

DaimlerChrysler AG, the first truly global share

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Abstract

On November 17, 1998, trading commenced in DaimlerChrysler ordinary shares, a single global registered share (GRS) certificate, on stock exchanges around the world. The GRS quotes, trades and settles in U.S. Dollars on the New York Stock Exchange and in Deutschemarks/Euros on the Frankfurt Stock Exchange through a new global share registrar linking German and U.S. registrars and clearing facilities. This study critically evaluates the new share structure and asks whether it is associated with an improvement in market quality. I find that the initiation of the program was associated with greater trading activity and enhanced liquidity overall, but there was a significant migration of its order flow back to Frankfurt during the first 6 months. While return volatility also increased significantly, this increase was not associated with the changes in trading activity, the changes in liquidity or the flow-back to Frankfurt. I argue that this new share structure to date has not improved the quality of the trading environment relative to other share structures.

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This study examines the capital market reactions to the introduction of the first-ever global registered share (GRS) by DaimlerChrysler (symbol: DCX) on November 17, 1998. The GRS was launched simultaneously in 21 markets around the world, including the New York and Frankfurt Stock Exchanges, following completion of the \$68 billion merger between Daimler Benz, a German automaker and industry group, and Chrysler. It was designed to be distinct from an American Depositary Receipt (ADR), which is the most popular cross-border share-trading facility used by non-U.S. companies. While an ADR is

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a separate certificate issued by U.S. depository banks as a claim against home-market shares deposited with a local custodial bank, the GRS involves only one security globally. It required the establishment of a single “global” share registrar, the coordination of transfer agents and an electronic linking of clearing corporations, all in order to facilitate its trading, settlement and seamless, fungible transfer from one market to another. The shares are quoted, traded and settled in U.S. Dollars in New York and Euros in Frankfurt. The creation of this facility was hailed as a landmark event for global equity markets.²

There are two contributions of this clinical study of DaimlerChrysler’s GRS.³ Firstly, it is the first to study an important new financial innovation for cross-border trading of shares for global companies.⁴ Secondly, and more importantly, it provides us as researchers with a unique experiment in which to evaluate the impact of international cross-listings on the liquidity and return volatility of the shares, a subject of increasing interest among policymakers around the world. While corporations see cross-listings as value-enhancing, the changes in liquidity, volatility and the cost of trading associated with potential order flow migration can adversely impact the quality of the domestic equity market. There have been dozens of studies that examine this question with mixed results (see Karolyi, 1998 for a survey). One consistent finding, however, is that the impact of cross-listing on liquidity and volatility depends on the extent of price/quote transparency across markets or the strength of intermarket informational linkages (Pagano, 1989; Chowdhry and Nanda, 1991; Domowitz et al., 1998). These studies show that if price information is freely available across markets, cross-listing results in an improvement in market quality; where information linkages are poor, however, cross-listing reduces liquidity and increases volatility in the domestic market. The GRS and its seamless global registration, transfer and settlement procedures was designed to provide a more “transparent” trading environment than a traditional ADR facility. The central hypothesis of this study is whether market quality improvements were observed with the introduction of DaimlerChrysler’s GRS.

I specifically investigate changes to two measures of market quality. First, I evaluate the impact of the introduction of the GRS on trading activity and liquidity. I compare the dollar value of trading and underlying bid-ask spreads in DCX to that of Daimler Benz and

² *Investment Dealer’s Digest* (December 14, 1998) announced the DaimlerChrysler merger as the Deal of The Year “Top Award Goes to DaimlerChrysler: Impact is likely to be Long-Lived” (p. 19). *Individual Investor* headlined with “A Stock Heard Round the World—Is DaimlerChrysler’s Global Share the start of a revolution?” (March 1999, p. 20). The cover story of *International Financial Law Review* pronounced “The DaimlerChrysler Revolution” (January 1999, p.19) and *M&A Lawyer*, “DaimlerChrysler: Global Shares for a Global Market” (January 1999, p. 2). See also, *Wall Street Journal* (September 22, 2001) “What in the World? Global Shares May Leave Obscurity.”

³ There are other recent studies of the DaimlerChrysler merger, but both focus on different interesting issues. Blasko et al. (2000) study value creation and cross-border transactions and Gordon (1999) addresses the impact of the merger event on shareholder capitalism in Germany. There are also two studies of the microstructure of trading in DCX shares by Grammig et al. (2001) and Harris et al. (2001). See also *The Economist* “The DaimlerChrysler Emulsion” (July 29, 2000, p. 67) and Vlasic and Stertz (2000).

⁴ As of May 2002, there are now four GRS securities. Celanese, a German chemical firm (symbol: CZZ), adopted the structure on October 25, 1999, as did UBS (symbol: UBS), the Swiss financial services firm, on May 18, 2000. On October 8, 2001, Deutsche Bank created a GRS.

Chrysler shares before the merger and find that trading volume increased and spreads decreased. However, I also show that a significant shift in trading activity took place away from New York to Frankfurt, the home market, a phenomenon referred to as “flow-back.” Ironically, many market observers hypothesized that the GRS would help to avert flow-back. In a February 1999 article on “Surviving Flowback” in *Global Finance*, it was quoted that, “. . .some bankers expect the global ordinary share to become the model for cross-border mergers seeking to contain flow-back. . .the single foreign share makes the share-custody process cheaper and easier and better aligns prices in the two markets, although in separate currencies” (p. 46). Second, I evaluate the impact of the introduction of the GRS on stock return volatility. I find that return volatility increased, but that it could not be associated with changes in trading activity or liquidity nor with the “flow-back” of trading activity to Frankfurt.

The remainder of the paper is organized as follows. The next section of the paper analyzes the structure of the new share facility, especially in comparison to existing ADR structures, and how its creation was related to the DaimlerChrysler merger. Results follow. For each test, I briefly sketch out the analytical framework for understanding the impact of cross-listings, in general, on liquidity and volatility, outlining the key predictions and existing results from the literature. The goal is to establish a benchmark for any findings on the impact of the introduction of the GRS for DaimlerChrysler. I conclude the paper by discussing various policy implications and ideas for future research.

1. The global registered shares of DaimlerChrysler

DaimlerChrysler was established in 1998 through a business combination of Daimler Benz and Chrysler to create a global, diversified manufacturer and distributor of automobiles, diesel engines, aircraft, helicopters, space and defense systems and other products and services. Daimler Benz was founded in 1895 in Stuttgart, Germany, and by the 1980s, it had become one of its largest industrial companies. In 1997, net sales were over \$68 billion and its market capitalization was \$36 billion on December 31, 1997. The company had over 550,000 shareholders with its shares distributed across 14 stock exchanges around the world, including the New York Stock Exchange (NYSE) as ADRs since 1993.⁵ Chrysler and its subsidiaries were based in Auburn Hills, Michigan and operated in two principal industry segments: automotive operations of cars, trucks and related parts, and financial services. It had \$61 billion in net sales in 1997, and its market capitalization was \$23 billion on December 31, 1997. The shares were held by 135,000 shareholders worldwide and its shares were traded worldwide, including Frankfurt, Berlin and Munich in Germany.⁶ On May 7, 1998, Daimler Benz and Chrysler announced their merger agreement, a share-for-share exchange effected with a new global registered share facility with a new name DaimlerChrysler (DCX). Under the terms of the proposal,⁷ the

⁵ Radebaugh et al. (1995) provide an in-depth clinical analysis of the 1993 Daimler Benz ADR listing.

⁶ Chrysler SEC 10-Q, September 30, 1998. www.sec.gov/Archives/edgar/data/791269.

⁷ Chrysler SEC 10-Q, September 30, 1998, Item 1, Note 4, p. 7.

exchange ratio was computed at 0.6325 new DCX shares per Chrysler share and even swap of DCX and Daimler Benz ordinary shares (or, 1.005 DCX per Daimler Benz share if over 90% were tendered). The transaction closed and the global share was launched on November 18, 1998. Appendix A outlines the chronology of key events.⁸

1.1. A global registered share

A global registered share (GRS) is an ordinary share of a company that trades and transfers freely across national borders. On U.S. exchanges, a GRS is quoted, traded and settled in U.S. Dollars. Unlike American Depositary Receipt (ADR), a GRS is the actual share of the company, not a receipt representing the ordinary shares deposited in trust. Daimler Benz and Chrysler management agreed to design and implement a global share as the only equity vehicle to be issued to all DaimlerChrysler stockholders with their merger transaction. In pursuit of this goal, the companies determined that: (1) the global share would be issued in registered rather than bearer form, eliminating the need for each share to be accompanied by dividend coupons; (2) a single, bilingual, multi-jurisdictional stock certificate representing the global shares would be developed that would satisfy applicable standards in Germany and the U.S.; and (3) transfer agents and registrars would be appointed in Germany, the U.S. and elsewhere to facilitate transfer and registration of shares. This three-pronged objective defined the facility that was ultimately formed.

Fig. 1 offers a schematic of the facility. The left side of the schematic outlines the structure required to execute the GRS program in North America; the right side, for Europe and Asia. Trading in the former would be on the NYSE, three regionals and Toronto and Montreal, whereas trading of the Europe/Asian structure would take place in Frankfurt, seven other German regional exchanges and six other major world exchanges. All share registration and transfer would be handled, respectively, by the U.S.-based and German-based agents/registrars. Establishment of the Europe/Asia segment required the introduction of registered shares instead of more common bearer shares in Germany. According to German stockholder law, 75% majority approval is required to amend articles of incorporation for such a change. The effect of the registration was that only registered shareholders would be deemed to be entitled to exercise voting rights and receive dividends. The settlement/book-entry of shares would be handled by the Depository Trust Company (DTC) in the U.S. and the Deutsche Börse Clearing in Germany. Together, the coordinated effort of the U.S. and German registrars relying on a continuously updated link between DTC and DBC would represent the new “global registrar” entity.⁹

Two critical rule changes were necessary in the U.S. to establish the GRS. The first was the DTC/DBC two-way link and the second was a SEC rule change sought by the NYSE. An electronic link between DTC and DBC was proposed to the SEC on September 15,

⁸ Of particular note is the October 1, 1998 decision by Standard and Poor’s to drop DCX from the S&P 500 index. See “Front end, Daimler and S&P in Head-on Collision” (Dow Jones Newswire, July 30, 1998), “Safeway to be Added to S&P 500” *Wall Street Journal*, November 6, 1998.

⁹ My thanks to Rene Vanguestaine and Patrick Colle of JP Morgan (New York and London, respectively) for sharing this information from the JP Morgan “Global Share Round Table” (Frankfurt, April 22, 1999).

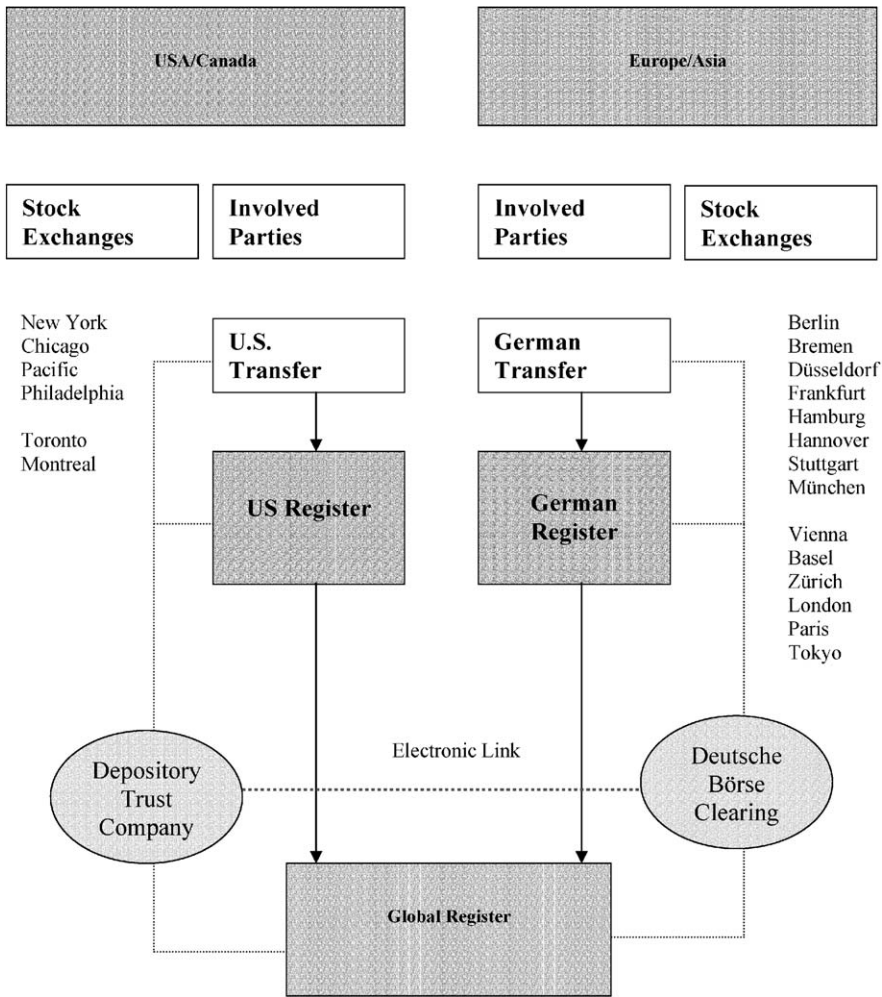


Fig. 1. The DCX global share program.

1998 (SEC approval on November 18) so that cross-border transactions could be cleared and settled in either the U.S. or Germany ensuring complete transparency in trading DCX shares. Under the new two-way interface, the two clearing agencies could use custody book-entry and physical delivery services of DTC for transactions involving securities eligible in both systems. If this change was not accepted, DBC participants would have had to physically withdraw securities from DBC in order to deliver share certificates to DTC precluding same-day execution and additional expense.¹⁰ The second SEC rule change filed by the NYSE on October 22, 1998 (approved October 26) sought adoption of

¹⁰ See “Critical Breakthroughs in the U.S.” *The M&A Lawyer* (January 1999, pp. 5–6).

an interpretation of its own rules relating to differences in stock certificates (e.g. steel-engraved vignettes) and in stockholder voting to allow for proxy procedures combining a variety of German and U.S. practices. Examples include special alternate provisions for the NYSE rule on 10-day prior notice of record date and 30-day separating period between record date and meeting date.

1.2. Comparison between global registered shares and ADRs

Since 1927 when JP Morgan introduced the first of its kind, the favored financial instrument that brought ease of trading in foreign securities to U.S. investors has been the ADR.¹¹ It represents a simple vehicle to transform foreign security ownership into U.S. trading and settlement. Over 2100 companies from around 50 countries around the world have used the ADR in one form or another to access U.S. equity markets by listing and/or raising capital.¹² Today, about 12% (3.4%) of the average daily turnover on the NYSE (Nasdaq-AMEX) is comprised of foreign listings.¹³

ADRs represent negotiable claims against home-market ordinary shares (in bearer or registered form) issued by a U.S. depositary bank (such as JP Morgan, Bank of New York or Citibank) and coordinated in the home-market through a local custodial bank affiliate. Settlement of cross-border trades takes place daily through ADR issuances or cancellations (“conversions”) conducted by the depositary bank, and fees for such transactions amount to about 5 cents per share. The ADRs quote, trade and settle in U.S. Dollars and dividends are paid in U.S. Dollars through the bank. Finally, the depositary bank maintains ownership records and processes corporate actions. [Table 1](#) summarizes the key benefits and costs of the ADR facility.

It is difficult to describe the new GRS facility and its benefits without recognizing the limitations of the ADR, and vice versa. As a fully fungible security, the GRS has “fewer moving parts” and does not require the intervention of the depositary bank. The per-share fee for conversion is subsumed by a single \$5 settlement cost to the DTC which is independent of the number of shares. At the same time, the coordination of the multi-agent transfer, clearance and settlement procedures of the GRS may be missing the oversight of the depositary bank in assuring efficient possession, movement of shares (e.g. lower trade failure rate) and in communicating corporate actions. In addition, the ADRs provide the flexibility of bundling (or unbundling) a number of home-market shares into a receipt and, therefore, creating a trading price range that is closer to its industry peers and perhaps creating additional liquidity. The second critical difference is that share ownership is more direct with a GRS than ADRs, where a depositary bank is interposed between issuer and investor. This depositary intermediary may restrict provision of subscription rights issued in the local market for U.S. investors because they must be nominated via the DTC; the

¹¹ New York Registered Shares represent another alternative for non-U.S. issuers, but they are necessarily a separate class of shares from the home-market ordinary shares, i.e. nonfungible. This alternative is popular among a number of Dutch companies, including Unilever, Royal Dutch Petroleum, Philips and KLM.

¹² See NYSE *Fact Book 2000*, Nasdaq-AMEX *Fact Book 2000*.

¹³ Federation Internationale des Bourses de Valeurs and NYSE’s Research and Planning Division, 1998.

Table 1
Advantages and disadvantages of global shares versus ADRs

Criteria	ADRs	Global shares
Definition	Negotiable claim created by a depository bank on underlying stock held in trust in the company's home market <ul style="list-style-type: none"> • US Dollar-denominated • Trades/settles as US security • Different forms trade over-the-counter or on exchanges 	Ordinary shares of company that trade and transfer freely across national borders and quotes as U.S. security in U.S. and as local security in home market <ul style="list-style-type: none"> • Same share certificate • Local currency denomination • Local trade/settlement rules
Advantages	<ul style="list-style-type: none"> • US Dollar-denominated • Clears and settles in U.S. to lower trade failure rate • Dividends in U.S. Dollars through depository banks • Bundling/unbundling ratio to set initial U.S. price • Depository bank maintains ADR ownership records, processes corporate actions 	<ul style="list-style-type: none"> • US Dollar quoted/traded • Clears and settles in U.S. • Dividends in U.S. Dollars through U.S. transfer agents • No additional intermediaries • No conversion fees • Fully fungible (features include seamless trading, same certificate, no legal restrictions on cross-border stock ownership) • All shareholders have equal status, direct voting rights, shareholder meeting invitations, rights offerings
Disadvantages	<ul style="list-style-type: none"> • Additional intermediary, e.g. depository bank • Conversion fees (up to \$0.05 per share, except for "direct conversions") • US Depository Trust Company nominates registered shareholders via depository and possible to exclude U.S. investors from tender, exchange or rights offer • Not fungible (see above) 	<ul style="list-style-type: none"> • Requires coordination among multiple clearance and settlement facilities • Substantial establishment and maintenance (legal) costs • Requires creation of registered shares instead of bearer shares (e.g. German convention) • Non-U.S. stocks cannot be held in U.S. in local currency, only in U.S. Dollars • Pre-emptive subscription rights traded in local market, but not in U.S. for U.S. shareholders

GRS ensures the same voting privileges, rights to receive dividends and other distributions and participate in rights offerings for all stockholders.

In summary, the GRS is a new and different cross-border settlement and trading facility for stocks than that of ADRs, the conventional vehicle for non-U.S. stocks choosing to cross-list their shares on U.S. markets. The GRS has lower trading costs in terms of elimination of per-share fees for conversions/cancellations of ADRs but, at the same time, involves more coordination among the various agents of the share transfer, clearance and settlement systems, and in the processing of corporate actions. The GRS is fully fungible and the quality of intermarket information linkages regarding quotes and prices should be higher, but they

also preclude the flexibility of ADRs in bundling/unbundling of shares into receipts, which can enhance liquidity. There exists evidence of significant changes in liquidity and return volatility around international cross-listings with ADRs; we now examine whether DaimlerChrysler's experience with the introduction of the GRS was different.

2. Data

Data is obtained from Datastream International. Daily opening and closing prices and trading volume (in thousands of shares) are drawn for Daimler Benz shares traded in Frankfurt (including the Xetra trading system from 1997) and the NYSE and for Chrysler shares on the NYSE.¹⁴ The beginning of the sample is October 6, 1993, the day that Daimler Benz listed ADRs on the NYSE, and it extends to September 10, 2001. From November 17, 1998, I collect opening and closing prices and trading volume for DCX shares traded on Amsterdam, Paris, Tokyo, Zurich, Easdaq, Toronto and the NYSE. Other than Frankfurt/Xetra and the NYSE, only Zurich captures more than 0.1% of the daily global trading volume, and it only reaches as high as 0.5%. As a result, I focus the analysis only on the major markets for Daimler Benz, Chrysler and DCX shares. I also collect prices and volume information on the DAX 100 and S&P 500 as representative market indexes.

I compute daily continuously compounded returns based on closing and opening stock prices of all three securities. All returns are denominated in U.S. Dollars using the Euro/Dollar exchange rate following January 1, 1999 and using the 1.95583 fixed conversion rate to Deutschemarks before January 1, 1999. The experiment requires a benchmark to test for the impact of the GRS shares of DCX after November 1998 on trading volume, returns and volatility. For this purpose, I construct an "as-if" DCX in the pre-merger period by means of a portfolio of Daimler Benz and Chrysler shares weighted by the merger exchange rate formula of 0.6325 (1.005) DCX shares per Chrysler (Daimler Benz) shares. There may be concerns about nonsynchronous returns horizons due to the different trading hours in Frankfurt (3:00 a.m. to 11:00 a.m., Eastern time) and New York (9:30 a.m. to 4:30 p.m., Eastern time). As a result, I compute this benchmark portfolio in two ways. First, I use close-to-close returns on Daimler Benz shares in Frankfurt and open-to-open returns on Chrysler shares on the NYSE, for which the trading hours align (coarsely) with close-to-close DCX shares in Frankfurt after November 1998. I refer to this portfolio as "DCX Frankfurt." Second, I use close-to-close returns on Daimler Benz ADRs on the NYSE and close-to-close returns on Chrysler shares on the NYSE, for which the trading hours align perfectly with close-to-close DCX shares on NYSE after November 1998. I refer to this portfolio as "DCX New York."¹⁵

¹⁴ Both shares traded on several other exchanges prior to merger, including the London Stock Exchange; however, the fraction of the trading activity is small (Montreal, Toronto, Tokyo, Zurich, Vienna) and the availability of the data for these other exchanges on Datastream International was limited (with the exception of LSE). For the remainder of this analysis, I focus on these two markets.

¹⁵ My supplementary analysis also includes tests for the GRS programs of Celanese (from October 29, 1999) and UBS (from May 19, 2000). I compute the returns and volume series for these shares using the major markets (Frankfurt/Xetra and NYSE for Celanese; Zurich and NYSE for UBS) and, in the case of UBS, the SMI (Swiss Market Index) is used as the market index. These data are available from the author.

3. The impact of the global registered share program on volume and volatility

3.1. Changes in trading volume and flow-back

Table 2 computes the U.S. Dollar value of trading on both exchanges for both Daimler Benz and Chrysler shares prior to the merger announcement (May 6, 1998) and the Frankfurt and New York trading in DCX shares since the inception of the global share facility in November 1998. Prior to May 6, 1998, the as-if DCX share trading activity is constructed using the share-for-share exchange ratio of 0.6325 (1.005) DCX shares per Chrysler (Daimler Benz) shares and the Frankfurt and NYSE trading in the two component shares.¹⁶ On average, 98.8% of the average daily trading of \$398 million (daily turnover of 1.34%) in Daimler Benz shares occurred in Frankfurt. Chrysler shares experienced the same distribution (99.9% on NYSE), but the average U.S. Dollar value of trading was about one-fourth that of Daimler Benz, averaging around \$100 million per day (daily turnover of 0.52%). Using the as-if DCX trading volume (with the merger exchange ratio), during the 5 years leading up to the merger, about 20% of the daily average \$550 million of trading (or 31% of combined 0.81% of daily turnover) occurred on the NYSE.

Fig. 2 shows the aggregate DCX trading over the entire 1993–2001 period. A structural break notably takes place around the merger announcement in May 1998 when the average daily value of Frankfurt and New York trading increased almost five times over.¹⁷ The Frankfurt trading in DCX after 1998 diminishes to around \$500 million per day, but that on the NYSE decline to less than \$100 million per day by mid-1999. Table 2 confirms this dramatic change in overall trading activity and in the geographic distribution of trading activity. Following the GRS launch, the average daily value of trading of DCX in Frankfurt increased to \$660 million (0.93% daily turnover) while that on the NYSE fell to \$51 million (0.07% daily turnover). Overall, the dollar value of trading in DCX increased by 27.6% and, the turnover activity, by 24.7%. Tests for differences in the mean dollar value of trading and the turnover ratios indicate that these changes are statistically significant at any reasonable level of confidence. The resultant fraction of NYSE trading declined to less than 10% of trading activity and turnover, also a statistically significant shift. I also compute the daily dollar value of trading and turnover in German DAX 100 and S&P 500 shares in order to benchmark the DCX activity. There is a statistically significant increase in mean value of trading overall after 1998 in both markets, but the increase in turnover is more modest and is only significant for the S&P 500, no doubt reflecting the strong performance of equity markets overall in the late 1990s.

Was the impact of the GRS launch on trading volume unusual? A survey of the evidence on international cross-listings suggests so (Karolyi, 1998). An early study by

¹⁶ Daimler Benz ADRs were bundled in a ratio of 6:1 and the U.S. dollar value of trading activity is adjusted accordingly.

¹⁷ On the merger announcement date of May 7, 1998, the U.S. dollar value of trading in Daimler Benz shares exceeded \$3.8 million and that in Chrysler shares exceeded \$1.8 million.

Table 2
Trading activity in Daimler Benz, Chrysler and DaimlerChrysler (DCX) stock, 1993–2001

	Daimler Benz AG		Chrysler		DaimlerChrysler			Market indexes	
	Frankfurt	NYSE	Frankfurt	NYSE	Frankfurt	NYSE	NYSE%	DAX 100	S&P 500
<i>Pre-merger period trading activity (Oct. 6, 1993 to May 6, 1998, 1062 obs.)</i>									
Value of trading (US\$, 000s)									
Mean	392,931	4588	325	103,025	390,976	167,451	20.23%	3630	19,437
Median	338,300	2256	259	88,006	336,617	143,877	19.62%	2867	17,130
Std. dev.	296,058	9901	198	77,282	294,585	123,933	7.51%	3229	9668
Turnover (% per day)									
Mean	1.341	0.016	0.004	0.519	0.558	0.249	31.51%	0.825	0.359
Median	1.161	0.006	0.003	0.427	0.493	0.205	30.52%	0.757	0.357
Std. dev.	0.872	0.039	0.003	0.476	0.362	0.211	11.82%	0.566	0.077
<i>Period following launch of global share program (Nov. 17, 1998 to Sept. 10, 2001, 677 obs.)</i>									
Value of trading (US\$, 000s)									
Mean					660,880	51,007	9.88%	5278	81,385
Median					543,935	33,936	8.59%	5271	79,363
Std. dev.					790,654	56,979	6.14%	7631	23,392
Turnover (% per day)									
Mean					0.929	0.077	9.88%	0.494	0.625
Median					0.742	0.055	8.59%	0.546	0.611
Std. dev.					1.066	0.099	6.14%	0.662	0.149
<i>Tests for differences across subperiods</i>									
Value of trading (US\$, 000s)									
<i>t</i> -statistic					7.20	–21.23	–30.85	4.64	72.39
<i>p</i> -value					(<0.001)	(<0.001)	(<0.001)	(0.002)	(<0.001)
Turnover (% per day)									
<i>t</i> -statistic					9.74	–20.63	–44.63	–11.50	46.67
<i>p</i> -value					(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)

All volume statistics are reported as thousands of U.S. Dollar equivalent of daily trading averaged over the years preceding the merger announcement and following the global registered share launch. Turnover statistics are computed relative to the outstanding market value of the firms. Prior to October 30, 1998, the equivalence of DCX trading and the composite market value of the firm is constructed using the merger exchange ratio formula of 0.6325 (1.005) DCX shares per Chrysler (Daimler Benz) share. Only trading volume for Daimler Benz, Chrysler and DCX shares on Frankfurt and New York are included. Similar calculations are performed for the DAX 100 and S&P 500 market indexes, except that they are in millions of US dollars. Data are obtained from Datastream International.

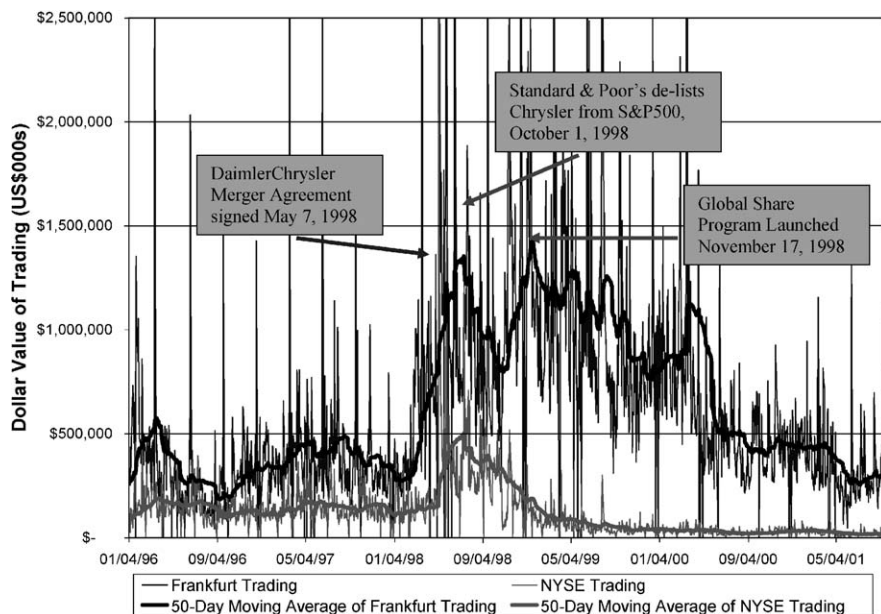


Fig. 2. Trading activity in DaimlerChrysler, Daimler Benz and Chrysler shares, 1993–2001.

Foerster and Karolyi (1993) examines Canadian stocks listing in the U.S. as ordinary shares (a similar share structure to the GRS). They find, on average, a 125% increase in combined trading in the U.S. and home market, including a 26% increase in the home market alone. Hargis (1998) and Domowitz et al. (1998) examine, respectively, 89 Latin American and 25 Mexican firms listing ADRs on the NYSE and also found a significant increase in combined trading volume of around 30%. The most comprehensive study to date is by Smith and Sofianos (1997) who study 128 NYSE-listed non-U.S. stocks and who experience an average 42% increase in the value of trading around the U.S. listing. Not only does the combined daily value of trading increase from \$240 million to \$340 million, that of the home market increases from \$210 million to over \$260 million, a 24% increase. This finding is the basis for their argument that U.S. listings are not a zero-sum game, but rather a “win–win” event. They also uncover in cross-sectional tests that the increase in combined value of trading was greater for those stocks from emerging markets, those listings associated with a capital-raising program and those closest in time zone to the U.S., none of which apply in the context of DCX.

A recent paper by Lowengrub and Melvin (2002) examines the volume effect for a small sample of German ADR listings (including Daimler Benz’s first listing in 1993). Unlike our finding for DCX, they actually show a significant volume drop in Frankfurt trading overall following listing, especially during the afternoon hours. They interpret this finding as evidence of a migration of trading to the new ADR platform, or, the reverse of flow-back. While the increase in combined value of DCX trading in Frankfurt and the NYSE is modest in economic magnitude compared to that in existing studies of

international cross-listings, the finding of significant flow-back to the home market (Frankfurt) is unusual.¹⁸

3.2. Changes in bid-ask spreads

Intraday bid and ask quotes and quote sizes were obtained from the NYSE's TAQ database for U.S.-based trading of Chrysler shares and Daimler Benz ADRs prior to the merger and for the U.S.-based trading of DCX global shares after the launch. During the pre-merger period, 2.8 million Chrysler quotes and almost 620,000 Daimler Benz ADR quotes were obtained and, during the post-merger period, 2.8 million DCX quotes were obtained. Intraday bid-ask spreads are deflated by their respective midpoints and are averaged on a weighted basis across each day by their respective combined bid and ask quote depths.

Table 3 summarizes the data. Spreads of Daimler Benz ADRs averaged around \$0.2555 per share, or 0.46% of the midpoint during the pre-merger period, whereas the raw spread of Chrysler shares was lower around \$0.1614 per share, though a higher 0.59% of the midpoint. For an as-if DCX share based on the merger exchange ratio formula and weighted by their respective combined quote depths, the average spread was \$0.2198 or 0.51% of the midpoint. The average spread for DCX shares after the launch of the GRS was \$0.1829 or 0.30% of the midpoint. This raw and relative spreads are both statistically significantly lower than that during the pre-merger period (robust *t*-statistics of -8.60 and -37.18 , respectively). Though this finding should be interpreted with caution given that many factors can influence spreads over time, the finding of a lower average spread is consistent with higher liquidity revealed in the volume effects documented above.

There are few studies with intraday data on spreads before and after the event of an international cross-listing. Several studies have shown that spreads and trading volume patterns for cross-listed stocks are related to trading hours in the respective markets (Werner and Kleidon, 1996 for U.K. stocks listed on the NYSE and Chan et al., 1995 for NYSE stocks listed on London or Tokyo). Foerster and Karolyi (1998) found that spreads declined by an average 7.4% for a sample of Canadian stocks listing on U.S. markets. Domowitz et al. (1998) employ an implicit spread measure based on adjusted serial covariances in returns for their sample of Mexican stocks. They find that spreads decline in 17 of their 22 stocks.

¹⁸ There are two exceptional circumstances that can partially explain the flow-back phenomenon. First, flow-back could have arisen as a mechanical consequence of risk arbitrageurs unwinding short Daimler Benz ordinary positions using new DCX shares during the merger period. We can dismiss the effect of this activity as it is likely to be transitory; the empirical analysis purposely excludes the merger period for that reason. Second, on October 1, 1998, Standard and Poor's announced that Chrysler and thus DCX shares would be dropped from the S&P 500 index. Studies of S&P 500 delistings (e.g. Shleifer, 1986; Beneish and Whaley, 1996; Lynch and Mendenhall, 1997) have debated, in general, whether the stock price and volume effects are permanent or transitory. In the case of Chrysler's delisting, while the stock price reaction was a statistically significant -2.82% , the volume impact was small and transitory. Moreover, the flow-back was not necessarily associated with a significant change in ownership. Supportive evidence from SEC filings is available from the author upon request.

Table 3
Bid-ask spreads in Daimler Benz (ADRs), Chrysler and DaimlerChrysler (DCX) stock on the NYSE, 1993–2001

	Daimler Benz ADR		Chrysler		DaimlerChrysler	
	Spread (\$)	Spread (%)	Spread (\$)	Spread (%)	Spread (\$)	Spread (%)
<i>Pre-merger period trading activity (October 6, 1993 to May 6, 1998, 1062 obs.)</i>						
Mean	0.2555	0.4602	0.1614	0.5880	0.2198	0.5110
Median	0.2438	0.4390	0.1696	0.6287	0.2138	0.5118
Std. dev.	0.0702	0.1249	0.0329	0.1806	0.0399	0.1125
Skewness	0.7337	0.1239	–0.6572	–0.4045	0.7253	0.2758
Kurtosis	0.3540	2.9298	0.5164	–0.8256	0.6205	0.5031
<i>Following launch of global share program (Nov. 17, 1998 to Sept. 10, 2001, 677 obs.)</i>						
Mean					0.1828	0.3022
Median					0.1777	0.2765
Std. dev.					0.0443	0.1260
Skewness					1.3650	1.3053
Kurtosis					5.9801	2.7021
<i>Tests for differences across subperiods</i>						
<i>t</i> -statistic					–18.61	–37.18
<i>p</i> -value					(<0.001)	(<0.001)

From NYSE's TAQ database, I obtain all bid and ask quotes with their respective quote depths (in lots) for Daimler Benz ADRs and Chrysler shares in the period preceding the merger announcement (October 6, 1993 to May 6, 1998, 1062 observations) and for DaimlerChrysler shares immediately following the global share launch (November 18, 1998 through September 10, 2001, 677 observations). Each day, I compute the depth-weighted average of intraday spreads for each stock in dollars and in percent relative to their prevailing midpoint quotes. During the pre-merger period, I also compute a depth-weighted average for the equivalence of DCX trading using the merger exchange ratio formula of 0.6325 (1.005) DCX shares per Chrysler (Daimler Benz) share.

3.3. Changes in volatility around the GRS launch

Table 4 presents summary statistics on the returns of Daimler Benz, Chrysler and DCX shares during the pre-merger period (1993–1998) and following the creation of the global shares (1998–2001). Close-to-close and open-to-open returns for the Daimler Benz shares in Frankfurt and ADRs in New York are computed as well as for the Chrysler shares in New York (Frankfurt trading in Chrysler shares is ignored). I also present summary statistics on the DAX 100 and S&P 500 indexes and the two as-if DaimlerChrysler benchmark portfolios. All returns are denominated in U.S. Dollars.

Overall, the returns for Daimler Benz's Frankfurt ordinaries and NYSE ADRs have very similar properties. The close-to-close Frankfurt returns and open-to-open NYSE ADR returns both average 0.028% per day and those relative to the close-to-close NYSE ADR returns (0.023%) are indistinguishable and likely reflect differences due to asynchronous trading hours. The daily standard deviation of close-to-close Frankfurt and NYSE returns hovers around 0.60%, though slightly higher for open-to-open returns in Frankfurt and slightly lower for close-to-close returns on the NYSE.¹⁹ Chrysler shares

¹⁹ Miller and Morey (1996) evaluate the potential for arbitrage in the intraday patterns in return spreads of Smithkline Beecham ADRs traded on the NYSE and ordinary shares traded on the London Stock Exchanges. They find that the returns spreads are too small to exploit.

Table 4

Summary statistics of returns on Daimler Benz, Chrysler and DaimlerChrysler (DCX) Shares, 1993–2001

	Daimler Benz Frankfurt		Daimler Benz ADR NYSE		Chrysler NYSE		DCX portfolios		DAX 100	S&P 500
	Close	Open	Close	Open	Close	Open	Frankfurt	New York	Close	Close
<i>Pre-merger period trading activity (Oct. 6, 1993 to May 6, 1998, 1062 obs.)</i>										
Mean	0.028%	0.029%	0.023%	0.028%	0.022%	0.024%	0.026%	0.022%	0.027%	0.034%
Std. dev.	0.601%	0.654%	0.594%	0.570%	0.834%	0.925%	0.576%	0.531%	0.389%	0.324%
Skewness	−0.262	−0.381	−0.123	−0.255	1.778	2.352	0.423	0.610	−0.786	−0.769
Kurtosis	4.557	4.861	3.771	6.078	19.94	32.37	9.959	7.592	6.064	8.367
<i>Period following launch of global share program (Nov. 17, 1998 to Sept. 10, 2001, 677 obs.)</i>										
Mean							−0.049%	−0.057%	−0.014%	0.001%
Std. dev.							0.873%	0.890%	0.564%	0.587%
Skewness							0.048	−0.285	−0.066	0.006
Kurtosis							0.727	1.374	0.362	1.494
<i>Tests for differences in mean returns across subperiods</i>										
<i>t</i> -statistic							−1.83	−1.99	−1.34	−1.23
<i>p</i> -value							(0.066)	(0.046)	(0.179)	(0.217)
<i>Tests for differences in variances across subperiods</i>										
<i>F</i> -statistic							1.46	1.79	1.34	2.09
<i>p</i> -value							(<0.001)	(<0.001)	(<0.001)	(<0.001)

Daily continuously compounded returns are computed based on closing and opening stock prices on Daimler Benz ordinary shares trading in Frankfurt, Daimler Benz American Depositary Receipts trading on the NYSE, Chrysler ordinary shares trading on the NYSE and the U.S. Dollar-denominated DAX 100 and S&P 500 indexes. Currency conversions are computed using 1.95583 fixed conversion to Deutschemark before January 1, 1999. All data are from Datastream International. During the pre-merger period, the equivalence of DaimlerChrysler stock is computed as a portfolio of returns on the two securities in the pre-merger period denominated in common currency (US Dollars) and computed according to the merger formula of 0.6325 (1.005) DCX shares per Chrysler (Daimler Benz) shares. The two portfolio combinations include: (1) “DCX Frankfurt” which is composed of Daimler Benz closing returns in Frankfurt with Chrysler opening returns on the NYSE and (2) “DCX New York” which is composed of Daimler Benz ADR closing returns and Chrysler closing returns, both on the NYSE. During the post-merger period, I compute the actual U.S. Dollar-denominated closing returns of the DCX global shares in Frankfurt and NYSE, respectively. *t*-statistic is a test of the difference in mean returns across the two subperiods and *F*-statistic is a test of the difference of the variance of returns across the two subperiods.

have higher standard deviations, positive skewness and significantly higher excess positive kurtosis.

The statistical attributes of the two as-if DCX portfolios—“DCX Frankfurt” and “DCX New York”—for the pre-merger period are also very similar. The “DCX New York” portfolio, which combines the close-to-close returns of Daimler Benz ADRs and Chrysler shares, has a lower standard deviation (0.531%) than the portfolio for which the returns are aligned with Frankfurt trading hours (0.576%, listed as “DCX Frankfurt”). The second panel shows the properties in the post-GRS launch period of the actual DCX Frankfurt and DCX New York returns, respectively, for comparison with the top panel. The returns after the GRS launch are negative during this bear (neutral) market period for the DAX 100 (S&P 500), but the differences across subperiods are only marginally significant (p -values of 0.066 and 0.046, respectively). The daily standard deviation of the returns has increased significantly to 0.873% for DCX returns in Frankfurt and 0.890% for DCX returns on the NYSE. This volatility is markedly higher relative to each of the two benchmark portfolios during the pre-merger period. The F -statistics suggest that the variances increased by 46% and 79%, respectively. Both are statistically significant increases.

In comparison with other studies of cross-listings, the variance increases are unusual and large. For example, for their sample of 153 firms listing on U.S. markets, Foerster and Karolyi (1999, Table IV) found that volatility decreased by 9%, on average, though the subsample from Europe (excluding UK) did experience an increase of almost 4%. Lowengrub and Melvin (2002, Table 2) also counter our evidence by uncovering decreases in volatility in morning and afternoon trading sessions for their sample of 11 cross-listing German firms, including a 3% (20%) decline for Daimler Benz morning (afternoon) trading sessions following their 1993 ADR listing.

That unconditional return volatility increase following the GRS launch needs to be interpreted with caution for several reasons. First, stock return volatility tends to be persistent over time and clusters in periods of calm and turbulence. It is important to allow for the conditional volatility of returns to vary over time. Second, the increase in overall return volatility appears to be associated with a market-wide increase in return volatility (Table 4, F -statistics for DAX100 and S&P 500 are 1.34 and 2.09, respectively), so I need to benchmark to identify a firm-specific increase in return volatility. Thirdly, several studies of international cross-listings have shown that these stocks experience significant changes in home market and U.S. market risk exposures or betas (Jayaraman et al., 1993; Foerster and Karolyi, 1993, 1999). As a result, I need to control for potential changes in market betas around the GRS launch. Finally, return volatility and how it varies over time conditionally has been shown to be systematically related to trading volume, in general, and theoretical models of international cross-listing have been developed that imply an empirical relationship between volatility and volume (Domowitz et al., 1998).

I propose the following econometric specification for the daily returns and volatility process:

$$R_t = \alpha_t + \beta_t^L R_{mt}^L + \beta_t^{US} R_{mt}^{US} + \theta^L H_t^L + \theta^{US} H_t^{US} + \varepsilon_t \quad (1a)$$

$$\varepsilon_t \sim N(0, h_t) \quad h_t = \gamma_t + \delta_t^a h_{t-1} + \delta_t^b \varepsilon_{t-1}^2 + \lambda_t V_t \quad (1b)$$

where R_t and R_{mt} are the daily returns on the security and a market index (R_{mt} is superscripted by L, for local market, and US, for the U.S. market), H_t is a holiday dummy variable and V_t is the volume on day t . The specification has several useful features. In Eq. (1b) for the conditional volatility, h_t , is a generalized autoregressive conditionally heteroscedastic (GARCH) model of order (1,1) which is allowed to vary over time. In my specification, the base-level volatility is captured by γ_t and any serial dependence with past volatility, h_{t-1} , and past idiosyncratic shocks, ε_{t-1}^2 . I expect that conditional volatility is strongly autoregressive, so δ^a and δ^b are both positive. I also control for market-wide factors—local DAX 100 and U.S. with S&P 500—in the equation for the mean returns (Eq. (1a)) with market betas, β_t^L and β_t^{US} , respectively. Finally, following Domowitz et al. (1998), the conditional volatility process has a transitory component which arises from trading frictions and which is captured in the responsiveness to volume, V_t , through a parameter λ_t . They interpret a positive value of λ_t as evidence of lower market quality and lower liquidity as increases (decreases) in volatility are more sensitive for a unit increase (decrease) in trading volume.

Each parameter is subscripted by t , which allows the parameters to vary over time. My central hypothesis focuses on whether the introduction of the DaimlerChrysler's GRS impacted the volatility process. As a result, I create a dummy variable, GRS_t , which takes a value of 1 after September 17, 1998 and 0 otherwise, and specify that all parameters vary with GRS_t .²⁰ Under the hypothesis that the GRS creates greater transparency and strengthens the informational links between the two markets, I expect a decrease in base volatility and a decreased sensitivity of volatility to trading volume, so that γ_1 and λ_1 are negative. Under the alternative hypothesis that the GRS creates less transparency between markets, I expect an increase in base volatility and an increased sensitivity of volatility to volume, so that γ_1 and λ_1 are positive.²¹

Table 5 presents the estimates for the time-varying parameter GARCH model. Coefficient estimates, with corresponding t -statistics from robust quasi-maximum likelihood standard errors, are reported with the log-likelihood function value. The results are reported separately for the two benchmark DCX portfolios in the pre-merger period relative to the DCX share returns in the post-merger period. There are several results of interest. First, in the conditional mean equation, the systematic risk exposures with respect to the local (DAX 100) and U.S. (S&P 500) markets differ for the two portfolios and change in different ways around the GRS launch. For example, in the pre-merger period, the “DCX Frankfurt” portfolio has a much larger exposure to the DAX ($\beta_0^L = 0.827$) than S&P ($\beta_0^{US} = 0.041$), whereas the “DCX New York” has a much larger exposure to the S&P

²⁰ I exclude the merger period (May 7, 1998 to November 17, 1998) from the analysis in order to focus on the shift in volatility associated with the event of the GRS launch. All parameters are allowed to shift with the introduction of the GRS.

²¹ The model is estimated with maximum likelihood using the numerical procedures of Berndt et al. (1974). The algorithm yields asymptotic standard errors, but I recompute the standard errors in a way robust to potential non-normality in residuals using quasi-maximum likelihood methods of Bollerslev and Wooldridge (1992).

Table 5
 Estimating changes in volatility and liquidity around the launch of DaimlerChrysler's global shares, 1993-2001

Portfolios	Conditional mean equation								Conditional volatility equation							log L	χ^2	
	Before GRS			After GRS			Holidays		Before GRS			After GRS						
	α_0 (10^3)	β_0^L	β_0^{US}	α_1 (10^3)	β_1^L	β_1^{US}	θ^L (10^3)	θ^{US} (10^3)	γ_0 (10^5)	δ_0^a	δ_0^b	λ_0 (10^4)	γ_1 (10^5)	δ_1^a	δ_1^b			λ_1 (10^4)
DCX	0.0902	0.8275	0.0413	-0.5847	0.0342	-0.0740	0.6261	-0.8081	0.0009	0.9206	0.0821	0.3196	0.3068	-0.0528	0.0048	-0.8079	9756.1	39.24
Frankfurt	(0.74)	(34.58)	(1.23)	(-2.06)	(0.61)	(-1.17)	(1.36)	(-1.49)	(0.06)	(76.98)	(7.34)	(1.22)	(2.55)	(-1.46)	(0.19)	(-1.55)		(<0.001)
DCX	-0.0350	0.2369	0.6493	-0.6825	0.0676	-0.0739	0.0171	0.2457	0.0001	0.9686	0.0375	0.0031	0.5801	-0.1719	0.0712	-0.1862	9701.1	63.20
New York	(-0.27)	(7.49)	(16.99)	(-2.29)	(1.09)	(-1.10)	(0.03)	(0.34)	(0.02)	(270.2)	(8.35)	(0.02)	(3.86)	(-4.42)	(2.69)	(-0.27)		(<0.001)

This table contains coefficient estimates and robust *t*-statistics (in parentheses) for a generalized autoregressive conditionally heteroscedastic (GARCH) model of the returns, volatility and volume in Daimler Benz, Chrysler and DaimlerChrysler shares. Daily continuously compounded returns are computed from closing and opening stock prices on Daimler Benz ordinary shares trading in Frankfurt, Daimler Benz American Depositary Receipts trading on the NYSE, Chrysler ordinary shares trading on the NYSE and U.S. Dollar-denominated prices of the DCX global shares in Frankfurt and NYSE. U.S. Dollar-denominated returns are also computed from closing values of the DAX 100 (R_{mr}^L) and S&P 500 (R_{mr}^{US}) indexes. Currency conversions are computed using 1.95583 fixed conversion to Deutschmark before January 1, 1999. All data are from *Datastream International*. The DCX returns in the post-merger period are extended back to October 6, 1993 by constructing portfolio returns on the two securities denominated in common currency (US Dollars) and computed according to the merger formula of 0.6325 (1.005) DCX shares per Chrysler (Daimler Benz) shares. The two portfolio combinations include: (1) "DCX Frankfurt" using Daimler Benz close-to-close returns in Frankfurt with open-to-open Chrysler returns on the NYSE and (2) "DCX New York" with Daimler Benz ADR close-to-close returns with Chrysler close-to-close returns, both traded on the NYSE. The model is specified as:

$$R_t = \alpha_t + \beta_t^L R_{mr}^L + \beta_t^{US} R_{mr}^{US} + \theta^L H_t^L + \theta^{US} H_t^{US} + \varepsilon_t, \quad \varepsilon_t \sim N(0, h_t) \quad h_t = \gamma_t + \delta_t^a h_{t-1} + \delta_t^b \varepsilon_{t-1}^2 + \lambda_t V_t, \quad \alpha_t = \alpha_0 + \alpha_1 GRS_t \quad \gamma_t = \gamma_0 + \gamma_1 GRS_t,$$

$$\beta_t^L = \beta_0^L + \beta_1^L GRS_t, \quad \delta_t^a = \delta_0^a + \delta_1^a GRS_t, \quad \beta_t^{US} = \beta_0^{US} + \beta_1^{US} GRS_t, \quad \delta_t^b = \delta_0^b + \delta_1^b GRS_t, \quad \lambda_t = \lambda_0 + \lambda_1 GRS_t,$$

where V_t is the turnover in total DCX trading in Frankfurt and on the NYSE (or equivalent construction before merger), GRS_t is a dummy variable equal to 0 before the launch of the global registered share and 1 afterwards, H_t^L and H_t^{US} are holiday dummy variables for the respective markets, $\log L$ is the log likelihood function value on convergence and χ^2 is a chi-squared test of the joint test that the coefficients associated with the GRS_{*t*} dummy variable equal 0 (*p*-value below in parentheses). Robust *t*-statistics are computed with Bollerslev-Wooldridge quasi-maximum likelihood standard errors. 1739 observations are used with the merger period from May 7, 1998 to Nov. 16, 1998 excluded with dummy variable interactions (coefficient estimates available upon request).

($\beta_0^{\text{US}} = 0.649$) than the DAX ($\beta_0^{\text{L}} = 0.237$). It is not surprising, however, since “DCX New York” includes Daimler ADRs and Chrysler shares, both traded on the NYSE. Other studies have shown that ADRs have larger market risk exposures to global factors than their ordinary share counterparts (Foerster and Karolyi, 1999; Patro, 2000). Another feature is the increase in local (DAX) and the decrease in U.S. (S&P) market risk exposures after the launch of the GRS. Though not statistically significant, β^{L} increases from 0.828 to 0.862 for “DCX Frankfurt” and from 0.237 to 0.305 for “DCX New York.” Finally, the intercepts represent a risk-adjusted return, which is significantly negative on average during the post-merger period.

Second, the estimates for the conditional volatility equation show how important it is to decompose price volatility in the way implied by the theoretical model of DGM. In particular, the base-level volatility coefficient γ_0 is positive for each portfolio and the coefficient that captures the transitory volatility sensitivity to volume, λ_0 , is positive in each case. Further, there is positive dependence in the autoregressive process specified for the conditional volatility over time and the time series is close to integrated ($\delta_0^{\text{a}} + \delta_0^{\text{b}} = 0.99$). Following the introduction of the GRS, there is a significant increase in the base-level volatility coefficient. For example, for “DCX Frankfurt,” γ_0 is close to zero and γ_1 is 0.307 (10^5) with a robust t -statistic of 2.55 and, for “DCX New York,” γ_1 is 0.580 (10^5) with a robust t -statistic of 3.86. Although significant in only one benchmark portfolio, the persistence of the volatility process declines following the launch of the GRS; δ_1^{a} ranges around -0.17 on a base of δ_0^{a} of 0.97 for “DCX New York.”

Third, the shifts in the volume coefficients (λ_1) following the GRS launch, though negative, are never statistically significant. For the “DCX Frankfurt” portfolio, λ_1 is -0.81 (robust t -statistic of 1.55) and, for the “DCX New York” portfolio, λ_1 is -0.19 (robust t -statistic of -0.27). In the previous two subsections, we showed evidence that the GRS launch is associated with an increase in trading volume and lower spreads, but this increased liquidity is not necessarily revealed with a lower sensitivity of price volatility to volume.

For each portfolio, I test whether the parameters associated with the GRS launch jointly equal zero. The χ^2 tests with seven degrees of freedom easily reject this null hypothesis. My finding here parallels that of DGM for the ADR listings of Mexican stocks: the increase in volatility is due to factors that are unrelated to volume. These findings appear to offer at best only mixed support for the hypothesis that the GRS created greater transparency. The initiation of the GRS is associated with an increase in base-level volatility (significant, positive γ_1), which counters the hypothesis, but it is not associated with an increase transitory volatility (negative though insignificant λ_1) in the sensitivity of volatility to volume.

4. Concluding remarks

DaimlerChrysler’s innovative new investment concept—the global registered share—has been hailed as a landmark event for global equity markets. Designed as one fully fungible share certificate trading seamlessly and with full transparency in different equity

markets, DCX was expected to enhance the overall liquidity, to reduce price volatility, to reduce cross-border trading and settlement costs and, therefore, to maximize shareholder value. This study critically evaluates the new global share program and asks whether the greater transparency of the GRS program improved market quality, a question that has challenged existing research on international cross-listings and one that is of paramount importance to policymakers around the world.

The study uncovers three main findings. First, the initiation of the program was associated with greater trading activity and enhanced liquidity overall which is revealed in the form of a significantly higher value of combined trading and of significantly lower intraday bid-ask spreads. Second, the program experienced a significant migration of its order flow back to Frankfurt during the first 6 months. Even today, the NYSE now retains only 5% of total global trading volume in the stock. Third, return volatility was significantly higher after the creation of the GRS even after controlling for market-wide increases in return volatility, for potential shifts in different market risk exposures and for transitory effects on volatility through its sensitivity to trading volume. In the case of each finding above, I benchmarked the results against existing research on volume, volatility and liquidity changes around international cross-listings. While the increase in trading volume and decrease in bid-ask spreads are both comparable to that experienced by other such firms, the extent of the flow-back of order flow to Frankfurt and the magnitude of the increase in volatility are unusual.

There are several useful insights to draw from this study for researchers and policy-makers alike. For researchers, a number of theoretical models of multimarket trading and liquidity have been proposed for understanding the impact of international cross-listings on volume, volatility and liquidity. Some specify how the degree of transparency or the information linkages across markets matter and provide useful guidance in understanding the importance of the structure of the share facility used for international cross-listings. After all, companies around the world use a wide variety of programs to list shares in the U.S., such as ordinary shares, New York registered shares, ADRs, offshore and private placement offerings and now global registered shares. The findings for DCX indicate that the GRS program had a favorable impact on the quality of the trading environment for the shares in terms of overall trading activity and liquidity, two outcomes that follow from the null hypothesis that the GRS represents a more transparent share structure. However, the DaimlerChrysler experience with the GRS also revealed two unfavorable outcomes with the flow-back and increased return volatility. One possible explanation is that there is greater transparency associated with the new GRS share facility but that the increased transparency does not reveal itself in the proxies I use for the quality of the trading environment. Alternatively, the higher quality trading environment stems from improvements associated with the GRS facility but which are not associated with transparency at all. To answer this question, we likely need to wait for more than one or a few cases to study. For policymakers, this study does advise caution for the enthusiasm of experts who have cheered the new global shares as a cheaper and easier share custody process that better aligns prices in the different markets by allowing for a seamless and fungible cross-border transfer. Some have even proposed global shares as a means to contain flow-back that many ADR programs experience. My findings suggest that these conclusions are premature at best.

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Appendix A. Chronology of DaimlerChrysler merger and global share program

Date	Event
January 12, 1998	Initial discussions between Juergen Schrempp of Daimler Benz and Robert Eaton of Chrysler during North American International Auto Show in Detroit
May 6, 1998	DaimlerChrysler merger agreement signed in London; terms of exchange offer set at 1.005 DaimlerChrysler shares per Daimler Benz share (if over 90% submitted) and 0.6235 DaimlerChrysler shares per Chrysler share
May 7, 1998	Merger agreement announced
May 7, 1998	Chrysler enters stockholder agreement with Kirk Kerkorian/Tracinda (who owns 13.74% of shares) to vote its shares in favor of transaction; Chrysler amends stockholders rights agreement (February 5, 1998) as inapplicable to merger
May 14, 1998	Daimler Benz supervisory board approves merger
July 23, 1998	European Commission approves merger
July 31, 1998	U.S. Federal Trade Commission approves merger
August 6, 1998	Announcement that DaimlerChrysler shares will trade as "global shares" rather than American Depositary Receipts
August 6, 1998	Daimler Benz and Chrysler mail proxy statements and prospectuses to shareholders
September 4, 1998	U.S. IRS private ruling received on tax consequences of merger for German and U.S. shareholders
September 18, 1998	Chrysler shareholders approve merger with 97.5% in favor (475.7 million in favor; 12.1 million against); Daimler Benz shareholders approve merger with 99.9% in favor
September 24, 1998	Initial exchange offer period open (expected to close on October 23, 1998)
October 1, 1998	Standard and Poor announces that Chrysler will be dropped from the S&P 500 index and replaced by Safeway on November 12
November 6, 1998	Chrysler issues 23.5 million shares to corporate pension plan to qualify for pooling-of-interests accounting treatment

Appendix A (continued)

November 9, 1998	Daimler Benz announces 98% of stock exchanged
November 12, 1998	DaimlerChrysler merger transaction closes; S&P 500 index drops Chrysler shares
November 17, 1998	DaimlerChrysler stock begins trading on 17 stock exchanges worldwide under symbol DCX
December 18, 1998	DAX 30 reweights index to reflect larger cap DCX shares

Source: Chrysler Form 10-Q (September 30, 1998), *Wall Street Journal* Publications, http://www.daimlerchrysler.de/index_e.htm.

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