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Increasing Returns in Futures Markets

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by

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ABSTRACT

This paper reviews the evidence for the hypothesis of increasing returns in Classical Economics, and addresses this hypothesis using data for several contracts traded on the Sydney Futures Exchange. It is argued that the ask-bid spread (a key transaction cost and a measure of liquidity) is a decreasing function of volume for both growing and declining contracts.

While almost all variables are integrated of order I(1), ask-bid spread and volume are cointegrated in two cases only. Estimation is by instrumental variables in the presence of an endogenous regressor. For two contracts the results clearly support the increasing returns hypothesis, while for the other two contracts, although parameter estimates are of the expected sign, statistical significance is lacking. There appears, therefore, to be evidence of increasing returns to liquidity. The implication of this is that concentration of futures trading is to be expected, both geographically and within exchanges.

INCREASING RETURNS IN FUTURES MARKETS

I

INTRODUCTION

Some major economists of the classical period thought that manufacturing activities were a prime candidate for increasing returns, and if they had written in the second half of the twentieth century they may have thought the same of some markets in the financial sector. Futures markets provide facilities for risk management. arbitrage and speculation. Our distinguished guest, Nobel Laureate Professor Kenneth J. Arrow, has written on futures markets, including his Presidential Address to the Western Economic Association International Conference in San Francisco 1981, in which he argued that prices in futures and securities markets over-react to new information, when account is taken of information received in the past and the potential receipt of future information (published as Arrow (1982)).

This paper investigates the question of increasing returns in futures markets with respect to a key transaction cost, the ask-bid spread, using data from some key contracts on the Sydney Futures Exchange, which is ranked around number ten in the world (according to volume). In Section II the concept of increasing returns in the work of Smith, Ricardo and J.S. Mill is discussed. It is suggested that while there is strong support for the idea of increasing returns in manufacturing, the concept is not unambiguous.

In Section III the economic functions of futures markets are outlined, and previous research on transactions costs and liquidity in futures markets is discussed. It is suggested that the ask-bid spread is a key transaction cost and a measure of liquidity, and can be expected to vary negatively with volume. Data are defined and tests performed for unit roots, and cointegration of non-stationary variables, in Section IV. Estimation procedures, also, are outlined in this section. In Section V results are presented, and the economic implications and policy significance of these results are discussed. Some conclusions are presented in Section VI.

II

HISTORICAL BACKGROUND

In the *Wealth of Nations*, Adam Smith argues that division of labour increases the productivity of labour. His three reasons for this outcome are well known: they are first, the increased dexterity of the workmen; second the reduction in time lost from changing jobs; and third, the consequent encouragement of the use of machinery (I, 11-14). In his famous pin-making example, he shows that the division[1] of labour leads to output increments which are far more rapid than the increase in all inputs (I, 8-9). The implications of this to Smith were, that while an increase in demand might raise the prices of manufactured goods in the short run, in the long run such prices would be reduced, as in the following passage:

> "The increase of demand, besides, though in the beginning it may sometimes raise the price of goods, never fails to lower it in the long run. It encourages production, and thereby increases the competition of the producers, who, in order to undersell one another, have recourse to new divisions of labour and new improvements of art, which might never otherwise have been thought of."
>
> (II, pp. 271-272)

Hollander (1973, pp.142-143) suggests that Smith's argument implies both a movement along a given production function and a shift in production function. Nevertheless, he interprets Smith to mean that the application of machinery and the invention of new machinery would follow increased specialization of labour, and that these developments would be undertaken by large firms only.

The accumulation of capital is both a pre-requisite and a post-requisite of the division of labour. It is a pre-requisite because, with specialization, a labourer cannot purchase his requirements until he has completed and sold his work, so that a stock of goods must be accumulated beforehand to provide him with materials and maintenance during the period of production. It is a post-requisite to provide the extra materials which a given number of men will process with division of labour, and to provide the machinery which employers will wish to introduce.

In the *Wealth of Nations*, the increased productivity stemming from the division of labour is both a means of and a reason for the demand for capital. While Smith devotes an important discussion to the process by which capital is increased, focussing on the path of saving into the wages fund, and then to workers' consumption expenditure, there is, in the *Wealth of Nations*, no discussion of the cost of capital. There is no suggestion that saving involves a sacrifice, and hence the only justifications offered for the receipt of profits are the risks taken and the trouble of investing capital.[2]

It should be noted that Smith did not think that division of labour was an unqualified benefit from the point of view of the labourer. He thought that specialization would make the ordinary labourer

> ". . . . as stupid and ignorant as it is possible for a human creature to become. The torpor of his mind renders him, not only incapable of relishing or hearing a part in any rational conversation, but of conceiving any generous, noble, or tender sentiment, and consequently of forming any just judgment concerning many even of the ordinary duties of private life."
>
> (II, 302-303)

Smith implied that the government should take steps to prevent these physical and mental ill effects of the division of labour (II, 303). Finally, it should be observed that while Smith had discussed the division of labour, and increasing returns in the pin-making example, in the *Glasgow Lectures* 1763, pp. 163-73, the concept of the division of labour is not an integral part of a theory of stock in the *Lectures*. Indeed, the *Glasgow Lectures* do not contain such a theory, and this part of Smith's work was developed mainly during his visit to France 1764-

66, and afterwards. (This is not to imply that Smith was totally indebted to the Physiocrats on this matter; see I, xxix; Dobb 1973, p.41.)

In David Ricardo's *Principles of Political Economy* (1821), division of labour is seen as a key factor, along with improvements in machinery and "increasing skill, both in science and art, of the producers", in reducing the natural price of all commodities, except agricultural produce[3] and labour, with economic progress (I, pp. 93-94). In manufacturing, Ricardo thought this tendency more than counterbalances the tendency to rise of the price of raw material components of manufactured goods (I, p.94). In his *Essay on Profits* (1815), Ricardo thought that improvements in division of labour in agriculture may occur, but would be unlikely to offset the tendency to diminishing returns (IV, p.412).

The argument of Ricardo, that with economic progress, the prices of manufactured goods tend to fall, could be interpreted, like that of Smith, to embrace both a movement along and a shift in, the production function. On the other hand, when discussing diminishing returns in the agriculture, Ricardo, in the *Essay on Profits* (1815), explicitly assumed "that no improvements take place in agriculture . . . " (IV, p.12).

John Stuart Mill (1848) in his *Principles of Political Economy* also thought that in agriculture, given "the state of agricultural skill", increased labour leads to a less than proportionate increase in agricultural produce. In manufacturing, however, Mill thought that the productive power of labour tends to increase with economic progress, and that "The larger the scale on which manufacturing operations are carried on, the more cheaply they can in general be performed" (pp. 702-703).

While there was strong support, therefore, for the concept of increasing returns in manufacturing among key classical economists, and especially in the work of Smith and Ricardo, the concept was not entirely unambiguous.

III

PRODUCTION AND COSTS IN FUTURES MARKETS

Futures contracts provide for delivery of a commodity or financial instrument, or settlement, at a specified future date at a specified location. These contracts are standardized with respect to quantity, quality, delivery date and delivery location. Futures contracts are traded on organized exchanges, where most contracts are closed out by reversal rather than by delivery. Futures markets are impersonal in the sense that to each buyer or seller the identity of the other contracting party is a matter of indifference, because a clearing house interposes itself between buyer and seller, and guarantees all transactions. This compares with spot markets, which generally are personal in this sense. Futures contracts may be compared with forward contracts, which typically are not standardised, but are tailored to the needs of the parties, are typically executed by delivery, and normally are not traded on exchanges.

Futures markets provide facilities for three types of transaction: the first is hedging; the second is arbitrage; while the third is speculation. Since the important contributions of Holbrook Working (see, for example Working 1953a, 1953b, 1962) hedgers have been regarded as agents who pursue the dual objectives of risk reduction and uncertain monetary gain (this decision-making process has been studied in an expected utility framework by Stein (1961, 1964), Johnson (1960) and others). In the classic contributions of Keynes (1930) and Hicks (1939), hedgers were regarded as agents who pursued risk reduction alone. Arbitrageurs trade in two financial instruments, often for the same commodity, with the objective of certain gain. (For example, if the futures price for a certain delivery date exceeds the current spot price by more than the marginal net cost of storage, then a riskless gain is to be had by buying spot, selling futures and making delivery.) Speculation, on the other hand, describes the activity of agents who take additional risk in the pursuit of uncertain gain. Some hedging and arbitrage type transactions pursue uncertain profit, and therefore contain speculative elements.

Veljanovski (1986, pp. 25-26) has argued that futures markets develop because they are a more efficient means of transferring certain bunles of property rights attached to price; that is futures markets permit agents to undertake some transactions at lower cost than do spot and forward markets. This is not true for all types of transaction: for example, a woollen mill producing fine woollen yarn would almost certainly find the spot market the most efficient means of obtaining the fine wool required.

The extent to which futures markets provide the facilities outlined above may be measured by the volume of transactions per period of time, or by the number of open positions (contracts) at a point in time. These two measures of production are likely to be generally, but necessarily perfectly, correlated: for example, the development of intra-day trading would be reflected in the growth of turnover, but not in open positions at the end of the day.

This paper focuses on the volume of transactions as a measure of production. It is assumed that increased volume (V, measured by the number of contracts traded) is normally accompanied by increased inputs of three types:

a) brokerage services (B) by members of the exchange, representing the contribution of the futures exchange to the execution of the transaction;

b) clearing house services (S), which are called into play as soon as an agent's position is opened; the clearing house must record the price at which the position is opened, and must account for the deposit margin, and any subsequent variation margins;

c) the information (I) which the futures exchange collects, processes and disseminates in the form of price quotations and other transaction data.

It is assumed that an increase in each of these inputs requires an increased dose of labour and capital in the Ricardian sense (see Ricardo (1821)). It is possible, however, that the labour and capital within a particular class of input may be substitutes, a relationship which was not allowed for in the Ricardian analysis. This production function may be written

$$V = f(B, S, I) \qquad (1)$$

where $f_B, f_S, f_I > 0$.

Normally, B, S and I would increase together in providing an increase in V. If the additional transactions were held for a long period, then B might increase faster than S. On the other hand, if increased trading were due to increased hedging activity which was essentially risk reducing in nature, with little in the way of financial innovations, then B might increase faster than I.

When all inputs increase by a proportion g, then volume increases by a proportion g^m; that is,

$$V = f(gB, gS, gI) \qquad (2A)$$
$$= g^m . f(B, S, I) \qquad (2)$$

and if m > 1 returns to scale are increasing.

The costs of transacting in futures markets are first brokerage (commission) fees, second clearing house fees, and third the ask-bid spread. The first two costs are charged directly to economic agents by exchange members and the clearing house respectively. The ask-bid spread is a search cost and would be expected to vary inversely with the liquidity of the market. If V is small, then little information is processed, and the ask-bid spread will be large. On the other hand, as V increases, more information is processed and the ask-bid spread becomes narrower. This spread is part of the cost of matching bids and offers: it is a cost to both buyer and seller, because it means that the buyer pays more, and the seller receives less, than desired in order to execute a transaction.

Telser and Higinbotham (1977) employ the standard deviation of market clearing prices as a measure of market liquidity. They argue that the distribution of market clearing prices is asymptotically normal[4]. Hence, these authors claim that the standard deviation of market clearing prices is a decreasing function of the square root of the number of transactions (p.976). On the basis of this argument, Telser (1981, p.17) argues that there are increasing returns to liquidity: one large market is more liquid than two markets, each half the size. Telser and Higinbotham (1977, pp. 995, 998) also found, in their empirical work on 51 commodities traded on US exchanges, that commission charges varied negatively with volume, but directly with open interest.[5]

In this paper the relationship between volume and ask-bid spread only is studied. The hypothesis addressed is that the ask-bid spread is a decreasing function of volume. This hypothesis is based on the concept of increasing probability of success, for an economic agent, as volume increases. For a potential buyer, *success* is defined as an ask price sufficiently close to the bid price for a transaction to occur (a corresponding definition could be employed for a potential seller). It is assumed that the probability of success is given by the Binomial Distribution. Then the probability of x successes is given by:

$$f(x) \quad = \quad \frac{n!}{x!(n-x)!} p^x q^{n-x}$$

where x = number of successes;
n = number of trials;
p = probability of success (in a single trial);
q = probability of non-success.

Substitution in the above formula will show that the probability of zero successes decreases as n increases; hence the probability of one or more successes must increase with n. *It is assumed in this paper that the ask-bid spread varies negatively with the probability of one or more successes.*[6]

Published data only are employed. The Chicago Board of Trade *Statistical Annual* and Chicago Mercantile Exchange *Yearbook* do not include data on ask and bid prices. The Sydney Futures Exchange began publication of a *Statistical Yearbook* in 1980, and published daily quotations of ask and bid prices from 1980 through 1991. In this paper, three representative contracts are studied: the 90 Day Bank Accepted Bills contract (both spot month and near future), the Ten Year Bond contract (spot month only) and the US dollar contract (spot month only). The first two are examples of current, successful contracts, frequently trading in excess of 20,000 lots per day for the spot month future. The US dollar contract is an example of a futures contract which had limited success, then traded thinly, and was subsequently delisted. It is included here for purposes of comparison; the hypothesis investigated presumably is reversible, and the ask-bid spread would be expected to widen as volume declined.

The 90 Day Bank Accepted Bills contract was introduced in October 1979, and was for many years the most heavily traded contract on the Sydney Futures Exchange. It provides for delivery of bank accepted bills of exchange, with a face value of A$500,000 in the months of March, June, September and December. It has developed significant liquidity in both the spot month future (the contract nearest to delivery) and the near future (the contract second closest to delivery), with average monthly volume of 474,800 contracts in 1992.

The Ten Year Commonwealth Government Treasury Bond contract began trading in December 1984, and also is a successful contract, with average monthly volume of 354,400 contracts in 1992. The contract refers to Commonwealth Government Bonds with 10 years to maturity with face value of A$100,000, and provides for mandatory cash settlement in the months of March, June, September and December. While this contract has developed significant liquidity, this is confined to the spot month, with the near future trading thinly.

The US dollar contract began trading in March 1980, and with a contract value of US$100,000, provided for mandatory cash settlement in the months of March, June, September and December. Although average monthly volume reached 3,597 contracts in 1982 (with a monthly maximum of 7,037 in July 1982), it had fallen to 976 contracts for the first half of 1987, and in September 1987 this contract was delisted. It was replaced by an "Australian Dollar" contract in February 1988 with face value A$100,000 and prices quoted in US cents per Australian dollar. This contract, however, traded thinly also, and was delisted in September 1991. (Results reported in this paper do not include the "Australian Dollar" contract).

To test the hypothesis that the ask-bid spread is a decreasing function of volume for these various contracts, the relationships are specified as follows: for Bank Accepted Bills (spot month) the ask-bid spread is observed two months prior to maturity, so that the relationship is

$$V_t = \alpha_0 + \alpha_1 ABP_{t,t+2} + e_t \quad (3)$$

where V = volume in contracts;

ABP = ask-bid spread as defined in Section IV;

t = time in months;

t+2 = delivery date of futures contract

e_t = error term;

α_0 = constant; $\alpha_1 < 0$

For the Bank Accepted Bills (near future) contract, the ask-bid spread is observed five months prior to delivery; hence the relationship is:

$$V_t = \alpha_o + \alpha_1 ABP_{t,t+5} + e_t \quad (4)$$

where t+5 = delivery date of futures contract.

For the Ten Year Bond (spot month) contract, the ask-bid spread is observed also two months prior to the maturity date; hence the relationship is:

$$V_t = \alpha_0 + \alpha_1 ABP_{t,t+2} + e_t \quad (5)$$

Similarly, in the case of the US dollar (spot month) contract, the ask-bid spread is observed two months prior to maturity, giving

$$V_t = \alpha_0 + \alpha_1 ABP_{t,t+2} + e_t \quad (6)$$

It is convenient to write these equations separately for the different contracts, because of the differential implications which unit root and cointegration tests may have upon these specifications.

IV

DATA, UNIT ROOT AND COINTEGRATION TESTS, AND ESTIMATION

DATA

Prices for Bank Bills and Ten Year Bond contracts traded on the Sydney Futures Exchange (SFE) are quoted as 100 minus the yield (in per cent per annum). The ask-bid spread (ABP) is defined as

$$[\text{ (ask price - bid price) / bid price}] \times 10^3$$

These prices are observed on the median trading day of the month. Observations for Bank Bills (spot month) are for a contract with maturity two months from the date of observation. Bank Bills mature in March, June, September and December; hence the ask-bid spread is observed in January, April, July and October. Volume (V) is the number of spot month futures contracts traded on the median trading day of the month. The sample period for estimation of the relationship for Bank Bills (spot month) is (01)1980 to (12)1990; after allowance for differencing and lags in instrument selection the number of observations is 41.

Observations for Bank Bills (near future) refer to the next contract with maturity after the spot month. Observations on ABP for the near future are made also in January, April, July and October; in January the near future is for June delivery; hence the delivery date for the near future is five months from the observation date. Ask-bid spread (ABP) and volume (V) for the near future are defined in terms corresponding to those above for the spot month. The basic sample period also is identical, although allowance for differencing and instrument lags in this case results in 40 observations.

Ten year Bond futures contracts mature also in the months of March, June, September and December. The ask-bid spread and volume are defined as above for Bank Bills, and are observed for the spot month contract only, two months prior to maturity, on the median trading day of the month. The basic sample period for Ten Year Bonds is (01)1985 to (12)1991, and after allowance for differencing and instrument lags, there are 26 observations.

Prices for the US dollar contract were quoted in Australian cents per US dollar, with maturity in the same months as discussed above. The ask-bid spread and volume are defined as above, and are observed for the spot month contract only, two months prior to maturity, on the median trading day of the month. The basic sample period is (04)1980 to (07)1987, which results in 29 observations after allowance for lags in instrument selection. Data on prices and volume for all contracts were taken from the Sydney Futures Exchange *Statistical Yearbook* 1980-81.

UNIT ROOT AND COINTEGRATION TESTS

To obtain meaningful estimates of the parameters of equations (3) to (6), it is necessary that the residuals of the estimating equations are stationary. This condition will be fulfilled if all the variables in these equations are stationary (i.e. integrated of order I(0)), or alternatively, if these variables are integrated of order I(1) or higher order, this condition will be fulfilled only if the non-stationary variables are integrated of the same order and are cointegrated. The first step in this procedure is to determine the order of integration of the variables in the model.

In the autoregressive representation of the time series

$$Z_t = \rho Z_{t-1} + e_t \tag{7}$$

where Z is an economic variable, ρ is a real number, and e_t is NID $(0, \sigma^2)$, if $|\rho| < 1$, Z_t converges to a stationary series as $t \rightarrow \infty$. On the other hand, if $\rho = 1$, there is a single unit root and Z_t is non-stationary, while if $|\rho| > 1$, the series is explosive.

Tests of the hypothesis H(ρ = 1) in (7), and for variations of this model with constant and time trend, were developed by Dickey and Fuller (1979, 1981). Critical values for these tests are given in Fuller (1976) and Dickey and Fuller (1981). These tests were extended by Said and Dickey (1984) to accommodate autoregressive processes in e_t of higher but unknown order. In this latter case the model is augmented by lagged first differences in Z to render e_t as NID $(0, \sigma^2)$, and the hypothesis H(ρ = 1) is tested by the Augmented Dickey-Fuller Test (ADF).

In this paper the following models were estimated by ordinary least squares (OLS) to test the hypothesis of a unit root in all variables in equations (3) to (6):

$$\Delta Z_t = \mu + \beta t + \gamma Z_{t-1} + e_t \tag{8}$$

$$\Delta Z_t = \mu + \gamma Z_{t-1} + \Phi_1 \Delta Z_{t-1} + e_t \tag{9}$$

$$\Delta Z_t = \mu + \gamma Z_{t-1} + \Phi_1 \Delta Z_{t-1} + \Phi_2 \Delta Z_{t-2} + e_t \tag{10}$$

$$\Delta Z_t = \mu + \beta t + \gamma Z_{t-1} + \Phi_1 \Delta Z_{t-1} + e_t \tag{11}$$

$$\Delta Z_t = \mu + \beta t + \gamma Z_{t-1} + \Phi_1 \Delta Z_{t-1} + \Phi_2 \Delta Z_{t-2} + e_t \tag{12}$$

where μ = constant;

β, Φ_1, Φ_2, are coefficients to be estimated;

e_t is assumed to be NID $(0,\sigma^2)$.

Models (8), (11) and (12) contain a time trend, (9) and (11) contain a single lagged value of ΔZ_t, and (10) and (12) contain two such lagged values.[7] In such cases (7) was estimated first, the other models being estimated as necessary to whiten e_t. The hypothesis H (ρ = 1) is addressed by testing the hypothesis H (γ = 0) in (8)-(12). This is executed by the ADF test, although it is now preferable to refer to critical values of MacKinnon (1991), which are based on more replications than the original Dickey-Fuller tables. Calculated ADF statistics, together with 5 per cent and 10 per cent critical values from MacKinnon (1991), are provided in Table 1 for all variables in (3)-(6). The low power of these tests is acknowledged in this case for only one (see Evans and Savin, 1981); in this case, for only one of the variables in equations (3) to (6), namely the 10 Year Bond ask-bid spread is the hypothesis of a single unit root rejected. For all other variables this hypothesis is not rejected, thus supporting the view that these other variables are non-stationary.

In equations (3), (4) and (6) there are two I(1) variables ABP and V. While ABP and V are non-stationary, it is possible that a linear combination of these variables, in each of (3), (4) and (6), may be stationary, i.e. they may be cointegrated, in which case the residuals of these equations will be stationary. To investigate whether these I(1) variables are cointegrated, the cointegration test analysed by MacKinnon (1991), which is based on the work of Engle and Granger (1987), was employed. The Engle-Granger technique is adequate in this case, because the question of cointegration refers to two variables only.[8] This test requires first that a relationship between the I(1) variables, such as the following, be estimated by OLS

$$V_t = \theta_1 + \theta_2 ABP_{t,t+k} + \theta_3 t + u_t \qquad (13)$$

where (t+k) is the maturity date of the futures contract. The hypothesis of no cointegration in (13) is addressed by testing the hypothesis that the estimated residuals ($\hat{u}_t$) in (13) contain a unit root. To test the hypothesis of a unit root in ($\hat{u}_t$) the following model was estimated for Bank Bills (near future):

$$\Delta\hat{u}_t = \gamma\hat{u}_{t-1} + \Phi_1\Delta\hat{u}_{t-1} + \Phi_2\Delta\hat{u}_{t-2} + e_t \qquad (14)$$

while for Bank Bills (spot month) and the US dollar contract the following model was appropriate:

$$\Delta\hat{u}_t = \gamma\hat{u}_{t-1} + e_t \qquad (15)$$

The hypothesis H ($\gamma = 0$) was tested using the Augmented Engle-Granger (AEG) test. As Table 2 shows, this hypothesis was not rejected at 5% for Bank Bills (near futures), but was rejected at 1% for Bank Bills (spot month) and the US dollar contract. These results support the view that the I(1) variables in equation (4) are not cointegrated, while in equations (3) and (6) the tests suggest that these variables are cointegrated.

These tests have implications for the specification of equations (3) to (6). In the case of Bank Bills (near future) where the volume and ask-bid spread are both I(1), but not cointegrated, the first difference has been taken of both variables in the interest of achieving stationary residuals. This re-specification also preserves the meaning of the coefficients in the original equation; hence the specification is now

$$\Delta V_t = \alpha_0 + \alpha_1 \Delta ABP_{t,t+5} + e_t \qquad (4A)$$

For both Bank Bills (spot month) and the US dollar, where the volume and ask-bid spread are both I(1) but evidently cointegrated, no change in specification was required, and both relationships were estimated in level form, as in (3) and (6). In the case of the 10 year Bond contract the volume only is non-stationary, and in the interest of achieving stationary residuals in (5), the first difference of V_t has been taken. This involves a change in interpretation of the coefficients, compared with the original equation. A reduction in the level of the ask-bid spread is now postulated to be associated with an increase in ΔV_t, on the hypothesis that α_1 is negative. In the new specification, then, changes in the ask-bid spread are linked to the *rate of change* of volume

$$\Delta V_t = \alpha_0 + \alpha_1 ABP_{t,t+2} + e_t \qquad (5A)$$

ESTIMATION

Equations (3) to (6) do not purport to be complete models of volume determination; i.e. they do not contain, as regressors, all variables likely to be important in accounting for volume changes. Equations (3) to (6) therefore, may possibly be mis-specified, and hence serial correlation may be present in the estimation of these equations.

In the absence of serial correlation, but in the presence of an endogenous regressor (ABP), instrumental variable (IV) estimation has been employed in the interest of obtaining consistent estimates. In this case a one period lag on ABP is an appropriate instrument for the ask-bid spread. This method has been employed for the 10 year Bond contract (Equation 5A) and for the US dollar contract (Equation 6). In the presence of serial correlation and an endogenous regressor, IV estimation has been employed, with a two period lag on ABP as an appropriate instrument for the ask-bid spread.[9] This method has been used for Bank Bills (spot month, Equation 3) and Bank Bills (near future, Equation 4A).

V

RESULTS

The results of these estimations are presented in Table 3, which provides parameter estimates, together with asymptotic t values for equations (3), (4A), (5A), (6),as well as the Durbin-Watson statistic, which is included for informal comparison with IV estimation.

Support for the hypothesis of increasing returns requires that the estimate of α_1 is negative and statistically significant. It will be seen that this support is provided only for the Bank Bills (near future) and US dollar contracts, for both of which the estimates of α_1 are significant at the 5% level (one tail test). While the estimates of α_1 for Bank Bills (spot month) and Ten Year Bond contracts have the expected sign, neither is significant. While it may be believed, therefore, that transactions costs in the form of the ask-bid spread have decreased with the growth of volume for the Bank Bills (spot month) and Ten Year Bond futures, the evidence presented here does not lend clear support for this hypothesis.

In any case, for the Bank Bills (near future) and US dollar contracts there is clear support for the view that the ask-bid spread varies negatively with volume, and hence for the hypothesis of increasing returns. In the former case, the volume has exhibited strong growth and has reached a relatively high level during the sample period. In the latter case volume has exhibited modest growth and decline during the sample period. In these contracts, therefore, there appear to be increasing returns to liquidity.

The main policy implications of these results is that futures trading could be expected to become concentrated geographically in a few key locations. This is consistent with the arguments of Telser and Higinbotham (1977, p.976) and Veljanovski (1986, pp. 34-5) and also with market developments in the US, Europe and Australia. In the US futures trading is dominated by four major exchanges which exhibit some contract differentiation (CBOT, CME, NYMEX and COMEX). In Western Europe, when *The Economist* (June 18, 1988, p.77) predicted the proliferation of futures markets post-1992, it might well have predicted the demise of most of the smaller markets, with LIFFE, MATIF, and DTB dominating trading in financial futures.[10] (Indeed, this seems to be foreshadowed in subsequent articles in *The Economist*: see March 16, 1991, p.81, and September 21, 1991, p.104). In Australia a futures market begun in Melbourne has exhibited little growth, while the Sydney Futures Exchange experienced record volumes in 1992. This does not imply that a futures exchange has simply to be first in to be best dressed. The failure rate of new contracts is in excess of 80 per cent, and exchanges must ensure that contract provisions are tailored to the needs of the markets, without being biased in favour of one side or the other.

In the case of Bank Bills (spot month), the evidence is not contrary to the increasing returns hypothesis, but the lack of significance of the estimate of α_1 leaves the issue unsettled. Further research is necessary to resolve this question. Similarly, with Ten Year Bonds, while the results do not contradict the increasing returns hypothesis, further research is necessary to clarify the situation resulting from the non-stationarity of volume, and the lack of significance of the estimate of α_1.

VI

CONCLUSIONS

This paper investigates the hypothesis of increasing returns in futures markets, with respect to the ask-bid spread, a key transaction cost and a measure of liquidity. It is argued that the ask-bid spread is a decreasing function of volume for both growing and declining futures contracts. This hypothesis is addressed using Sydney Futures Exchange data for Bank Accepted Bills, Ten Year Bond and US dollar contracts. The first two are very successful, currently traded contracts, while the third attained a modest volume and declined, and was subsequently delisted. All variables in the study are integrated of order I(1), except the Ten Year Bond ask-bid spread which is stationary.

Cointegration tests suggest that the volume and ask-bid spread are cointegrated in the case of Bank Bills (spot month) and US dollar contracts, but not in the case of Bank Bills (near future). (First differences are employed in this last case, and also for Ten Year Bond volume.) Estimation proceeds by way of instrumental variables, in the presence of an endogenous regressor (the ask-bid spread), with correction for first order autocorrelation for Bank Bills (spot month and near future).

There is clear support for the increasing returns hypothesis in the case of Bank Bills (near future) and US dollar, with a negative and statistically significant relationship between volume and the ask-bid spread. For Bank Bills (spot month) and Ten Year Bond contracts a negative relationship was found between volume, and ask-bid spread, but this is not statistically significant. In these last two cases, further research is necessary to clarify the issue.

The major policy implication of these results is that, since there appear to be increasing returns to liquidity, concentration of futures trading is to be expected, both geographically and within exchanges. Promoters of futures contracts and exchanges should be wary of proliferation, unless there is clear evidence of product differentiation with respect to content or time zone, although the latter is of reduced importance with the onset of global trading.

* * *

TABLE 1
Unit Root Tests

Contract Variable	Model	Calculated ADF Statistic	5% Critical Value	10% Critical Value	Integration Order
<u>Bank Bills</u>					
Spot month ABP	10	-1.779	-2.934	-2.605	I(1)
V	10	-1.233	-2.934	-2.605	I(1)
<u>Bank Bills</u>					
Near Future ABP	10	-1.801	-2.934	-2.605	I(1)
V	12	-1.692	-3.522	-3.191	I(1)
<u>10 Year Bond</u>					
ABP	9	-5.344	-2.980	-2.629	I(0)
V	8	-2.959	-3.587	-3.228	I(1)
<u>US Dollar</u>					
ABP	11	-1.134	-3.580	-3.224	I(1)
V	9	-2.287	-2.971	-2.624	I(1)

TABLE 2
Cointegration Tests

Equation	Variable	Calculated AEG Statistic	5% Critical Value	1% Critical Value	Durbin-Watson Statistic
(3) Bank Bills (spot month)	$ABP_{t,t+2}$ V_t	-6.230	-4.008	-4.706	1.938
(4) Bank Bills (near future)	$ABP_{t,t+5}$ V_t	-1.931	-3.489	-4.175	2.104
(6) US Dollar	$ABP_{t,t+2}$ V_t	-5.116	-4.124	-4.903	2.034

TABLE 3
Parameter Estimates: Equations (3), (4A), (5A), (6)*

Equation Contract	α_0	α_1	ρ	N	Durbin-Watson Statistic
(3) Bank Bills (spot month)	6704.840 (2.484)	-55.575 (-0.460)	0.616 (4.688)	41	2.362
(4A) Bank Bills (near future)	177.630 (0.841)	-32.452 (-1.722)	-0.421 (-1.756)	40	2.261
(5A) Ten Year Bond (spot month)	5057.360 (1.541)	-594.033 (-1.312)	-	26	1.829
(6) US Dollar (spot month)	152.799 (5.991)	-79.411 (-2.454)	-	29	1.626

*Asymptotic t values are in parentheses; N is the number of observations

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ENDNOTES

[1] References to the *Wealth of Nations* are to the Cannan edition, first published in 1904, and subsequently published by Methuen and University of Chicago press. The text of the Cannan edition is based on the fifth edition of the *Wealth of Nations* 1789, the last published in Smith's lifetime.

[2] Nassau Senior (1836) was the first economist to argue that the act of saving (and hence capital accretion) involved a sacrifice, which he called abstinence, and profit was regarded as a reward for this sacrifice. Saving involved a sacrifice because the postponement of present consumption was regarded by Senior as a "painful exertion", and not the same as the choice between two present goods. This is what Bowley (1937) called the difficulty of taking the future into account.

[3] In Ricardo, diminishing returns in agriculture may be due to inferior fertility or location of marginal land. Neither of these is the same as diminishing returns to a fixed factor, although diminishing returns in this last sense are implicit in his analysis (see Mitchell 1967, Chapter 5).

[4] This assumes implicitly that each set of transactions is a random sample from an infinite population, and that the market clearing price is the means of the sample. Telser and Higinbotham (1977, p.975) claim also that the introduction of futures trading may reduce the standard deviation of market clearing prices, by compressing trading into time slots. This is consistent with an earlier empirical result of Powers (1970, pp. 460-64) whose results suggested that the introduction of futures trading reduced the variance of prices in the cash market.

[5] It is interesting to note that Telser (1981) does not believe that studies, such as Mandelbrot (1963), which claim that price changes in futures markets are leptokurtic, invalidate the hypothesis of asymptotic normality. This is because these studies ignore volume and because the results may be due to changes in the underlying supply and demand conditions.

[6] Alternatively, the ask-bid spread could be assumed to vary negatively with the average number of successes. The mean of the Binomial Distribution $\mu = np$, and hence the average number of successes (μ) increases with n, during any trading period, given p.

[7] Fuller (1976) has shown that the limit distribution of the t statistic for $\hat{\gamma}$ is independent of the number of lags of ΔZ in the equation.

[8] In the case of three or more I(1) variables the maximum likelihood procedure of Johansen and Juselius (1990) would be necessary to identify all cointegrating relationships.

[9] The instruments employed in the estimation of equation (3) are as follows: V_t, ABP_{t-2}.

The instruments employed in the estimation of equation (4A) are: ΔV_t, $\Delta\ ABP_{t-2}$

In the estimation of equation (5A) the instruments are: ABT_{t-1}, t, ΔV_{t-1}

In the estimation of equation (6) the instruments are: V_t, t, ABP_{t-1}

[10] The Key to these abbreviations is as follows: CBOT: Chicago Board of Trade; CME: Chicago Mercantile Exchange; NYMEX: New York Mercantile Exchange; COMEX: Commodity Exchange Inc.; LIFFE: London International Futures Exchange; MATIF: Marche a Terme Internationale de France; DTB: Deutsche Terminborse.