CORPORATE GOVERNANCE, DISCLOSURE, AND MINORITY SHAREHOLDER EXPROPRIATION: THE SAGA OF DAIMLERCHRYSLER

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Abstract

This paper examines a series of DaimlerChrysler events and finds unique evidence about whether disclosure requirements can compensate for weak corporate governance standards in protecting minority shareholders from expropriation. We show that strict disclosure requirements, though they improve the flow of information to all shareholders, fail to substitute for strong corporate governance measures. Strict disclosure complements strong corporate governance, and both may be required to create environments in which firms can raise capital and fund growth opportunities most efficiently.

Keywords: corporate governance, disclosure, minority shareholder, cross-listing, trading costs

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1. Introduction

Large shareholders typically control European and Asian industrial giants, leaving minority shareholders less than well protected.[i] In a study of the legal protection afforded minority shareholders across 27 countries, German shareholder protection ranked among the very worst (La Porta, Lopez-de-Silanes, Shleifer and Vishny, 2002). In the early 1990s, Daimler-Benz, one of the largest firms in Germany, was no exception. In 1993, with Deutsche Bank owning 24% of the equity, Mercedes AG Holding 25%, and the Emirate of Kuwait 14%, its controlling shareholders decided to cross-list Daimler-Benz on the New York Stock Exchange (NYSE).

All foreign firms that cross-list in the U.S. subject themselves to higher disclosure standards. In addition to listing on a major U.S. stock exchange, Daimler was required to file financial statements with the SEC and report any material non-financial information as well. Cross-listed firms are also followed more closely by U.S. stock analysts and the business press. These legal disclosure requirements and additional scrutiny by the investing community improved both the quantity and quality of information available to all shareholders about Daimler.[ii]

By early 1998, the cross-listed Daimler shares were widely held and actively traded worldwide, including significant volume originating in the United States. In September of 1998, Daimler and Chrysler shareholders, majority and minority owners alike, overwhelmingly approved a merger creating DaimlerChrysler AG (DCX) through an exchange of the cross-listed share for the first "global registered share" (GRS; see Karolyi (2003) for a thorough analysis of this new financial instrument). The so-called "merger of equals" was widely expected to realize both operating efficiencies (Blasko, Netter, and Sinkey, 2000) and, via the informational transparency of the GRS, improved access to international capital markets.

Instead, when DCX incorporated it adopted German corporate governance standards. U.S. institutional ownership in Chrysler was largely replaced by European banks that not only directly monitor the working capital financing of DCX but also may sit on its Management and Supervisory Boards. Such superior access and corporate control created distinct advantages for large German institutional owners relative to minority owners; foreign shareholders in the U.S. found themselves among this minority group. These advantages included the ability to: expropriate the private benefits of control from minority shareholders; share these benefits with management, effectively creating a collusion,[iii] and; profit from trading DCX shares with superior information. As a result, minority owners priced their shares less aggressively – i.e., the bid-ask spread widened -- to minimize their losses from

transacting with controlling shareholders. As their spread increased, U.S. minority shareholders' trading costs rose and U.S. trading volume fell as it migrated to Germany, the relatively cheaper trading venue.

The merger between Chrysler and Daimler and consequent changes in corporate governance create an ideal clinical study for isolating our hypothesis about the failure of the enhanced disclosure requirements to effectively compensate for lax corporate governance standards in protecting minority shareholders. To test this hypothesis, we use market microstructure techniques to explore changes in the bid-ask spread that are associated with the change in corporate governance and the control over the flow of information about the Chrysler assets. We look "inside" the trading mechanism that creates the observed transacted stock price, namely the bid-ask spread, to generate evidence on shifts in the quality and quantity of information available to minority versus controlling shareholders. The bid-ask spread should grow as minority shareholders learn that traders on the other side of the spread possess superior information about the company, information which is born out of their majority control of the firm and its senior management compensation, asset disposition, and financing and risk-taking strategies.[iv]

We find the decision to merge and become a German stock corporation significantly weakened the protection of minority shareholders, particularly prior owners of Chrysler assets, and led to their expropriation by controlling shareholders and principal creditors of the consolidated firm.[v] How? Consistent with Coffee (1999, 2002), we find that the answer lies in the lack of protection afforded minority shareholders by the corporate governance structure of the newly combined DCX entity.

2. Daimler's 1993 U. S. cross-listing and 1998 merger with Chrysler

Examining the significance to minority shareholders of the 1998 DCX merger begins with understanding Daimler's earlier decision to become the first German firm to cross-list in the U.S. In 1993, Daimler's controlling parties chose to cross-list the firm on the NYSE, apparently having concluded that the benefits of cross-listing outweighed the costs. What were these costs and benefits? The out-of-pocket costs include the accounting, legal, printing and first-time registration fees with the Securities and Exchange Commission (SEC), the listing costs of the exchange, and the costs incurred to meet additional disclosure requirements (Radebaugh, Gebhardt, and Gray, 1995). Perhaps more significantly, cross-listing sacrifices some of the private benefits of control by majority investors.

However, foreign firms can clearly benefit from cross-listing on major U.S. exchanges. Miller (1999) finds that such firms earn significant abnormal returns at the cross-listing announcement. Doidge, Karolyi, and Stulz (2004) report that the Tobin's *q* ratios of foreign companies with shares traded on major U.S. exchanges were 37% higher than those of non-listing firms, even after controlling for growth.

Earlier studies attributed these benefits to a lower cost of capital due to global risk-sharing (Karolyi and Stulz, 2003). More recent evidence (Doidge, Karolyi, and Stulz, 2004) links the benefits to enhanced minority shareholder protection which increases the value of all the cross-listed firm's publicly traded shares. Significant protection for minority shareholders is contained in the corporate governance standards imposed by the NYSE. These standards protect minority interests by regulating the firm's rules and processes that govern the rights and responsibilities of the board, managers and other stakeholders, including such essential issues as board and committee structure, incentive pay, and voting rights. Since foreign firms can waive the stricter corporate governance standards in cross-listing, however, the bulk of the benefits from cross-listing in the U.S. must come from enhanced disclosure alone (Coffee, 2002).

2.1. Benefits of higher disclosure standards: better information and lower agency costs

All foreign firms that cross-list in the U.S. subject themselves to higher disclosure standards. Firms that choose to cross-list with a Level II ADR, as did Daimler, are required to list on a major U.S. stock exchange, file SEC Registration Statement Form F-6, and annually file Form 20-F within six months of the issuer's end of fiscal year. Form 20-F requires a reconciliation of the cross-listed firm's financial statements to U.S. GAAP accounting principles. It also requires disclosure of non-financial items pertinent to an analyst's projection of future cash flows such as legal challenges, risk factors, competition analyses, related party transactions, material contracts, ownership, officers and directors, and executive compensation (Doidge, Karolyi, and Stulz, 2004).

In addition to these higher disclosure requirements, exchange-listed firms are subject to tender offer and "going private" rules, insider trading regulations, and the anti-fraud provisions of U.S. securities laws. U.S. cross-listed firms attract the scrutiny of U.S. securities analysts, auditors, rating agencies, regulators, and financial journalists, who generate and distribute information about the firm. As a result, cross-listed firms have increased earnings forecast accuracy (Lang, Lins, and Miller, 2003) and increased market reaction to earnings announcements (Bailey, Karolyi, and Salva, 2004).

The legal disclosure requirements and other sources of additional scrutiny by the investing community improve both the quantity and quality of information available to all shareholders about the cross-listed issuer. This enhanced disclosure provides some protection for minority shareholders and is a

possible source of the observed benefits to firms that cross-list in the U.S.

The other likely source of the benefits generated by U.S. cross-listing centers on the reduction in the agency costs of controlling shareholders (Coffee, 1999, 2002). When minority investors are poorly protected by the legal environment, controlling shareholders and principal creditors can easily extract value from the firm at the minority shareholders' expense. Rather than being forced to disgorge excess cash (Dittmar, Mahrt-Smith, and Servaes, 2003), controlling shareholders can divert a disproportionate share of corporate profits before managers distribute the rest as dividends. The diversion can take many forms, including excess payments to major creditors for contract services, non-arms-length asset transactions, grants of special drawing rights, as well as outright theft (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 2002). In addition, controlling creditors can mitigate their default risk by biasing the selection of capital budgeting projects against risks that would benefit stockholders.

Recent evidence supports this view. Gugler, Mueller and Yurtoglu (2004) find that firms in countries with civil-law systems, like Germany, earn returns on investment below their cost of capital. In contrast, firms in countries with English common-law systems, like the U.S., recover their costs of capital. In a direct test of the private benefits of control, Doidge (2004) examines the dual class shares (with different voting rights) of firms with U.S. cross-listings. He finds that the price of minority (low-voting) shares increases significantly more on cross-listing than the price of controlling shares, and cites this as evidence that the private benefits of control decrease for firms that cross-list. Doidge, Karolyi, and Stulz (2004) find that the "U.S. listing reduces the extent to which controlling shareholders can engage in expropriation and thereby increases the firm's ability to take advantage of growth opportunities" (p. 205).

Siegel (2005) studies the extent to which foreign firms can bypass their countries' weak legal institutions by listing equities in New York and abiding by U.S. securities laws. He finds that while the potential for legal bonding associated with cross-listing is tenuous, primarily because the SEC and minority shareholders failed to enforce these laws against cross-listed foreign firms, the individual cross-listed firm can choose to benefit from reputational bonding. Mexican cross-listed firms that survived a significant economic downfall with a clean reputation were rewarded by the international capital markets with unimpaired long-term access to outside financing. We posit that DaimlerChrysler sought the reputational bonding effects of U. S. cross-listing.

In 1993, Daimler's controlling shareholders and creditors contemplated using stock to fund strategic growth opportunities for a strong company in the midst of an auto industry consolidation. Cross-listing in the U.S. was a particularly promising way to initiate a growth-through-acquisition strategy. The resultant increase in disclosure and reduction in agency costs raised stock value and enabled Daimler to use the 1993 cross-listing as a first step in financing stock-swap acquisitions like the 1998 merger with Chrysler.

2.2. Chrysler's 1998 merger with Daimler: a new corporate governance regime for Chrysler

The intent of Daimler-Benz and Chrysler to merge via a stock swap was announced on May 7, 1998. The two companies planned to incorporate as a German stock company with a total of 18 people on its Management Board, with 10 from Daimler and 8 from Chrysler. This Management Board was to be responsible to a 20-member Supervisory Board; dual board structures are quite common in Germany. The Supervisory Board authorizes accounting statements, hires executives, and ratifies all major restructuring decisions. After much negotiation, one of these 20 seats was released to the UAW. The rest were split more traditionally, with nine going to German labor and the remaining 10 split between Daimler and Chrysler outside directors.

Daimler-Benz's merger negotiations with Chrysler were marked by the high levels of secrecy and non-disclosure associated with German corporate governance culture (Radebaugh, Gebhardt, and Gray, 1995). In particular, Daimler declined comment on the well-known disparity between German and U.S. executive compensation[vi] and thereby fueled speculation about an explosion in the future compensation of DCX's German executives. In addition, a May 1, 1998 amendment to Germany's Stock Corporation Act had lifted prior restrictions on German corporations against awarding executive stock options contingent on company performance.

In theory, stock options or restricted stock grants for the senior German executives could have served as an effective substitute for the weak minority shareholder protection associated with Germany's corporate governance. This substitute would have been especially important to Chrysler minority stockholders because of the possibility going forward that German executives on the new DCX management team might tighten their own control over the consolidated assets. Moreover, minority shareholders had to realize that Chrysler executives would support almost any transition because of the generous financial package they were due to receive at closing.[vii]

On the other hand, Kerkorian and minority shareholders at Chrysler had ample reason to believe that the incentives of Chrysler executives were already sufficiently aligned with shareholder interests. Kerkorian had been assured, both in private and in the May 7th Agreement, that the integration of the two firms would constitute a "merger of equals" with

Chrysler executives remaining in control of the Chrysler pool of assets.[viii] After all, four of the Chrysler senior officers appointed to the new DCX Management Board had received incentive contracts heavily weighted toward performance-based compensation in the form of stock appreciation rights (SARs).[ix]

A SAR gives its holder the right to receive an amount equal to the appreciation on a specified number of shares over a specified period of time. Unlike a stock option, the recipient is not required to pay to exercise the SAR, and the recipient receives the payoff in cash rather than stock. In this case, each dollar that DCX appreciated above $75.56 earned these former Chrysler executives a dollar in SAR cash exercisable either six or twelve months after the consummation date of the merger (i.e., in March or September 1999). Despite disclosing the additional SARs-based incentive pay for Eaton, Lutz, Valade, and Holden, DCX remained totally silent on the issue of German executive compensation.

2.3. The role of SARs

Apart from these one-time-only payments to Chrysler executives at the consummation of the merger, a €2 million and a €41.7 million 1998 total compensation expense for the DCX Supervisory and Management Boards, respectively, were disclosed in the 20-F Consolidated Statement released March 24, 1999.[x] Some of this compensation was triggered by pre-merger dividend growth under Daimler-Benz's prior executive contracts and therefore provided no incentive alignment for DCX shareholders going forward. The rest consisted of 22 million new SARs on the appreciation of DCX Ordinary Shares, and two sets of 241,200 convertible bonds granting SARs on DCX Ordinary Shares exercisable six and twelve months from the September 1998 date of issue.[xi]

The new system of SARs created additional contingent compensation for the senior management team at a conversion threshold of €106.15 ($122.65 on September 18, 1998) exercisable in March and September of 1999. Thus, when issued, the SARs were out of the money; even if the minority shareholders on either continent had been aware of them at the time of the merger vote, they would have viewed these convertible bonds and SAR grants as no more effective than out-of-the-money stock options at aligning executive with shareholder incentives in minimizing agency costs. And, as it turned out, the SARs expired valueless: following an $82 share price on the first day of trading in November 1998 (Figure 1), DCX tested new highs $99 in December and $108 in January before beginning a sustained decline to $89 in March, $70 in September 1999, and $53 or lower since March 2000.

Although the German Commercial Code requires disclosure only of the total compensation paid to the Management Board (not broken down by individual manager or type of compensation), the convertible bond instrument would normally have been disclosed during the merger negotiations when shareholders voted to authorize contingent capital stock. By choosing to issue SARs rather than stock conversion privileges, however, DCX avoided the need for shareholder approval. As a result, disclosure of these grants was delayed until the release of the Annual Report and 20-F in March 1999, a full six months later.

SARs settled in cash, during a pooling-of-interests merger, provided an excellent opportunity to hide the executive compensation grants. The SARs and DCX convertible bonds represented a new liability which necessitated a contra equity account on the asset side of the balance sheet. Pooling-of-interests mergers are filled with plug numbers, including shareholder equity. It was therefore easy to hide the extent to which the issue of the SARs and convertibles to the German executives was actually an expropriation of minority shareholder equity value from the Chrysler pool of assets. Further, any information regarding the expropriation was delayed because GAAP-compliant disclosure of the contra equity account was not mandatory until the Consolidated Statement appended to the 1998 DCX Annual Report was released March 24, 1999, two months late and six months after the merger was approved.

Thus, at a time when DCX compensation was changing in management's favor, minority shareholders were left in the dark to wonder if their shareholder protections were in greater jeopardy (Gordon, 2000). The revelations in the February 25th public announcement of the consolidated report and the March 24th release of the 20-F directly addressed the growing uncertainty as to whether minority shareholders had retained access to material information on Chrysler's cash flows, particularly those relating to executive compensation, now that the assets were controlled by German corporate governance. The clear implication was that they had not. This expropriation from minority shareholders suggests that the merger itself continued a governance structure wherein majority German shareholders and principal creditors could enjoy significant private benefits of control.

A timeline of merger events is presented in Table 1. On September 18, 1998, shareholders on both continents approved the pure stock swap deal creating DCX. Because the consolidated company was incorporated as a German legal entity, Chrysler was deleted from the S&P 500 Index October 12th. On November 17, 1998, global registered shares in DCX began trading at $82 on seventeen exchanges throughout the world. A price of $70 for DCX in September 1999 implied that a share of Chrysler stock was worth $43.65 ($70 x .6235) one year after the approval of the merger, almost identical to the $44 at the April 14, 1998 merger agreement lock-in date. Over the intervening seventeen-month period, the 28% merger premium (from $44 to $57) that Chrysler

CEO Bob Eaton had negotiated for Chrysler stockholders had completely eroded away.[xii]

3. Corporate Governance, Disclosure, and the Bid-Ask Spread

It is corporate governance (through contracts, markets, rules, and regulations) which enables the decision-making process that creates and then allocates asset cash flows. Disclosure requirements, while having everything to do with the *revelation* of the ex-post mean and variance of these asset cash flows, actually have nothing to do with their *creation*. It is much more difficult to mandate the disclosure of behind-the-scenes negotiations between controlling parties. But, again, it is these negotiations about the types of asset, compensation, and financing strategies a company may employ that, in turn, create the profits and risks that underlie corporate value. In countries where the board members, controlling shareholders and principal creditors can enjoy the private benefits of control, even the most stringent disclosure requirements do too little to prevent the expropriation of this value from minority shareholders.

We posit that DCX is an ideal clinical study for isolating the inability of disclosure requirements to effectively compensate for weak corporate governance standards in protecting minority shareholders. U.S. institutional ownership in Chrysler was largely replaced by European banks that not only directly monitor the working capital financing of DCX, but also may sit on its Management Board and place staff assistants throughout the senior DCX executive offices. In addition, European banks that are major stockholders or creditors may also sit on the Aufsichtsrat Supervisory Board that authorizes all corporate restructuring deals and must approve the annual report and other accounting statements. In a nominal sense, this bank access actually exceeds that of the senior DCX executives themselves because the management team of a German corporation is not allowed to serve on the Aufsichtsrat. Such extraordinary differences in access to information suggest a significant information advantage for European banks and greater informational uncertainty for minority investors, despite the transparency of accounting statements mandated for the GRS.

To test our hypothesis, we use market microstructure techniques to explore changes in the bid-ask spread that are associated with the change in corporate governance and the control over the flow of information about the Chrysler assets. We look "inside" the trading mechanism that creates the observed transacted stock price, namely the bid-ask spread, to generate evidence on shifts in the quality and quantity of information available to minority versus controlling shareholders, i.e. we look at changes in the symmetry of the information sets available to uninformed (or "liquidity") traders versus informed traders. The bid-ask spread should grow as minority shareholders learn that traders on the other side of the spread possess superior information about the company, information which is born out of their majority control of the firm's senior management compensation, asset disposition, and financing and risk-taking strategies.

It may seem that an event study of the stock price reaction to an announcement of the expropriation would be in order, but an event study approach is inappropriate in this case in part because there was no definable date on which the specifics of the merger negotiations were announced.[xiii] Instead, there was a two- to three-month period, as the financial statements were delayed from their expected January, 1999 release date, during which uncertainty about the disposition of assets, alignment of executive incentives, and change of control grew. The late February release included financial reports with only very basic bottom-line accounting results such as company profit margins, but no data were provided on either total or disaggregated compensation or other assets that would have enabled the investing public to infer the expropriation. In fact, all the press releases accompanying the limited February reports promised that the omitted details, including data on executive compensation, would be released at the annual shareholders' meeting on March 31st. But no such information was contained in the March release of the consolidated financial statements. Instead, in a March 31, 1999 joint press conference held by Schrempp and Eaton, they announced that, unlike the former Chrysler, DCX would be issuing no more proxy statements and thus no longer disclosing the compensation of its top executives.[xiv]

Further, the mean stock price reaction to announcements, either direct or indirect, about possible expropriation comes 'too late" in the price-formation process for our purposes. We are interested in the actions taken by traders on either side of the bid-ask spread as their information set about access to material information about this new merged entity evolves. Theoretically, the resulting observed mean stock price could remain unchanged while the bid-ask spread widens or shrinks as uninformed traders take measures to minimize their exposure to losses against informed traders.

3.1. Development of hypotheses

We argue that the delay through January and February of 1999 in the release of DCX's Annual Report and 20-F and the material information about DCX cash flows and risks they contained, caused minority investors (e.g., U.S institutional investors) to realize that their heretofore unencumbered access to speedy and accurate information about Chrysler assets had deteriorated markedly. Throughout this period, U.S. investors faced a higher risk of trading with informationally advantaged controlling German shareholders and Daimler's principal creditors, a so-called "picking off risk." Foucault (1999) and Foucault, Kadan, and Kandel (2001) show that

informational uncertainty can increase the picking off risk for uninformed or liquidity traders which induces them to price their trades less aggressively. For example, if under normal conditions liquidity traders were willing to sell at $10.05, under increased informational uncertainty they might raise their ask to $10.12. Likewise, if they had been willing to buy at $9.95, in the face of additional picking off risk they might offer only $9.90. Thus the asymmetric information, or "adverse selection," component of the spread has risen resulting in wider overall spreads (from $10.05 - $9.95 = $0.10 to $10.12 - $9.90 = $0.22) and reduced depth.

The newly subsumed Chrysler assets were now under the control of a German stock corporation with concentrated control rights, markedly diminished minority shareholder protection (Franks and Mayer, 2001), and differential access to company decision-making processes for European institutional investors. With German bankers dominating the DCX Supervisory Board of Directors, majority investors, particularly concentrated German shareholders and creditors, had greater control over DCX's combined assets and greater access to information about the cash flows generated by those assets. Thus we predict that the mean level of information about the newly merged assets would be lower and the variance of information would be higher (Coval, 1996; and Brennan and Cao, 1997) among those U.S. institutional traders more likely (at least initially) to do trades in New York than among European institutional traders more likely to do trades in Frankfurt, leading to our first testable hypothesis:

> $H1_0$: Because of the change in corporate governance brought on by the merger and the substantial delay in revealing the full effects of German incorporation on the merged firm, adverse selection costs in DCX trading increase on the NYSE relative to the Frankfurt Stock Exchange.

With little or no change expected in order processing costs, the other main component of total trading costs, this difference in the adverse selection component of the spread leads to increased relative trading costs in New York. Of course, the two primary markets for DCX's shares have significantly different market architecture which may well generate a different level of trading costs in the two trading venues. Consequently, we will focus our attention not on the relative levels of trading costs but rather on the changes over time in relative trading costs post-merger. Therefore, we test:

> $H2_0$: Because of the change in corporate governance brought on by the merger and the substantial delay in revealing the full effects of German incorporation on the merged firm, DCX trading costs in New York increase relative to DCX trading costs in Germany.

Although the 1993 cross-listing in the U.S. was pivotal to the acceptance by Chrysler shareholders of the 1998 DCX global registered share and stock swap, Coffee (2002) argues that continued U.S. trading of DCX beyond the time of the merger was not. That is, given the ease and reliability of GRS trading, little prevented trading from flowing back to German capital markets when and if lower trading costs presented themselves. Liquidity traders would be expected to cluster where the trading costs are lowest (Chowdry and Nanda, 1991), deserting the high information cost market. Informed "stealth" traders would then be expected to follow, to "hide" among the larger number of liquidity traders. We predict that these developments led to a migration of both ownership and trading from New York to Germany. Hence, if hypotheses $H1_0$ and $H2_0$ are confirmed, we will also test a price discovery hypothesis:

> $H3_0$: Information signals that get impounded into permanent price changes for the post-merger DCX firm will appear first in the Frankfurt market.

4. Data

We obtain German trading data from the Frankfurt Stock Exchange (FSE) and NYSE trading data from the NYSE's TAQ database. The merger of Daimler-Benz AG and Chrysler Corporation was consummated with an exchange of stock in late October 1998. We have the price, time, and size of every GRS trade from the first day of trading on November 18th through May 1999 for both exchanges. The FSE data contain many order characteristics of the electronic order book that are explained in detail in *Xetra: Market Model Release*, available from Gruppe Deutche Borse. The NYSE data also include the price, time, and quantity of every quote that betters an existing quote. Because quotes may be recorded ahead of trades (Lee and Ready, 1991) we adjust the NYSE quote times by five seconds. We discard the first trade of the day. We convert DEM and EUR prices to USD prices using trade-to-trade foreign exchange data from Olsen Associates.

We use all of the data for our analysis except when investigating which market is contributing to price discovery. That analysis uses only data for the period (typically two hours) during which trading overlaps on the NYSE and FSE each day. To facilitate comparison we convert all Frankfurt times to New York time, taking into account differences in the implementation of daylight savings time.

4.1. Empirical model of trading costs and components of the spread

As is customary in the literature, we represent the trading costs faced by traders in DCX with the bid-ask spread. We measure the bid-ask spread with the implicit spread, calculated as $2\sqrt{-c}$ where c is the covariance of returns, following Roll (1984).[xv]

We measure the adverse selection cost component of the bid-ask spread as a percentage of

the (effective) spread, across all trade sizes. Then, we examine this cost within various trade size categories to detect the effect of individual versus institutional trades on relative trading costs. Following Lin, Sanger, and Booth (1995), all trades are divided into five size-percentile categories from lowest trade size to highest trade size: less than 25th percentile (below 100 shares traded for DCX), 25th to 50th percentile, 51st to <75th percentile, 76th to 90th percentile, and above 90th percentile (over 3300 shares traded). For each of the six months after the merger for each size category (and for the entire sample), the adverse selection cost is estimated as,

$$\Delta Q_{t+1} = \alpha + \lambda Z_t + e^{q}_{t+1} \quad (1)$$

where $\Delta Q_{t+1} = Q_{t+1} - Q_t$, Q_t is the log of the quote midpoint at time t, Z_t equals $P_t - Q_t$, P_t is the log of the trade price at time *t* and e_{t+1} is the error term. The adverse-selection component is represented by the parameter, λ.

In addition to market metrics, we employ error correction/cointegration methods to estimate the contribution of each market to price discovery using the common factor share approach of Gonzalo and Granger (1995). The specification for these common factor models is explained in Harris, McInish, and Wood (2003a and 2003b) and elaborated in a technical appendix available from the authors.

5. Empirical results

5.1. Trading costs and migration

Table 2 demonstrates a significant increase in the adverse selection component of the NYSE spread in January and February of 1999, consistent with hypothesis $H1_0$. In Panel A we report the adverse selection cost for each month for each trade size class. In the three largest trade size classes, the adverse selection costs peak in the January-February 1999 period. In the 26-50th trade size class, the highest single month for the adverse selection component is January. Only in the smallest trade size class is the peak month not January or February and even in this case the January/February average is again higher than any other pair of months.

In Panel B of Table 2, we test for differences between the adverse selection costs for the two-month periods surrounding the February 25th, 1999 public announcement of the consolidated results. Specifically, the two-month period from January 1 through February 24 is tested against the two-month period from November 18 to December 31 and that from February 25 through the end of April.[xvi] For example, across all the order flow (bottom row of Panel B) the adverse selection component of the spread averaged .55 cents in November-December then increased to .64 cents in January-February as uncertainty surrounding the delayed consolidated accounting results escalated. After the consolidated results were released on February 25th, and information about the risks and cash flows of the consolidated DCX assets became public, the adverse selection component declined to .47 cents. The .64 cents is statistically significant at 10% relative to the prior .55 and the subsequent .47 cents in a Wilcoxon rank sum test of the daily adverse selection components from the two periods (t = 1.89).

More important are the results for the specific trade size classes. Consistent with the findings in Benveniste, Marcus, and Wilhelm (1992), Barclay and Warner (1993) and Chakravarty (2001) that informed traders stealth trade in mid-size classes, the 51st -75th percentile size class isolates the hypothesis that higher information costs for U.S. institutional investors and other liquidity suppliers raised the adverse selection component of the trading costs. From a .50 cents average in November-December, Panel A shows the adverse selection component increased to .59 and .63 cents in January and February then fell back to .47 and .50 in March and April. The January-February mean of .61 cents is significantly higher at the 5% level relative to both the prior and subsequent periods (t = 2.28). In addition, the largest trades (>90th percentile) show a statistically significant increase at 5% in adverse selection costs to 1.21 cents in January-February relative to the .85 cents in November-December (t = 2.08). We interpret all these results as strong evidence consistent with hypothesis $H1_0$ of differential access to information in New York trades until the late February release of the consolidated DCX annual report.

Table 3 shows that, consistent with hypothesis $H2_0$, trading costs as measured by spreads increased substantially and depth plummeted in New York with the delay in the release of the complete 1998 financial results to February 25, 1999 and of the consolidated annual report (10K) to March 24, 1999: New York spreads peaked in late February and March at an average of 6.6 cents relative to 5.0 cents in November/December, and average trade size (Table 1) declined from 2,849 in November/December to only 1,538 in February/March. In contrast, spreads in Frankfurt actually declined from 6.7 cents in November to 5.7 cents in February and March, and 5.0 cents in April. Wilcoxon rank sum tests of the mean spreads each day during the first six months of trading confirm that the New York spread is significantly higher in 1999 than in 1998 (t = 3.87) while the Frankfurt spread (Panel B) is lower in 1999 than in 1998 (t = 3.84).

Market quality assessments that also bear on the migration of trading from New York to Frankfurt are indicated by the depth on Xetra relative to the NYSE. Starting from higher mean November trade sizes of 3,125 shares in New York and 2,187 in Frankfurt, trade size in New York collapsed to 1,561 in April 1999 compared to 1,717 in Frankfurt. In general, DCX liquidity improved in Frankfurt relative to New York over the period.

As the adverse selection cost of trading DCX on the NYSE rose and the NYSE spread increased, the dollar volume of trading in New York declined substantially. Table 1 shows that the 28% NYSE dollar volume of DCX worldwide trading in November shrank by half to 14% in January and shrank again by nearly half to 8% in March. In contrast, on the FSE the dollar-equivalent volume of DCX worldwide trading rose from 69% in November to 89% in March.

There are two alternative hypotheses that we cannot fully distinguish based on our empirical findings. First, we recognize that perhaps relative trading costs rose in New York and liquidity migrated to Xetra, not because of the potential for expropriation of minority investors, but because Xetra is a superior trading system. Xetra's market design of screen-based trading with an electronic limit order book that preserves anonymity for both demanders and suppliers of liquidity has attracted much of the order flow away from the Deutsche Bourse floor trading. However, Xetra has not dominated New York or other international exchanges in numerous other cross-listings, so the trading mechanisms in Xetra are an unlikely explanation for the migration of trading from New York to Frankfurt.

Secondly, the 44% to 21% decline in U.S. equity ownership of DCX is consistent with the desire of U.S. mutual funds to disinvest because of Standard and Poor's October 1998 deletion of Chrysler from the S&P 500 index. The deletion did trigger substantial selling pressure from U.S. fund managers tracking the S&P 500, but others generated sufficient counterparty order flow to maintain market capitalization in the early months following the merger. Figure 1 shows that DCX tested new highs for several months after the index deletion. Moreover, DCX's SEC 13F quarterly filings show that U.S. institutional ownership peaked three months after the deletion at 67.7 million shares in the last quarter of 1998 and remained at 54.5 million shares as late as the first quarter of 1999. In the timeline of Table 1, therefore, we show that the U.S. institutional sell-off really occurred in March and April 1999, six and seven months after the deletion. Only then did U.S. ownership of DCX abruptly decline to 21%.

5.2. Price discovery results

Consistent with $H3_0$, price discovery concentrated in Frankfurt by March of 1999. We see from the estimated common factor weights[xvii] in the last two columns of Table 4 that after the NYSE spreads rose, the trades that led to new permanent price moves shifted from approximately 50% in New York and Frankfurt in January and February to 90% in Frankfurt by March and April. Grammig, Melvin, and Schlag (2005) confirm a 9% information share for the NYSE prices in their study of price discovery for DCX stock trading from August through October 1999 focused on foreign exchange (FX) adjustments.[xviii]

The error correction results in Table 5 further confirm these findings. New York price changes (in the right-hand column of Table 5) respond in a statistically significant magnitude (and with the expected sign) to price disparity with Frankfurt as reflected by the error correction term. That is, once the internal information about Chrysler arising from the direct monitoring by German banks of DCX consolidated cash flows became less available to U.S. analysts and typical NYSE institutional traders, New York prices began to adjust themselves consistently to any disparity from Frankfurt prices. In contrast, Frankfurt prices seldom adjusted to randomly-induced disparity from New York prices. The FSE came to dominate DCX price discovery because it was favored by liquidity traders who wished to execute with European institutional buyers and sellers that exhibited the least informational uncertainty

6. Discussion

The basic story supported by our findings is really quite simple. Despite the transparency afforded by the GRS in the cross-listing, when DCX incorporated, the consolidated firm adopted German monitoring and control practices. German control rights diminished the protection of minority stockholders relative to U.S. control rights, and foreign shareholders in the U.S. found themselves among this minority group. Access and control created an informational advantage for large German institutional owners relative to minority owners. Recognizing said asymmetries, New York limit order submitters and the NYSE specialist priced less aggressively, thereby raising the adverse selection component of the New York spread. Volume in New York declined and overall trading costs rose, driving uninformed trades in DCX to a cheaper trading venue in Frankfurt. Spreads were lower than in New York because of the reduced informational uncertainty of the large DCX shareholders and principal creditors supplying liquidity on the FSE. An ever-greater proportion of the information-based trading, therefore, followed the available liquidity to the German market.

The evidence in Tables 2 - 5 is overwhelming that the adverse selection component of the spread, and trading costs more generally, rose in New York relative to Frankfurt and that, as a result, price discovery migrated from New York to Frankfurt. Total spreads and their adverse selection component peaked in New York throughout January and February 1999. Informational asymmetries appeared in the largest trade sizes where stealth trading by informed investors is most likely. The fact that these effects show up over a two-month period is consistent with our contention that the informational advantage arose from differential control rights and differential access to internal company accounting data rather than from a time-specific information event as one

might see, for example, in an event study of the price reaction to the March 24th release if it had publicly announced – which it did not -- the expropriation of Chrysler assets in the pooling of interest merger.

The role of German control rights and the asymmetric information advantage for German institutional investors are best understood within the context of Daimler's equity capital-raising over the decade of the 1990s. In 1993, Daimler-Benz employed the strict disclosure requirements of a Level II ADR on the NYSE to mitigate the effects of a weak corporate governance structure on the Daimler stock price. Growth through acquisitions was crucial to surviving the consolidation sweeping across the global auto industry. Finding that poorly protected minority investors were initially reassured by the disclosure requirements of their cross-listing, Daimler orchestrated a pure stock-swap with Chrysler that allowed pooling-of-interests merger accounting with all its numerous plug numbers. Adopting a SAR system settled in cash to incent the consolidated management team also allowed the private benefits of controlling shareholders and principal creditors to continue.

The revelation over a three and a half week period (February 25th to March 23rd 1999) six months after the merger of SARs for the German executives proved pivotal to the sell-off of U.S. institutional ownership. Unlike option contracts or the granting of restricted stock, the performance-based SARs settled in cash were non-dilutive. Nevertheless, because they represented a contingent liability, the SARs triggered an offsetting contra equity account on the DaimlerChrysler balance sheet. Minority shareholder interests were thereby expropriated. Unbeknownst to minority shareholders like 21st Century Fund and Fidelity, this expropriation had taken place at the consummation of the merger in September 1998. What the extraordinary secrecy from September to December and the delayed release of the 20F from January to March signaled was the ability of controlling shareholders and principal creditors to control the flow of information. This (perceived) asymmetry of information shows up in our rising estimates of the asymmetric information component which peaked in January and February (see Table 2) and in the NYSE spreads in January, February, and March (see Table 3).

What the full revelation of the expropriation itself in the 20F filing in March signaled was the ability of controlling shareholders and principal creditors to expropriate equity value without shareholder approval. Shortly thereafter U.S. institutional investors sold their long positions in DaimlerChrysler. Unlike the gradual migration of trading from New York to Frankfurt in response to rising NYSE spreads (17% of total trading volume on the NYSE in December, 14% in January, 10% in February, 8% in April, and 5% in March, see Table 1), the sell-off of U.S. institutional ownership proved quite dramatic. From a peak ownership of 67.7 million DCX shares in December of 1998, U.S. institutional investors still owned 54.5 million shares in March 1999. However, by April, the shares held by U.S. institutions had fallen to 12 million.

7. Conclusion

Weaker corporate governance accentuates the information disadvantage perceived by minority shareholders relative to the direct access of controlling shareholders and principal creditors. Disclosure is one thing; access to corporate decision-making processes and their supporting analyses is quite another. Because of weaker board composition standards, less incentive-based executive compensation, and fewer voting rights, the consolidated DCX posed a threat to U.S institutional investors who feared expropriation of their minority shareholder interests. When the statement of consolidated operations and the 20-F reconciliation revealed the full extent of the executive compensation arrangements involved with the merger transaction, fears of continuing minority expropriation led to a sell-off by U.S. institutions and a further concentration of ownership in Germany.

Cross-listing disclosure requirements, though they provide measurable reductions in asymmetric information, are insufficient to compensate for weak corporate governance in protecting minority shareholders. Consistent with a growing accounting literature that suggests that increased disclosure -- whether through analyst following (Lang, Lins, and Miller, 2004), cross-listing in the U.S. (Leuz, 2006), or voluntary commitment to higher regulatory disclosure standards (Leuz and Verrecchia, 2000) – allows a firm to improve corporate governance, we find unique evidence in the bid-ask spread that strict disclosure complements strong corporate governance. Both measures are required to create environments in which firms can raise capital and fund growth opportunities most efficiently.

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Table 1. Timeline of DCX events in the twelve months following the merger announcement

May-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Feb-99	Mar-99	Apr-99
Merger announced	Merger Approved	Deletion from S & P 500	First day of trading			1998 consolidated results released	1998 annual report and 20-F released	
							U.S. sell off	U.S. sell off
DCX Stock Price			$82	$99	$108	$97	$89	$96
% U.S. Ownership			44%					21%
% NYSE Trades			28%	17%	14%	10%	8%	5%
U.S. Institutional Shares				67.7 million			54.5 million	

Table 2. Adverse selection component of the NYSE effective spread. In Panel A, we report the adverse selection cost component of the spread for DCX in cents estimated using the approach of Lin, Sanger, and Booth (1995). In Panel B, we test mean daily estimates across three two-month periods -- November and December 1998, January and February 1999 (up through February 24, the day before the consolidated report was released), and February 25th through the end of April, 1999. We report the results for the entire sample and for percentiles of trade size: below 26th percentile trades, 26-50th percentile, 51-75th, 76-90th, and above 90th. The test statistics are based on ranking the daily values and then performing a t-test of the ranks for any pair of the three periods. This is equivalent to a Wilcoxon rank sum test.

Panel A: Mean daily adverse selection cost by month (in U.S. cents)

	November	December	January	February	March	April
<26th	.22	.46	.38	.33	.22	.24
26-50th	.36	.25	.47	.17	.35	.40
51-75th	.52	.48	.59	.63	.47	.50
76-90th	.40	.73	1.06	.54	.28	.63
>90th	.86	.84	1.31	1.11	.98	1.26
Entire Sample	.51	.60	.78	.50	.40	.53

Panel B: Wilcoxon rank sum test of daily adverse selection cost

	November-December	January-February	March-April
<26th	.34	.36	.23
26-50th	.30	.32	.38
51-75th	.50	.61**	.48
76-90th	.56	.80	.46
>90th	.85	1.21**	1.12
Entire Sample	.55	.64*	0.47

**Significant at the 0.05 level
*Significant at the 0.10 level

Table 3. Market metrics for DCX

For DCX, we report the mean trade price in U.S. dollars, number of trades, trade size, and spread for the NYSE (Panel A) and FSE (Panel B). The merger of Daimler and Chrysler was consummated by an exchange of shares on October 27, 1998 and trading in these shares began on November 17. The implicit spread is calculated as 2√-c, where c is the covariance of returns. The spreads are expressed in U.S. dollars.

	1998		1999			
	Nov.	Dec.	Jan.	Feb.	March	April
Panel A: New York Stock Exchange						
Trade price	$89.00	$91.36	$104.37	$97.27	$89.55	$95.64
No. of trades	7,539	11,796	11,157	8,132	8,348	10,520
Trade size						
Mean	3,125	2,572	1,869	1,457	1,618	1,561
St. Deviation	8,641	5,990	4,062	3,294	3,985	3,985
Minimum	100	100	100	100	100	100
Maximum	339,000	250,000	150,000	100,000	102,000†	140,600
Implicit spread	$0.049	$0.051	$0.054	$0.065	$0.066	$0.061
Panel B: Frankfurt Stock Exchange						
Trade price	$87.27	$91.47	$104.18	$97.44	$89.65	$96.52
No. of trades	24,025	30,145	34,953	25,740	33,279	34,848
Trade size						
Mean	2,187	1,790	1,751	1,683	1,706	1,717
St. Deviation	2,746	1,994	1,945	1,736	1,816	1,763
Minimum	1	1	1	1	1	1
Maximum	95,000	25,800	71,200	23,400	25,000	22,900
Implicit spread	$0.067	$0.065	$0.067	$0.057	$0.066	$0.050

†Two upstairs trades of 1 million shares each have been omitted from these calculations.

Table 4. Common factor weights for price discovery in New York and Frankfurt

For the hours in which both exchanges are open, we compare the contribution to price discovery of synchronous NYSE and FSE price series. Each trade is adjusted for the EUR/USD exchange rate quotation using transaction data from Olsen Associates. We report results of the cointegration and common factor tests. For the cointegration analysis, the null hypothesis is H_0:r = 0 and the alternate hypothesis is H_a:r =1. Trace (column 2) and Hmax (column 3) are the Johansen cointegration test statistics. The 5% critical value is 8.08 with rejection of the null hypothesis of no cointegration indicated by a single star. The conclusion (column 4) summarizes whether the underlying variables are cointegrated at order one. The common factor analysis results are presented in the last two columns; f_{FR} and f_{NY} are the common factor weights for the P_{FR} and P_{NY} price series, respectively. Statistical significance at (at least) a 5% critical value is indicated by a star.

	Cointegration results				Common factor results	
	Cointegration tests					
	Trace	Hmax	Conclusion	$\sum\gamma$	f_{FR}	f_{NY}
January	10.41*	9.57*	C(1)	-0.300	0.537	0.463
February	8.51*	7.82	C(1)	0.127	0.587	0.413
March	11.65*	11.24*	C(1)	-0.209	0.895*	0.105
April	26.60*	25.43*	C(1)	0.189	0.908*	0.092
May	13.04*	13.03*	C(1)	0.185	0.830*	0.170

Table 5. Error-correction models.

For each series in the two-variable information structure, we present estimates and t-scores of the error correction model for log changes. The error-correction term, Z(t-1), is specified as (minus) the difference P_{NY} - P_{FR} for the New York and Frankfurt price series. The error correction term has the expected sign and is statistically significant at the 0.01 level in the New York price change equation, but is insignificant in the Frankfurt equation. This five-month (January-May) estimation is consistent with the one-way price discovery from Frankfurt to New York detected in the common factor estimates (see Table 4) for March, April and May.

VECTOR ERROR CORRECTION MODEL

ΔPRICE (FRANKFURT)		ΔPRICE (NEW YORK)	
Constant	-0.001 (-0.02)	Constant	0.002 (6.27)*
$\Delta PRICE_{FR}$ (t-1)	-0.162 (-4.96)*	$\Delta PRICE_{FR}$ (t-1)	0.093 (2.86)*
$\Delta PRICE_{FR}$ (t-2)	-0.048 (-1.54)	$\Delta PRICE_{FR}$ (t-2)	0.051 (1.62)
$\Delta PRICE_{NY}$ (t-1)	0.153 (4.70)*	$\Delta PRICE_{NY}$ (t-1)	-0.104 (-3.21)*
$\Delta PRICE_{NY}$ (t-2)	0.044 (1.42)	$\Delta PRICE_{NY}$ (t-2)	-0.053 (-1.69)
Z(t-1)	0.00017 (0.06)	Z(t-1)	0.019 (6.37)*
F Statistics		F Statistics	
Model	5.54*	Model	14.82*
$\Delta PRICE_{FR}$	12.31*	$\Delta PRICE_{FR}$	4.37*
$\Delta PRICE_{NY}$	11.06*	$\Delta PRICE_{NY}$	5.42*
Z (t-1)	0.00	Z (t-1)	40.6*

* Indicates significance at 1%

The estimated vector error correction model is:

$$\Delta P_{FR} = \alpha_{FR} + \sum_{i=1}^{2} \beta_{FR,\,t-i}\, P_{FR,\,t-i} + \sum_{i=1}^{2} \beta_{NY,\,t-i}\, P_{NY,\,t-i} - \gamma_{FR}(P_{NY} - P_{FR})_{t-1}$$

$$\Delta P_{NY} = \alpha_{NY} + \sum_{i=1}^{2} \beta_{NY,\,t-i}\, P_{NY,\,t-i} + \sum_{i=1}^{2} \beta_{FR,\,t-i}\, P_{FR,\,t-i} - \gamma_{NY}(P_{NY} - P_{FR})_{t-1}.$$

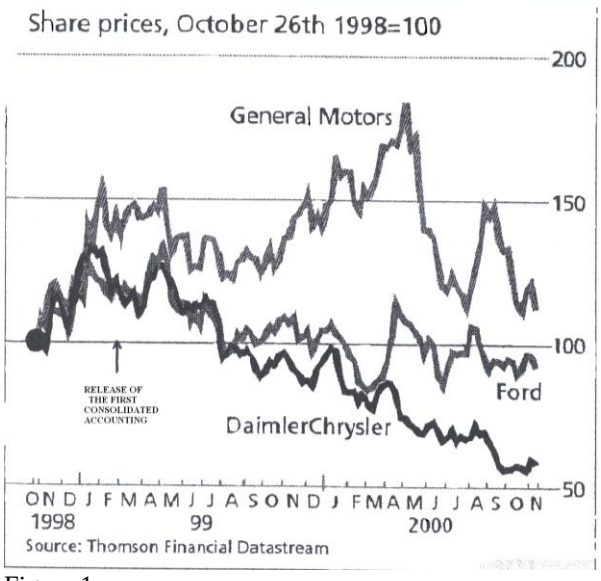

Figure 1

Endnotes

[i] Several studies find that large shareholders of European firms obtain private benefits of control at the expense of minority shareholders (e.g., weak evidence on Swedish firms is found in Bergstrom and Rydqvist, 1990; strong evidence on Italian firms is found in Zingales, 1994; Dyck and Zingales, 2004, report an average 14% premium for the private value of control across 39 countries), though U.S. firms are not exempt (see, e.g., Barclay and Holderness, 1989).

[ii] In addition, Ball (2002) finds that several changes in corporate governance were associated with the increased disclosure standards required by Daimler-Benz' 1993 U.S. cross-listing. We posit, however, that these changes were insufficient to protect minority shareholders from expropriation by the controlling shareholders of the merged firm in 1998.

[iii] Brickley, Lease, and Smith (1988), Pound (1988), Pagano and Roell (1998), and Desai (2005) explore the costs of ownership concentration generated when controlling shareholders pursue the private benefits of control at the expense of minority shareholders. Maug (2002) provides a theoretical overview of the nature of the collusion between dominant shareholders and management at the expense of small shareholders.

[iv] In an empirical analysis of financial contracting by venture capitalist investors, Kaplan and Stromberg (2003) find that the allocation of control rights, such as board rights, voting rights, and liquidation rights, are a central feature of financial contracts and are routinely separated from cash flow rights in observed financial contracts. Cash flow rights become more sensitive to (expected) performance when incentive and asymmetric information problems become more severe, as they were in the DaimlerChrysler merger. Finally, cash flow rights and control rights can be individually tied to observable and verifiable measures of performance, a finding which supports theories that predict shifts in shareholder control under various states of the world.

[v] This view of the merger is consistent with remarks of DCX CEO Juergen Schrempp to the *Financial Times*, October 30, 2000, pp. 1-2, with the consolidated class action complaint of shareholders in David Rosenberg v. DCX, Federal District Court of Delaware, Nov. 2000, and with a Deutsche Bank Research Department Briefing, July 2002.

[vi] In 1997, Chrysler CEO Bob Eaton had salary, bonuses and options worth $16 million, eight times the estimated $2 million total compensation of Daimler-Benz CEO Juergen Schrempp. Chrysler's No. 2 executive Bob Lutz had $13 million in total compensation, roughly equal to the $12.3 million disclosed for the entire ten-person senior management team of Daimler-Benz. *New York Times*, August 13, 1998, p. D4.

[vii] The August 6, 1998 proxy statement revealed that the 30 top Chrysler executives stood to gain $279 million in cash and stock from the early exercise of every management stock option Chrysler had ever granted. For example, CEO Bob Eaton stood to gain $70 million, Robert Lutz $27 million, Thomas Stallkamp $25 million, Gary Valade $23 million, and Bob Pawley $22 million (Vlasic and Stertz, 2000, p. 267). Exactly as was previously disclosed, the full $279 million was recognized as an expense eight months later in the Notes to Consolidated Financial Statements, Note 21, Stock-Based Compensation, released March 24, 1999.

[viii] Tracinda Corporation v. DaimlerChrysler AG, Federal District Court of Delaware, filed November 27, 2000.

[ix] The August 6 proxy statements detailed the reloading of 2,267,579 SARs on DCX Ordinary Shares for Bob Eaton, 638,380 for Robert Lutz, 442,685 for Gary Valade, and 407,771 for James Holden. Notes to Consolidated Financial Statements, DaimlerChrysler AG, Note 21, Stock-Based Compensation, released March 24, 1999.

[x] Notes to Consolidated Financial Statements, Note 21, Stock-Based Compensation, released March 24, 1999.

[xi] SEC Form 20-F, DaimlerChrysler AG, File No. 1-12356, Item 11, Compensation of Directors and Officers, released March 24 and filed March 31, 1999.

[xii] Blasko, Netter, and Sinkey (2000).

[xiii] Blasko, Netter, and Sinkey (2000) examine the cumulative abnormal returns to DCX at critical dates following the May 7, 1998 worldwide announcement of the pending merger. They find significantly positive excess returns at the announcement and significant negative cumulative returns as of the first day of DCX trading in October. The only significant event dates these authors can identify after careful analysis of the business press are rumors in mid-January of 1999 about DCX' takeover of Nissan, to which the market responded negatively, and the March 10, 1999 announcement that the Nissan deal was off, considered good news by the capital market as measured by excess stock returns.

[xiv] New York Times, April 1, 1999, p. C6.

[xv] We repeat our tests on two other measures of the spread for the NYSE. The quoted spread is the best ask minus the best bid, and the effective spread is twice the absolute difference between the trade price and the most recent quote midpoint (Bessembinder and Kaufman, 1997). The results are consistent with those reported here. We do not have quote data for the FSE, and thus present only the implicit spread for that exchange.

[xvi] We did more detailed testing of the period beginning with the February 25th public announcement and ending on March 23rd, the day before DCX released its annual report and filed a 20-F with the SEC. These results showed no difference in the adverse selection cost component of the spread in the intervening four weeks and the subsequent four weeks (March 24th to the end of April). Hence we grouped these periods together in the Wilcoxon test.

[xvii] In separate tests reported in columns 1 through 4, we confirmed significant cointegration between the two GRS price series for DCX trading in Frankfurt and New York, implying that there is one common factor corresponding to the common stochastic trend.

[xviii] Grammig, Melvin and Schlag (2004) show that the 91% Germany information share is biased upwards by a negligible 1% when one ignores FX innovations.