THE CHARACTERISTICS AND TRADING BEHAVIOUR OF DUAL-LISTED COMPANIES

Jaideep Bedi, Anthony Richards and Paul Tennant

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Abstract

We examine the characteristics and stock price behaviour of existing and recently unified dual-listed companies (DLCs, also known as Siamese-twin companies). DLC structures are effectively mergers in which companies agree to combine their operations and cash flows, but retain separate identities and shareholder registries. We identify 14 such international structures and survey the rationales that have been advanced for the creation as well as the unification of such groups.

We find that three recent Anglo-Australian DLCs exhibit the 'excess comovement' phenomenon identified by Froot and Dabora (1999) and confirm this phenomenon has persisted for the long-standing Anglo-Dutch DLCs. We also investigate what happens to the market exposures of DLCs that have been abandoned in favour of a unified structure. Standard models would suggest there should be no change in the betas of the combined firm, while models of trading-based comovement would suggest that betas could change. We find that the market value of the unified DLCs becomes more (less) correlated with the market index of the new primary (secondary) market after unification. Together with the evidence for excess comovement, this result is consistent with a model where the market prices of assets depend not only on fundamentals, but also on the location of trade and the investors that hold the assets.

Finally, we conduct an event study into the stock returns of DLC twins around the time of unification announcements. Unifications of the share structure have typically occurred on the market that placed the higher value on the cash flows of the DLC. Not surprisingly, the pricing of the twins converges after these announcements, and we find that a rise in the value of the discounted twin is apparently accompanied by a modest fall in the value of the twin trading at a premium.

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1. Introduction

The phenomenon of substantial price differences between dual-listed (or 'Siamese twin') companies has been very widely cited following the influential work of Froot and Dabora (1999). Dual-listed company (DLC) structures are effectively mergers between two companies in which they agree to combine their operations and cash flows and make similar dividend payments to shareholders in both companies, while retaining separate shareholder registries and identities. In this respect a dual listing is quite different to a cross listing. Whereas a dual listing involves the quasi merger of two separate entities, a cross listing occurs when an individual company establishes a secondary listing on a foreign stock exchange, the most prominent arrangement being via American Depositary Receipts (ADRs).[1]

Apart from the work of Froot and Dabora and Rosenthal and Young (1990), there appears to be no other work looking at this interesting phenomenon. Yet DLC structures are not an archaic structure, and this paper documents 12 DLC structures put in place over the last 15 years, in addition to 2 longstanding cases (Royal Dutch/Shell and Unilever) made prominent by these earlier papers. Indeed, in the recent battle to take over UK-listed P&O Princess Cruises Plc, both US suitors (Royal Caribbean Cruises Ltd and Carnival Corporation) proposed to merge via a DLC structure. The rationale for DLC structures appears to have been that the structure has been a key element for some companies in facilitating cross-border mergers or international expansion. However, many of the recently formed DLCs have not proved durable, with 6 of the 12 recent DLCs already unified into a more conventional single share structure.

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[1] Karolyi (1998) provides a survey discussion of cross listings and Pagano, Röell and Zechner (2002) examine the motives for cross listings.

DLCs are an interesting phenomenon because of the insights they can yield about both corporate structure and asset pricing. Although the shares of the two companies represent identical claims on the future cash flows of the group, substantial divergences in the pricing of these claims are observed. Rosenthal and Young document the persistent mispricing of Royal Dutch/Shell and Unilever throughout the 1980s but find that transactions costs would have precluded trading rules designed to take advantage of these price differentials. Froot and Dabora (1999) investigate whether stock returns of DLCs are affected by the location of trade. They find that the return of each 'twin' appears to be correlated with the market on which it is most actively traded. For example, when the New York market rose relative to the UK market, they found that the price of Royal Dutch (which traded relatively more in New York over their sample) increased compared to the price of Shell (which traded relatively more in London).

Accordingly, the mispricing of DLCs is frequently cited as representing an anomaly to the efficient market hypothesis (Mullainathan and Thaler 2000; Barberis and Thaler 2002). In particular, Froot and Dabora's evidence is interpreted as evidence that stock prices reflect in part the sentiment and behavioural biases of investors and market-makers that dominate trading in the asset in question. The findings are not unique in this respect. A related example is the case of closed-end mutual funds which often trade at substantial premia or discounts to their net asset value, a result that Lee, Shleifer and Thaler (1991) and Shleifer (2000) attribute to small-investor sentiment.

This paper presents new evidence into four aspects of DLCs. First, since DLCs can now be said to be a reasonably widely used corporate structure, we document the formation of 12 new DLC structures over the last 15 years and outline the reasons that have been cited for the adoption of such structures, and for the subsequent unification of the share structure where this has occurred.

Second, we show that excess comovement and substantial price divergences between DLC twins have remained pervasive phenomena in six large remaining DLCs. If the large price divergences identified by Rosenthal and Young and Froot and Dabora did represent a source of arbitrage profit, we would expect arbitrage activity to have occurred and resulted in a reduction in the size of the typical price gap. We note several instances where particular institutions have attempted to find

ways to arbitrage the price differences, but conclude that the ongoing price differences suggest little success in this regard.

Third, we study what happens to the betas or market exposures of DLC companies in cases where the structure is abandoned in favour of a single entity with one primary listing. In particular, we identify four cases where such unifications were not accompanied by other changes in the underlying business of the companies and examine if the betas of the combined company change as a result of it changing from a dual listing on two exchanges to a single primary listing on one exchange. A traditional view of asset pricing would suggest there should be no change in the betas of the combined company following such a change. By contrast, the model of trading-induced comovement proposed by Barberis, Shleifer and Wurgler (2002) would suggest an increase in the beta with respect to the market which is the new primary listing of the unified company, and a decrease in the other market where there is no longer a primary listing. Since the unifications result in compositional changes in the international equity indices produced by major index providers – there is an increase in the stock's index weight in the former market and a deletion from the index of the latter market – our test is related to the tests of Barberis, Shleifer and Wurgler (2002) who examine changes in betas following inclusions or exclusions from the US S&P 500 index. Our results suggest that the betas do indeed change in the manner predicted by a model of trading-induced comovement. Our results are also consistent with the results of Chan, Hameed and Lau (2003) who show that the exposures of four prominent Hong Kong companies in the Jardine Group experienced large changes in their market exposures following the change of their primary listing to the Singapore Exchange. Together with the earlier evidence for excess comovement in DLCs, this result is consistent with a range of related evidence that the market prices of assets depend not only on fundamentals, but also on the location of trade and the investors that hold the assets.

Finally, we conduct an event study into the behaviour of the market value of DLCs in cases where the share structure is unified. Not surprisingly, the pricing of the twins converges following the announcement of unification, but it is of interest to ask if this occurs via an increase in the share price of the company that is trading at a discount or a fall in the share price of the twin that is trading at a premium, and if there is any impact on overall company value. The tests suggest a rise in the price of the twin trading at a discount, with some modest evidence of a fall in the

company trading at a premium. On average, there is little change in total firm value, implying that we can say little from this event study about the way that markets view DLC structures versus conventional mergers.

The rest of this paper is arranged as follows. Section 2 provides an introduction to DLCs, a listing of DLC structures, and discusses some of the reasons cited for and against such a structure. Section 3 documents the price differentials existing in the cases of the six large continuing DLCs, and discusses some of the reasons why they are not eliminated. Section 4 outlines the data used in the three empirical sections of the paper. Sections 5, 6, and 7 contain the results from the tests for excess comovement and for changes in market exposures following the unification of DLCs, and from the event study for changes in market values following unification announcements. Our conclusions are presented in Section 8.

2.   Why Do Companies Choose DLC Structures?

DLC structures are effectively mergers between two companies in which they agree to combine their operations and cash flows, but retain separate shareholder registries and identities. One form of DLC involves the two companies transferring their assets to one or more jointly owned subsidiary holding companies. The holding company then passes dividends back to the main companies, which distribute them according to a predetermined ratio. Alternatively, instead of the transfer of assets, there may be contractual arrangements to share the cash flows from each other's assets. The operations of the two companies are closely coordinated, and in most cases the companies share a common board of directors.

Table 1: Dual-listed Companies

Company	Country	Period of DLC
Shell Transport & Trading Co PLC Royal Dutch Petroleum	UK Netherlands	Since 1907
Unilever PLC Unilever NV	UK Netherlands	Since 1930
ABB AB ABB AG	Sweden Switzerland	January 1988–July 1999
SmithKline Beecham PLC SmithKline Beecham	UK US	July 1989–April 1996
Fortis (B) Fortis (NL)	Belgium Netherlands	June 1990–December 2001
Reed Elsevier PLC Reed Elsevier NV	UK Netherlands	Since January 1993
Rio Tinto Limited Rio Tinto PLC	Australia UK	Since December 1995
Dexia Belgium Dexia France	Belgium France	November 1996–February 2000
Nordbanken Merita	Sweden Finland	December 1997–March 2000
Allied Zurich PLC Zurich Allied	UK Switzerland	September 1998–October 2000
BHP Billiton Limited BHP Billiton PLC	Australia UK	Since June 2001
Brambles Industries Limited Brambles Industries PLC	Australia UK	Since August 2001
Investec Limited Investec PLC	South Africa UK	Since July 2002
P&O Princess Cruises PLC Carnival Corporation	UK US	Since April 2003

Table 1 provides a listing of 14 existing or recently unified DLC structures.[2] With one exception, all DLCs have been the result of mergers between companies

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[2] The table includes all those widely held DLC structures over recent decades that could be identified from a range of sources. It excludes cases of twins that do not trade separately. For example, in the Anglo-Irish Wedgwood/Waterford merger, shareholders in each company received an equity unit that consists of a share in each company. A similar arrangement occurred in the creation of the Anglo-French EuroTunnel enterprise. Unlike the cases discussed in this paper, the shares of the companies do not trade as different companies as the equity units cannot be split. The table also excludes cases of linked companies that did not have identical dividend flows.

domiciled in different countries.[3] An examination of these cases suggests that companies may choose DLC structures rather than conventional mergers for a number of reasons:[4]

- *Tax or accounting factors*. A DLC structure may minimise capital gains tax obligations that would result from a conventional merger. Alternatively, home-bias and differences in national tax systems may favour a DLC structure whereby cross-border dividend payments to shareholders are minimised. Similarly, accounting regimes may favour a DLC over a conventional merger or acquisition if the latter would require recognising and amortising goodwill that results from the merger.

- *National identity issues and foreign investment regimes*. A conventional merger or takeover would result in the disappearance of one of the companies. Since complicated cross-border mergers typically require various forms of official approval, DLCs that preserve the existence of each company in each market may be the best way of ensuring that approval. In addition, in cases where the two companies are of similar size, the management of the companies may both wish to avoid the appearance of having been taken over.

- *Operational and corporate governance issues*. The existing contractual arrangements of the companies may cause various types of rights to be triggered (e.g., options in debt contracts, and rights of other companies involved in joint ventures) in the event of a takeover or conventional merger.

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[3] The exception is the recent case of Investec PLC/Limited. This Anglo/South African DLC was formed not from a merger, but from a 'demerger' and the creation of a new UK company holding the UK assets of the South African parent. As with other DLCs, the purpose of the transaction was to facilitate Investec's international expansion. However, the rationale for a DLC structure rather than a simple UK secondary market listing appears to have been to meet South African government requirements concerning exchange controls. Since Investec has a substantially smaller capitalisation than the other DLCs, this article focuses on the more conventional and larger DLCs created through mergers.

[4] Some of the reasons cited by companies in adopting DLCs are provided in the 12 April 2001 'Proposed DLC Merger Explanatory Memorandum' from BHP Billiton and the 25 June 2001 'Information Memorandum: Dual Listed Companies Proposal' from Brambles. Hancock, Phillips and Gray (1999), Glanz and Sanderson (2001), Smith and Cugati (2001), and Hancock, Gray and Sommelet (2002), also provide further discussion of DLCs, and their advantages and disadvantages relative to conventional mergers.

However, these consequences may be avoided if the merger occurs in the form of a DLC arrangement.

- *Perceptions of better access to capital markets*. Since local investors are already familiar with their respective companies, management may believe that the merged company will have better access to capital markets if it maintains listings in each market.

- *Concerns over 'flow-back'*. In a conventional merger with a stock swap, the merged company will have to choose one country for its domicile and primary listing, and the shareholders from the other country will receive equity in a company domiciled in a foreign market. The merged company will now be a larger company and will see a higher weight in the share market index of its country of domicile, but it will disappear from the index in the other market. A DLC may be chosen if it is thought that a merger would result in selling pressure in one market exceeding increased investor interest in the other market.

However, the fact that most cross-border mergers do not take the form of a DLC and that some companies have decided to unify their DLC structures implies that there are also possible disadvantages to DLCs. These may include:[5]

- *Complexity of operations*. The contractual arrangements of DLCs provide procedures for the treatment of the interests of the shareholders of both companies in the case of capital raisings, asset sales and other events. Nonetheless, the existence of two sets of shareholders may at times constrain the flexibility of management and the full benefits of a more conventional merger may not in practice be realised.

- *Regulatory issues*. The ongoing operations of the separate companies means that the DLC must satisfy the accounting and regulatory frameworks of two countries. This is likely to be costly, and may constrain the ability of management to maximise the joint value of the two companies.

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[5] Further details on the factors that lead companies to end DLC structures are provided in the 28 August 2000 press release by Fortis, the 17 April 2000 'Share unification plan' presentation of Zurich Financial Services, and the 1999 Annual Reports of Dexia, ABB and MeritaNordbanken.

- *Liquidity, transparency and shareholder value issues*. In practice, the existence of two separate companies may result in less share market liquidity than would result if there was a single larger company. In addition, investors may view the DLC structure as somewhat complex and less transparent than a conventional single company. Hence, they may value the two parts of the company less highly than they would a single larger company.

3.   Examples of Dual-listed Companies and Puzzles in Their Pricing

Of the six large DLCs existing in early 2003, three involved companies from the United Kingdom and the Netherlands (Royal Dutch Shell, Unilever and Reed Elsevier) and three involved companies from the United Kingdom and Australia (Rio Tinto, BHP Billiton, and Brambles Industries). We refer henceforth to these as the Anglo-Dutch and Anglo-Australian DLCs.

The concentration of UK, Australian and Dutch companies in this group raises the question of whether there is something peculiar to these countries to encourage DLCs. No obvious explanation appears to exist, though one possible factor may be that a listing on the London equity market is viewed as particularly attractive, and that given the choice between a single listing on another market and a dual listing that also includes London, companies may choose not to give up their London listing.

Given that Froot and Dabora concentrated on two of the Anglo-Dutch cases, we begin our discussion of the continuing DLCs with a presentation of some basic facts about the more recent Anglo-Australian DLCs. The first of these resulted from the 1995 merger of Australian mining company CRA and UK-listed RTZ, which already held a 49 per cent stake in CRA. The two companies have subsequently been renamed Rio Tinto Limited (which is traded on the Australian Stock Exchange) and Rio Tinto PLC (which is traded on the London Stock

Exchange). The sharing agreement stipulates that the dividend and capital rights of each PLC share relative to each Limited share are on a 1:1 basis.[6]

Given that the two classes of Rio Tinto shares entitle the holder to exactly the same flow of dividends, one might have expected that they should have traded at the exact same price. An examination of the share prices shown in Figure 1 shows that they are highly correlated.[7] However, significant and persistent price divergences have existed, even after using a 20-day moving average to mitigate any impacts from asynchronous trading. Each company has traded at a significant premium at particular times, and the average of the price differential over the full seven-year period has been a premium of the UK listing over the Australian listing of around 2 per cent.

BHP, the large diversified resource company, was the second Australian company to enter into a DLC structure when it merged with Billiton, a UK/South African resources company in July 2001. The equalisation ratio is 1:1, such that a UK share has the same economic value and voting rights of an Australian share.[8] From the outset, the relative value of the Australian scrip has been higher than its UK counterpart (Figure 2) with the premium averaging 8 per cent.

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[6] The RTZ holding in CRA has since been reduced to less than 40 per cent. Under the terms of the merger, in cases where the companies did not share a common interest, the RTZ stake in CRA was not to be used to cast votes, implying that PLC (Limited) shareholders hold 76.5 (23.5) per cent of votes on joint decisions.

[7] Indeed, the standard tests suggest that the two price series for each of the three Anglo-Australian DLCs and Anglo-Dutch DLCs (when expressed in a common currency) are cointegrated. Data sources for the stock prices and exchange rates used in this section are provided in Section 4.

[8] Shareholders in the Australian (UK) arm hold 60 (40) per cent of the combined company.

Figure 1: Rio Tinto Limited and PLC
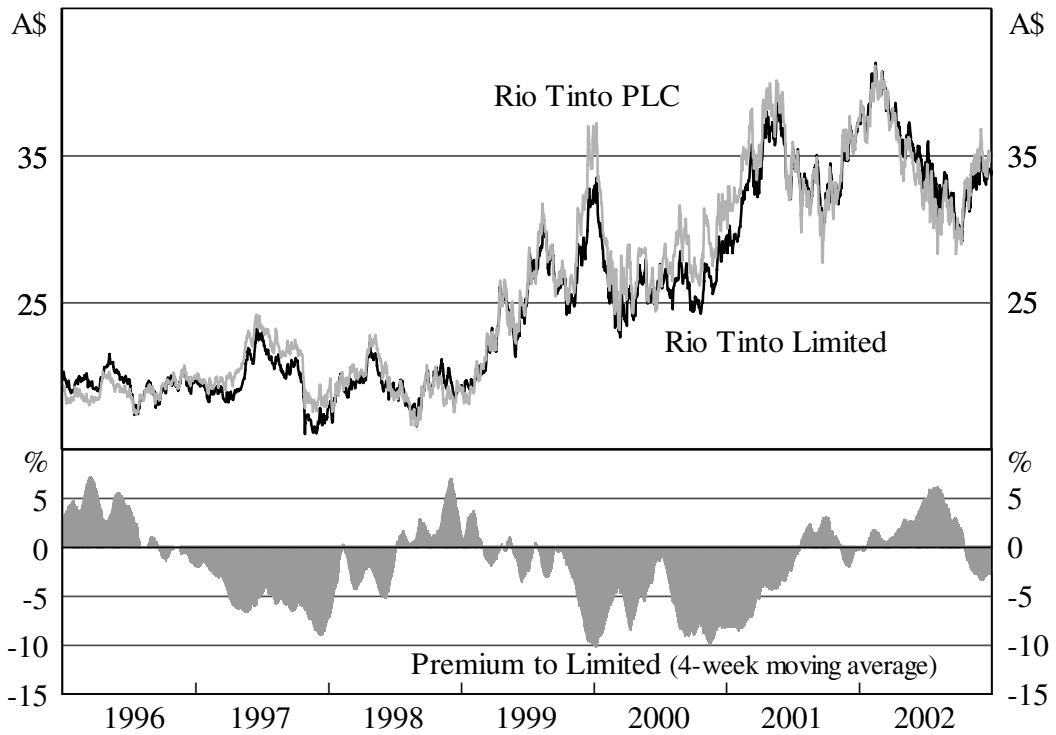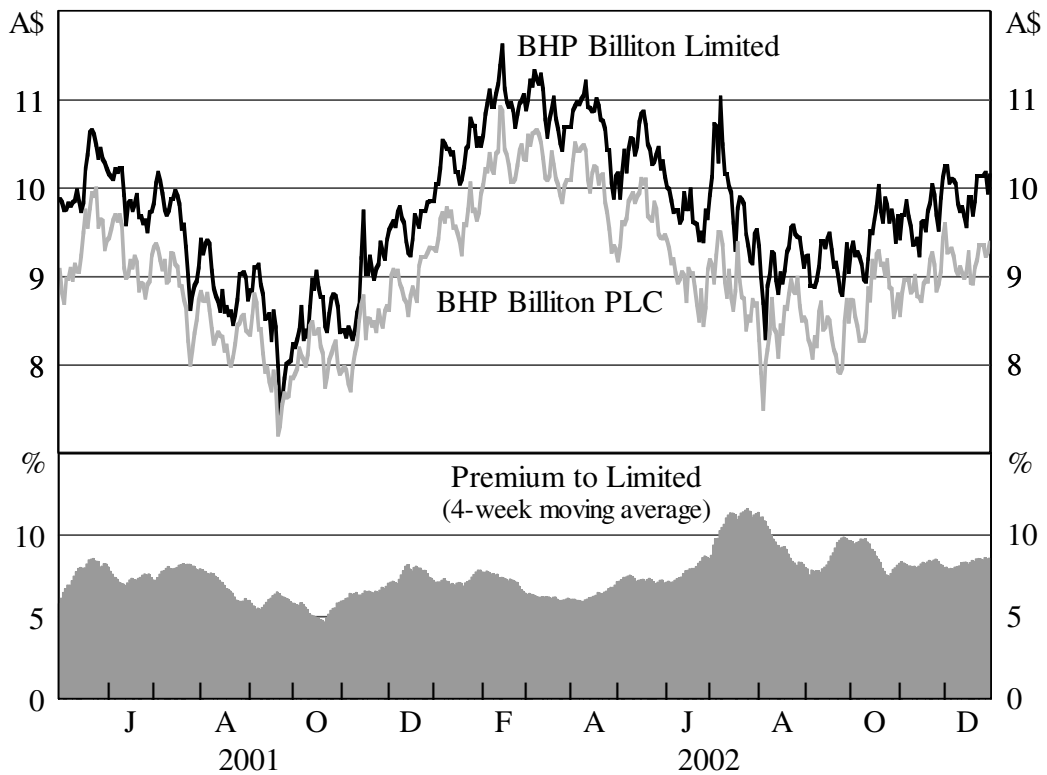
Share prices and price differential

## Figure 2: BHP Billiton Limited and PLC

Share prices and price differential

The most recent Anglo-Australian DLC was formed in August 2001 when Brambles, the Australian industrial firm, merged with the industrial services arm of UK-listed GKN. Just as there had been pre-existing ownership links between the Rio Tinto companies, Brambles and GKN had an existing relationship, including joint ventures. Similar to the other two Australian DLCs, the equalisation ratio is 1:1.[9] Figure 3 shows the sizeable premium, averaging 9 per cent, at which the Australian share has traded relative to the UK share.

Figure 3: Brambles Limited and PLC

Share prices and price differential
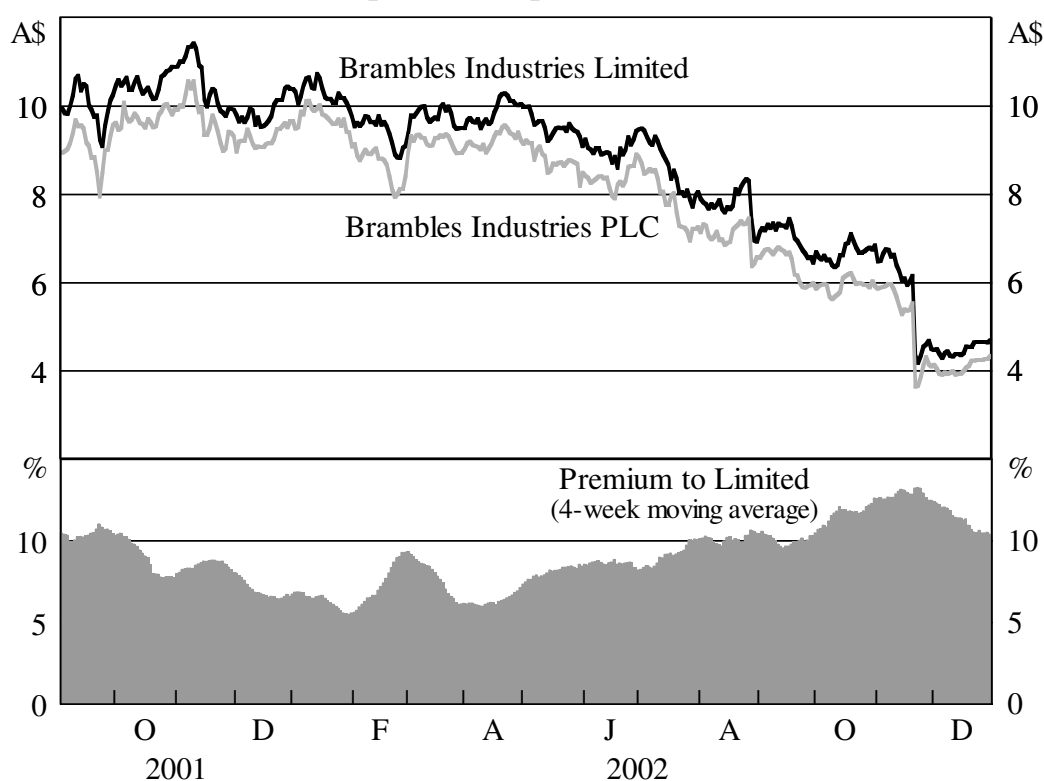
The price differentials of the three Anglo-Australian DLCs are shown in Figure 4. The premia have at times moved together, however, there have also been times when they have moved in opposing directions. Although the premium for Rio Tinto has changed sign over the seven-year period of the DLC, in the cases of BHP Billiton and Brambles (for which only around 18 months of data exist), the Australian twin has consistently traded at a premium. Data for the median absolute price differentials are shown in Table 2.

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9 Shareholders in the Australian (UK) arm hold 57 (43) per cent voting interest in the combined group.

Figure 4: Price Differentials for Anglo-Australian DLCs

4-week moving average of daily premia
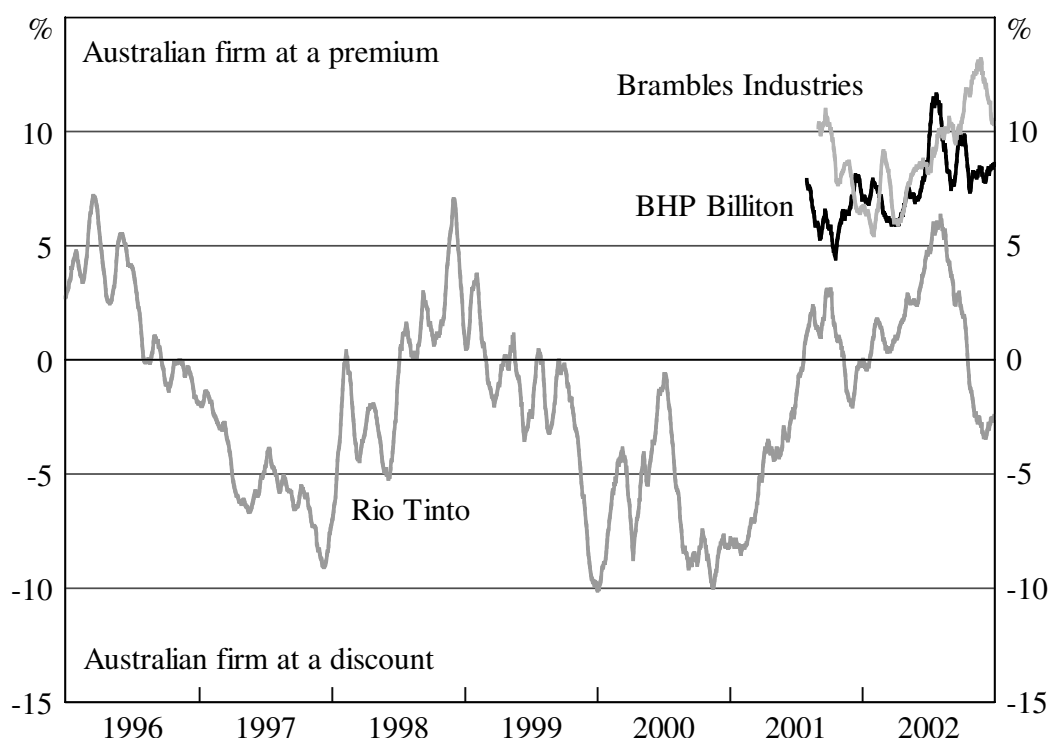
Royal Dutch Petroleum and Shell, Unilever NV/PLC, and Reed Elsevier NV/PLC are the three other examples of continuing DLCs on overseas markets.[10] Created in 1907, Royal Dutch/Shell is the oldest example of a DLC. Both companies trade on a number of exchanges, but Royal Dutch is incorporated in the Netherlands while Shell is incorporated in the United Kingdom. The Unilever group was formed in 1929 from the merger of a Dutch margarine company, Margarine Unie and Lever Brothers, a British soap maker. Unilever NV and Unilever PLC are listed on the Dutch and UK stock exchanges respectively. Finally, Reed Elsevier was formed from the January 1993 merger of Reed International PLC, a UK-listed publishing and information company, and Elsevier NV, a Dutch-listed publishing company.

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[10] The groups' interests are split respectively as follows: 60:40 in favour of Royal Dutch; 50:50 for Unilever; and 52.9:47.1 in favour of Reed Elsevier PLC.

**Table 2: Price Differential for Anglo-Dutch and Anglo-Australian DLCs**

Mean absolute deviation – per cent

	1980–1995	1996–2002	September 1999–2002
Royal Dutch/Shell	9.53	8.48	4.70
Unilever	8.86	9.59	8.06
Reed Elsevier	–	9.28	8.20
Rio Tinto	–	3.92	4.36
BHP Billiton	–	–	7.39
Brambles Industries	–	–	8.87

Notes: This table shows the mean absolute deviation from price parity (in per cent) for each of the six DLC arrangements, calculated using end-week data. The period 1980–1995 corresponds to the sample period in Froot and Dabora (1999), and 1996–2002 corresponds to the period following their sample period. The period September 1999–December 2002 corresponds to the period following the publication of the article by Froot and Dabora (1999) in the *Journal of Financial Economics*. The data for BHP begin in April 2001 and the data for Brambles Industries begin in August 2001.

The long-run behaviour of the price differentials for the three Anglo-Dutch DLCs is shown in Figure 5. As has been documented by Froot and Dabora (1999), the price differentials for Royal Dutch/Shell and Unilever are surprisingly large and variable. It is, however, noteworthy that the extreme price differentials seen in the early 1980s have not been repeated, which may reflect the greater integration of capital markets and the reduction of transactions costs over the last two decades. Interestingly, there is some evidence of correlation across the three DLCs. At one level this might not appear entirely surprising if the excess comovement result of Froot and Dabora is an extremely persistent phenomenon rather than just a short-run one. However, the fact that there is substantial variance in the proportion of trading of the Dutch twins that occurs on different markets implies that the correlation might not be so easily attributed to common influences from the relative performance of national markets.[11]

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[11] In particular, a substantial fraction of trade in Royal Dutch occurs in the US market, whereas almost none of the trade in Reed Elsevier NV occurs in that market.

Figure 5: Price Differentials for Anglo-Dutch DLCs

4-week moving average of daily premia
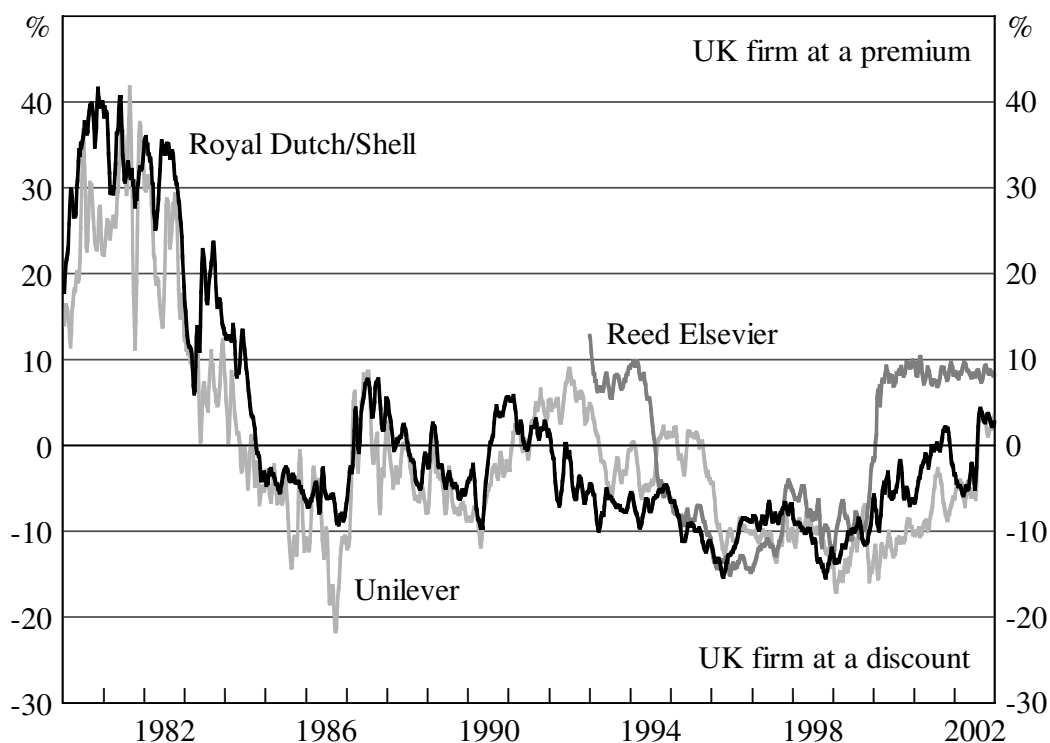
If there is a tendency for anomalies documented by researchers to be reduced or eliminated after their publication, one might have expected to see a decline in the magnitude of DLC price differentials following the publication of Froot and Dabora's work. Although the sample is too short to draw firm conclusions, the data for median absolute price differentials in Table 2 appear to provide only limited evidence for this. (Further, the evidence would be weaker if the comparison instead used the date of the publication of the working paper version of the article). In particular, although the mean absolute deviation for Shell has fallen substantially relative to historical levels, the declines in the other two cases are much less obvious.

Just as Froot and Dabora were unable to identify 'fundamental' factors that could explain the price differentials that they identified in the Anglo-Dutch cases, so too do fundamentals-based explanations appear unable to explain substantial price differences between the Australian and UK arms of the three more recent DLCs. For example, the stocks in each of these DLCs are all actively traded and appear in benchmark market indices, suggesting that liquidity differences are unlikely to be

able to explain substantial price differences.[12] Furthermore, tax factors do not appear to be able to justify the differential, since investors from third countries do not obtain any major tax advantage from investing in a particular twin.[13]

Given that the ongoing large and variable price spreads in both the Anglo-Dutch and Anglo-Australian DLCs are difficult to explain based on fundamentals, they represent something of an anomaly. The reason why the price spread has not been eliminated by investors is presumably related to the lack of fungibility (or exchangeability) between the scrips. In particular, the different listings of a DLC are distinctly different companies, with no fungibility that would allow instantaneous riskless arbitrage.[14] Instead, attempts by investors to take advantage of the price differential via a long position in the discount stock and a short position in the premium stock require investors to have long horizons and to be able to withstand short-term losses should the differential widen.[15] Indeed, one of the positions held by Long-Term Capital Management (LTCM) during its 1998 collapse was a US$2.3 billion position in Royal Dutch/Shell that incurred losses when the price differential widened sharply (see Lowenstein (2000)). This

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[12] The three Australian stocks are all included in the ASX 100 index, while the three UK stocks have all been included in the FTSE 100 index, except that Brambles PLC slipped from the FTSE 100 to the FTSE 250 in December 2002, in the last month of the sample studied here.

[13] For example, in the Anglo-Australian cases, Australian investors would prefer the local stock of a DLC due to the dividend taxation credits they receive (and which are not available to UK investors). However, for third-country investors who can be viewed as the marginal investors, the choice would depend on the respective tax treatment between their country and the country of listing. In many instances, including the US case, current tax treaties suggest that in most cases third-country investors would be largely indifferent between the Australian and UK stock.

[14] By contrast, price divergences between DLC twins and their respective ADRs in the New York market are far smaller. For example, both Rio Tinto and BHP Billiton have ADRs attached to each of their listings, and the prices of each ADR is invariably almost exactly equal to the price in the respective primary listing. Since investors can exchange ADRs for the underlying stock (i.e., the different scrip are fully fungible), price differentials can be arbitraged away and are limited to the very small transactions costs involved in such exchanges.

[15] The lack of fungibility between the shares exposes the investors to noise trader risk, i.e. the risk that the mispricing worsens in the short run (see De Long, Shleifer, Summers and Waldmann (1990); Shleifer and Vishny (1997)). Abreu and Brunnermeier (2002) propose an additional related risk, which they refer to as synchronisation risk, and is based on the uncertainty an arbitrageur faces about when his or her peers will exploit an arbitrage opportunity.

illustrates the difficulty that investors face in attempting to arbitrage away such premiums.

A less complete form of arbitrage would involve long-only investors switching out of the premium stock and into the discount stock. However, this type of activity may be limited by home biases or by mandates that limit the asset allocation of institutional investors. For instance, a manager with a mandate to invest only in Australian (UK) stocks may be prevented from purchasing the UK (Australian) scrip, even though the two scrips offer the same set of dividends and have highly correlated returns. An example of the existence of these home biases or mandate restrictions can be seen in the share registry of the BHP Billiton twins, where the majority of the largest 20 shareholders in BHP Billiton Ltd in late 2002 were Australian institutions, although none of the top 20 shareholders in BHP Billiton PLC were Australian institutions.[16]

One interesting attempt to circumvent the constraints imposed by country-based mandates was the introduction by an Australian broker of warrants, traded on the Australian Stock Exchange on the UK arms of BHP Billiton and Rio Tinto.[17] The intention was to provide Australian managers with mandates to invest only in Australian securities with a means of effectively investing in foreign assets. However, the low volume of trading in these warrants suggests limited arbitrage activity of this nature.

Of course, switching between DLC twins should be more feasible in the case of large institutional investors with a global mandate. Indeed, newspaper reports suggest that there are instances of institutional investors switching between DLC twins. For example, the US-based Capital Group, which had been the largest investor in BHP Billiton Ltd, was reported to have switched in 2002 into BHP Billiton PLC.[18] However, the implication of the substantial price differences that are observed on an ongoing basis is that this type of behaviour is fairly limited.

In principle, the data for the average price premia for these six DLCs, plus the average premia for other cases prior to their unification, might offer some hope for

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[16] This information on stockholdings is taken from Bloomberg.

[17] See 'Offshore exposure with a little bit of DLC', *Australian Financial Review*, 15 April 2002, p 23.

[18] See 'Easy 10pc on BHP arbitrage', *Sydney Morning Herald*, 28 August 2002, p 24.

understanding what factors are relevant in determining which (if any) company will trade at a premium. Some preliminary analysis failed to offer any systematic relationship, so we conclude that the sample of DLCs is too small to differentiate between explanations for the direction of the premia. However, one interesting observation comes from the Anglo-Australian DLCs, where the Australian twin has traded consistently at a substantial premium in two of the three cases. This specific evidence about how different national markets value the same set of equity cash flows can be viewed as refuting claims that are sometimes made that companies listed on smaller markets are at an inevitable cost-of-capital disadvantage and can increase shareholder value by simply shifting their primary listing to larger overseas markets.

4. Data

In this section, we briefly outline the sources of data used in the empirical tests in the remainder of the paper. We calculate returns for the various companies involved in the tests using price and dividend data from Datastream or Bloomberg. Data for market indices were obtained from Datastream and include series for the Australian ASX 100, Belgian BEL 20, Dutch AEX, Finnish HEX 25, French CAC 40, Swedish OMX, Swiss SPI, UK FTSE 100, and US S&P 500. Returns for individual stocks and market indices were calculated in log-differenced form.

Exchange rate data for the Anglo-Australian DLCs are log changes based on Sydney closing rates from Bloomberg while exchange rate changes for all other DLCs are based on London closing rates from Datastream.

5. Testing for Excess Comovement

The phenomenon of assets with similar cash flows trading at quite different prices is interesting. While these differences do not provide an opportunity for pure riskless arbitrage, they are nonetheless an anomaly. Froot and Dabora (1999) find that the price differential is correlated with the relative performance of the markets in which the twins trade most. They propose that this comovement with the market index where most of a twin's trading occurs is a reflection of prices in each market being influenced by market sentiment.

Given the recent creation of three Anglo-Australian DLCs, this section tests whether the twins in these companies are also subject to excess comovement. Further, we also test whether the excess comovement for the longer-standing Anglo-Dutch DLCs has endured. In each case we apply Froot and Dabora's methodology and test the hypothesis that each twin's price comoves excessively with the market on which it trades most. For example, comovement would imply that positive market shocks in Australia are associated with an increase in the price of the Australian twin relative to the price of the UK twin.[19] Accordingly, we regress the return differential between the two companies on the returns of the Australian and UK market indices plus the currency return:

$$r_{i,t}^a - r_{i,t}^b = \beta_0 + \beta_1 r_{m,t}^a + \beta_2 r_{m,t}^b + \delta r_{i,t}^{exr} + \varepsilon_t \qquad (1)$$

where $r_{i,t}^a$ and $r_{i,t}^b$ are log returns on the Australian and UK twins in DLC i, $r_{m,t}^a$ and $r_{m,t}^b$ are the log returns on the Australian and UK stock market, and $r_{i,t}^{exr}$ is the log return on the AUD/GBP exchange rate. We also run the corresponding regression for the Anglo-Dutch DLCs.

The use of standard market indices in such regressions potentially creates a bias when one of the companies is included in a market index. For example, each of the Australian and UK twins are included in the ASX 100 and FTSE 100, respectively. However, similar to the evidence in Froot and Dabora (1999), we find the effect of this bias is minor since each firm bears a relatively small weight in its index. However, in the case of the tests for the Anglo-Dutch DLCs, when we use the Dutch AEX 100 index we remove Royal Dutch due to its significant weight.

The null hypothesis is that changes in the price differential are uncorrelated with the performance of the two national markets on which the DLCs trade, but may be correlated with exchange rate movements since the dependent variable is the difference between price changes of assets traded in different currencies. Indeed, if the twins' prices (in a common currency) always moved together, we would expect a coefficient of minus unity on the exchange rate variable. For instance, an appreciation in the Australian dollar/pound sterling exchange rate should result in a

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[19] For all three Australian-UK DLCs, the Australian and UK arms trade mostly on the Australian Stock Exchange and London Stock Exchange, respectively.

relative increase (decrease) in the local-currency price of the UK (Australian) scrip.

The alternative hypothesis based on the comovement phenomenon is that β_1 will be positive and β_2 will be negative. For example, a shock to the overall Australian (UK) equity market is expected to be associated with an increase (decrease) in the local currency price of the Australian twin relative to the local currency price of the UK twin. The implication is that the price differential is being driven to an extent by market-specific liquidity shocks or relative market sentiment.

We have estimated Equation (1) using a wide range of return horizon, but for brevity, Table 3 presents results only for horizons of 2, 5, 10 and 20 days. The reason for presenting longer horizon returns is to ensure that any estimated excess comovement is not due to asynchronous trading effects or very short-term liquidity shocks, and also to get a sense of the persistence of such effects.[20] These results all involve rolling regressions using overlapping data, so the statistical tests are based on Newey-West standard errors to account for the moving average error process that is introduced.[21]

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[20] In the case of the Anglo-Australian DLCs there is typically an eleven-hour difference between UK and Australian market closing times. One possible approach to minimise the problems of asynchronous trading would be to use Australian closing prices and UK opening prices (approximately a three-hour time difference). Unfortunately, data problems with opening prices precluded this approach. Instead, we conduct the regressions under the implicit assumption that most global equity price discovery occurs during Northern Hemisphere trading hours, so that a majority of price discovery for the Anglo-Australian DLCs also occurs during London trading. Hence, the regressions actually use Australian returns to day t and UK returns to day t-1. However, the results from an estimation using day t returns for both markets are similar, especially for longer-horizon returns.

[21] Although the standard errors are corrected by the Newey-West procedure, there is no similar adjustment to the adjusted R^2, which is biased upwards, especially as the extent of overlap increases.

Table 3: Testing for Excess Comovement, Anglo-Australian DLCs

	Rio Tinto				BHP Billiton				Brambles			
	2-day	5-day	10-day	20-day	2-day	5-day	10-day	20-day	2-day	5-day	10-day	20-day
β_1	0.65***	0.45***	0.41***	0.42***	0.77***	0.41***	0.28**	0.42***	0.65***	0.29**	0.24**	0.02
	(0.06)	(0.06)	(0.06)	(0.03)	(0.14)	(0.14)	(0.11)	(0.07)	(0.19)	(0.14)	(0.11)	(0.11)
β_2	−0.55***	−0.45***	−0.38***	−0.34***	−0.40***	−0.23***	−0.22***	−0.29***	−0.33***	−0.22***	−0.15**	−0.07
	(0.04)	(0.04)	(0.04)	(0.02)	(0.08)	(0.08)	(0.07)	(0.04)	(0.11)	(0.07)	(0.07)	(0.06)
δ	−0.35***	−0.56***	−0.71***	−0.85***	−0.71**	−0.86	−0.76**	−0.91	−0.73*	−0.97	−1.07	−1.05
	(0.06)	(0.06)	(0.06)	(0.03)	(0.12)	(0.13)	(0.09)	(0.06)	(0.16)	(0.11)	(0.11)	(0.10)
β_0	−0.01	−0.02	−0.05	−0.15**	−0.02	−0.03	−0.08	−0.39	−0.01	−0.04	−0.04	−0.06
	(0.04)	(0.08)	(0.13)	(0.08)	(0.09)	(0.16)	(0.18)	(0.24)	(0.12)	(0.19)	(0.24)	(0.23)
Adjusted R²	0.22	0.27	0.37	0.49	0.22	0.28	0.43	0.66	0.06	0.19	0.32	0.49
Observations	1 824	1 821	1 816	1 806	389	386	381	381	364	361	356	356

Notes: This table provides tests of whether the three recent Anglo-Australian DLCs also demonstrate the excess comovement phenomenon identified by Froot and Dabora (1999). It reports estimates of Equation (1): $r^a_{i,t} - r^b_{i,t} = \beta_0 + \beta_1 r^a_{m,t} + \beta_2 r^b_{m,t} + \delta r^{exr}_{i,t} + \varepsilon_t$, where $r^a_{i,t}$ and $r^b_{i,t}$ are the log returns on the Australian and UK twins, respectively, $r^a_{m,t}$ and $r^b_{m,t}$ are the log returns on the Australian and UK stock markets, respectively, $r^{exr}_{i,t}$ is the log return on the AUD/GBP exchange rate, and all log-difference returns are multiplied by 100. To take account of asynchronous trading, the Australian returns are measured to day t and the UK returns are measured to day $t-1$. Newey-West standard errors are shown in parentheses. Rejections of the null hypothesis at the 10, 5 and 1 per cent levels are denoted by *, ** and ***, respectively. The sample period is January 1996–December 2002 for Rio Tinto, July 2001–December 2002 for BHP Billiton, and August 2001–December 2002 for Brambles Industries.

Our results confirm the excess comovement findings of Froot and Dabora. Almost all coefficients are significantly different from zero at the 1 per cent level and of the expected sign. At the 2-day horizon, it may not be surprising that β_1 is strongly positive and that β_2 is strongly negative, i.e., that the relative price of the twins is very substantially affected by the relative performance of their national markets. However, any short-term effects from liquidity shocks should be largely absent in longer-term returns. Yet at the 10-day horizon, for example, the estimates for β_1 and β_2 of around 0.30 and –0.25, respectively, imply that a 10 per cent increase in the Australian (UK) benchmark index is associated with an increase in the relative price of the Australian (UK) twin of around 3 (2½) per cent.

Furthermore, it may not be surprising that the exchange rate coefficient δ is typically substantially less than –1 at the 2-day horizon, so that exchange rate changes in the very short-term have significant effects on the price differential. However, at longer horizons it also remains less than –1. For example, estimates for β_3 of around –0.8 at the 10-day horizon imply that a 10 per cent change in the Australian dollar/pound sterling exchange rate would tend to be associated with a 2 per cent increase in the (common currency) relative price of the twin from the country that has seen an appreciation.[22]

The observation that the magnitude of the coefficients on the two market indices falls (and that on the exchange rate coefficient rises) as the return horizon lengthens, suggests that excess comovement may be largely a short-run phenomenon. However, results from regressions using 50-day returns (available upon request) continue to show excess comovement for Rio Tinto and BHP Billiton, suggesting that the comovement is still present at fairly long horizons.

Given that Froot and Dabora's finding of excess comovement was based on data only up to 1995, it may be of interest to see if this phenomenon has continued more recently. Accordingly, we estimated versions of Equation (1) for Royal Dutch/Shell, Unilever and Reed Elsevier for 1996–2002, and also for 1989–1995, the previous seven-year period. In the case of the first two DLCs, we follow Froot and Dabora and include the return on the S&P 500 index and the change in the US

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[22] When we impose the restriction that β_3 is equal to –1, the finding that β_1 and β_2 are significantly different to zero remains robust.

dollar/pound sterling exchange rate to reflect the significant share of trading of the Dutch twin that occurs in the US market. In all three cases, the dependent variable is defined as the return on the Dutch twin less the return on the UK twin, so the alternate hypothesis of excess comovement would suggest that the sum of the coefficients on the Dutch and US market indices will be positive, and the sign of the coefficient on the UK market index will be negative.

The results for the Anglo-Dutch DLCs tell a similar story to the tests for the Anglo-Australian DLCs. Table 4 shows the results from the 10-day return specification (results for other horizons are available from the authors). In almost all cases, we reject the null hypothesis concerning the market indices at the 1 per cent level. Comparing the results of the two periods, there is some indication that the degree of excess comovement has lessened somewhat since the end of Froot and Dabora's sample. However, we hesitate to cite this result as evidence of a reduction in the degree of the anomalous return behaviour of these DLCs, since the earlier data on the mean absolute price differential in Table 2 would not really support such a conclusion.

The results for both the Anglo-Dutch and Anglo-Australian DLCs therefore imply that excess comovement with aggregate market indices is a pervasive feature of the pricing of DLCs. In addition, the results consistently suggest a less-than-unit response of the relative valuation of the twins to movements in the exchange rate. In a sense, it appears that the market pays too much attention to one type of information (overall market indices) that should be irrelevant to the relative valuation of the twins but pays too little attention to information (exchange rates) that is relevant to their relative valuation.

Table 4: Testing for Excess Comovement, Anglo-Dutch DLCs

Company	Constant	AEX	FTSE	S&P	EUR/GBP	EUR/USD	Adjusted R^2
Sample period: January 1989–December 1995							
Royal Dutch Shell	0.03	0.15***	–0.33***	0.10***	–0.67	–0.12	0.40
	(0.08)	(0.04)	(0.03)	(0.04)	(0.06)	(0.04)	
Unilever	–0.01	0.19***	–0.41***	0.03	–0.54	–0.15	0.28
	(0.10)	(0.04)	(0.04)	(0.05)	(0.07)	(0.05)	
Reed Elsevier[a]	0.37***	0.26***	–0.53***	–	–0.75***	–	0.39
	(0.07)	(0.04)	(0.04)		(0.05)		
Sample period: January 1996–December 2002							
Royal Dutch Shell	–0.07	0.18***	–0.27***	0.00	–0.67	–0.09	0.40
	(0.08)	(0.03)	(0.04)	(0.03)	(0.07)	(0.06)	
Unilever	–0.06	0.14***	–0.21***	0.10***	–0.82	0.02	0.25
	(0.10)	(0.05)	(0.06)	(0.04)	(0.09)	(0.07)	
Reed Elsevier	–0.10	0.14***	–0.18***	–	–0.78***	–	0.28
	(0.09)	(0.04)	(0.05)		(0.06)		

Notes: This table provides tests of whether the excess comovement phenomenon identified by Froot and Dabora (1999) has persisted beyond their sample period. It uses 10-day returns and shows estimates from the equation: $r_{i,t}^a - r_{i,t}^b = \beta_0 + \beta_1 r_{m,t}^a + \beta_2 r_{m,t}^b + \beta_3 r_{m,t}^c + \delta r_{i,t}^{exr1} + \delta r_{i,t}^{exr2} + \varepsilon_t$ where: $r_{i,t}^a$ and $r_{i,t}^b$ are the log returns on the Dutch and UK twins, respectively; $r_{m,t}^a$, $r_{m,t}^b$ and $r_{m,t}^c$ are the log returns on the Dutch, UK and US stock markets, respectively; $r_{i,t}^{exr1}$ and $r_{i,t}^{exr2}$ are the log returns on the EUR/GBP and EUR/USD exchange rates, respectively; and all log-differenced returns are multiplied by 100. In the case of the Dutch exchange rate, the guilder is used in place of the euro prior to 1999. Newey-West standard errors are shown in parentheses. Rejections of the null hypothesis at the 10, 5 and 1 per cent levels are denoted by *, ** and ***, respectively, except in the case of the regression coefficients for the exchange rate variables in the Royal Dutch/Shell and Unilever equations, where there is no prediction about the size of the parameter estimates.

(a) Sample period is January 1992–December 1995.

6. Testing for Changes in Market Exposures Following Unification of DLCs

We next explore another aspect of the excess comovement phenomenon based on a different group of DLCs. In particular, we exploit the fact that six DLC structures have been discontinued within the last decade, and replaced with a more conventional single company structure. These firms are listed in Table 5, and some further details of the unification of their share structures are provided in Section 7.

Table 5: Details of Unified DLCs

Company and country	Industry	Period as a DLC	Unification announcement date	Market capitalisation Million t=0	Premium Per cent t=-3	Premium Per cent t=+1
Zurich Allied (Switzerland) Allied Zurich (UK)	Insurance and financial services	September 1998– October 2000	17/04/2000	£10 908 £17 309	11.7	6.0
Dexia (Belgium) Dexia (France)	Banking and financial services	November 1996– February 2000	20/09/1999	€5 233 €4 819	9.5	0.2
Nordbanken (Sweden) Merita (Finland)	Banking and financial services	December 1997– March 2000	20/09/1999	€7 257 €4 475	4.5	0.0
ABB AG (Switzerland) ABB AB (Sweden)	Electrical engineering and infrastructure	January 1988– July 1999	04/02/1999	US$10 800 US$10 000	12.5	6.1
Fortis (B) (Belgium) Fortis (NV) NL (Netherlands)	Banking and financial services	June 1990– December 2001	28/08/2000	€25 500 €19 200	0.2	0.4
SmithKline Beecham (USA) SmithKline Beecham PLC (UK)	Pharmaceuticals	July 1989– April 1996	20/02/1996	£19 327	2.5	2.1

Notes: In each case, the company trading at a discount prior to unification is listed second. Market capitalisation data were obtained from Bloomberg and company annual reports as close as possible to the unification date ($t=0$).

In cases where two companies become one, the listing arrangements typically change from two primary listings to a single primary listing in one market and a secondary listing in the other. In some cases the company may remain in the national market index of the country that is now the secondary listing, but international index providers such as Morgan Stanley Capital International (MSCI), Dow Jones and Bloomberg typically transfer the entire index weight to the country of the new primary listing. This is likely to have implications for the location of the trading of the company's shares, with a shift towards the market of the new single primary listing. However, if markets are perfectly integrated and the fundamentals, or firm-specific risks, associated with the combined company have not changed then the exposures of the combined firm to various markets should not have changed.

However, studies have shown that location of trade and the way that stocks are traded can influence stock prices. In addition to Froot and Dabora (1999), Chan, Hameed and Lau (2003) investigate the case of the Jardine Group companies that shifted their listings from Hong Kong to Singapore in 1994. They find that the stocks became more correlated with the Singapore market after the change in listing, despite the core business of the group remaining in Hong Kong. Two other related examples are studied by Barberis, Shleifer and Wurgler (2002) and Sosner and Greenwood (2002), who examine changes in correlation following inclusions or exclusions from major stock indices, namely the US S&P 500 index and the Japanese Nikkei 225 index, respectively. Both sets of authors find that when a stock is added to an index it becomes substantially more correlated with the other stocks in that index, and less correlated with stocks that are not in the index, with an equivalent impact for deletions from an index. The unification of a DLC provides another opportunity to examine how stock prices are affected by trading-related factors.

The prediction of a model of trading-induced comovement is that following the unification of a DLC and the shift to a single primary listing on one market, the exposure of the market value of the combined group to the market index of the market of the new single primary listing will rise. Similarly, there should be a fall in the market exposure of the combined group to the market that no longer has a primary listing. That is, just as the existence of a DLC arrangement allows for predictions about comovement, so to does the unification of a DLC arrangement into a conventional merger.

We test the prediction of trading induced comovement by estimating a model similar to that estimated by Chan, Hameed and Lau (2003) and focusing on four unifications where there are clear predictions about market exposures. We regress the return of the combined company, both before and after unification, on the returns of the market indices of the two markets where the DLC traded. The return on the combined company post-unification is directly observed from the trading of the company on the new primary or new secondary market. However, we do not directly observe the return on the combined company in the pre-unification period. Hence, we calculate it as:

$$r_{i,t}^{comb} = \alpha r_{i,t}^{a} + (1-\alpha)\left(r_{i,t}^{b} - r_{i,t}^{exr}\right) \tag{2}$$

where α is the weight of the twin (company a) in the market that becomes the new primary listing, $1-\alpha$ is the weight of the twin (company b) that becomes the new secondary market listing, $r_{i,t}^{a}$ and $r_{i,t}^{b}$ are the returns of the respective companies, and $r_{i,t}^{exr}$ is the change in the exchange rate between the two countries in question.

Although the problem of differences in trading hours is not a significant issue for the DLCs that have unified, we take account of possible non-trading effects or asynchronicity of trading by estimating market exposures using 2-day returns (though the results are not especially sensitive to this).[23] We test for a change in market exposures by estimating the following equation:

$$r_{i,t}^{comb} = \beta_1 + \beta_2 r_{m,t}^{p} + \beta_3 r_{m,t}^{s} + \beta_1^{*} D_t + \beta_2^{*} D_t r_{m,t}^{p} + \beta_3^{*} D_t r_{m,t}^{s} + \varepsilon_{i,t} \tag{3}$$

where $r_{m,t}^{p}$ and $r_{m,t}^{s}$ are the log returns of the market indices for the new primary and new secondary market indices, respectively, and D_t is a dummy variable taking the value zero in the pre-unification period and unity in the post-unification period.[24] We estimate this regression using data for 200 days prior to the

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[23] All are cases of European firms with no more than one-hour's difference in trading hours, with the exception of SmithKline Beecham which traded in the US and UK and was subject to a five-hour difference in trading hours.

[24] For presentational purposes, the model and results we present exclude the change in the exchange rate as an additional explanatory variable. The results are, however, broadly similar if this is also included.

announcement of unification, and 200 days post-unification beginning 20 days after the first trading day as a unified company.[25]

The parameter estimate on the dummy interaction terms provides the test for whether there has been a significant shift in market exposures. The null hypothesis that the market exposures of the combined company are not affected by the changed trading arrangements is that these dummy interaction terms are zero. The alternate hypothesis of a change in market exposures due to changed trading arrangements is that β_2^* will be positive and β_3^* will be negative.

Although we have data for six unified DLCs, we omit two of these in conducting the tests for changes in betas. In the case of Merita Nordbanken, the Finnish-Swedish financial group (which was renamed Nordea following its unification), the announcement of the unification of the share structure was accompanied by the announcement of a takeover of Norway's Christiania Bank. We omit this case since the takeover could have resulted in a fundamentals-based change in the market exposures of the combined company. We also omit the case of the Belgian-Dutch Fortis financial group because the unification was accompanied by the announcement that the group would retain dual primary listings. Indeed, different providers of regional and global indices have taken different decisions as to which of the two listings is included in their indices.

This leaves four cases where the unification of the share was not accompanied by any changes in the underlying business of the group and where the unification announcement explicitly stated that one particular market would become the new primary market for the group. These include: ABB, the Swiss/Swedish industrial conglomerate; Dexia, the Belgian/French financial firm; SmithKline Beecham, the Anglo-American pharmaceutical company which has subsequently merged with Glaxo Wellcome to form GlaxoSmithKline; and Zurich Allied/Allied Zurich, the Swiss/UK insurer which is now called Zurich Financial Services.[26] In these cases, although the merged company remained in the market index of each country,[27] the

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[25] By combining the pre- and post-unification data into a single regression, we are implicitly making the assumption that the variance of the residual is equal in the two different periods, an assumption which is not rejected by Chow tests.

[26] The post-unification primary market is listed first where applicable.

[27] An exception is Allied Zurich, which was deleted from the FTSE 100.

combined group is treated by all major global index providers (including MSCI, FTSE, Bloomberg, and Dow Jones) as belonging entirely to one market.

The results for the tests for changes in market exposures following DLC unification are shown in Table 6. The results provide very clear evidence that the betas of the combined firm change very markedly following the unification of the share structure. Furthermore, the results are exactly as would be predicted by a model of trading-induced comovement. In particular, the beta for the market that becomes the single primary listing for the merged company rises in all cases by about 0.4 and there is a corresponding fall in the beta for the market that is now the secondary listing. All the estimated changes are significant at the 10 per cent level, except for the estimate for β_3^* in the SmithKline Beecham regression, where the result appears to reflect an atypical low parameter on the US market in the particular pre-unification sample that was used.

Table 6: Testing for Changing Market Exposures in Unified DLCs

	β_1	β_2	β_3	β_1^*	β_2^*	β_3^*	Adjusted R^2
ABB	–0.30*	0.97***	0.34***	0.45*	0.34**	–0.34***	0.55
	(0.17)	(0.10)	(0.08)	(0.24)	(0.17)	(0.11)	
Dexia	–0.07	0.31***	0.38***	0.20	0.28**	–0.36***	0.31
	(0.12)	(0.11)	(0.09)	(0.17)	(0.13)	(0.11)	
Zurich	–0.25	1.19***	0.26*	0.06	0.53**	–0.39*	0.44
	(0.17)	(0.17)	(0.14)	(0.24)	(0.25)	(0.20)	
SmithKline Beecham	0.19*	0.76***	0.03	–0.09	0.56***	–0.04	0.26
	(0.11)	(0.14)	(0.15)	(0.15)	(0.20)	(0.19)	

Notes: This table provides tests for whether the betas or market exposures of the combined DLCs change following the unification of the share structure into a single company. It uses 2-day returns and shows estimates from Equation (3): $r_{i,t}^{comb} = \beta_1 + \beta_2 r_{m,t}^P + \beta_3 r_{m,t}^s + \beta_1^* D_t + \beta_2^* D_t r_{m,t}^P + \beta_3^* D_t r_{m,t}^s + \varepsilon_{i,t}$ where $r_{i,t}^{comb} = \alpha r_{i,t}^a + (1-\alpha)\left(r_{i,t}^b - r_{i,t}^{exr}\right)$ is the return of the combined DLC. α represents the pre-unification weight of the primary stock. After unification $\alpha = 1$. $r_{m,t}^P$ and $r_{m,t}^s$ are the returns of the primary and secondary markets, respectively. D_t is a dummy variable that is equal to 1 in the post-unification period and 0, otherwise. The returns used are 2-day rolling log returns, with log-differences multiplied by 100. Newey-West standard errors are shown in parentheses. Rejections of the null hypothesis at the 10, 5 and 1 per cent levels are denoted by *, ** and ***, respectively.

One possible explanation for the change in market exposures might be that the value of the unified firm is measured solely on the market that is now the primary listing, whereas the value of the pre-unification combined firm is measured partly in the market which is now the secondary market listing. Hence, it could potentially be the case that the shift in betas is due to the change in the source of prices for the pre- and post-unification returns. This possibility was examined by estimating Equation (3) with post-unification returns calculated from market prices on the secondary market (and changing the currency of measurement for the pre-unification returns.) The results of this alternate test are almost identical to the results shown in Table 6, which is not surprising since the prices of the unified company are essentially equal on the primary and secondary markets.

Hence, we conclude that even though there is no change in the fundamental exposures of these companies, the conversion of a DLC arrangement into a conventional merger results in substantial changes in exposures to the two markets where the DLC twins previously traded. Since unification results in changes in the twins' weights in global and regional indices, this result corresponds closely to the results of Barberis, Shleifer and Wurgler (2002) and Sosner and Greenwood (2002), who find related results for index inclusions and deletions in the United States and Japan. In addition, the shift from two primary listings to a single primary listing is somewhat analogous to the relisting of the Jardine Group companies studied by Chan, Hameed and Lau (2003), and our results are also very similar. Overall, our results are exactly as would be predicted by a model of trading-based comovement, whereby the pricing of assets is partly determined by the location of trade and the investors who trade them.

7.   An Event Study of Announcements of DLC Unifications

In the final analysis of the paper, we conduct an event study into the performance of DLC twins around the time of announcements that the DLC structure would be discontinued and replaced by a more conventional single company structure. We do so using data for the six DLC arrangements listed in Table 5 that chose to unify their share structure companies over 1996–2001. Not surprisingly, the pricing of

the twins converges substantially in these cases,[28] but it is of interest to ask if this occurred via an increase in the value of the company that was trading at a discount, or a fall in the share price of the twin that was trading at a premium. Alternatively, both share prices might have risen, or both might have fallen. Indeed, any evidence for systematic gains or losses in overall market value might provide some indication of how investors view DLC arrangements relative to more conventional unified share structures.

We define the day of the announcement that management is proposing to unify the share structure as our event day ($t=0$), and denote $ar_{i,t}^{j}$ as the abnormal return of company j in DLC i for period t, which is given by:

$$ar_{i,t}^{j} = r_{i,t}^{j} - E(r_{i,t}^{j}) \tag{4}$$

where $E(r_{i,t}^{j})$ is the expected log return from the market model.

We estimate the market model for each company as:

$$r_{i,t}^{j} = \alpha + \beta_1 r_{i,t}^{a} + \beta_2 r_{i,t}^{b} + \beta_3 r_{i,t}^{exr} + \varepsilon_t \tag{5}$$

where $r_{i,t}^{a}$ and $r_{i,t}^{b}$ are the log returns for markets a and b, and $r_{i,t}^{exr}$ is the log change of the relevant exchange rate for period t. The market model is estimated over a 100-day window ending 20 days prior to the announcement of unification. We then tested whether announcement-window abnormal returns were significantly different from zero, looking both at the abnormal return on announcement day, and the cumulative abnormal return over a three-day period centred on the announcement day.

We also investigate if the value of the combined firm changes around the announcement of unification. We do this by replacing the individual company return $r_{i,t}^{j}$ in Equations (4) and (5) with the company return $r_{i,t}^{comb}$ described in Equation (2).

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[28] In several cases, the convergence at the time of the announcement is not complete, which is presumably due to the uncertainty as to whether shareholders will vote to approve management's plans to unify the share structure.

One problem with the event study for the impact of DLC unification announcements is that four of the six announcements occurred in conjunction with other potentially value-relevant announcements.[29] These confounding events weaken our ability to single out the impact of the unification announcement on overall company value. However, these events should have no impact on the tests for the relative performance of the twins. An additional problem is that in some cases special payments were paid to shareholders in just one twin. Although these may impact on the relative valuation of the twins, they have no impact on the overall company value.[30]

The results of the event study are summarised in Table 7, which shows the excess returns for the six company pairs for both the announcement day and the 3-day announcement window. Three individual twins trading at a discount prior to the announcement (ABB AB, Merita and Dexia France) showed large positive abnormal returns (of 5 per cent or more) on the event day that were significant at the 1 per cent level. In addition, two companies trading at a premium (Dexia Belgium and Zurich Allied) showed significant negative abnormal returns (of around 4 per cent) on the day of announcement. On average, the companies trading at a discount rose by 3 per cent, while the premium companies fell by 1.6 per cent, with both of these averages being significantly different to zero at the 1 per cent level.

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[29] This was the case for ABB (annual profit was US$1.305 billion relative to average expectation of US$1.23 billion), SmithKline Beecham (annual profit was £1.36 billion relative to average expectation of £1.33 billion), and Fortis (half-year net income was €1.56 billion relative to average expectation of €1.54 billion). Merita Nordbanken made its announcement in conjunction with the takeover of Christiania Bank. These data on earnings expectations are taken from stories in Bloomberg.

[30] There are payments in three such cases, mostly to shareholders in the twin losing the primary listing, but in one case to the twin trading at a premium and gaining the primary listing.

Table 7: Excess Returns to DLC Twins around Unification Announcements

Company	Individual twin		Difference between twins		Total company value	
	1-day	3-day	1-day	3-day	1-day	3-day
ABB AB[a]	8.2***	14.5***	6.6***	6.5**	4.8**	11.1***
ABB AG	1.6	8.0**				
Fortis (NL)[a]	0.5	–4.4	0.1	–1.1	0.4	–4.0
Fortis (B)	0.4	–3.3				
Merita[a]	5.3***	6.3**	5.9***	5.8**	1.7	2.9
Nordbanken	–0.6	0.6				
SmithKline Beecham[a]	–1.2	–2.9	0.5	0.1	–1.4*	–2.9*
SmithKline Beecham PLC	–1.7*	–3.0*				
Allied Zurich[a]	0.1	0.0	4.9***	7.2**	–2.7*	–4.3*
Zurich Allied	–4.7***	–7.2***				
Dexia France[a]	5.0***	8.3***	9.8***	9.4***	–0.2	3.7**
Dexia Belgium	–4.8***	–1.1				
Average for discount companies	3.0***	3.6***	4.6***	4.7***	0.8	1.9*
Average for premium companies	–1.6***	–1.0				

Notes: This table shows the excess returns (based on a market model) of DLC twins around the date of the announcement of the unification of the DLC into a unified share structure. The 3-day returns are cumulated from one day before the event day (the unification announcement) to one day after. The results show log returns multiplied by 100. The statistics for the difference between the twins are for the performance of the company trading at a discount relative to the company trading at a premium. Significance at the 10, 5 and 1 per cent levels is denoted by *, ** and ***, respectively.
(a) Company previously trading at a discount.

In four cases we can reject the hypothesis that there was no difference in the relative performance of the twins, and not surprisingly, in each case it was the discount company that outperformed. The two cases where there is no significant difference in the performance of the twins (SmithKline Beecham and Fortis) are those DLCs with the smallest price differentials prior to the announcement. On average, the return differential for the four DLCs with a significant

pre-announcement price differential (ABB, Merita Nordbanken, Allied Zurich, and Dexia) was around 5 per cent.[31]

Over the 3-day period the average cumulative abnormal return of the discount firms was 3.6 per cent, significant at the 1 per cent level. The average cumulative abnormal return for the premium companies was –1 per cent, but not significantly different to zero. Hence, the significance of the negative abnormal returns for the firms trading at a premium is dependent upon the length of the return window used.

In terms of total firm value, the average across all six cases was a small, but statistically insignificant, increase on the day of the announcement. Only one group, ABB, recorded a statistically significant positive return on the event day, but two groups showed weakly significant falls in market value. Thus, the overall picture on the announcement day is one of increases in the value of the twins trading at a discount being mostly offset by falls in the value of the twins trading at a discount. However, when the return horizon is increased to 3 days, we find an increase in average overall firm value over the 3-day window that is significant at the 10 per cent level. However, the problem of confounding events, mostly positive in nature, means that we cannot be too categorical in attributing it to the unification announcement.

At one level, the finding of modest gains should not be surprising given the way in which the unification has occurred. Unification typically involves the company announcing that its new single primary listing will be on the market that – at least at the time of the announcement – placed the higher valuation on the cash flows of the twin companies.[32] That is, management might be considered to be undertaking a form of arbitrage by closing out the dual listing on the market that attached a

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[31] Since this can be thought of as the excess return on a notional long-short position, it indicates that – at least at times of unification announcements – arbitrage positions in DLCs can be quite profitable. This suggests that it might be of interest to revisit the work of Rosenthal and Young (1990) with a much larger sample of DLCs and see whether arbitrage trading would have been profitable more generally (i.e., not just looking *ex post* at cases of unification). Gatev, Goetzmann and Rouwenhorst (1999) provide an example of an empirical study of 'pairs trading' based on the identification of highly correlated equities.

[32] The case of Fortis – where there was little discount or premium – is an exception, since the single share structure that eventuated did not have a single primary listing but had a dual primary listing on the Belgian and Amsterdam exchanges.

lower valuation and moving the entire listing to the market which valued the company more highly. However, given that these differences in valuations on different markets might be relatively transitory – as well as the confounding events – the finding of possibly modest gains in overall firm value presumably cannot be generalised to any strong conclusions about the way that markets value DLC structures versus unified share structures.

8.   Conclusion

The results of this paper bolster the findings of Froot and Dabora (1999) by showing that price divergences between DLC twins and excess comovement in market valuation are pervasive phenomena in a larger sample of DLC cases. An innovation of the paper has been to study cases where DLC structures are abandoned in favour of a more conventional unified share structure. Even though the fundamentals of the combined firm should not have changed, we find that the market exposures of the combined firm do change, and in the direction that would be implied by models of trading-based comovement. Our results are consistent with recent work by Barberis, Shleifer and Wurgler (2002), Sosner and Greenwood (2002), and Chan, Hameed and Lau (2003) who study how the covariance of returns changes due to changes in the index composition or trading location. Together with the excess comovement finding, these results all point to a model where asset prices are determined by more than fundamentals and are influenced by the location of trade, the investors who trade them, and the manner by which trading occurs.

Our survey of DLC structures (shown in Table 1) and the recent evidence – including the two Anglo-Australian DLCs formed in 2001, the Anglo-South African Investec DLC implemented in 2002, and the DLC arrangements proposed recently by both US bidders for UK-listed P&O Princess Cruises PLC – suggests that there may well be further instances of the DLC structure as the process of corporate international expansion continues.[33] However, the survey also indicates

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[33] Hancock, Gray and Sommelet (2002) also suggest that DLC arrangements may become more frequent and involve companies from a wider range of countries than has hitherto been seen.

that many of the DLC arrangements put in place over the last 15 years have been replaced by more conventional unified share structures. Subject to the caveat of the small sample and confounding events, our event study of unification announcements suggests that there is little evidence that unifying a DLC – when this occurs on the market that trades at a premium – has a substantial effect on overall combined firm value. This result suggests that there are at least some cases where markets see the choice between a DLC arrangement and a conventional merger as having little impact on firm value. It is unlikely of course that markets are always indifferent between the two structures, so most mergers will no doubt continue to be conventional ones.

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