data, Glick computes the average of the *un*weighted means as 0.147 and the median as 0.146, which implies a skewness of 0.073 (computed as $3(\bar{X} - \text{median} / \text{standard deviation}))$ (page 74).

However, the skewness weighted by each industry's average share of the total capital stock is 0.85, which Glick says 'is still in a range considered relatively normal'. As reference to Figure 1 shows, this distribution is not only not symmetrical, but is not even uni-modal: in fact it has no less than *four* modes and three anti-modes.

This thought might inspire two possible strategies. One strategy would follow the line implied by his own discussion, and investigate the higher moments of the distribution of industry average profit rates. The second would note that Glick is wholly dependent on the use of the mean to characterise industry profit rates, and that use of this to test convergence is dependent on the implicit assumption that all industries have intra-industry distributions of a similar kind.

It is easy to see the possible dangers of this by considering the case of two industries with similar means, but where one industry's intra-industry distribution is gamma with shape parameter equal to one (that is, an exponential distribution) and the other industry's is gamma with shape parameter equal to 10 (that is, an approximately normal distribution). The mean and mode will be approximately equal in the second industry, but in the first the modal profit rate will be zero and the median about 0.67.[9] If these different distributions persisted through time, how realistic would it be to speak of their profit rates equalising? Conversely, but equally problematically, consider the case of two industries with identical modal rates of profit, but with distributions of opposite skewness, and hence different means: does one feel justified in saying that the profit rates of these industries are *not* in some sense convergent, if these distributions persist through time?

4 Reproducing Glick

4.1 Methodology

We begin our tests by applying Glick's methods to our FAME dataset to provide a baseline for further discussion. We thus calculate his statistic V_1 for the four profit rate measures which he found to exhibit the greatest evidence of gravitation.

Limitations on our FAME database mean some profit rate measures can be computed only for the period 1991-1995. These limitations do not apply in the case of the Glick profit rate measures investigated here, but we nonetheless restrict our work to these years so as to produce results comparable with those for other profit rate measures which we will examine later in the paper.

Glick is extremely critical of tests for profit-rate equalisation which do not cover a sufficient time span. Yet while his NIPA data covers 22 (1958-79), quite long enough to meet his objections, Glick does not hesitate to

[9] Value of exponential median based on the empirical formula due to Doodson (1917).

draw conclusions from his Value Line data, which only cover 14 years (1969-82), a period only slightly longer than the business cycle, which is the source of the problems he identifies in preceding studies. As we shall see in the following section, this short run of data is from some viewpoints a positive advantage.

At this point it is convenient to introduce some extra notation. Glick's decomposition of the total variance V can be used to measure the variance of averages of any entities about some unifying average (V_1), with the variance of the entities about their own averages left as a residual (V_2) making up the overall variation V.

One may usefully distinguish (a) variance of 'industry' (meso-level entity) averages about a common macro average (that is, the economy as a whole), (b) variance of 'firm' (micro-level entity) averages about the averages of 'industries', and (c) variance of firm averages around the macro average. To avoid confusion while at the same time preserving comparability with Glick, we thus propose the notation V^{a}, V^{b} and V^{c} (with appropriate subscripts and hats where necessary) to denote respectively meso/macro, micro/meso and micro/macro situations.

This is a scheme in which Glick's own quantities do not have a clear place (inasmuch as they concern the variance of lower-meso-level objects about higher-meso ones – that is, comparison of 2-digit industry averages to the manufacturing average) although his own presentation implies that his results are type V^{a}. We therefore consider those tests which are strictly analogous to his alongside V^{a} tests proper.

Notwithstanding their formal similarity, these three variants of Glick's V-statistics measure different things. Type V^{a} statistics relate to industries, and thus V_1^{a} measures what Glick (1985) wants to measure, namely the persistence of inter-industry profit differentials.

Type V^{b} statistics relate to firms: thus V_1^{b} measures the persistence of individual firms' profit differentials within a given industry. However in Glick's theoretical perspective this is *not* a measure of market power due to concentration of industry, since persistent variation in profit rates implies some firms experiencing persistently *lower* profit rates than average (unless one thinks, which the standard literature does not, of the advantages of market power accruing to the beneficiaries at the expense of other firms within the industry concerned).

Rather, for Glick, firms can preserve higher profit rates by preserving a cost advantage, and most pertinently by innovation involving more capital-intensive production techniques (though in principle this could also be through privileged access to cheaper inputs, including labour; the latter would also include the ability to differentially increase absolute rather than relative surplus value).

Type V^{c} statistics also relate to firms, and thus V_1^{c}, like V_1^{b}, measures the persistence of firm-level profits. However, recall Glick's assertion that the most desirable data would relate to line-of-business. All but the simplest (and smallest?) enterprises' products are in more than one line. From this point of view V^{c} statistics represent the lowest-available level of disaggregation, and are properly considered alongside the V^{a} statistics for the different SIC levels – representing an *n*-digit level of aggregation, where *n* is unknown (and inconsistent, in that larger firms produce a wider range of use values than smaller ones – see the FTC data in section 6.3.1 above). Thus V_1^{c} statistics would be comparable with V_1^{a}, not V_1^{b}.

4.2 Results

As pointed out in our review of Glick, his theory of competition maintains that profits are equalised by migration of capital to sectors with higher profit-rates from sectors with lower ones but provides no reason to exclude any particular sector of the economy from this process. Thus there is no rationale for confining investigation to manufacturing industries alone, as is the case in his empirical investigation.

Our calculations of V_1^{a} are therefore made for two different sets of industries: first, for 18 manufacturing industries whose definitions (Table 4) are designed to correspond as closely as possible to those used in Glick's own study (remembering, as pointed out in the previous section, that these are not strictly speaking type V^{a} statistics); second, for all 61 industries defined at the two-digit level by the UK 1981 SIC.

Table 4: Mapping from UK SIC codes to Glick manufacturing industries

Glick industry	**1981 UK SIC industries**
Food	41, 42 (excluding 429, tobacco, which is excluded by Glick)
Textile	43
Apparel	45
Furniture	467 (remainder of 46 excluded by Glick]
Paper	471, 472
Printing	475
Chemicals	25, 26
Petroleum	14
Rubber	48
Leather	44
Cement (stone, clay, glass)	24
Primary metals	22
Fabricated metals	31
Machinery	32, 33
Electrical equipment	34
Transport equipment	35, 36
Instruments	37
Miscellaneous	49

V_1 statistics for two-digit industries provide base-line results for work in the following sections. For each of the four profit rate measures examined Figure 2 compares V_1 statistics from Glick's own study (G) and the corresponding UK industries (aG), and V_1^a statistics for the whole UK economy (sic812).

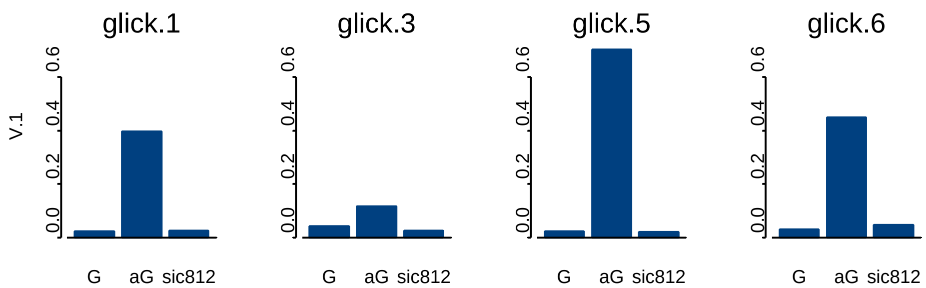

Figure 2: V_1-statistics for two-digit industries, Glick profit rate measures

As can be seen, the results imply a very much smaller degree of profit-rate gravitation within UK manufacturing than in the US, except in the case of Glick 3, though the improvement here is only apparent in relation to the other profit rate measures: the V_1 statistic is still more than twice as high as in Glick's own work. In contrast, the apparent gravitation across all two-digit industries is much greater, and on a par with that found within US manufacturing considered in isolation.

These results seem odd for two reasons. First, if dispersion within manufacturing is large, how can it be smaller for the whole economy, including manufacturing? Secondly, why should UK manufacturing show less evidence of gravitation than the US's? One might argue that this is explained by the exceptionally high concentration of industry in the UK, but on the other hand might this not be offset by the competitive pressure exerted by the UK economy's greater openness, measured by the value of trade relative to total output?.

It is possible to outline hypotheses which might explain these results: the period in question was one during which UK exchange and interest rates experienced radical reversals (it includes the events of the so-called 'Black Wednesday' of 1992). Thus one might argue that the persistent within-manufacturing dispersion might be accounted for by the difference in fortunes between manufacturing sectors which were especially exposed to these events and those which were less so. (Recall that the reported V_1 statistics for manufacturing industry represent the variance of industry means around the *sectoral* mean, *not* about the mean for the economy as a whole).

However, while many would accept as a stylised fact that service industries in general are less exposed to overseas competition, it is also true that the UK non-manufacturing economy sector includes large financial and transport services industries as well as a significant primary industry with major overseas exposure (that is, oil and gas extraction). On this basis it is difficult to accept that gravitation in the non-manufacturing part of the economy should be significantly stronger. And one might also argue that those service sectors not exposed to the international economy might experience considerably less pressure towards equalisation.

A possible source of difference might be that the boundaries between two-digit UK SIC manufacturing industries are not the same as for Glick's classification (Table 4), but it seems hard to believe that this alone could account for such big differences. Somewhat more plausible would be to attribute the differences to the fact that the relative proportions of the different industries are different in the two economies.

We forego any attempt at further substantive investigation, as beyond the scope of the present work. For present purposes the important point is that we have demonstrated our point that confining investigation of gravitation to the manufacturing sector alone, rather than to the economy as whole as demanded by the classical theory of competition, may indeed be seriously misleading.

5 Testing Glick

5.1 The level of aggregation

In this section we test to see whether varying the level of aggregation at which Glick's V_1 statistic is calculated produces the expected results. Defining the movement from the four- to the one-digit level of SIC classification as an increase in level of aggregation, and a movement from higher to lower values of V_1 as an increase in gravitation, we should expect a positive correlation (see section 6.3.1).

In our review of Glick we noted that he himself suggests that tests of gravitation using data aggregated to the two-digit industry level may well be inappropriate; the particular notion of 'market' to which the classical theory of competition refers is most closely approximated by the 'line of business' data briefly collected in the US. From this perspective even firm-level data, such as that available through FAME, is potentially at too high a level of aggregation, especially in the case of larger firms.

We apply his methods to our FAME dataset once again, but now also to industries aggregated at the one-, three- and four-digit levels of the 1982 UK SIC system. We also calculate V_1 for all *firms*; this may be considered as a test at an n-digit level, where n is an unknown, and possibly varying, number greater than four; we therefore expect to find less evidence of profit-rate gravitation than in the other four cases. As in the previous section we restrict ourselves for the time being to the four best Glick profit rate measures.

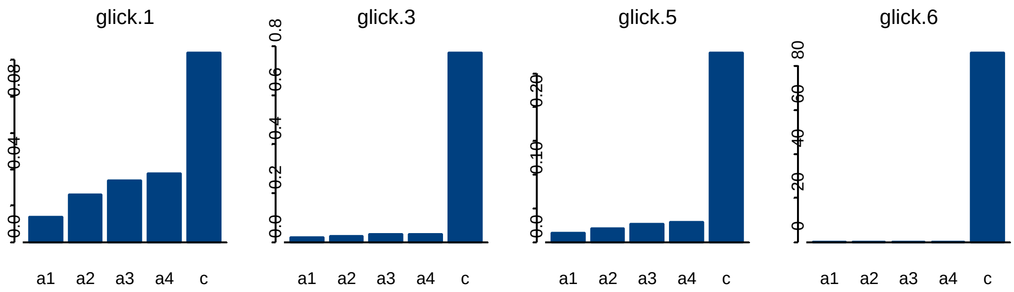

Figure 3: V_1-statistics for different levels of aggregation, Glick profit rate measures

In Figure 3 bars labelled 'a1' to 'a4' represent values of V_1^a for one- to four-digit industries, and bars labelled 'c' represent V_1^c calculated across *firms*, not industries (note that the vertical scales vary from panel to panel).

The striking result to be seen from the Figure is that the aggregation/gravitation correlation is apparently strongly positive, as expected: V_1 is smaller, hence apparent profit-rate gravitation higher, at lower levels of aggregation, including at the notional *n*-digit level constituted by firms as a further level of aggregation below the four-digit one (sufficiently pronounced, in the case of Glick 6, to mask the results in respect of the other levels).

5.2 The measure of dispersion

Glick's preferred measure of profit-rate gravitation is V_1, the variance of the time-averages of industry profit rates. We have criticised this on the grounds that it does not tell us how to compare two cases where V_1 is equal but V, the overall variance, is unequal. To meet this difficulty we have suggested that a natural alternative is the ratio $\hat{V} = V_1/V$, in other words the *proportion* of V which is accounted for by V_1. The possible significance of this can be seen by referring to Figures 4 and 5 (here the panels have a common vertical scale.)

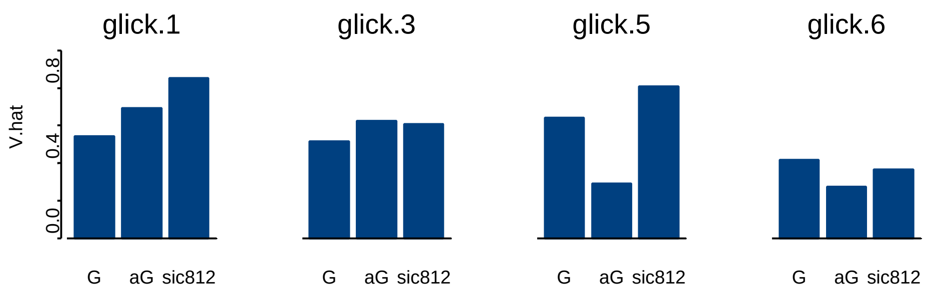

Figure 4: $\hat{V}$ statistics for two-digit industries, Glick profit rate measures

Figure 4 corresponds to Figure 2 above, in presenting a comparison of the results from Glick's own work with equivalent data from the UK economy. Using $\hat{V}$ as the measure of gravitation substantially alters the previous results: where we saw much less gravitation in UK manufacturing than in the US, we find it comparable or greater, while whole-economy gravitation is now greater than or comparable to that within the manufacturing sector.

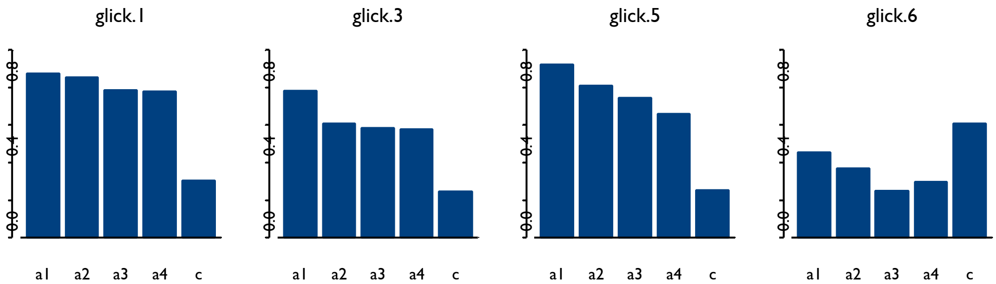

Figure 5: $\hat{V}$ statistics for different levels of aggregation, Glick profit rate measures

Figure 5 compares with Figure 3 above, showing the effect of testing at different levels of aggregation. In this case the qualitative picture is *reversed*, resulting in a perverse (that is, negative) correlation of gravitation with aggregation (including the results in respect of $\hat{V}^c$, except in the case of Glick 6).

Use of $\hat{V}$, therefore, allows us to obtain results broadly consistent with Glick's original work, in terms of two-digit industries; however, it undermines the apparent confirmation of our expectations about the relationship between aggregation and gravitation.

5.3 Alternative profit rate measures

It is pertinent to ask how use of this modified test statistic might alter conclusions about the appropriate profit rate measure for testing gravitation. We do this by comparing results for 12 profit rate measures, first using V_1 and then using $\hat{V}$. The profit rate measures are the four Glick measures already investigated together with the four standard accounting ratios and the four 'traditional marxist' measures identified by Gillman (1957:000).

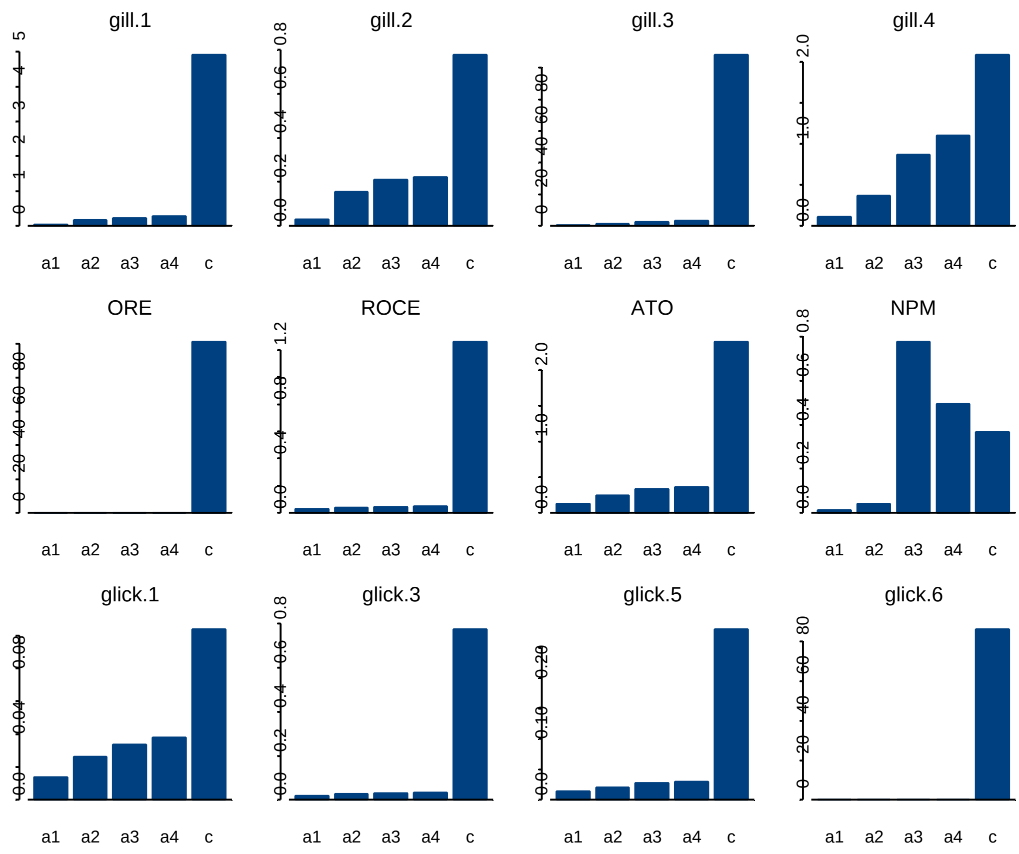

Figure 6: V_1-statistics for different levels of aggregation, multiple profit rate measures

Figure 6 shows the results with Glick's preferred V_1 statistic, including those previously obtained for the Glick measures.[10] As can be seen, the expected pattern of correlation between aggregation and gravitation obtains for the eight extra measures (with NPM, net profit margin, being idiosyncratic). Also repeated is the consistency of the results for firm-level gravitation with the view that this is simply a further level of aggregation below the four-digit one.

But the most important result is that Gillman's 'marxist' measures do very much worse than any of Glick's measures, in the sense of having much larger V_1 statistics, at all levels of aggregation (with the exception of the V_1^c statistics for Glick 3 and Glick 6).

[10] See Figure 3 above: as there the vertical scale varies from panel to panel.

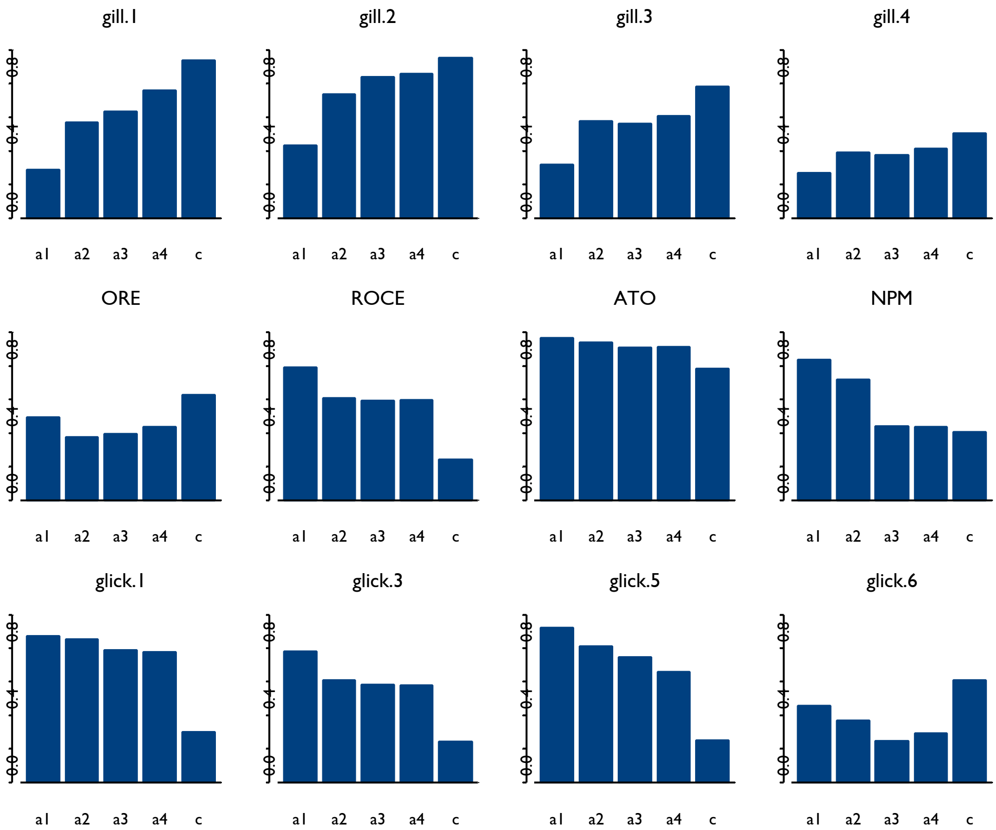

Figure 7: $\hat{V}$ statistics for different levels of aggregation, multiple profit rate measures

Figure 7 shows the results with $\hat{V}$, again including those previously obtained for the Glick measures.[11] Once again, considering the value of V_1 relative to the total variance V radically alters the conclusions to be drawn.

Above, we saw that for Glick's preferred profit rate measures the apparent correlation between aggregation and gravitation became perverse when considering $\hat{V}$. This perverse correlation also appears in the case of three of the accounting measures (where ORE and its analogue Glick 5 are now idiosyncratic).

[11] See Figure 6.5 above; as there, the panels have a common vertical scale.

But in the case of the Gillman measures this perverse correlation is not merely diminished, but reversed in sign. Apparent profit-rate gravitation is now increased by aggregation, as one would expect.

Moreover, the supposed greater evidence of profit-rate gravitation provided by Glick's profit rate measures disappears. The relative variance of his best measures is no smaller than that of any of the Gillman measures, indicating that they find the same or less evidence for gravitation. Indeed Gillman 4 is now better than any other measure bar Glick 6, which like its fellows suffers from the perverse correlation complained of above.

5.4 Conclusion

Our internal critique of Glick focussed on his use of data for manufacturing industries alone, rather than the whole economy, his choice of profit rate measure, the level of aggregation of the data, and his chosen test statistic. Replicating his methodology using our U.K. data set has supported all four aspects of this critique.

- His test statistic produces an unlikely relation between the evidence for gravitation in two-digit manufacturing industries and two-digit industries for the economy as whole

- Using the relative measure of gravitation $\hat{V} = V_1/V$ corrects this, at the expense of showing a perverse relation between aggregation and gravitation

- Using Gillman's Marxian profit rate measures and the relative measure of gravitation not only produces the expected relation between aggregation and gravitation, but also results in better evidence for gravitation than Glick's preferred measures.

6 Industry distributions: the *L*-moments perspective

The preceding sections of this paper have established that Glick's work on profit gravitation is indeed vulnerable to the 'internal' critique. This section will implement our 'external' critique of Glick by using random-sized random samples to estimate *L*-moment ratios.[12]

Our external critique included the points made in sections 3.3 and 3.4. The first point was that he does not test the full implications of his hypothesis, in that he does not show that *intra*-industry profit rate dispersions are indeed bigger or more persistent than *inter*-industry ones, as his discussion of dispersion implies. The second was that Glick does not look systematically at higher moments of profit rate distributions.

We suggested that this thought might inspire two possible strategies: first, follow the line implied by Glick's discussion, and investigate the higher moments of industry average profit rates; second, investigate whether different industries appear to follow different distributional models.

If we examine the means and co-efficients of *L*-variation, as well as the *L*-skewness and *L*-kurtosis, this second strategy can also shed light on the question of the scale and persistence of intra-industry dispersion; therefore it is the one we shall pursue.

We thus intend here to use our perspective and methods to test both the general robustness of Glick's theoretical perspective and the appropriateness of his preferred profit-rate measures in comparison with alternatives.

[12] The standard text on *L*-moments is Hosking and Wallis (1997); our use of randomly-sized random samples to estimate them is discussed in Chapter Four, and pursued in Chapter Five, of Wells (2007).

6.1 Methods

Objectives We will estimate the *L*-statistics and plot the results in *L*-skewness/*L*-kurtosis space, this time for each industry to be considered, for each of the years for which data is available. This will provide direct evidence on the comparability of different industry distributions, and on their persistence through time. However, we will lay more stress than before on the use of plots in *L*-moment ratio space – in particular the coefficient of *L*-variation (c*L*v)/*L*-skewness and mean/c*L*v planes – to identify relationships between skewness and dispersion.

We wish to further restrict the scope of the work, in order to avoid both an excessively diffuse discussion and a potentially overwhelming burden of computation; we do this by further selection within the set of profit rate measures and by confining the investigation to a single level of aggregation. Our primary focus will be on the two-digit industries defined in the 1981 SIC and on five profit rate measures, using the same data sets as used in the previous sections of this paper. The profit rate measures will be Gillman 3 and Gillman 4, Glick 1 and Glick 5, and the asset turnover rate (ATO); for details, see Table XX.

We justify these choices as follows. With regard to the profit rate measures, we have shown that our relativised version of Glick's test statistic avoids problems in reproducing Glick's work with UK data, at the expense of destroying the ability of his preferred profitability measures to exhibit the theoretically-expected pattern of variation across different levels of aggregation. In contrast, not only do all the Gillman measures examined above demonstrate the expected relationship, but the two selected here demonstrate greater evidence of profit-rate gravitation than any of the Glick measures. Among the latter we choose the two measures which perform best in Glick's own work. In short, we are selecting the two measures m ost preferred by ourselves and the two most preferred by Glick.

ATO is not chosen because of any suggestion that it is subject to gravitation. Rather, we select it because we know from Wells (2007: 91) that the whole-economy distribution across firms shows a unique bi-modal structure, which it is easy to show is attributable to clear differences of distributional form within one-digit SIC industry 8, financial services (see below). Whether this bi-modality is carried through into the distribution of rates of return at the capital level is harder to judge. Certainly there is some suggestion of it in the empirical density function Wells (2007: 117), but on the other hand this plot also has some of the features of an exponential distribution Wells (2007: 171). This measure thus provides a clear demonstration of the potential of the methods employed here.

The choice of the two-digit level is taken in the interests of comparability with Glick's own study, although our work in section 6.5 strongly suggests that a wider study should look at the internal distributions at the four-digit level.

Data For strict comparability of results within the present paper we further choose to use the same FAME company data sets used in the earlier sections of this paper; that is, ones for each profit rate measure comprising all those firms for which the relevant measure can be computed for all five years of available data.

However, we note that for a broader study of this question this is not necessarily the most desirable choice. Our own view is that any theory of profit rate distributions must apply to the whole population of firms existing at any particular moment, and not to a subset composed of those which happen to survive some particular time interval, especially if that time interval is chosen arbitrarily on the basis of what data happen to be available to the investigator.

The decision to restrict ourselves to sets of surviving firms has the further consequence that for some industries and some profit rate measures the number of firms concerned is too small to compute the full set of *L*-moments, with the result that we have to exclude these cases. However, although widening the study to include all firms in each year would tend to raise the number of firms included in each industry, working at the preferred four-digit level would tend to lower it again.

Sampling The objectives outlined here imply a substantial computational effort: at the two-digit level there are up to 61 industries to be examined for each profit rate measure tested, and we have five years' data for each industry. The RS2 technique used in Wells (2007) involves taking 100 samples for each profit rate measure in each year, each constructed by concatenating 100 sub-samples (to cope with the fact that the extreme ranges of the capital measures could otherwise lead to samples to be too small to be of use). We then have to calculate the first four *L*-moments for each sample, and the time taken for this increases rapidly with size of sample.

The present case involves working with up to $5 \times 61 \times 5 \times 100 = 152{,}500$ samples; since within-industry dispersion of firm size is likely to be smaller than the overall dispersion, we can take advantage of this to reduce the number of sub-samples. The ideal method would involve making the number of sub-samples depend on the shape of the firm-size distribution, but this is itself a complex topic. We therefore take the simpler approach of setting the number of sub-samples at $500/n$, where n is the number of firms in the industry.

6.2 Results

The *L*-moment analysis of inter-industry variation yields three main results, demonstrating (1) why Glick's preferred measure of gravitation performs so differently from our relativised version $\hat{V} = V_1/V$, (2) that skewness of within-industry distributions does indeed undermine the validity of inter-industry comparisons relying on means, and (3) that *L*-moments distinguish distributional models in relation to different industries as well as to different profit rate measures.

Relative *versus* absolute gravitation Glick seeks to demonstrate the existence of classical gravitation by showing that the absolute variance of the time-averages of industry profit rates is small, a quantity he denotes by V_1. As we have shown above this measure has the defect that it fails to provide a conclusive criterion in cases where V_1 is equal but total V (the total variance of annual industry rates) is unequal.

This can be removed by considering instead the relativised measure $\hat{V} = V_1/V$, but when applied at different levels of aggregation this produces counter-intuitive results for his preferred measures of the profit rate. These counter-intuitive results do not apply in the case of those measures which we regard as the appropriate marxist measures, and moreover these latter display more evidence of gravitation than do Glick's at the levels of aggregation lower than the two-digit one (used by Glick, but admitted by him to be an excessively high one).

The following charts indicate why this is so. For each of the five profit rate measures to be considered in this section, Figures 8 to 12 plot annual industry mean profit rates against annual co-efficients of *L*-variation (c*L*v) for each of the two-digit industries for which the statistics can estimated by our RS2 procedure.[13] The plotting characters denote the one-digit sector into which each two-digit industry falls; thus in a sector with five two-digit industries we will see up to 25 observations plotted.

To provide comparability without obscuring differences in structure of the data, the scales for the mean are constrained within the range -0.25 to 2.0 with the actual minimum (maximum) being the minimum (maximum) of the data if greater (less) than the standard limit; the scale for the c*L*v is from 0 to 1.0 in all cases.

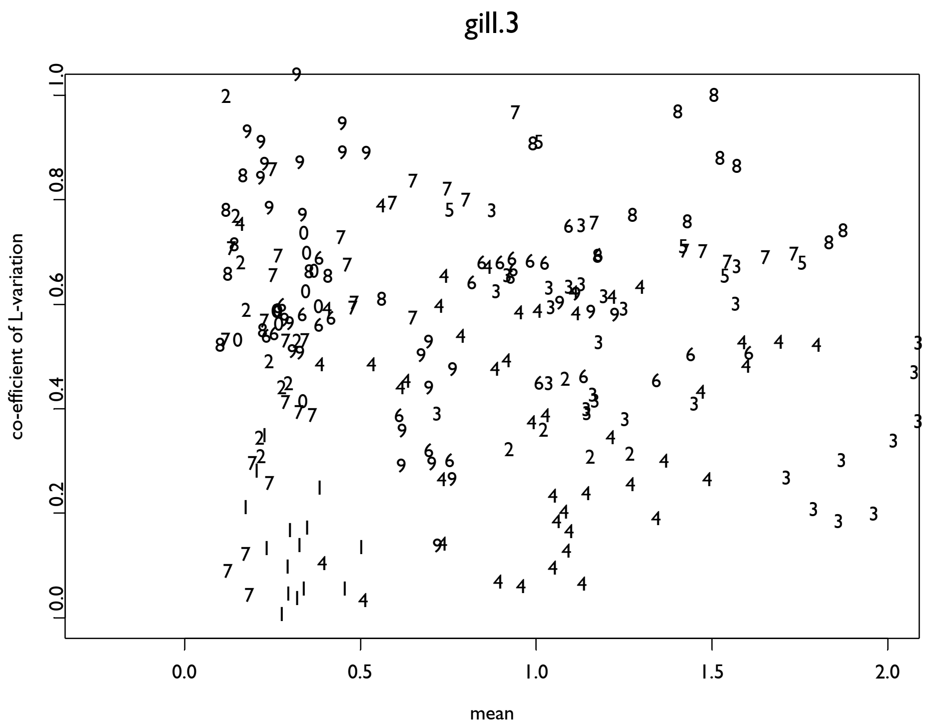

Figure 8: Gillman 3, mean/c*L*v space

[13] The restriction to firms for which there is data for all five years, coupled with the extreme skewness of firm size, means that even at the two-digit level there are in some industries too few firms to allow calculation of sample *L*-moments.

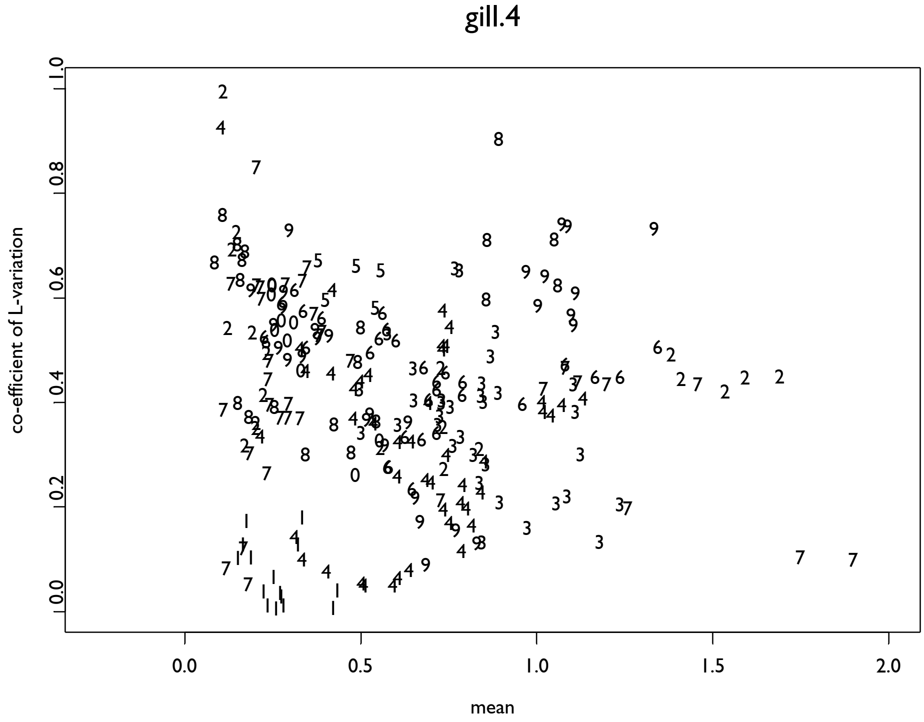

Figure 9: Gillman 4, mean/*cL*v space

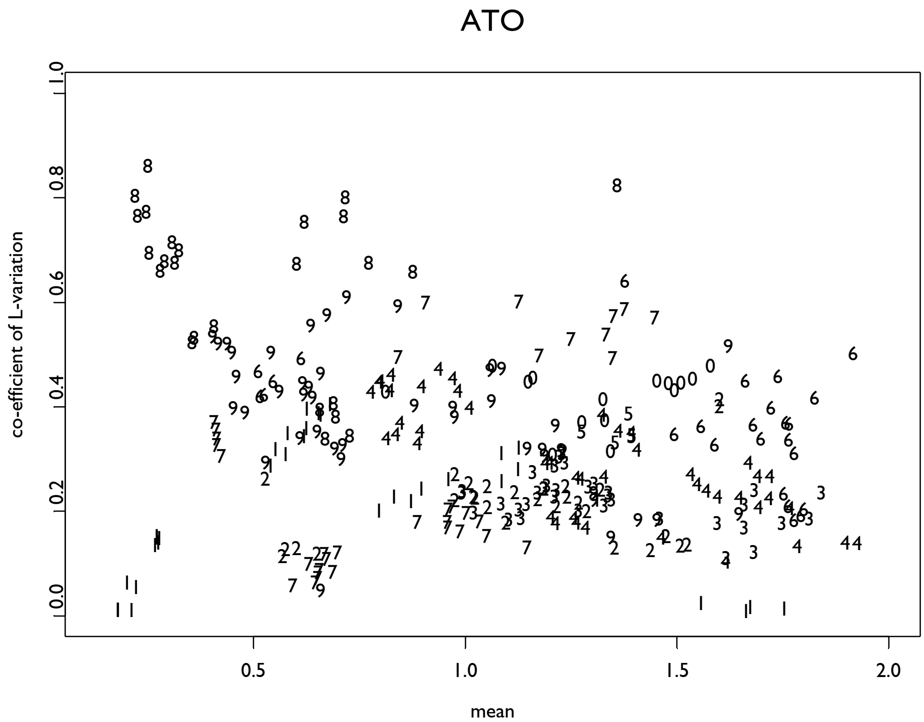

Figure 10: ATO, mean/*cL*v space

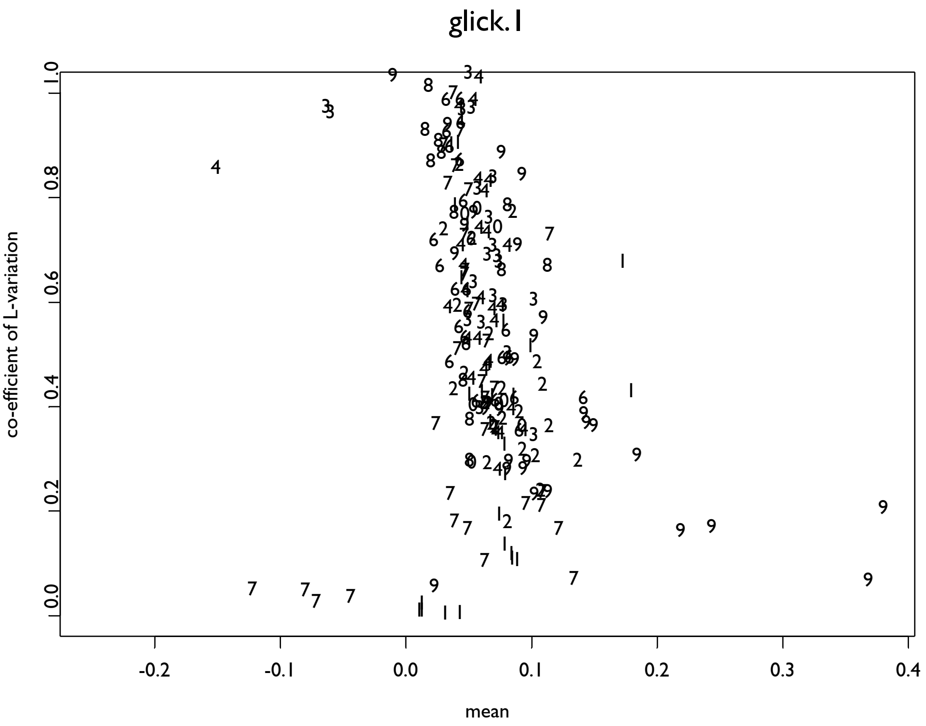

Figure 11: Glick 1, mean/*cL*v space

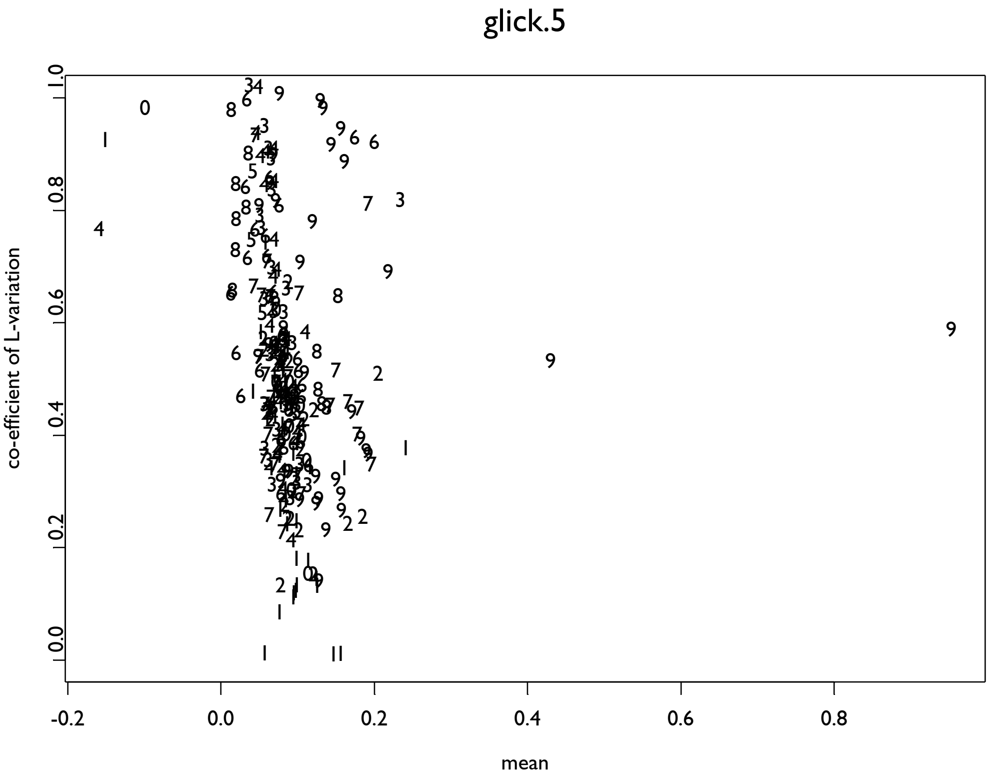

Figure 12: Glick 5, mean/*cL*v space

As can be seen from the means for the Gillman 3 and 4 measures and ATO (Figures 8, 9 and 10 respectively) are (very roughly) evenly distributed over the range between zero and 2.0. By contrast, the means of Glick 1 and 5 are highly concentrated around the 0.1 mark (Figures 11 and 12 respectively).

Recall that at the two-digit level the profit rate measure Gillman 4 had a $\hat{V}$ score of 0.4, whereas Glick 1 and Glick 5 had values in excess of 0.8, Glick 3 one of 0.6, and only Glick 6 improved (marginally) on 0.4. The implication is that notwithstanding the lower V_1 statistics (the variation of the industry time-averages) of the Glick measures when compared to other measures, they are large compared to the overall variation V of industry profit rates because the latter is also very low.

Implications of within-industry skewness We have previously pointed out that if within-industry profit-rate distributions are skewed the mean is not obviously better than, say, the mode as a statistic for assessing the gravitation of industry profit rates. The most extreme case is that of two industries with distributions which are similar in shape except for having opposite skewness; in this case equality of means implies dispersed modes and vice versa, and in either of these two eventualities a mean-based test of gravitation will give the opposite answer to a mode-based test.

The next set of figures plots RS2 estimates of *L*-skewness and *L*-kurtosis for five profit rate measures. As in the previous section each plot shows five years of observations for two-digit industries, identified by the one-digit sector to which they belong. In each plot we show the loci of a number of three-parameter location-scale-shape distributions given by Hosking and Wallis (1997); they are the generalised logistic; the generalised extreme value; the three-parameter lognormal; the three-parameter gamma, or Pearson Type III; the Weibull; and the generalised Pareto, considered from top to bottom at *L*-skewness = 0.25; also shown are the loci of several two-parameter location-scale distributions: the uniform (■ in the Figure), the Gaussian (◆), the exponential (●), and the Gumbel (▲).

L-skewness and *L*-kurtosis are bounded: considered independently, *L*-skewness can take any value in the range $(-1, 1)$ and *L*-kurtosis any value in $(-0.25, 1)$. However, there are combinations of *L*-skewness and *L*-kurtosis which no distribution can have, indicated by the shaded area of the chart.

At first glance the most obvious feature (Figures 13, 14 and 15 respectively) is that the two Gillman measures and ATO all display a marked tendency to positive skewness (in the case of Gillman 3, of a fairly extreme kind), whereas within-industry skewness of the two Glick measures is clustered symmetrically about zero (Figures 16 and 17 respectively).

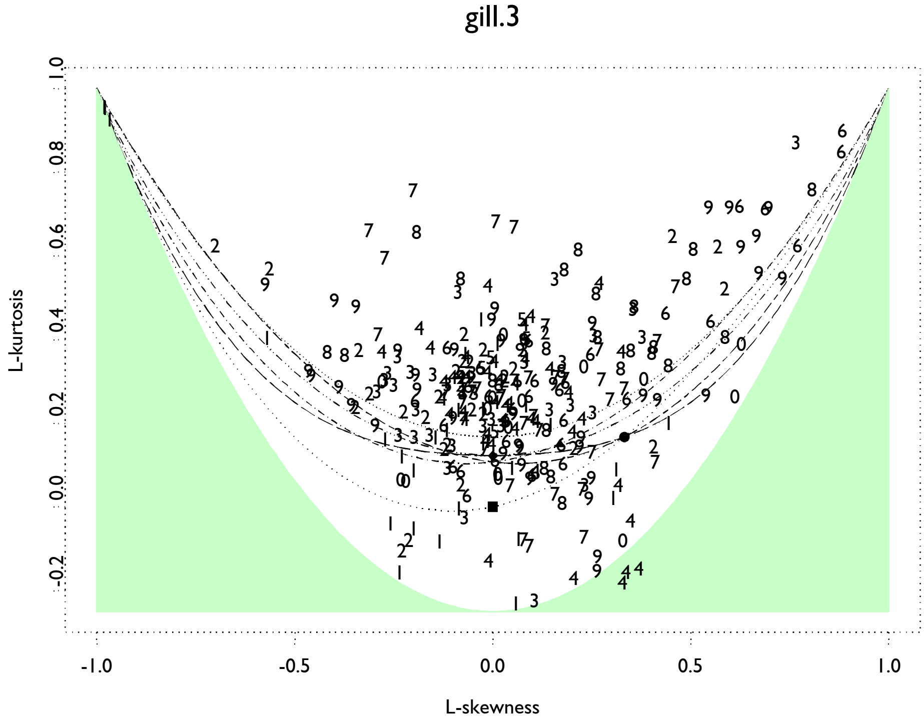

Figure 13: Gillman 3, *L*-skewness/*L*-kurtosis space

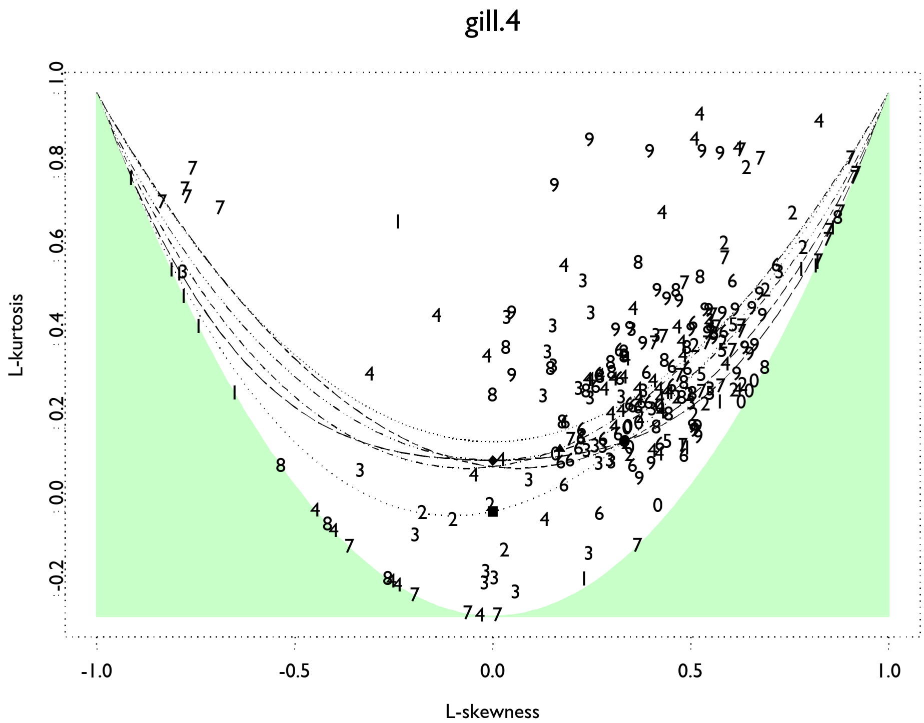

Figure 14: Gillman 4, *L*-skewness/*L*-kurtosis space

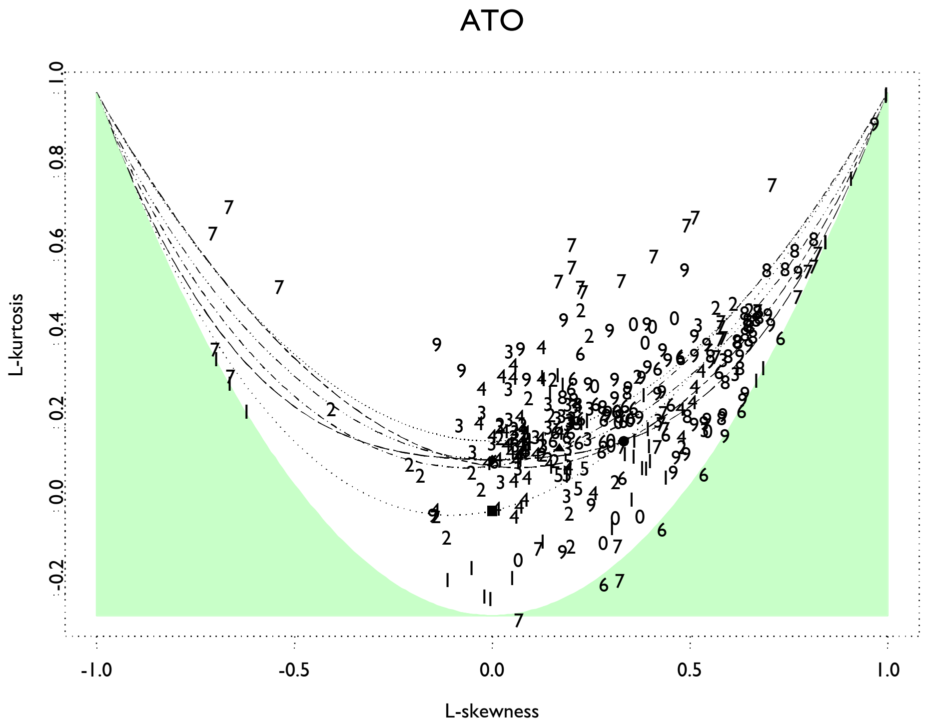

Figure 15: asset turnover (ATO), *L*-skewness/*L*-kurtosis space

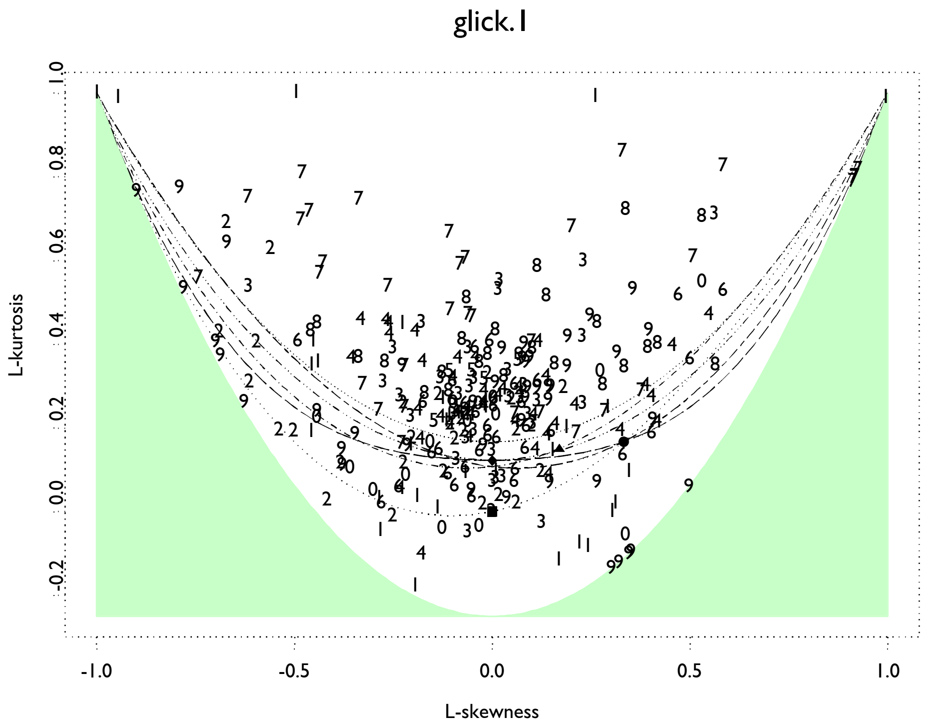

Figure 16: Glick 1, *L*-skewness/*L*-kurtosis space

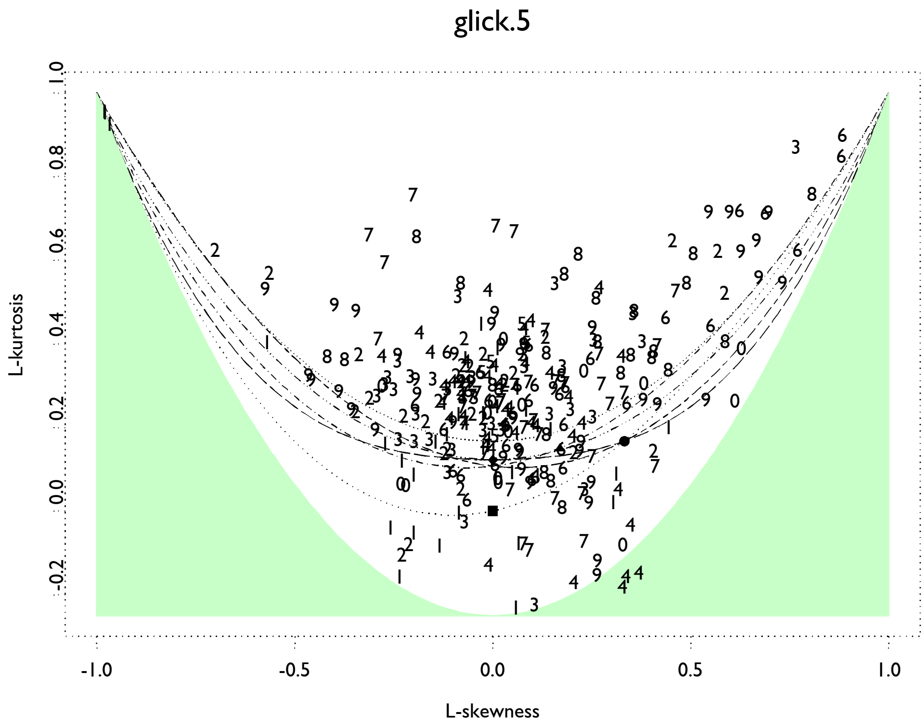

Figure 17: Glick 5, *L*-skewness/*L*-kurtosis space

It might be thought that this implies that any problem caused by skewness is thus less severe for Glick's preferred measures, but in fact the reverse is the case: taking location in *L*-skewness/*L*-kurtosis space as a summary of the shape of a (unimodal) distribution, what Figures 18 and 19 show is that for any arbitrarily-chosen industry there is a high probability of finding another industry the distribution of which has similar shape but opposite skewness, precisely the extreme case envisaged above.

Moreover, the distribution of industries in c*Lv*/*L*-skewness space is also approximately symmetrical, implying that for an industry whose distribution has arbitrary scale there is likely to be one of similar scale but opposite skewness.

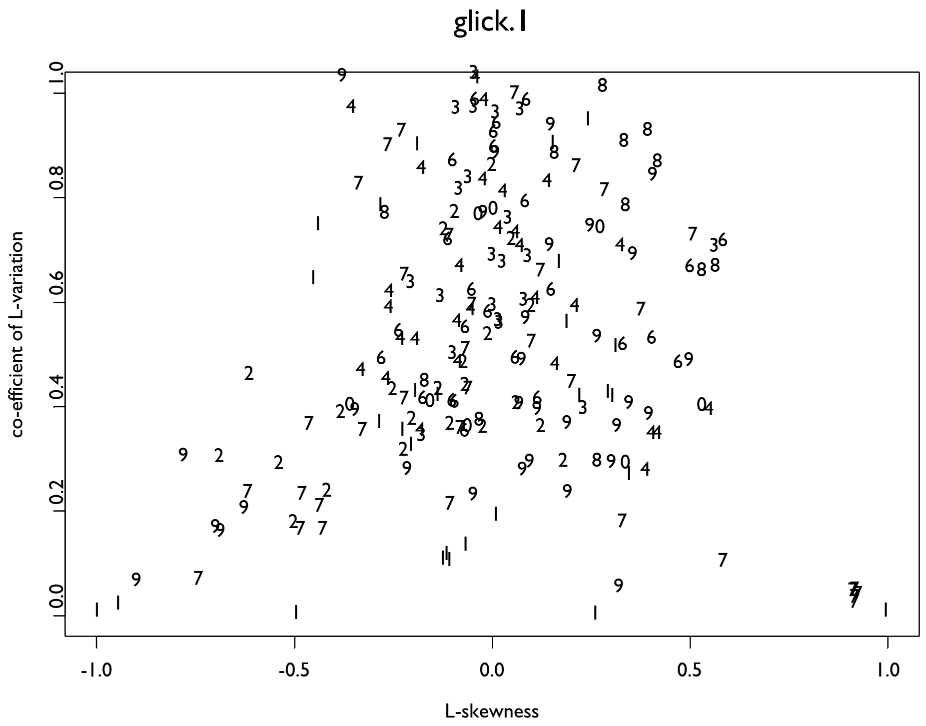

Figure 18: Glick 1, *L*-skewness/c*L*v space

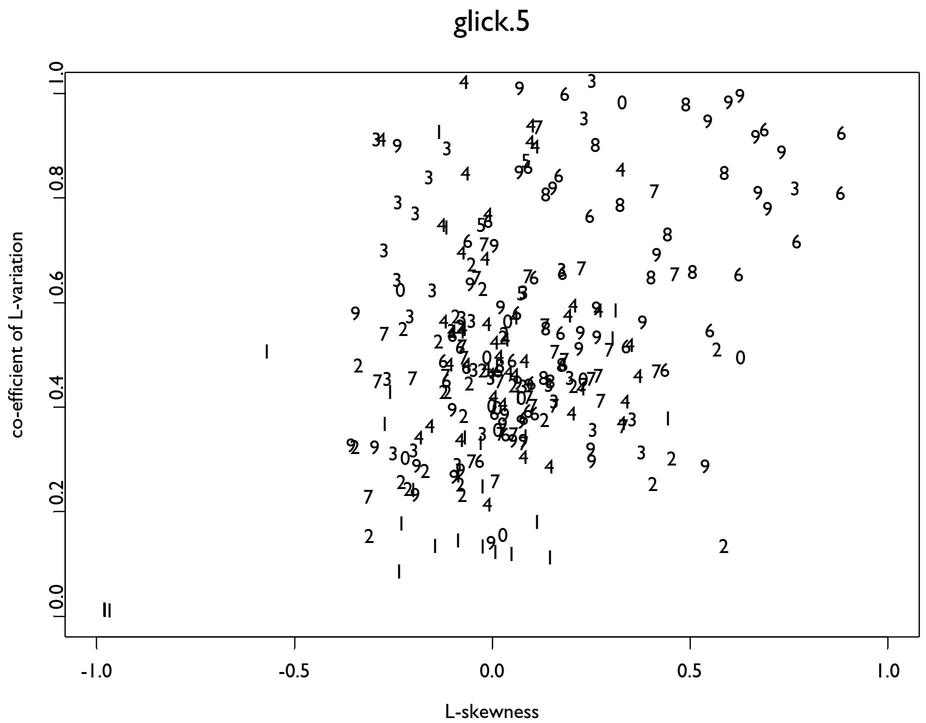

Figure 19: Glick 5, *L*-skewness/c*L*v space

Taken together these facts suggest that, if one measures two-digit industry profit rates according to Glick's preferred measures, the skewness problem suggested here is likely to be prevalent: for any particular industry there is likely to be another whose distribution is a mirror image of the first – and if their means exhibit any tendency to gravitation their modes will tend to diverge. Thus it should not be a surprise if means-based tests produce inconsistent or counter-intuitive results.

In contrast, the other profit rate measures examined here show not only strong positive correlation between skewness and kurtosis, but (not shown here) also some evidence for positive correlation between skewness and scale; thus the mirror-image case should be rare, and to that extent so should that of mean- and mode-based measures conflicting.

6.3 Resolving power of *L*-moments

Of the total of 21 profit rate measures noted in the Appendix, the only one to exhibit any trace of bi-modality over the economy as a whole is ATO. Here we show that this overall bi-modality results from a mixture of different distributional types relating to different industries, and that these different models are successfully distinguished by *L*-moment analysis.

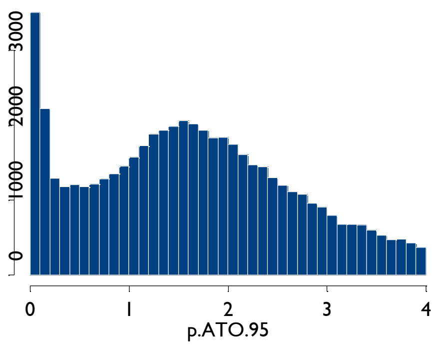

Figure 20: asset turnover rate (ATO), whole economy, firm-level distribution

Figure 20 is an enlarged version of the relevant panel of Figure 3.5, the empirical density distribution estimated by histogram. Figure 21 shows histograms of ATO for each one-digit sector; as can be seen, the sectoral distributions vary considerably in form. Note the top left panel: this shows sector 8, banking and finance, to have a pronounced spike at approximately 0–25 per cent (as does sector 5, extreme right of middle row).

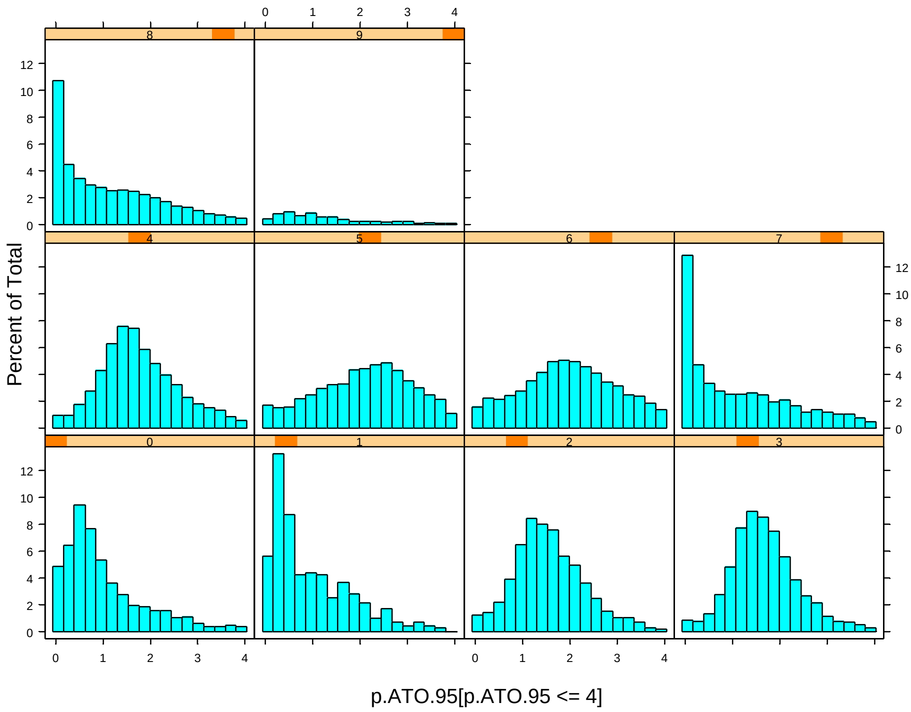

Figure 21: ATO firm-level distribution by one-digit sector

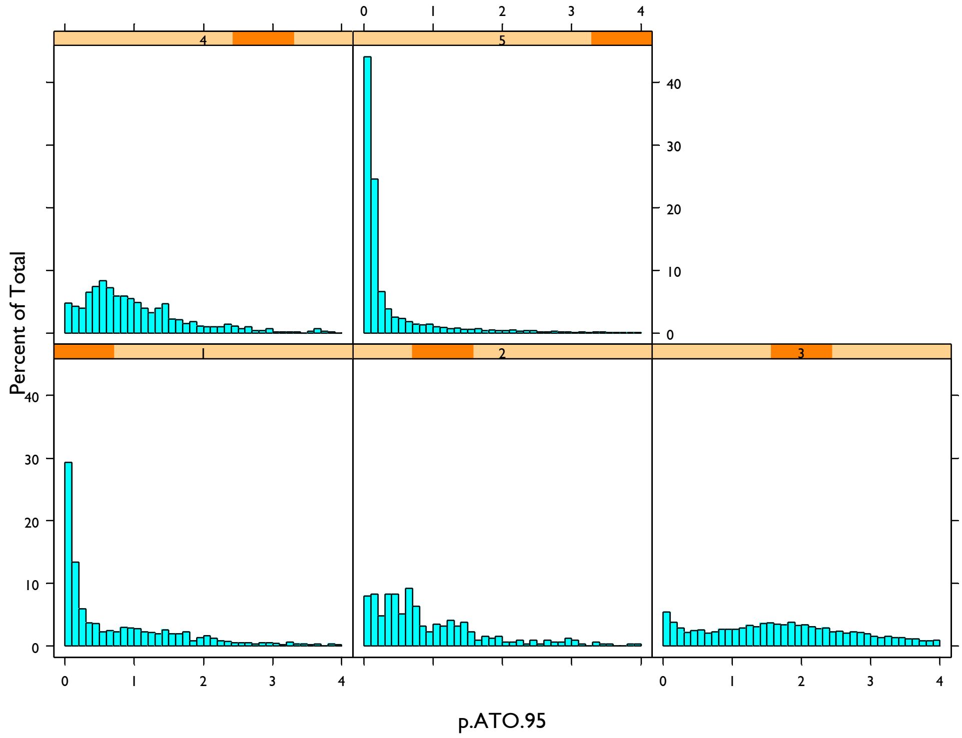

Figure 22: ATO firm-level distribution; sector 8 by two-digit industry

Moving to the two-digit level, the histogram density estimates for industries 81 to 85 are given in Figure 22. We see that the left-hand spike in sector 8 is largely due to the distributions of industries 81 (banking and finance: bottom left panel) and 85 (owning and dealing in real estate: right hand of upper row).

Of the three, the biggest contribution comes from industry 85, which is larger than 81. It will be noted that industry 83 exhibits strong bimodality on its own; investigation of this at lower levels of aggregation seems likely to reveal a further pattern of mixtures of distributions.

The charts above are of the profit rate distribution across firms, irrespective of their size, as measured by the relevant capital measure. We now show that qualitatively similar results flow from applying our RS2 method of randomly-sized capital-weighted samples.

Figures 23 to 25 show three cross-sections of *L*-moment ratio space – respectively, the *L*-skewness/*L*-kurtosis, *L*-skewness/c*L*v and mean/c*L*v planes – with five annual estimates for each of the two-digit industries within sector 8, plotted using the appropriate second digit. These reveal that with the exception of industry 84 (renting of movables) all industries in the sector have exceptionally high skewness, kurtosis and coefficients of *L*-variation (c*L*v). They also suggest that the concentration of rates around 0.1 is largely due to industries 81 (banking and finance as such) and 85 (owning and dealing in real estate), that is, industries whose 'profits' are in fact rents. All this is consistent with the evidence of the histograms.

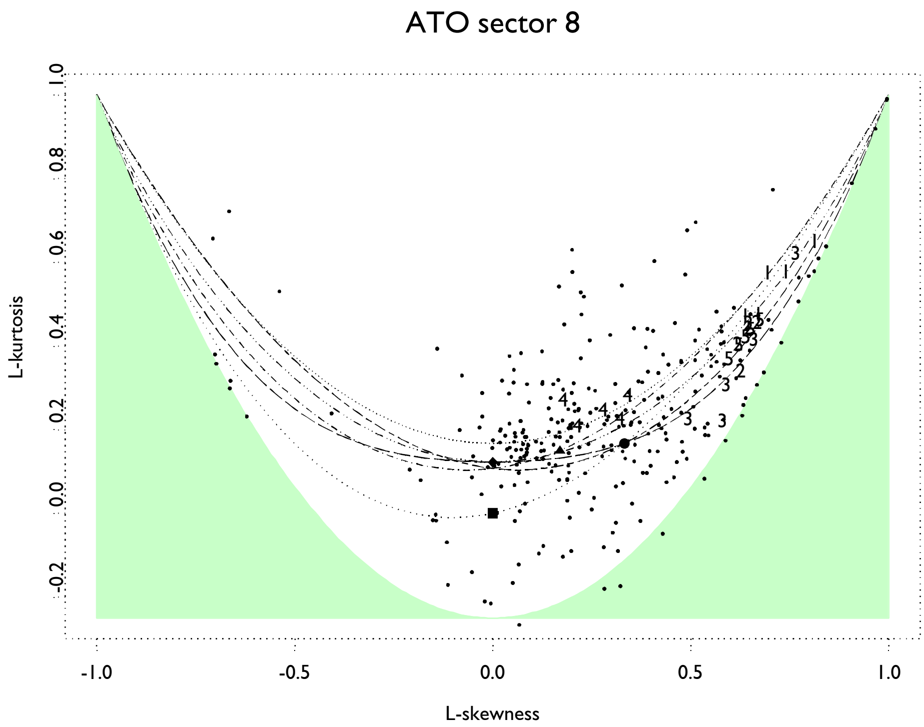

Figure 23: ATO, *L*-skewness/*L*-kurtosis space, sector 8

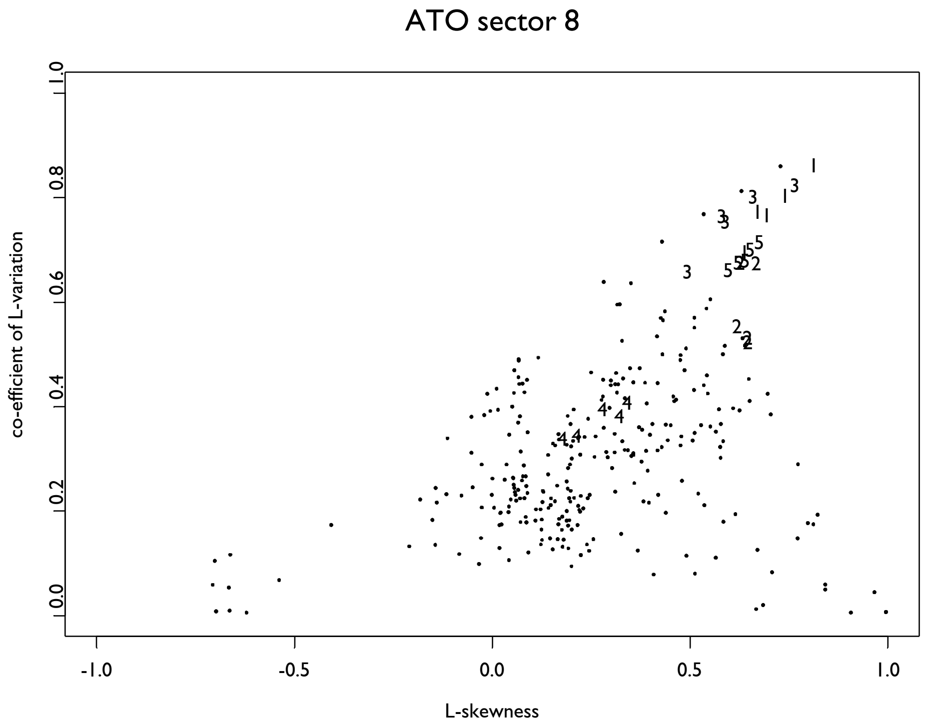

Figure 24: ATO, *L*-skewness/c*L*v space, industries 81-85

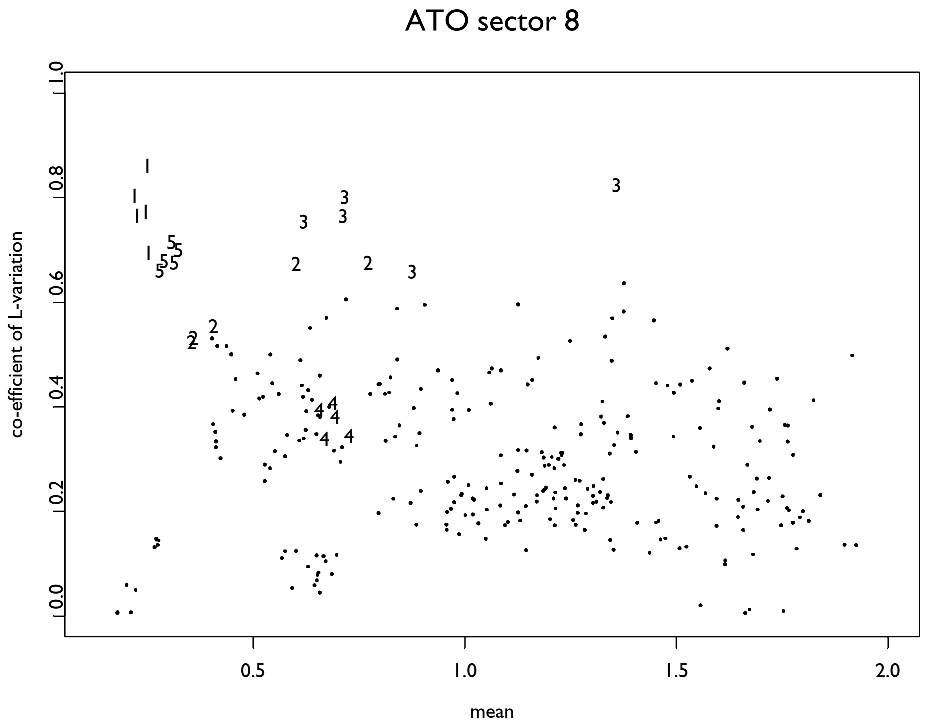

Figure 25: ATO, mean/cLv space, industries 81-85

7 Conclusion

We have argued that Glick's (1985) tests of the gravitation of industry profit rates may be questioned on several theoretical and methodological grounds: that they are at an excessively high level of aggregation (as suggested by Glick himself), are wrongly confined to consideration of manufacturing industry alone, use a questionable test statistic, focus on inappropriate measures of the profit rate, and depend on an implicit assumption that within-industry profit rates are similar in shape.

On each of these points we have shown that empirical testing with UK data confirms that our suspicions are indeed justified.

Our internal critique of Glick used tests based on his own methods: these were shown to produce different estimates of degree of gravitation at different levels of aggregation, as they also do for the whole economy as opposed to manufacturing. Only our relativised modification of Glick's test statistic escapes problems in comparing whole economy gravitation with that within manufacturing, and in comparing UK manufacturing with US manufacturing. However, our version of the statistic shows Glick's preferred measures of the profit rate to provide less evidence of gravitation than the marxist measures, directly contrary to both his theoretical assumptions and his empirical tests.

Our external critique of Glick used tests based on random-sized random samples and the method of *L*-moments to reveal the reason for the results of the preceding work. His profit rate measures show that the overall dispersion of industry profit rates is very small, while the dispersion of industry time average rates is large compared to this overall dispersion; with the marxist measures the industry time averages have a large dispersion, but this is small relative to the overall dispersion. Independently of this, Glick's assumption that convergence of mean rates is a reliable measure of gravitation is shown to be questionable in respect of his preferred profit rate measures (but, ironically, Gillman's marxist ones are less likely to be so), because of the possibility of radically different distributions of profit rates within industries at the two-digit level of aggregation.

Table 5: Profit rate measures in Glick and Gillman, and accounting ratios

PRM	Type	Description	Notes
gill.1	Flow	no depreciation	Gillman (1957) describes this as the 'traditional' Marxist measure
gill.2	Flow	with depreciation	
gill.3	Stock	Fixed capital only	
gill.4	Stock	Fixed and circulating constant capital	
gill.5s	Stock	Fixed capital, diminished *s* (unproductive labour is deducted from profits)	See also glick.8
gill.5f	*Flow*	depreciation, diminished *s*	Not actually calculated by Gillman, but mentioned as a possibility, though he claims that it is 'less pertinent' to the practical operation of capitalist enterprise; thus we add *s* and *f* to the subscripts
gill.6	Flow	augmented c *(and* diminished *s)*	Here unproductive expenditure is considered as a form of circulating constant capital.*Note* that although the text suggests (page 98) that Gillman intends to augment *c instead* of diminishing *s*, it is clear from line 8 of his Table I (page 99) that he in fact calculates it as shown in his Table 3.1 in Chapter Three.
gill.7s	Stock	diminished *s* with taxes	Gillman describes this as the 'capitalist' measure; he calculates this for three years only, reported in his Table K, page 102
gill.7f	*Flow*	diminished *s* with taxes	Not discussed or calculated by Gillman, but included for comparison with gill.5s and gill.5f
ORE	Stock	Operating return on equity	See also Glick 6
ROCE	Stock	Return on capital employed	See also Glick 1
ATO	Flow	Asset turnover	
NPM	Stock	Net profit margin	See also Glick 7
glick.1	Stock	(profit + net interest)/total assets	See also ROCE
glick.2	Stock	(profit + net interest)/(net plant + inventories + cash)	
glick.3	Stock	Profit/total assets	
glick.4	Stock	Profit/(net plant + inventories + cash)	
glick.5	Stock	(profit + depreciation)/total assets	
glick.6	Stock	Profit/equity	See also ORE
glick.7	Flow	Profit/sales	See also NPM
glick.8	Stock	(profit + net interest + taxes)/net plant	See also gill.5s

Notes: (1) in column 1 profit rates are labelled by the object names used in computations; thus Gillman 1 is labelled gill.1, Glick 1 as glick.1, *etc.* (2) see Wells (2007), Chapter Three for discussion of the use of FAME data to compute these rates.

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