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This paper investigates the motivations and practice of nonfinancial firms with regard to using financial options in their risk management activities. To this end, it provides a comprehensive account of the existing empirical evidence on the use of derivatives in general and options in particular by nonfinancial corporations across different underlyings and countries. Overall, a significant number of 15%-25% of the firms outside the financial sector use financial options. This reflects the fact that options are very versatile risk management instruments that can be used to hedge various types of exposures, linear as well as nonlinear. In particular, options are a useful component of corporate risk management if exposures are uncertain, e.g. due to price and quantity risk. Depending on the correlation between price and quantity risk, the optimal hedge portfolio consists of a varying combination of linear and nonlinear risk management instruments. Moreover, the accounting treatment as well as liquidity effects can impact the choice of derivative instrument. At the same time, there may be agency-related incentives to use options because of their role to present dual bets on both direction as well as future volatility of the underlying.

Keywords: Options, derivatives, risk management, exposure, corporate finance

JEL Classification: G3, F4, F3

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Abstract

This paper investigates the motivations and practice of nonfinancial firms with regard to using financial options in their risk management activities. To this end, it provides a comprehensive account of the existing empirical evidence on the use of derivatives in general and options in particular by nonfinancial corporations across different underlyings and countries. Overall, a significant number of 15%-25% of the firms outside the financial sector use financial options. This reflects the fact that options are very versatile risk management instruments that can be used to hedge various types of exposures, linear as well as nonlinear. In particular, options are a useful component of corporate risk management if exposures are uncertain, e.g. due to price and quantity risk. Depending on the correlation between price and quantity risk, the optimal hedge portfolio consists of a varying combination of linear and nonlinear risk management instruments. Moreover, the accounting treatment as well as liquidity effects can impact the choice of derivative instrument. At the same time, there may be agency-related incentives to use options because of their role to present dual bets on both direction as well as future volatility of the underlying.

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1 Introduction

The use of derivative instruments ('derivatives') has become common practice in the risk management activities of nonfinancial firms around the world (see e.g. Bartram, Brown and Fehle, 2003). In particular, derivatives are widely used to manage foreign exchange rate (FX) and interest rate (IR) risks, while the use of commodity price derivatives is more concentrated in particular industries. While these instruments are only one tool of risk management, the use of derivatives can be interpreted as a proxy for corporate risk management, and various theories have established a case for hedging at the firm level of nonfinancial firms, based on capital market imperfections such as underinvestment problems (Myers, 1977), taxes (Smith and Stulz, 1985), financial distress (Stulz, 1996) or management incentives (Stulz, 1984). Indeed, there is some empirical support for these theories (e.g. Géczy, Minton, and Schrand, 1997). In contrast, while it can be observed that nonfinancial firms use a variety of instruments to manage financial risks, it is not clear whether the full potential of these instruments is being realized (since not all firms use derivatives and not all of them use all types) and, more importantly, whether they are used appropriately.

This paper contributes to the literature by investigating the choice of derivative financial instruments, particularly with regard to options, by nonfinancial firms. To this end, comprehensive evidence on derivatives use collected by the Bank of International Settlements (BIS) is presented, indicating that financial options account for 15% of global derivatives turnover attributed to nonfinancial firms. This percentage is with 17.5% and 25.2% higher in the United States and the UK, respectively. Results based on statistics focusing on notional amounts outstanding are similar. Moreover, an exhaustive account of the existing evidence from questionnaires on derivatives usage by firms outside the financial sector is provided to complete the picture. Most of this evidence is based on questionnaires, such as the prominent Wharton survey in the United States and, more recently, similar polls of CFOs in

other countries. This survey evidence is complemented with data based on corporate disclosure information, since firms in many countries provide information about their risk management activities in general and derivatives use in particular in their reports, either required by law or voluntarily. These results confirm the observation that firms use derivatives on a regular basis. In particular, across different countries, about 50%-60% of nonfinancial firms are reported to use derivatives, and a significant number (between 16%-44%) use financial options (mostly with foreign exchange rates and interest rates as underlyings).

Subsequently, theoretical rationales for the choice of derivative instruments and particularly the use of options are explored. On a basic level, financial theory suggests that if and when used for hedging purposes, derivative instruments should be chosen based on the exposure profile of the firm and the payoff characteristics of the instrument. Thus, instruments with linear payoff profiles such as forwards, futures and swaps are suitable for linear exposures, while the nonlinear payoff profile of options is appropriate to hedge a nonlinear exposure.¹ In general, however, options are very flexible hedging instruments, and portfolios of options can be constructed to hedge simple and complex, linear and nonlinear exposures. Nonlinear exposures result if corporate cash flows are uncertain and a nonlinear function of the risk factor, such as an exchange or interest rate, for instance as a result of price and quantity risk (Stulz, 2003). The optimal hedge portfolio depends on the correlation between price and quantity risk, and often involves combinations of both linear as well as nonlinear hedging instruments (Gay, Nam and Turac, 2001; Brown and Toft, 2002). In addition, accounting considerations can favor the use of options in the absence of hedge accounting. Similarly, there may be agency-related incen-

¹ Derivatives with a linear (nonlinear) payoff profile refer to derivative instruments whose payoff is a linear (nonlinear) function of the price of the underlying asset.

tives to use options because of their role to present dual bets on both direction as well as future volatility of the underlying.

The paper is organized as follows. Section 2 presents a comprehensive analysis of the existing evidence regarding which derivative instruments nonfinancial firms use and to what extent they use options. Subsequently, Section 3 analyzes rationales and motivations for the use of derivatives as part of the risk management activities of nonfinancial firms and discusses when and why the use of options can be sensible. Section 4 presents conclusions.

2 Evidence of the Use of Options by Nonfinancial Corporations

The use of derivative financial products, such as forwards, futures, options and swaps, has grown exponentially over the last decades (see e.g. Bartram, 2000). This is true primarily for over-the-counter (OTC) instruments, but also, though to a much lesser degree, for the smaller market of exchange-traded derivatives. According to statistics by the Bank for International Settlement, notional amounts outstanding of OTC derivatives still grew by 38% from 1998 to 2001, reaching nearly \$100 trillion in June 2001 (BIS, 2002). Contracts on foreign exchange and interest rates are the most important segments of the derivatives market: Notional amounts for foreign exchange contracts accounted for \$20.4 trillion, and interest rate contracts reached \$75.8 trillion in 2001. While financial institutions (banks, insurance companies, etc.) account for roughly 80% of the OTC market volume (Bartram, Brown and Fehle, 2003; Allen and Santomero, 1998), derivatives transactions by nonfinancial firms are considerable in terms of their absolute value.

Table 1 presents a breakdown of derivatives turnover attributed to nonfinancial firms by instrument type and country. Across all countries, the largest share of derivatives transactions pertains to foreign exchange rates (82.5%), while interest rates are much less important as underlyings (17.5%). These relative dimensions are similar for the two countries with the largest share of the world deriva-

tives market, the United States and the UK, who account for 22.1% and 20.3% of world market, respectively. On a global level, the fraction of turnover of foreign exchange options is 11.4%, while it is 3.8% for interest rate options. In contrast, both foreign exchange and interest rate options are being used more frequently in the United States (13.0% and 4.5%, respectively) and in the United Kingdom (17.1% and 8.1%). While the derivatives turnover in other countries is much smaller in general, options turnover constitutes a more important fraction of the country's total turnover in some countries. To illustrate, foreign exchange options have high turnover in Taiwan (41.7%), Bahrain (20.5%), Malaysia (19.6%) and Ireland (19.3%). By the same token, options on interest rates are a high percentage of total turnover in Luxembourg (21.9%), Belgium (10.7%) and Mexico (9.1%).

While turnover is significantly higher for foreign exchange rate derivatives compared to interest rate derivatives, the proportions are reversed for notional amounts outstanding (Table 2).² Amounts outstanding on interest rate derivatives account for 60%-70% of the total amount outstanding, while foreign exchange derivatives are about half (25%-40%). Forwards (for foreign exchange) and swaps (for interest rates) are the most popular derivatives based on notional amounts as well, but options still account for an important percentage of total amounts outstanding: 5.0% (foreign exchange) and 14.3% (interest rates) (year-end 2002).

In addition to the above statistics compiled by the BIS based on its triennial survey, various researchers have sought to provide evidence on the use of derivatives by nonfinancial firms. This data is generally collected at the user, i.e. individual firm level. Early studies rely on questionnaires about de-

² The turnover for foreign exchange rate derivatives has generally declined (by 12%), while interest rate derivatives' turnover has risen (by 86%) over the last three years. This is primarily due to structural changes (notably the introduction of the Euro) that led to a decline in the size of the position in foreign exchange rate products, while the positive market environment over the last couple of years led to an expansion of the market for interest rate derivatives. In spite of the contraction in the market for foreign exchange derivatives, turnover is still substantially higher compared to interest rate products largely due to the shorter maturities of foreign exchange rate contracts.

derivatives usage. Their most prominent representation is the Wharton survey, which has been conducted for several years in the United States; subsequently similar surveys have been carried out in different countries. In recent years, regulators have often come to require firms to disclose information on financial derivatives usage as part of their annual reporting. To illustrate, firms in the United States, the U.K., Canada, Australia and New Zealand as well as firms reporting according to IAS are obliged to include such information in their annual reports. Moreover, many firms choose to disclose data on their derivatives positions and risk management activities voluntarily. Consequently, several recent studies have collected information on derivatives usage by nonfinancial firms on the basis of their annual reports.

Table 3 reports the results of these studies, with Panel A referring to general derivatives use, and Panels B, C and D pertaining to foreign exchange rate, interest rate and commodity price derivatives, respectively. As one of the first studies, Nance, Smith and Smithson (1993) study 169 U.S. non-financial firms in a survey and report 62% of them as using derivatives (Panel A). Mian (1996) studies a large sample of 3,022 firms and finds percentages of derivatives' users of 26% for all derivatives, 15% for currency, 15% for interest rate and 5% for commodity price derivatives. Similarly, in an analysis of the derivatives use of 372 *Fortune 500* firms, Géczy, Minton and Schrand (1997) report derivatives usage by 59% and 41% for general derivatives use and foreign exchange rate derivatives, respectively. In the 1998 Wharton survey, Bodnar, Hayt, and Marston (1998) find that in a sample of 399 U.S. non-financial firms, 50% use derivatives. In particular, 42% use foreign exchange, 38% use interest rate, and 28% use commodity price derivatives. A study of 451 firms by Howton and Perfect (1998) results in percentages of derivatives use of 62% for all derivatives contracts, 45% for FX derivatives, and 45% for interest rate derivatives. The most recent and most comprehensive study on derivatives usage based on accounting information is Bartram, Brown and Fehle (2003), covering a sample of 7,263 firms in 48 countries. While there is variation across countries and industries, roughly 60% of the

firms use derivatives across the entire sample. Derivatives use is most frequent for foreign exchange rate risk (45%), followed by interest rate risk (33%) and commodity price risk (10%).

With regard to the instruments used, about 15%-30% of all firms use options. Bartram, Brown and Fehle (2003) find about 16% of the nonfinancial firms in their global sample using options. The survey evidence also suggests that there is substantial variation across countries. To illustrate, options are more popular risk management instruments in the United States (32% in Phillips, 1995; 34% in Bodnar, Hayt and Marston, 1998) and in the UK (44% in Grant and Marshall, 1997) (Table 3, Panel A). The choice of instrument also varies across underlyings. Based on evidence for a global sample, nonfinancial firms mostly use forwards (36%) to manage foreign exchange rate risk, while swaps (11%) and options (10%) are less popular (Bartram, Brown and Fehle, 2003). For interest rate risk management, swaps are used most frequently (29%); interest rate options are used as well, but less often (7%). Commodity price derivatives are generally used less frequently, and there are few differences across different instruments (3% for futures; 2% for options), with some variation across industries. Survey evidence corroborates that options are used more often to manage foreign exchange rate risk (e.g. by 44% in the UK (El-Masry, 2003), or 22% in the United States (Bodnar, Hayt and Marston, 1998)) (Table 3, Panel B). In contrast, options are less popular when interest rates are the underlying (20% in the UK (El-Masry, 2003), 14% in the United States (Bodnar, Hayt and Marston, 1998)).

To summarize, nonfinancial firms have come to use financial derivatives on a regular basis, as demonstrated by the statistics on derivatives usage. This pertains primarily to instruments on foreign exchange rate and interest rate risk and includes a variety of instruments, most important of which are basic derivatives products (forwards, futures, options and swaps). Derivatives use can be interpreted as a proxy for corporate risk management, and various theories have established a case for hedging at the firm level of nonfinancial firms in order to increase shareholder value. These hedging motives are gen-

erally based on capital market imperfections such as financial distress (Smith and Stulz, 1985; Shapiro and Titman, 1986; Stulz, 1996), taxes (Smith and Stulz, 1985), underinvestment problems (Myers, 1977; Bessembinder, 1991; Froot, Scharfstein, and Stein, 1993) or management incentives (Stulz, 1984; Stulz, 1990; Mayers and Smith, 1982). Several studies put these theories to a test and find some, though limited empirical support (e.g. Nance, Smith and Smithson, 1993; Mian, 1996; Géczy, Minton, and Schrand, 1997).

Although it is thus evident that nonfinancial firms use a variety of instruments as part of their risk management activities, little is known about the motivations of nonfinancial firms to choose particular types of derivative instruments. Consequently, rationales for the choice of derivatives in general and the use of options in particular for corporate risk management are explored in the next section.

3 Rationales for the Use of Options in Corporate Risk Management

While nonfinancial firms could use financial derivatives for speculative as well as for hedging purposes, the existing empirical evidence suggests that derivatives are being used mostly to reduce (rather than increase) financial exposures at the firm level. On a fundamental level, nonfinancial firms around the world that use foreign exchange rate derivatives generally have higher foreign sales, foreign income and foreign assets, and firms that use interest rate derivatives have higher leverage compared to nonusers (Bartram, Brown and Fehle, 2003). There is also direct evidence from a sample of S&P 500 nonfinancial firms that the use of currency derivatives significantly reduces their exchange rate exposure (Allayannis and Ofek, 2001). Hentschel and Kothari (2001) show that derivatives users have few if any measurable differences in risk (measured by the volatility of a firm's stock price or its exposures to variations in exchange rates and interest rates) associated with the use of derivatives compared to firms that do not use derivatives, which suggests that derivatives are not being used for speculative purposes. Similarly, for a global sample of firms, Bartram (2003) shows that – consistent with hedging motives of

corporate derivatives use – users of derivatives have higher gross (or pre-hedging) exposures, but significantly lower net (or post-hedging) exposures and also show significantly lower stock return volatilities compared to non-users. Along the same lines, evidence in Brown, Crabb and Haushalter (2003) suggests that the economic significance of speculative components of selective hedging is small.

Provided that nonfinancial firms generally appear to use derivatives with the overall intention to reduce their exposures, financial theory seems on first sight to provide clear guidance regarding the choice of instrument. On a basic level, risk management theory suggests the nature of the exposure to determine the appropriate risk management instrument. In particular, derivatives that have a linear payoff profile (forwards, futures, swaps, etc.) would seem suitable to hedge a linear exposure, while nonlinear exposures would call for the use of instruments with nonlinear payoff profiles (such as options and portfolios of options) related to the very same underlying risk factor in order to achieve variance minimization (see e.g. Stulz, 2003; Smithson, 1998). Exposures are linear as opposed to nonlinear if they do not change for variations in the risk factors, i.e. if they are independent of them. The classic example of a linear exposure is a foreign currency receivable (without default risk), as the amount at risk in foreign currency is independent of the exchange rate.

While nonlinear exposures have generally received relatively little attention in the literature, financial theory suggests several situations that give rise to a nonlinear or asymmetric effect of financial risks on firm value (Bartram, 2004). In particular, nonlinear exposures exist if corporate cash flows (and thus firm value) are a nonlinear function of the considered risk factor(s). As a result, the exposure itself is a function of the risk factors and thus random/uncertain, e.g. when a firm faces price as well as quantity risk that are not perfectly correlated, so that the exposure is contingent on the risk factor. For example, the cash flows of nonfinancial firms can depend on foreign exchange rates in a nonlinear fashion, because foreign currency appreciations lead to both a higher number of units sold abroad and

to higher home currency cash flows per unit sold, rendering the exposure a function of the exchange rate (Stulz, 2003; Sercu and Uppal, 1995). While these arguments have been mostly made with regard to exchange rate risk, they extend in principle to other sources of risk (such as changes in interest rates and commodity prices) as well. To illustrate, the interest rate exposure of a fixed-income security changes with the level of interest rates, i.e. the convexity of duration.

Exchange rate movements often also prompt firms to react with operative decisions, such as shifting sourcing and production between countries, if import, export and production decisions are flexible (Adam-Müller and Wong, 2002; Kogut and Kulatilaka, 1994; Ware and Winter, 1988). In general, operative flexibility represents a real option to the firm that has by definition a nonlinear payoff. The exposure is also asymmetric if exporting firms use greater pricing-to-market during periods of foreign currency appreciations in order to build market share (subject to the threat of trade restrictions). Alternatively, capacity constraints and quantitative trade restrictions can cause exporting firms to apply greater pricing-to-market during periods of foreign currency depreciations (Knetter, 1994). As a result of export price adjustments, the cash flow and value of an exporting firm is a convex function of the exchange rate (Sercu and Uppal, 1995). If firms use multiple currency price lists, they effectively grant an option, which has a nonlinear payoff profile, to their customers (Kanas, 1996a; Kanas, 1996b; Giddy and Dufey, 1995). The effect of currency movements is also one-sided with regard to default risk, thus inducing a nonlinear exposure.

While linear derivative instruments are suitable to hedge linear exposures as a static hedge (i.e. without changing the hedge until its maturity), they can also be used for a delta hedge of a nonlinear exposure. Nevertheless, this entails the rapid and continuous adjustment of the derivatives' hedge position as the risk factor changes (dynamic hedge), and it requires subsequent changes in the risk factor to be small, as the hedge only works well for small risk changes. For a static linear hedge of a nonlinear

exposure, the effectiveness of the hedge depends significantly on the correlation between price and quantity risk (Stulz, 2003). As a result, forwards and futures are often not the best choice of derivative instrument to hedge nonlinear exposures with regard to variance minimization.

Options, in contrast, are very versatile risk management instruments that can be used well to hedge various types of exposure. They can not only be combined into a static portfolio to replicate linear derivative instruments in order to hedge linear exposures, but options and portfolios of options can be used effectively to hedge (complex) nonlinear exposures as well. In particular, static option positions can be created that hedge nonlinear exposures significantly better than static positions of linear derivatives such as forwards and futures (Stulz, 2003). This makes them very flexible and valuable risk management tools. In fact, almost any arbitrary payoff function can be hedged with a piecewise linear approximation using a tailored portfolio of options. While short-term corporate cash flows may have little uncertainty and can be hedged effectively with linear derivatives, most future corporate cash flows bear price and quantity risk, resulting in nonlinear exposures that make a case for the use of options in corporate risk management.

Options are often also used as insurance against unfavorable market movements, i.e. to eliminate downside risk while keeping the upside potential. For example, firms with floating rate debt buy interest rate caps when they expect interest rates to rise in order to limit the cost of borrowing, while allowing them to benefit from lower funding cost when interest rates decrease. Similarly, firms can enter into floors to protect the income from variable-rate investments. The choice of using swaps or caps/floors is often based on the firms' view of future interest rates. However, the use of options in this case, while protecting the position against losses, is not a hedge in a variance minimizing sense. In fact, options are suitable instruments to create a speculative position in the guise of hedging, e.g. when op-

tions are used to hedge linear exposures (Giddy and Dufey, 1995).³ Finally, it can also be sensible for firms to buy put options on their own stocks in order to reduce financial constraints in bad states of the world.⁴

Recent research directly models the choice of a value-maximizing firm to use linear (forwards) and nonlinear (options and custom/exotic) derivative contracts in the presence of price and quantity risk (Brown and Toft, 2002). The use of a variety of derivatives appears consistent with the objective of value maximization when the firm faces financial distress costs. The optimal hedge is dependent on the correlation between price and quantity risk, price and quantity volatilities, and the profit margin. To illustrate, linear derivatives are efficient risk management tools if quantity and price risk are uncorrelated, which possibly explains the popular use of forwards, futures and swaps. In contrast, firms with negative correlation between price and quantity risk are more likely to benefit from options (and exotic derivatives). Moreover, firms should use more options if they face large quantity risk or small price risk and large positive or negative price-quantity correlation. Also, consistent with observations about risk management practices, the model predicts that firms often hedge less with forwards when cash flows are in the more distant future.

When examining the optimal mix of linear and nonlinear hedging instruments, the optimal hedge portfolio consists largely of linear instruments for firms with little or no quantity risk (Gay, Nam

³ 32% of U.S. nonfinancial firms using derivatives are reported to at least sometimes actively take positions in currency derivatives, 61% (59%) alter the size (timing) of their hedge based on their market view of exchange rates (Bodnar, Hayt and Marston, 1998). With regard to interest rate risk, 41% actively take positions, while 59% and 66% alter the size or the timing of their hedge depending on their market view.

⁴ Indeed, whenever a decision to use derivatives is based on management's view on rates it has nothing to do with hedging – but this is difficult to ascertain empirically. As an aside, note that it has been shown that options are not a good choice of instrument to hedge a bid for a project in a foreign country. In this case, hedging with options is inferior to using linear derivatives or not hedging at all (Stulz, 2003).

and Turac, 2001). In contrast, higher levels of quantity and price risks give rise to using fewer linear contracts and more nonlinear instruments (long put options) in order to avoid overhedging. This substitution effect between linear and nonlinear instruments is a function of the price-quantity correlation. If the correlation is negative, there is a natural hedging effect reducing the overall demand for hedging instruments and leading to more substitution into nonlinear contracts as the overhedging problem is aggravated. In contrast, in the case of positive price-quantity correlation, higher demand for derivatives results, as they can reduce some of the quantity risk as well, and more (less) linear (nonlinear) derivatives are used.

Besides rationales for the use of options in corporate financial management based on risk management considerations, the accounting treatment of derivatives may have an impact on the choice of instrument as well. According to the 1998 Wharton survey on financial risk management, the accounting treatment is the issue of highest concern regarding the use of derivatives (Bodnar, Hayt and Marston, 1998). When a company uses derivatives with linear payoff profile such as forwards, futures and swaps to hedge an underlying position, the derivatives' position can result in an accounting loss (hedge accounting would solve this problem, but may be difficult to apply for anticipated exposures). To illustrate, when a firm uses a forward contract to hedge a receivable in foreign currency, the forward contract will show a loss if the domestic currency depreciates. At the same time, the value of the underlying asset (the receivable) increases in value in return, so that the combined position of the underlying asset and the derivative remains constant and independent of exchange rate movements. The elimination of the upside potential on the underlying asset is the price for the protection the derivative offers for situations where the underlying asset loses value.

If these principles of hedging are not well understood, CFOs may find themselves in difficulties explaining to management and shareholders losses on their derivatives' position and concomitant nega-

tive effects on earnings, especially since they occur at times where the hedged asset would have made a big gain without the derivative hedge. These accounting effects can make the use of financial options preferable. When companies take long positions in options, these will never cause negative cash flows, except for the option premia, which can be amortized over time. In contrast, options provide welcome gains in situations where the underlying asset loses value. These effects can render the use of options preferable, even if the exposure to be hedged would require a linear hedging instrument. At the same time, there may be agency-related incentives to use options because of their role to present dual bets on both direction as well as future volatility of the underlying.

A related argument pertains to potential liquidity effects of the hedge. These result from the fact that exchange-traded derivatives are marked to market. If a company uses futures for hedging purposes, the firm will have to meet margin calls in situations where the value of the underlying asset appreciates. These margin payments put a drain on the firm's liquidity before the value gain on the underlying is realized. The case of MGRM, the U.S. affiliate of Metallgesellschaft, drastically illustrates the importance to account for these liquidity effects. For nonfinancial firms that take long positions in options, no comparable effects exist even for exchange-traded instruments.

4 Summary and Conclusion

In this paper, the motivations and practice of nonfinancial firms with regard to derivatives usage is investigated. The focus is on the use of options and the rationales of firms outside the financial sector to enter into options positions as part of their risk management activities. To this end, an exhaustive account of the existing empirical evidence on financial derivatives usage by nonfinancial firms is provided, based on statistics by the BIS, corporate surveys and the analysis of annual report data. Across different countries, a significant number of 15%-25% of firms use options.

Several rationales for the use of options by nonfinancial firms are explored. In particular, op-

tions and portfolios of options are very flexible hedging instruments that allow hedging various payoff patterns, including linear and nonlinear exposures. Options are particularly useful hedging tools in the presence of nonlinear exposures, as they offer a nonlinear payoff profile. Nonlinear exposures result when corporate cash flows are uncertain and a nonlinear function of the risk factor, rendering the exposure itself dependent on the risk factor. In the case of price and quantity risk, the optimal hedge portfolio depends on the correlation of both risks and in many cases involves a combination of linear and nonlinear risk management instruments. Moreover, differences in the accounting treatment of derivatives as well as liquidity effects have to be considered and constitute possibly important factors in determining the choice of derivative instrument. At the same time, there may be agency-related incentives to use options because of their role to present dual bets on both direction as well as future volatility of the underlying.

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Table 1: Derivatives Turnover Attributed to Nonfinancial Firms by Country

This table reports derivatives usage based on the Bank for International Settlements (BIS) Triennial Surveys. The statistics are based on daily averages of OTC derivatives turnover (in millions of U.S. dollars) with nonfinancial customers by country in April 2001, net of local inter-dealer double-counting. The first column reports the fraction (in %) of the total OTC turnover per country relative to the world total. The following columns report the turnover of different instruments (forwards, swaps, options) by underlying (foreign exchange rates, interest rates) relative to the country total. Foreign exchange forwards include out-right forwards and foreign exchange swaps and are calculated as the difference between the country total and the sum of options and currency swaps. Interest rate derivatives refer to single currency interest rate instruments. Missing values are denoted by “_” (reported size of the position is zero). The table is based on the following tables of the 2001 BIS Triennial Survey (BIS, 2001): E.27, E.28, E.29, E.32, E.33, E.34, and E.35.

Country	% of world	Foreign Exchange Derivatives				Interest Rate Derivatives			
		% of country	% Forwards	% Swaps	% Op-tions	% of country	% Forwards	% Swaps	% Options
Australia	3.5	77.4	68.7	1.6	7.1	22.6	16.4	5.7	0.5
Austria	0.1	85.0	79.4	0.6	5.0	15.0	13.1	0.6	1.3
Bahrain	0.0	95.5	61.4	13.6	20.5	4.5	4.5	_	_
Belgium	0.6	69.7	63.6	2.2	3.9	30.3	3.8	15.7	10.7
Brazil	0.6	78.7	39.9	27.4	11.4	21.3	2.2	17.9	1.1
Canada	3.9	84.0	66.4	3.2	14.4	16.0	1.4	10.9	3.7
Colombia	0.0	100.0	94.1	_	5.9	_	_	_	_
Czech Republic	0.1	97.1	87.9	0.7	8.6	2.9	0.7	1.4	0.7
Denmark	1.8	89.4	84.9	0.4	4.0	10.6	6.9	2.8	0.9
Finland	0.4	96.7	92.8	_	3.9	3.3	2.0	0.9	0.4
France	2.5	59.4	49.2	0.9	9.3	40.6	7.6	27.9	5.0
Germany	4.3	59.1	55.3	0.9	2.9	40.9	7.4	28.8	4.7
Greece	1.0	99.9	99.7	_	0.2	0.1	_	_	0.1
Hong Kong	1.8	95.2	84.3	1.1	9.7	4.8	1.0	2.1	1.6
Hungary	0.0	100.0	90.2	_	9.8	_	_	_	_
India	0.3	98.5	97.7	0.6	0.3	1.5	_	1.5	_
Indonesia	0.1	99.0	98.0	1.0	_	1.0	_	1.0	_
Ireland	0.4	88.6	68.0	1.3	19.3	11.4	1.8	5.7	3.9
Italy	0.8	78.5	64.5	2.0	12.0	21.5	0.6	15.6	5.4
Japan	8.5	91.3	76.5	1.1	13.6	8.7	_	8.0	0.8
Korea	0.5	99.5	84.6	2.1	12.8	0.5	_	0.5	_
Luxembourg	0.4	77.4	72.7	0.7	4.0	22.6	0.7	_	21.9
Malaysia	0.3	100.0	80.4	_	19.6	_	_	_	_
Mexico	0.0	86.4	81.8	0.0	4.5	13.6	2.3	4.5	9.1
Netherlands	1.6	90.4	82.6	1.5	6.3	9.6	1.2	7.0	1.4
New Zealand	0.3	91.4	87.6	1.8	2.0	8.6	1.5	7.1	_
Norway	0.6	81.5	80.2	0.4	0.9	18.5	16.0	2.0	0.5
Philippines	0.1	100.0	97.9	2.1	_	_	_	_	_
Portugal	0.1	92.7	90.1	_	2.6	7.3	_	7.3	_
Saudi Arabia	0.1	98.8	84.7	_	14.1	1.2	_	1.2	_
Singapore	6.6	99.2	90.7	0.2	8.2	0.8	0.1	0.5	0.2
South Africa	0.8	99.7	96.8	_	2.9	0.3	0.2	_	0.1
Spain	0.5	80.1	57.1	10.1	12.9	19.9	1.2	12.3	6.5
Sweden	5.4	81.7	80.3	0.3	1.0	18.3	17.3	1.0	0.1
Switzerland	8.6	99.4	85.8	0.0	13.5	0.6	0.4	0.1	0.0
Taiwan	0.5	97.7	55.5	0.5	41.7	2.3	_	1.8	0.5
Thailand	0.2	98.0	92.9	4.1	1.0	2.0	_	2.0	_
U.K.	20.3	80.1	60.7	2.3	17.1	19.9	2.9	8.9	8.1
USA	22.1	78.6	65.2	0.3	13.0	21.4	1.4	15.5	4.5
World	100.0	82.5	69.7	1.3	11.4	17.5	3.6	10.2	3.8

Table 2: Notional Amounts of Derivatives Outstanding with Nonfinancial Firms

This table reports derivatives usage based on the Bank for International Settlements (BIS) Triennial Surveys and Quarterly Reviews. The statistics are based on global amounts outstanding of OTC derivatives with nonfinancial customers at the end of June 1995, 1998, 2001 and at the end of December 2002. The table shows the fraction (in %) of notional amounts outstanding attributed to different underlyings (foreign exchange, interest rate, equity) and instruments (forwards, swaps, options). The data is obtained from the following tables: Panel A, tables E.49 in 2001 BIS (2002) and 20A in BIS (2003). Panel B, tables E.28, E.29, E.33, E.34, and E.35 in 2001 BIS (2002), tables E-10, E-11, E-28, E.29, E-33, E-34, and E-35 in 1998 BIS (1999), and tables 1-J, 1-K, 9-I, 9-J, 10-E, 10-F, and 10-G in 1995 BIS (1996).

	1995	1998	2001	2002
Foreign Exchange (total)	42.1	40.3	35.9	25.3
Forwards and FX swaps	24.1	24.7	20.3	12.8
Currency swaps	10.6	0.6	9.8	7.4
Options	7.4	14.9	5.8	5.0
bought	3.5	6.7	3.1	
sold	3.9	8.2	2.7	
Interest Rates (total)	57.9	57.1	60.7	71.5
Forwards	4.3	5.2	6.8	4.2
Swaps	42.0	38.1	40.8	53.0
Options	11.5	13.8	13.1	14.3
bought	4.7	5.8	4.6	
sold	6.8	8.0	8.5	
Equity (total)		3.5	3.7	3.2
Forwards and swaps		0.6	0.6	0.7
Options		2.0	2.0	2.5
bought		0.8	1.1	
sold		1.2	0.9	
Other (total)	0.3		0.8	

Table 3: Survey Evidence of Derivatives Use by Nonfinancial Corporations

The table shows for each empirical study the data source (AR=annual report, Q=questionnaire), sample size, the country studied, the percentage of firms using derivatives (in general), as well as the percentage of firms using particular instruments. For options, percentages on OTC options and exchange-traded options are reported in brackets. Similarly, the statistics for structured derivatives and hybrid debt are reported in brackets for exotic/other derivatives. Panel A refers to general derivatives use, Panel B to foreign exchange rate derivatives, Panel C to interest rate derivatives, and Panel D to commodity price derivatives.

Panel A: General Derivatives Use

study	source	sample	country	% deriva- tives	% for- wards	% fu- tures	% swaps	% options	% exotic/other
Bartram, Brown, Fehle, 2003	AR	7263 firms	48 countries	60.3	37.9	4.4	32.1	16.3	
El-Masry, 2003	Q	173 firms	U.K.	67.0	29.0	13.0	23.0	46.1	8.0 [6.0 / 2.0]
Guay, Kothari, 2003	AR	413 firms	USA	56.7					
Berkman, Bradbury, Hancock, Innes, 2002	AR	158 mining and industrial firms	Australia	55.7					
Graham, Rogers, 2002	AR	442 firms	USA	35.7					
Judge, 2002	AR, Q	598 FT 500 firms	U.K.	70.6	52.0	4.0	46.3	27.8	
Nguyen Faff, 2002	AR	469 firms	Australia	74.2	-----56.3-----		56.1	27.1	
Sheedy, 2002	Q	131 firms	Singapore, Hong Kong	78.0				22.9 ^a	
Bodnar, de Jong, Macrae, 2001	Q	84 firms (ASE)	The Netherlands	59.5	57.7	2.0	28.6	20.3 [19.3 / 1.0]	8.8 [6.9 / 1.9]
Hentschel, Kothari, 2001	AR	425 Fortune 500	USA	51.4					
Mallin, Ow-Yong, Reynolds, 2001	Q	231 firms (LSE)	U.K.	59.9					
De Ceuster, Durinck, Laveren, Lodewyckx, 2000	Q	73 firms	Belgium	65.8					
Fatemi, Glaum, 2000	Q	71 firms (FSE)	Germany	88.0					
Prevost, Rose, Miller, 2000	Q	155 firms (NZSE)	New Zealand	67.1	14.4	2.7	30.2	33.6	0.7
Alkebäck, Hagelin, 1999	Q	163 firms (SSE)	Sweden	51.5					
Bodnar, Gebhardt, 1999	Q	126 firms	Germany	77.8					
Guay, 1999	AR	4966 firms	USA	37.2					
Jalilvand, 1999	Q	154 firms (MSE)	Canada	75.3					
Bodnar, Hayt, Marston, 1998	Q	399 firms	USA	50.0				34.0	
Howton, Perfect, 1998	AR	451 firms	USA	61.7	-----25.8-----		27.9	9.3	
Berkman, Bradbury, Magan, 1997	Q	79 firms (NZSE)	New Zealand	53.1					
Géczy, Minton, Schrand, 1997	AR	372 firms	USA	59.1					
Grant, Marshall, 1997	Q	55 firms	U.K.	50.0	79.2	35.6	4.5	44.0	
Khim, Liang, 1997	Q	69 firms	Singapore	78.3					
Berkman, Bradbury, 1996	Q	116 firms (NZSE)	New Zealand	47.4					
Bodnar, Hayt, Marston, 1996	Q	350 firms	USA	40.6					
Mian, 1996	AR	3022 firms	USA	25.5					
Bodnar, Hayt, Marston, Smithson, 1995	Q	530 firms	USA	34.5					
Phillips, 1995	Q	657 firms	USA	63.2	45.5	10.7		32.2 [23.4 / 8.8]	31.0 [8.2 / 22.8]
Dolde, 1993	Q	244 Fortune 500 firms	USA	85.0					
Nance, Smith, Smithson, 1993	Q	169 Fortune 500 firms	USA	61.5					

^a Excluding commodity price options.

Table 3: Survey Evidence of Derivatives Use by Nonfinancial Corporations (continued)

Panel B: Foreign Exchange Rate Derivatives Use

study	source	sample	country	% deriva- tives	% for- wards	% fu- tures	% swaps	% options	% exotic/other
Bartram, Brown, Fehle, 2003	AR	7263 firms	48 countries	45.2	36.5	1.2	11.1	9.7	
El-Masry, 2003	Q	173 firms	U.K.	42.8	24.0	7.1	9.8	43.8	5.3 [2.7 / 2.7]
Guay, Kothari, 2003	AR	413 firms	USA	34.6	-----30.0-----		23.1	6.5	
Lel, 2003	AR	373 firms	35 countries	63.0					
Berkman, Bradbury, Hancock, Innes, 2002	AR	158 mining and industrial firms	Australia	38.6					
Graham, Rogers, 2002	AR	442 firms	USA	24.2					
Judge, 2002	AR, Q	131 FT 500 firms	U.K.	70.2				18.3	5.0
Nguyen, Faff, 2002	AR	469 firms	Australia	62.0					
Sheedy, 2002	Q	84 firms	Singapore, Hong Kong	70.2				31.0	
Allayannis, Ofek, 2001	AR	378 S&P 500 firms	USA	42.6					
Allayannis, Weston, 2001	AR	720 firms	USA	37.0					
Bodnar, de Jong, Macrae, 2001	Q	126 firms (ASE)	The Netherlands	57.1	43.9	0.0	1.1	6.9 [6.9 / 0.0]	5.1 [4.0 / 1.1]
Mallin, Ow-Yong, Reynolds, 2001	Q	231 firms (LSE)	U.K.		46.8	3.9	17.3	21.2 [19.0 / 2.2]	
De Ceuster, Durinck, Laveren, Lodewyckx, 2000	Q	73 firms	Belgium	64.4	59.8		47.3	52.3 [46.1 / 6.2]	12.5
Fatemi, Glaum, 2000	Q	71 firms (FSE)	Germany	83.6					22.0
Jalilvand, Switzer, 2000	Q	154 firms (MSE)	Canada	67.5					
Loderer, Pichler, 2000	Q	114 firms (ZSE)	Switzerland	84.4			44.0	12.9 [10.3 / 2.6]	
Prevost, Rose, Miller, 2000	Q	155 firms (NZSE)	New Zealand		53.7	1.7	14.3	29.4 [29.4 / 0.0]	
Alkeböck, Hagelin, 1999	Q	163 firms (SSE)	Sweden	93.0	23.2	23.2	22.7	13.1 [10.3 / 2.8]	
Bodnar, Gebhardt, 1999	Q	126 firms	Germany	74.6					
Guay, 1999	AR	4966 firms	USA	33.5				1.0	
Bodnar, Hayt, Marston, 1998	Q	399 firms	USA	41.5				22.0	
Gay, Nam, 1998	AR	486 firms	USA		-----28.4-----		10.1	9.3	
Howton, Perfect, 1998	AR	451 firms	USA	45.0	-----39.9-----		10.9	12.0	
Berkman, Bradbury, Magan, 1997	Q	79 firms (NZSE)	New Zealand		38.3	2.3	15.3	24.4 [16.5 / 7.9]	
Géczy, Minton, Schrand, 1997	AR	372 firms	USA	41.4	-----29.3-----			12.1	
Grant, Marshall, 1997	Q	55 firms	U.K.	46.9					
Khim, Liang, 1997	Q	69 firms	Singapore		65.2	62.3	33.3	52.1 [0.0 / 52.1]	15.9
Bodnar, Hayt, Marston, 1996	Q	350 firms	USA	30.9	23.9	9.0	12.1	20.4 [15.5 / 4.9]	7.7 [5.5 / 2.2]
Mian, 1996	AR	3022 firms	USA	14.6					
Bodnar, Hayt, Marston, Smithson, 1995	Q	530 firms	USA		12.7	2.3	5.8	9.2 [6.7 / 2.5]	
Phillips, 1995	Q	657 firms	USA	47.6	36.9	4.1	15.2	14.0	
Batten, Mellor, Van, 1993	Q	94 firms	Australia	76.6	39.4	4.3	22.3	20.2	2.1

Table 3: Survey Evidence of Derivatives Use by Nonfinancial Corporations (continued)

Panel C: Interest Rate Derivatives Use

study	source	sample	country	% deriva- tives	% for- wards	% fu- tures	% swaps	% options	% exotic/other
Bartram, Brown, Fehle, 2003	AR	7263 firms	48 countries	33.0	0.7	0.5	29.0	7.4	
El-Masry, 2003	Q	173 firms	U.K.	31.5	3.2	3.2	17.6	20.4	12.4 [8.5 / 3.9]
Guay, Kothari, 2003	AR	413 firms	USA	34.6	2.2		33.2	3.6	
Berkman, Bradbury, Hancock, Innes, 2002	AR	158 mining and industrial firms	Australia	23.4					
Graham, Rogers, 2002	AR	442 firms	USA	24.9					
Judge, 2002	AR, Q	131 FT 500 firms	U.K.	54.2	-----31.3-----			18.4	41.7
Nguyen, Faff, 2002	AR	469 firms	Australia	51.0					
Sheedy, 2002	Q	84 firms	Singapore, Hong Kong	54.6				27.3	
Bodnar, de Jong, Macrae, 2001	Q	126 firms (ASE)	The Netherlands	48.2	13.5	1.4	25.1	8.2 [8.2 / 0.0]	8.2
Mallin, Ow-Yong, Reynolds, 2001	Q	231 firms (LSE)	U.K.		0.9	0.9	34.6	10.8 [9.5 / 1.3]	
De Ceuster, Durinck, Laveren, Lodewyckx, 2000	Q	73 firms	Belgium	56.2	31.6	25.0	49.0	28.8 [26.1 / 2.7]	18.5
Fatemi, Glaum, 2000	Q	71 firms (FSE)	Germany	71.0					
Jalilvand, Switzer, 2000	Q	154 firms (MSE)	Canada	60.4					
Prevost, Rose, Miller, 2000	Q	155 firms (NZSE)	New Zealand		26.0	6.7	49.5	51.8 [49.3 / 2.5]	
Alkebäck Hagelin, 1999	Q	163 firms (SSE)	Sweden	25.8	6.7	13.9	23.2	9.3 [3.6 / 5.7]	
Bodnar, Gebhardt, 1999	Q	126 firms	Germany	69.1					
Guay, 1999	AR	4966 firms	USA	51.2					
Bodnar, Hayt, Marston, 1998	Q	399 firms	USA	38.0	-----22.0-----		32.5	14.0	
Gay and Nam, 1998	AR	486 firms	USA		-----5.3-----		43.2	14.6	
Howton, Perfect, 1998	AR	451 Fortune 500 firms	USA	45.4	-----4.9-----		27.3	4.9	
Berkman, Bradbury, Magan, 1997	Q	79 firms (NZSE)	New Zealand		21.8			15.9 [15.9 / 0.0]	
Grant, Marshall, 1997	Q	55 firms	U.K.	34.4					
Khim, Liang, 1997	Q	69 firms	Singapore			42.0	37.7	39.1	30.4
Bodnar, Hayt, Marston, 1996	Q	350 firms	USA	29.6	5.3	6.8	28.1	10.1 [8.3 / 1.8]	
Mian, 1996	AR	3022 firms	USA	14.5					
Bodnar, Hayt, Marston, Smithson, 1995	Q	530 firms	USA		2.5	1.0	17.7	5.1 [3.0 / 2.1]	
Phillips, 1995	Q	657 firms	USA	57.1	9.2	2.4	37.1	6.8	19.5
Hakkarainen, Kasanen, Puttonen, 1994	AR, Q	84 firms (HSE)	Finland		18.0	71.0	45.0	34.0	
Block, Gallagher, 1986	Q	193 Fortune 500 firms	USA	19.2					

Table 3: Survey Evidence of Derivatives Use by Nonfinancial Corporations (continued)

Panel D: Commodity Price Derivatives Use

study	source	sample	country	% deriva- tives	% for- wards	% fu- tures	% swaps	% options	% exotic/other
Bartram, Brown, Fehle, 2003	AR	7263 firms	48 countries	10.0	2.8	3.1	2.9	2.4	
Brown, Crabb, Haushalter, 2003	AR, Q	44 gold mining firms	USA, Canada	84.6					
El-Masry, 2003	Q	173 firms	U.K.	6.0	1.0	1.0	1.1	2.9	
Guay, Kothari, 2003	AR	413 firms	USA	8.7	-----6.1-----				3.1
Berkman, Bradbury, Hancock, Innes, 2002	AR	158 mining and industrial firms	Australia	17.7					
Judge, 2002	AR, Q	131 FT 500 firms	U.K.	14.8					
Nguyen, Faff, 2002	AR	469 firms	Australia	26.4					
Sheedy, 2002	Q	84 firms	Singapore, Hong Kong	14.8					
Bodnar, de Jong, Macrae, 2001	Q	126 firms (ASE)	The Netherlands	11.9	0.0	0.7	2.1	5.6 [4.2 / 1.4]	3.6 [2.9 / 0.7]
Mallin, Ow-Yong, Reynolds, 2001	Q	231 firms (LSE)	U.K.		0.4	3.0	3.0	2.6 [1.3 / 1.3]	
De Ceuster, Durinck, Laveren, Lodewyckx, 2000	Q	73 firms	Belgium	11.0					
Haushalter, 2000	AR, Q	100 oil and gas firms	USA	57.0	-----44.1-----				29.0
Jalilvand, Switzer, 2000	Q	154 firms (MSE)	Canada	25.3					
Prevost, Rose, Miller, 2000	Q	155 firms (NZSE)	New Zealand		4.2	3.3	2.1	1.7 [1.7 / 0.0]	
Alkebäck Hagelin, 1999	Q	163 firms (SSE)	Sweden	6.2	1.0	3.1	2.1	1.5 [1.0 / 0.5]	
Bodnar, Gebhardt, 1999	Q	126 firms	Germany	34.2					
Guay, 1999	AR	4966 firms	USA	20.9					
Bodnar, Hayt, Marston, 1998	Q	399 firms	USA	28.0				14.0	
Gay, Nam, 1998	AR	486 firms	USA		-----5.8-----		7.2	4.3	
Berkman, Bradbury, Magan, 1997	Q	79 firms (NZSE)	New Zealand	3.6	9.5		4.7	2.3 [2.3 / 0.0]	
Grant, Marshall, 1997	Q	55 firms	U.K.	15.0					
Bodnar, Hayt, Marston, 1996	Q	350 firms	USA	15.0	7.8	9.9	8.1	9.2 [6.5 / 2.7]	1.8 [1.7 / 0.1]
Mian, 1996	AR	3022 firms	USA	5.2					
Tufano, 1996	AR, Q	48 gold mining firms	USA	85.4				64.6	
Bodnar, Hayt, Marston, Smithson, 1995	Q	530 firms	USA		3.9	4.4	3.0	6.7 [3.9 / 2.8]	
Phillips, 1995	Q	657 firms	USA	23.1	9.2	5.5	4.6	4.8	