

Foreign Currency Hedging and Firm Value: A Dynamic Panel

Approach

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Abstract

I reinvestigate the effect of foreign currency hedging on firm value. Consistent with prior research, my initial analysis suggests foreign currency hedging is associated with an increase in firm value. However, this analysis ignores the possibility that firm value may affect foreign currency hedging. I find foreign currency hedging depends on past amounts of firm value, and after controlling for this feedback effect, foreign currency hedging no longer affects firm value. This paper highlights the importance of controlling for the possibility of feedback from past amounts of firm value to the current amount of hedging when examining the effect of hedging on firm value.

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1. Introduction

The Modigliani and Miller (1958) irrelevance proposition suggests that in perfect capital markets hedging does not increase firm value since shareholders can undo any hedging activities implemented by the firm. Recent theories, however, argue that when capital markets are imperfect, hedging can increase a firm's value by influencing its expected taxes, expected financial distress costs and investment decisions.¹ More recently, researchers have examined the effect of hedging with derivatives on firm value. For example, Allayannis and Weston (2001) find that in a broad sample of firms, the value of firms that hedge foreign currency risk is, on average, 4.87% higher than non-hedgers and Carter, Rogers and Simkins (2006) find that fuel hedging increases firm value by 5%-10% for a sample of U.S. airlines.

Guay and Kothari (2003), however, challenge the hypothesis that hedging with derivatives is associated with an increase in firm value. They find that potential gains on hedging portfolios are economically small and are unlikely to generate large changes in firm value. Guay and Kothari (2003) suggest that the increase in firm value documented in Allayannis and Weston (2001) is either driven by other risk management activities, such as operational hedges, that are correlated with derivatives use, or that the results are spurious. Consistent with this, Jin and Jorion (2006) find no relation between hedging and firm value for a sample of oil and gas producers.

Jin and Jorion (2006) argue that the positive relation between hedging and firm value documented in previous studies could be due to endogeneity. One possible source of

¹ For example, in Smith and Stulz (1985), hedging can increase firm value by reducing expected taxes or financial distress costs. In Froot, Scharfstein and Stein (1993), hedging can reduce underinvestment costs when cash flow is volatile and external finance is costly.

endogeneity is reverse causality. That is, the positive relation between hedging and firm value documented in previous studies may be because higher firm value creates an incentive to hedge rather than hedging causing higher firm value. Another possible source of endogeneity is unobserved heterogeneity, which arises when time invariant unobservable firm specific factors affect both hedging and firm value. Allayannis and Weston (2001) and Carter, Rogers and Simkins (2006) use firm fixed effects to control for unobserved heterogeneity. However, the use of firm fixed effects requires that hedging is strictly exogenous, which ignores the possibility of feedback from past amounts of firm value to the current amount of hedging. If firms adjust the amount of their hedging in reaction to past amounts of firm value, then hedging is not strictly exogenous, and the estimated effect of hedging on firm value can be biased and inconsistent.

To control for these endogeneity problems, I estimate the effect of hedging on firm value in a dynamic framework, using the system generalized method of moments (GMM) estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). The dynamic framework captures persistence in firm value by including lagged firm value as an explanatory variable, while the system GMM estimator uses a first-difference transformation to control for unobserved firm heterogeneity and uses lagged values of firm value and foreign currency hedging as instrumental variables to control for failure of the strict exogeneity assumption.

I estimate the effect of foreign currency hedging on firm value for a sample of 408 large U.S. nonfinancial firms with foreign sales from operations abroad over the period 1996 to 2000. To facilitate comparison to previous studies, I initially assume that foreign

currency hedging is strictly exogenous. I find a strong positive relation between foreign currency hedging and firm value when using lagged firm value as the only control variable, consistent with the univariate results of Allayannis and Weston (2001). However, this relation is much weaker when I control for other factors that affect firm value. My results suggest foreign currency hedging increases firm value by 6.33% when foreign currency hedging is assumed to be strictly exogenous. However, I find that foreign currency hedging is positively related to past amounts of firm value and is therefore not strictly exogenous. After controlling for the dependence of foreign currency hedging on past amounts of firm value, I no longer find that foreign currency hedging affects firm value. This result holds for firms with greater foreign currency exposure. I find weak evidence that foreign currency hedging is associated with a higher firm value for firms with a greater probability of financial distress.

The main contribution of this paper is to show that foreign currency hedging is not strictly exogenous and after controlling for the failure of the strict exogeneity assumption, foreign currency hedging has no affect on firm value. This paper is also the first to examine the effect of hedging in a dynamic framework, which is appropriate when firm value is serially correlated.

The remainder of this paper is organised as follows. Section 2 reviews prior research on hedging and firm value. Section 3 describes the empirical method. Section 4 describes the data and the variables used in the empirical analysis. Section 5 presents the results on the relation between foreign currency hedging and firm value. Section 6 concludes.

2. Prior research

Theories of hedging based on capital market imperfections, suggest hedging can increase firm value. For example, Smith and Stulz (1985) argue that if a firm's tax function is convex, hedging can reduce its expected tax liability by reducing the volatility of its taxable income. Smith and Stulz (1985) also argue that if financial distress is costly, hedging increases firm value by reducing the probability of financial distress, and hence the expected costs of financial distress. Froot, Scharfstein and Stein (1993) argue that with volatile cash flows and costly external finance, hedging can mitigate underinvestment by ensuring a firm has sufficient internal funds to finance valuable investment opportunities. Leland (1998) argues that hedging can increase a firm's debt capacity, and therefore increases firm value due to the tax deductibility of interest payments.

A large body of empirical studies on this topic investigate which theory explains firms' actual hedging activities. For example, Graham and Rogers (2002) find that tax function convexity does not influence a firm's hedging activities, but hedging leads to greater debt capacity. Haushalter (2000) and Graham and Rogers (2002) find a positive relation between hedging and leverage, consistent with the view that greater expected financial distress costs cause greater hedging. Finally, Nance, Smith and Smithson (1993) and Geczy, Minton and Schrand (1997) find a positive relation between hedging and investment opportunities, consistent with the view that hedging mitigates the underinvestment problem.

The empirical evidence on the effect of hedging on firm value is mixed. Allayannis and Weston (2001) conclude that in a sample of large U.S. multinationals, the value of

firms that hedge foreign currency risk is, on average, 4.87% higher than non hedgers. Carter, Rogers and Simkins (2006) find that fuel hedging increases firm value by 5%-10% for a sample of U.S. airlines. Mackay and Moeller (2007) find that hedging concave revenues and leaving concave costs exposed increases firm value by 2%-3% for a sample of U.S. oil refiners. However, Guay and Kothari (2003) find that the potential gains on hedging portfolios are small when compared to cash flows and firm size and are unlikely to generate large changes in firm value. Jin and Jorion (2006) also find that hedging does not affect firm value for a sample of U.S. oil and gas producers.

To estimate the effect of hedging on firm value, researchers typically use pooled ordinary least squares and firm fixed effects. However, a consistent estimate of the effect of hedging on firm value using either pooled ordinary least squares or firm fixed effects requires that hedging is strictly exogenous. Strict exogeneity rules out the possibility of feedback from past amounts of firm value to the current amount of hedging. That is, under the strict exogeneity assumption, hedging affects firm value but firm value does not affect hedging. A weaker exogeneity assumption is that hedging is sequentially exogenous (or predetermined) in the sense that past amounts of firm value affect the current amount of hedging. The sequential exogeneity assumption appears reasonable given that both theoretical models and prior empirical studies suggest that firm value affects hedging. For example, if firms with higher valuations have many valuable investment opportunities, then these firms may have greater incentives to hedge (Froot, Scharfstein and Stein (1993)). Consistent with this prediction, Nance, Smith and Smithson (1993), Geczy, Minton and Schrand (1997), and Gay and Nam (1998) find that investment opportunities are a determinant of hedging. Given that the estimated increase

in firm value documented in previous studies could be biased and inconsistent if hedging is not strictly exogenous, it is important to re-examine the question of whether hedging affects firm value after controlling for the possibility of feedback from past amounts of firm value to the current amount of hedging. This paper addresses this issue.

3. Empirical Method

I estimate the causal effect of foreign currency hedging on firm value using a dynamic GMM panel estimator. This estimator was introduced by Holtz-Eakin, Newey and Rosen (1988) and Arellano and Bond (1991) and further developed by Arellano and Bover (1995) and Blundell and Bond (1998). The econometric model to be estimated is

$$y_{it} = \alpha y_{i,t-1} + \gamma w_{it} + \mathbf{x}'_{it} \boldsymbol{\beta} + c_i + u_{it} \text{ for } i = 1, \dots, N \text{ and } t = 2, \dots, T, \quad (1)$$

where y_{it} is firm value for firm i in period t . The lagged value of this variable is included as an explanatory variable to capture persistence in firm value. This results in the entire history of the explanatory variables w_{it} and \mathbf{x}_{it} being included in equation (1) so that the causal effect of the explanatory variables is conditioned on this history. The main variable of interest is w_{it} , the amount of foreign currency hedging for firm i in period t . The coefficient γ therefore measures the short-run effect of foreign currency hedging on firm value given $y_{i,t-1}$, with the long-run effect given by $\gamma/(1-\alpha)$. The vector \mathbf{x}_{it} includes control variables, which are discussed in Section 4.3.2 below, and year dummies that capture common shocks to firm value of all firms. The unobserved effect c_i contains firm specific time invariant unobserved factors, such as managerial quality and

managerial risk preferences, that may affect both foreign currency hedging and firm value. Finally, u_{it} is an error term, capturing all other omitted factors.

The GMM estimation procedure includes two important steps. The first step eliminates the unobserved firm specific time invariant effect c_i by first-differencing equation (1), resulting in

$$\Delta y_{it} = \alpha \Delta y_{i,t-1} + \gamma \Delta w_{it} + \Delta \mathbf{x}'_{it} \boldsymbol{\beta} + \Delta u_{it} \quad \text{for } i = 1, \dots, N \text{ and } t = 3, \dots, T, \quad (2)$$

where $\Delta y_{it} = y_{it} - y_{i,t-1}$, $\Delta y_{i,t-1} = y_{i,t-1} - y_{i,t-2}$, $\Delta \mathbf{x}'_{it} = \mathbf{x}'_{it} - \mathbf{x}'_{i,t-1}$, and $\Delta u_{it} = u_{it} - u_{i,t-1}$.

Estimation of equation (2) by ordinary least squares, however, results in inconsistent estimates because $y_{i,t-1}$ is correlated with $u_{i,t-1}$, and hence the explanatory variable $\Delta y_{i,t-1}$ is correlated with the error term Δu_{it} . The second step addresses this endogeneity problem by using lags of y_{it} dated $T-2$ and longer as instrumental variables for $\Delta y_{i,t-1}$, resulting in the following moment conditions:

$$E(y_{i,t-s} \Delta u_{it}) = 0 \quad \text{for } t = 3, \dots, T \text{ and } s \geq 2. \quad (3)$$

For example, y_{i1} can be used as an instrument in the first-differenced equation at period $t = 3$, both y_{i1} and y_{i2} can be used in the first-differenced equation at period $t = 4$, and the vector $(y_{i1}, y_{i2}, \dots, y_{i,T-2})$ can be used in the first-differenced equation for period $t = T$.

Additional moment conditions can also be used, depending on the exogeneity assumptions of the explanatory variables w_{it} and \mathbf{x}_{it} . For example, if $\mathbf{z}_{it} \equiv (w_{it}, \mathbf{x}_{it})$ is

strictly exogenous in the sense that the explanatory variables are uncorrelated with all past, present and future realisations of the error term u_{it} , then the complete time series $(\mathbf{z}_{i1}, \mathbf{z}_{i2}, \dots, \mathbf{z}_{iT})$ can be used as instruments in each of the first-differenced equations. Assuming \mathbf{z}_{it} is strictly exogenous results in the following additional moment conditions for the first-differenced equations:

$$E(\mathbf{z}_{is} \Delta u_{it}) = 0 \text{ for } t = 3, \dots, T \text{ and } s = 1, \dots, T. \quad (4)$$

There are several econometric weaknesses with the first-differenced GMM estimator. First, Arellano and Bover (1995) argue that variables in levels may be poor instruments for first-differenced variables. In particular, if the time series y_{it} is highly persistent, Blundell and Bond (1998) find that lagged levels of the series are only weakly correlated with subsequent first-differences, so that the instruments for the first-differenced equations are weak. Using Monte Carlo experiments, Blundell and Bond (1998) show that the first-differenced GMM estimator has large finite sample bias and poor precision when the instruments are weak. Second, the coefficients on time invariant explanatory variables are not identified because the first-differencing transformation eliminates these variables from the model. Furthermore, it may also be difficult to identify a causal effect if the explanatory variable of interest varies little over time for a given firm.

To address these problems I use the system GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). The system GMM estimator combines the first-differenced equation in (2) with the levels equation in (1) and uses lagged levels as instruments for the first-differenced equations and lagged first-differences as

instruments for the levels equations. Blundell and Bond (1998) show that the system GMM estimator has smaller finite sample bias and greater precision than the first-differenced GMM estimator when the explanatory variables are persistence. An additional advantage of the system GMM estimator is that it is now possible to identify the coefficients on time invariant explanatory variables or explanatory variables that vary little over time for a given firm. This is important because the main variable of interest in this paper, the amount of foreign currency hedging, has a within firm standard deviation of only 3% and hence varies little over time for a given firm. Consequently, estimating equation (1) with only the first-differenced equations is unlikely to identify an association between foreign currency hedging and firm value because the cross sectional variation is not exploited.

The equations in levels, however, still contain the unobserved firm specific time invariant effect c_i . Appropriate instruments must now be used to control for the unobserved firm specific time invariant effect. The system GMM estimator uses first-differences of the explanatory variables as instruments for the levels equations. These instruments are valid under the assumption that the correlation between the levels of the explanatory variables and the unobserved firm specific time invariant effect is constant over time. Under this assumption, the first-differences of the explanatory variables are uncorrelated with the unobserved firm specific time invariant effect. Assuming \mathbf{z}_{it} is strictly exogenous results in the following moment conditions for the levels equations:

$$E(\Delta y_{i,t-1}(c_i + u_{it})) = 0 \text{ for } t = 3, \dots, T, \quad (5)$$

and

$$E\left(\Delta \mathbf{z}_{it} (c_i + u_{it})\right) = 0 \text{ for } t = 2, \dots, T. \quad (6)$$

The consistency of the system GMM estimator depends on the validity of the instruments and the absence of serial correlation in the error terms u_{it} . To address these concerns I use two specifications tests suggested by Arellano and Bond (1991). The validity of the instruments can be tested using Hansen's (1982) test of overidentifying restrictions. This test produces a J statistic which has an asymptotic χ^2 distribution under the null hypothesis that the instruments are valid. The assumption that there is no serial correlation in the error terms u_{it} can be tested by testing for serial correlation in the first-differenced residuals. If the error terms, u_{it} , are not serially correlated, the first-differenced residuals should exhibit negative first-order serial correlation but no second-order serial correlation. Failure to reject the null hypothesis of both specification tests gives to support to my dynamic panel model.

Thus far, I have assumed that w_{it} , the amount of foreign currency hedging, is strictly exogenous in the sense that w_{it} is uncorrelated with all past, present and future realisations of the error term u_{it} . Strict exogeneity rules out the possibility of feedback from past amounts of firm value to the current amount of foreign currency hedging. Failure of the strict exogeneity assumption can result in a biased and inconsistent estimate of the effect of foreign currency hedging on firm value. Wooldridge (2002) presents the following regression based test for strict exogeneity using first-differences:

$$\Delta y_{it} = \delta w_{it} + \gamma \Delta w_{it} + \Delta \mathbf{x}'_{it} \boldsymbol{\beta} + \Delta u_{it} \quad \text{for } i = 1, \dots, N \text{ and } t = 2, \dots, T. \quad (7)$$

Under the null hypothesis of strict exogeneity, $\delta = 0$. If $\delta \neq 0$, then past amounts of firm value affect the current amount of foreign currency hedging and a weaker sequential exogeneity assumption can be used to generate a consistent estimate of the effect of foreign currency hedging on firm value. Under sequential exogeneity, u_{it} is uncorrelated with current and past values of w_{it} but may be correlated with future values of w_{it} . If w_{it} is sequentially exogenous, moment condition (6) is still valid for the levels equations, and lags of w_{it} dated $T-1$ and longer can be used as instruments for Δw_{it} in the first-differenced equations. This results in the following additional moment conditions for the first-differenced equations:

$$E(w_{i,t-s} \Delta u_{it}) = 0 \quad \text{for } t = 3, \dots, T \text{ and } s \geq 1. \quad (8)$$

4. Data

4.1. Sample

I construct a sample of 408 large U.S. nonfinancial firms over the period 1996 to 2000, based on the screening criteria in Allayannis and Weston (2001). The sample consists of nonfinancial firms listed in COMPUSTAT's Industrial Annual Files with total assets of more than \$500 million in each fiscal year between 1996 and 2000. I retain observations that meet the following criteria: the firm has no missing data on sales and market value; the firm is not financial (SIC codes 6000-6900); the firm is not a regulated utility (SIC codes 4900-4999); the firm's 10-K reports are available from EDGAR; and the firm

discloses the notional value of its foreign currency derivative holdings, if any. I further restrict the sample to those firms that face ex-ante foreign currency exposure. This is important because it allows me to interpret the absence of foreign currency derivatives as a decision not to hedge rather than a lack of foreign currency exposure. I follow Allayannis and Ofek (2001) and Allayannis and Weston (2001), and define firms to have ex-ante foreign currency exposure if they disclose foreign sales from operations abroad in the COMPUSTAT Geographic Segment files in the fiscal year of derivative usage. One concern with selecting firms based on their foreign sales from operations abroad is that a firm might not face ex-ante foreign currency exposure due to its foreign sales being denominated in U.S. dollars. I therefore exclude from the sample, firms that state in their 10-K report that they do not have any foreign currency exposure because the majority of their foreign sales are denominated in U.S. dollars. The final sample consists of 408 firms from 1996 to 2000, or 1,893 firm year observations, with 347 firms present in all 5 years.

During the sample period, Statement of Financial Accounting Standard (SFAS) 119 required firms to disclose the notional value, nature and terms of their derivative contracts. SFAS 119 also required firms to disclose whether they use derivatives for trading or nontrading purposes. I only examine foreign currency derivatives held for nontrading purposes. The Financial Accounting Standards Board issued SFAS 133 in June 1998 to supersede SFAS 119. SFAS 133, which is effective for fiscal years beginning July 15, 2000, requires firms to disclose the fair market value of their derivative contracts, but does not require the disclosure of notional values. Consequently,

the last year of my sample is 2000 because the data are not sufficiently detailed after that time.

4.2. Dependent variable

Following Allayannis and Weston (2001), I use Tobin's Q as the proxy for firm value. I use the market to book ratio as an approximation of Tobin's Q , which is calculated as the book value of assets minus the book value of common equity plus the market value of common equity, all divided by the book value of assets.² While it is possible to calculate more complicated measures of Tobin's Q , the market to book ratio is commonly used as a proxy for Tobin's Q in the empirical corporate finance literature.³ Furthermore, Allayannis and Weston (2001) find a high degree of correlation between the market to book ratio and more complicated measures of Tobin's Q . Table 1 presents autocorrelation coefficients of Tobin's Q for each of the years 1996 to 2000. The time series of Tobin's Q is highly persistent with the first-order autocorrelation coefficients ranging from a minimum of 0.792 to a maximum of 0.881. This suggests that a dynamic panel estimator should be used to capture the persistence in Tobin's Q .

4.3. Explanatory variables

4.3.1. Foreign currency hedging

Following previous research, I assume that firms conduct their hedging through the use of derivatives. Consequently, this study investigates the effect of hedging with

² I also use industry adjusted Tobin's Q as a proxy for firm value and obtain similar results.

³ See for example Allayannis and Weston (2001), Coles, Daniel and Naveen (2008), Jin and Jorion (2006), Mackay and Moeller (2007), Palia (2001), Porta, Lopez-de-Silanes, Shleifer and Vishny (2002), Shin and Stulz (1998), and Villalonga and Amit (2006).

foreign currency derivatives on firm value beyond any hedging firms can achieve with operating and financing decisions. I obtain data on each firm's foreign currency derivative holdings from 10-K filings available from EDGAR. I search each 10-K filing for text strings such as "derivative", "financial instrument", "forward", "hedg", and "market risk". If a reference is made to any of these key words, I read the surrounding text to obtain data on the year end total notional value of foreign currency forward, and option contracts. Following Allayannis and Ofek (2001), these values do not include currency swaps because these financial instruments are mainly used by firms to either convert foreign debt into domestic debt or to convert domestic debt into foreign debt.

I use a continuous variable to measure foreign currency hedging. The continuous variable is measured by the fiscal year end total notional value of foreign currency forward and option contracts scaled by the book value of total assets for foreign currency derivative users, or zero for nonusers.⁴ Several studies employ a binary variable, indicating the use of derivatives.⁵ However, unlike the continuous variable, this variable does not capture the amount of foreign currency hedging and hence cannot distinguish between those firms that fully hedge and those that partly hedge.⁶

4.3.2. Control variables

I include the following control variables, as used in Allayannis and Weston (2001):

⁴ Total notional values have been used in Berkman and Bradbury (1996), Gay and Nam (1998), Howton and Perfect (1998), Allayannis and Ofek (2001), and Knopf, Nam and Thornton (2002).

⁵ See for example, Nance, Smith and Smithson (1993), Mian (1996), Geczy, Minton and Schrand (1997), Haushalter (2000), Allayannis and Ofek (2001), and Allayannis and Weston (2001).

⁶ I also use the binary variable in the subsequent analysis. The variable choice does not materially affect the conclusions with respect to the effect of foreign currency hedging on firm value.

1) *Firm Size*: The literature has found that firm size is positively related to both the decision to hedge and the amount of hedging.⁷ Allayannis and Weston (2001) also find that firm size is negatively related to Tobin's Q . I use the natural logarithm of total assets to control for the possibility that Tobin's Q and foreign currency hedging are related through the size of the firm.

2) *Profitability*: Profitable firms are likely to have higher Tobin's Q ratios than less profitable firms. If hedgers are more profitable, they are likely to have higher Tobin's Q ratios. I control for profitability with return on assets, defined as the ratio of net income to the book value of total assets. I expect a positive coefficient on this variable.

3) *Access to financial markets*: If hedgers have limited access to financial markets, their Tobin's Q ratios may be high because they only invest in those projects with the highest net present value. To proxy for the ability to access financial markets, I use a dummy variable which equals one if the firm paid dividends on common equity during the fiscal year, and zero otherwise. If a firm paid a dividend, it is less likely to be financial constrained and may therefore have a lower Tobin's Q . I expect a negative coefficient on this variable.

4) *Leverage*: A firm's capital structure also may be related to its value. For example, the trade off theory predicts that leverage increases firm value owing to the tax benefits of debt. Greater leverage can also act as a positive signal of managerial quality (Ross (1977)), suggesting a positive relation between leverage and firm value. On the other hand, several studies find a negative relation between leverage and investment opportunities owing to the agency costs of debt (e.g., Rajan and Zingales (1995) and

⁷ See Geczy, Minton and Schrand (1997), Haushalter (2000), Allayannis and Ofek (2001), and Graham and Rogers (2002) for empirical evidence regarding the relationship between firm size and derivatives use.

Faulkender and Petersen (2006)). Since Tobin's Q can also act as a proxy for investment opportunities, the findings in these studies suggest a negative relation between leverage and firm value. I control for differences in capital structure by using the ratio of total debt to the book value of total assets as a proxy for leverage, where total debt is defined as the sum of short-term debt and long-term debt.

5) *Investment opportunities*: Myers (1977) suggests that firm value also depends on future investment opportunities. Since Geczy, Minton and Schrand (1997) and Allayannis and Ofek (2001) find that hedgers are more likely to have larger investment opportunities, it is important to control for investment opportunities. I measure investment opportunities with the ratio of capital expenditures to total sales, the ratio of research and development expenditures to total sales and the ratio of advertising expenditures to total sales. I expect a positive coefficient on these variables.

6) *Industrial diversification*: Empirical evidence suggests that industrial diversification is negatively related to firm value (e.g., Lang and Stulz (1994) and Berger and Ofek (1995), and Servaes (1996)). I control for the effect of industrial diversification on firm value by using a dummy variable equal to one if the firm operates in more than one business segment, and zero otherwise. I expect a negative coefficient on this variable.

7) *Geographic diversification*: I use the ratio of foreign sales to total sales to control for geographic diversification. Previous empirical evidence on the effect of geographic diversification on firm value is ambiguous.⁸ However, it is important to control for geographic diversification because firms with a higher percentage of foreign sales are

⁸ For example Morck and Yeung (1991) and Bodnar, Tang and Weintrop (1999) find a positive relation between geographic diversification and firm value while Christophe (1997) and Denis, Denis and Yost (2002) find a negative relation between geographic diversification and firm value.

more likely to hedge (see Geczy, Minton and Schrand (1997) and, Allayannis and Ofek (2001)).

8) *Credit rating*: The credit quality of a firm, as reflected in its credit rating, may also affect firm value. I control for credit quality by constructing seven dummy variables that specify the credit rating of the firm.⁹

4.4. *Summary Statistics*

Table 2 presents summary statistics on firm characteristics and the variables used in the analysis. The sample includes 1,893 firm year observations with a mean (median) value of assets of \$8,583 (\$2,468) million and a mean (median) value of sales of \$7,455 (\$2,403) million. The mean (median) foreign sales to total sales ratio is 33.4% (32.1%). The mean (median) total notional value of foreign currency derivatives, as a percentage of total assets, is 4.9% (1.7%). The mean (median) Tobin's Q is 2.296 (1.833), suggesting that the average firm is profitable with valuable investment opportunities. For the average (median) firm, the debt to assets ratio is 26.3% (25.1%), the capex to sales ratio is 8.0% (5.2%), the R&D to sales ratio is 3.6% (1.3%), and the advertising to sales ratio is 1.2% (0.0%). Finally, 69.8% of the sample firms pay a dividend on common equity during the sample period and 70.2% of the sample firms operate in more than one business segment.

Table 3 presents correlation coefficients for the variables used in the analysis. Foreign currency hedging has a positive association with Tobin's Q . Additionally, both firm size and the ratio of foreign sales to total sales have a positive association with Tobin's Q and

⁹ I follow Allayannis and Weston (2001) and use one dummy for AAA firms, one for AA+ to AA-, one for A+ to A-, one for BBB+ to BBB-, one for BB+ to BB-, one for B+ to B-, and one for CCC+ and below.

foreign currency hedging, which highlights the importance of including these variables as controls in the multivariate analysis.

5. Results

In this section, I test the hypothesis that foreign currency hedging increases Tobin's Q , a proxy for firm value. I begin the analysis by estimating the effect of foreign currency hedging on Tobin's Q , assuming that foreign currency hedging is strictly exogenous. Next, I test whether foreign currency hedging is strictly exogenous and then re-estimate the effect of foreign currency hedging on Tobin's Q after controlling for the dependence of foreign currency hedging on past amounts of Tobin's Q . Finally, I discuss the robustness of the results.

5.1. The effect of foreign currency hedging on Tobin's Q assuming foreign currency hedging is strictly exogenous

To facilitate comparison to previous studies, I estimate the regression model in equation (1) assuming foreign currency hedging is strictly exogenous. Table 4 reports results for a one-step system GMM estimator, with asymptotic standard errors that are adjusted for heteroskedasticity (White (1980)) and within firm correlation.¹⁰ Regression 1 in Table 4 reports the results of the effect of foreign currency hedging on Tobin's Q with lagged Tobin's Q as the only control variable. The coefficient on foreign currency hedging is positive and significant at the 1% level, which is consistent with the univariate results of Allayannis and Weston (2001). In regression 2 of Table 4, I include the control

¹⁰ Although a more efficient two-step system GMM estimator is available, Blundell and Bond (1998) find that inference based on the one-step estimator can be more reliable than the two-step estimator, even in moderately large samples. The one-step system GMM estimator has recently been used in Cheung and Wei (2006).

variables discussed in Section 4.3.2. The coefficient on foreign currency hedging is still positive but it is only weakly related to Tobin's Q , with a p -value of 0.080. The estimated long-run effect of foreign currency hedging on Tobin's Q is 1.939,¹¹ suggesting that a change from no foreign currency hedging to the average amount of foreign currency hedging (for hedging firms) of 7.5% is associated with an increase in firm value of 6.33%.¹²

Several control variables are statistically significant. For example, consistent with previous studies,¹³ I find that Tobin's Q is positively related to profitability, research and development expenditure, and advertising expenditure. I also find a negative relation between Tobin's Q and leverage, which is consistent with the findings in Demsetz and Villalonga (2001) and Anderson and Reeb (2003).

Table 4 also reports tests for the absence of first-order and second-order serial correlation in the first-differenced residuals in addition to Hansen's (1982) test of overidentifying restrictions (J statistic), which tests the validity of the instruments. As expected, I reject the null hypothesis of no first-order serial correlation in the first-differenced residuals. However, I cannot reject the null hypothesis no second-order serial correlation in the first-differenced residuals at the 10% level for regression 1 and at the 5% level for regression 2 (the p -values are 0.103 and 0.074, respectively). Furthermore, the Hansen (1982) test for overidentifying restrictions shows that the null hypothesis of valid instruments is not rejected (the p -values for the J statistics of regressions 1 and 2 are

¹¹ The long-run effect is calculated as: foreign currency coefficient / (1 – lagged Tobin's Q coefficient) = 0.634 / (1 – 0.673) = 1.939.

¹² This is calculated as: long-run effect / average Tobin's Q × average amount of hedging for hedging firms = 1.939 / 2.296 × 7.5% = 6.33%.

¹³ See for example Lang and Stulz (1994), Palia (2001), Denis, Denis and Yost (2002), and Anderson and Reeb (2003).

0.179 and 0.110 respectively).¹⁴ Overall, the results from these tests support the dynamic panel specification.

5.2. Testing strict exogeneity

Table 5 reports the results of the regression based test of strict exogeneity in equation (7). Under the null hypothesis that foreign currency hedging is strictly exogenous, the coefficient on the level of foreign currency hedging in the first-differenced regression should be zero. Regression 1 reports the results with no control variables, while regression 2 includes control variables. The coefficients on the level of foreign currency hedging in regressions 1 and 2 are both positive with p -values of 0.024 and 0.016 respectively. I therefore reject the null hypothesis that foreign currency hedging is strictly exogenous and conclude that foreign currency hedging is related to past amounts of Tobin's Q .

5.3. The effect of foreign currency hedging on Tobin's Q assuming foreign currency hedging is sequentially exogenous

Since I reject the hypothesis that foreign currency hedging is strictly exogenous, I now investigate the effect of foreign currency hedging on Tobin's Q under the sequentially exogenous assumption. Table 6 reports results for a one-step system GMM estimator, with asymptotic standard errors that are adjusted for heteroskedasticity (White (1980)) and within firm correlation. Regression 1 in Table 6 reports the results of the effect of foreign currency hedging on Tobin's Q with lagged Tobin's Q as the only control

¹⁴ Although there is weak evidence of second-order serial correlation in the first-differenced residuals of regression 2, the Hansen (1982) test for overidentifying restrictions shows that the null hypothesis of valid instruments is not rejected.

variable while regression 2 in Table 6 includes the full set of control variables. Although the coefficients on the foreign currency hedging variables in the regressions are positive, they are statistically insignificant. These results highlight the importance of controlling for the failure of the assumption that foreign currency hedging is strictly exogenous. The most striking example is in the regression with lagged Tobin's Q as the only control variable. When foreign currency hedging is assumed to be strictly exogenous, its coefficient is positive and significant at the 1% level. However, when foreign currency hedging is assumed to be sequentially exogenous, the coefficient is positive but is no longer statistically significant.

Table 6 also reports several specification tests. First, the test for no second-order serial correlation in the first-differenced residual is not rejected at the 10% level for regression 1 and at the 5% level for regression 2 (the p -values are 0.103 and 0.074, respectively). Second, the p -values for the Hansen (1982) test for overidentifying restrictions show that the null hypothesis of valid instruments is not rejected (the p -values for regressions 1 and 2 are 0.366 and 0.255 respectively). Finally, I also report the results for difference in Hansen tests. The difference in Hansen test examines the validity of the assumption that foreign currency hedging is sequentially exogenous. It compares the J statistic under the weaker assumption of sequential exogeneity to the J statistic under the stronger strict exogeneity assumption. Under the null hypothesis, foreign currency hedging is sequentially exogenous while it is strictly exogenous under the alternative. The p -values for the difference in Hansen test show that I cannot reject the null hypothesis that foreign currency hedging is sequentially exogenous. Consequently, the

difference in Hansen test provides additional evidence against the assumption that foreign currency hedging is strictly exogenous.

I also examine the strength of the instruments used for foreign currency hedging in the first-differenced and levels equations by running reduced form regressions.¹⁵ For the first-differenced equation, the first and second lags of the level of foreign currency hedging are strong instruments, while the third and fourth lags are potentially weak. For the levels equations, the first-difference of foreign currency hedging is strongly related to the level of foreign currency hedging. To gauge the impact of the potentially weak instruments on the previous results, I re-estimate the system GMM model with only the first and second lags foreign currency hedging as instruments and find that the overall outcome is consistent with my previous results. I also strengthen the instrument set with external instruments. The system GMM estimates in regression 2 of Table 6 suggests that firm size and foreign sales can be omitted from the model specification. This suggests that I may be able to strengthen the instrument set by including firm size and foreign sales as external instruments, and testing their validity. Prior empirical research suggests that firm size and foreign sales should be positively related to foreign currency hedging (e.g., Geczy, Minton and Schrand (1997) and Allayannis and Ofek (2001)). Regression 3 in Table 6 reports the system GMM results using firm size and foreign sales as external instruments. Although the coefficient on foreign currency hedging has increased, it is still statistically insignificant with a p -value of 0.327. Additionally, the

¹⁵ Examining the strength of the instruments is difficult when using system GMM because of the way in which the instruments are created and also because the first-differenced and levels equations are estimated in a system.

increase in the p -value for the Hansen (1982) test for overidentifying restrictions indicates that firm size and foreign sales are valid instruments.

5.4. Robustness

After rejecting the hypothesis that foreign currency hedging increases firm value under the sequential exogeneity assumption, I explore the effect of foreign currency hedging on value for firms that are likely to benefit from foreign currency hedging. For example, firms with greater foreign currency exposures are more likely to benefit from foreign currency hedging than firms with low foreign currency exposures. In addition, Smith and Stulz (1985) suggest that firms with a greater probability of financial distress are also likely to benefit from foreign currency hedging. I maintain the assumption that foreign currency hedging is sequentially exogenous and include the full set of control variables discussed in Section 4.3.2 throughout the subsequent analysis.¹⁶

I examine the effect of foreign currency hedging on firm value for firms with low foreign sales and high foreign sales. I define firms with a ratio of foreign sales to total sales less than or equal to the 50th percentile as low foreign sales firms. Otherwise, firms are considered to be high foreign sales firms. The results are presented in Panel A of Table 7. I find that the effect of foreign currency hedging on firm value for firms with greater foreign sales is positive but insignificant (the p -value is 0.157).

I also examine the effect of foreign currency hedging on firm value for firms with a low probability of financial distress and firms with a high probability of financial distress. My proxy for a firm's probability of financial distress is its one year distance to default, which is estimated using Merton's (1974) option pricing model. The distance to default

¹⁶ My qualitative results are similar when assuming that foreign currency hedging is strictly exogenous.

measures the difference between the asset value of a firm and the face value of its debt, scaled by the standard deviation of the firm's asset value. A lower distance to default is associated with a greater probability of financial distress. I define firms with a distance to default less than or equal to the 50th percentile as low distance to default firms. Otherwise, firms are considered to be high distance to default firms. The results are presented in Panel B of Table 7. The coefficient on foreign currency hedging is positive but it is only weakly related to Tobin's Q for low distance to default firms (the p -value is 0.099), indicating that foreign currency hedging weakly affects firm value for firms with a higher probability of financial distress.

6. Conclusion

I re-examine the effect of hedging on firm value for a sample 408 large nonfinancial U.S. firms that are exposed to foreign currency risk over the period 1996 to 2000 using a dynamic panel estimator. Much of the empirical literature that has examined the effect of hedging on firm value implicitly assumes that hedging is strictly exogenous, which rules out the possibility of feedback from past amounts of firm value to the current amount of hedging. In this paper, I provide evidence that foreign currency hedging is positively related to past amounts of firm value and therefore fails the strict exogeneity assumption. After controlling for the dependence of foreign currency hedging on past amounts of firm value, I find that foreign currency hedging has no affect on firm value. This is contrary to the findings reported in Allayannis and Weston (2001).

This paper has two implications for future research on the effect of hedging on firm value. First, researchers should consider a dynamic framework when firm value is found

to be persistent. Second, researchers should test the assumption that hedging is strictly exogenous and control for the failure of this assumption.

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Table 1
Serial Correlation of Tobin's Q

This table presents autocorrelation coefficients of Tobin's Q . The sample includes nonfinancial COMPUSTAT firms with assets greater than \$500 million and foreign sales for 1996 to 2000. All coefficients are statistically significant at the 1% level.

	1996	1997	1998	1999	2000
1996	1.000				
1997	0.881	1.000			
1998	0.718	0.850	1.000		
1999	0.710	0.703	0.792	1.000	
2000	0.645	0.693	0.740	0.876	1.000

Table 2
Summary Statistics

This table presents summary statistics for the variables used in the analysis. The sample includes nonfinancial COMPUSTAT firms with assets greater than \$500 million and foreign sales for 1996 to 2000. *Tobin's Q* is the book value of assets minus the book value of common equity plus the market value of common equity, all divided by the book value of assets. *Total FX derivatives to assets* is the total notional value of foreign currency forward and option contracts divided by the book value of total assets. *Firm size* is the natural logarithm of the book value of total assets. *ROA* is the ratio of net income to the book value of total assets. *Dividend dummy* is a dummy variable set equal to one if the firm paid dividends on common equity during the fiscal year, and zero otherwise. *Debt to assets* is the ratio of total debt to the book value of total assets. *Capex to sales* is the ratio of capital expenditure to total sales. *R&D to sales* is the ratio of research and development expenditure to total sales. *Advertising to sales* is the ratio of advertising expenditure to total sales. *Diversification dummy* is a dummy variable equal to one if the firm operates in more than one business segment, and zero otherwise. *Foreign sales to total sales* is the ratio of foreign sales to total sales.

Variable	<i>N</i>	Mean	Median	Std. Dev.	Min.	Max.
<i>Firm characteristics</i>						
Total assets (millions)	1893	8583	2468	28390	503	437006
Total sales (millions)	1893	7455	2403	17906	224	206083
<i>Dependent variable</i>						
Tobin's <i>Q</i>	1893	2.296	1.707	1.833	0.453	19.152
<i>Hedging variable</i>						
Total FX derivatives to assets	1893	0.049	0.017	0.081	0.000	0.656
<i>Control variables</i>						
Firm size	1893	8.035	7.811	1.196	6.221	12.988
ROA	1893	0.058	0.059	0.088	-1.149	0.578
Dividend dummy	1893	0.698	1.000	0.459	0.000	1.000
Debt to assets	1893	0.263	0.251	0.176	0.000	1.447
Capex to sales	1876	0.080	0.052	0.102	0.000	1.637
R&D to sales	1893	0.036	0.013	0.056	0.000	0.513
Advertising to sales	1893	0.012	0.000	0.036	0.000	0.352
Diversification dummy	1893	0.702	1.000	0.457	0.000	1.000
Foreign sales to total sales	1893	0.334	0.321	0.195	0.000	1.000

Table 3
Correlation Coefficients

This table presents correlation coefficients for the variables used in the analysis. The sample includes nonfinancial COMPUSTAT firms with assets greater than \$500 million and foreign sales for 1996 to 2000. *Tobin's Q* is the book value of assets minus the book value of common equity plus the market value of common equity, all divided by the book value of assets. *Total FX derivatives to assets* is the total notional value of foreign currency forward and option contracts divided by the book value of total assets. *Firm size* is the natural logarithm of the book value of total assets. *ROA* is the ratio of net income to the book value of total assets. *Dividend dummy* is a dummy variable set equal to one if the firm paid dividends on common equity during the fiscal year, and zero otherwise. *Debt to assets* is the ratio of total debt to the book value of total assets. *Capex to sales* is the ratio of capital expenditure to total sales. *R&D to sales* is the ratio of research and development expenditure to total sales. *Advertising to sales* is the ratio of advertising expenditure to total sales. *Diversification dummy* is a dummy variable equal to one if the firm operates in more than one business segment, and zero otherwise. *Foreign sales to total sales* is the ratio of foreign sales to total sales. Coefficients with an asterisk (*) are significantly different from zero at the 1% level.

	Tobin's <i>Q</i>	Total FX derivatives to assets	Firm size	ROA	Dividend dummy	Debt to assets	Capex to sales	R&D to sales	Advertis- ing to sales	Diversifi- cation dummy	Foreign sales to total sales
Tobin's <i>Q</i>	1.000										
Total FX derivatives to assets	0.175*	1.000									
Firm size	0.141*	0.178*	1.000								
ROA	0.425*	0.080*	0.065*	1.000							
Dividend dummy	-0.114*	0.015	0.171*	0.097*	1.000						
Debt to assets	-0.340*	-0.104*	0.039	-0.380*	0.048	1.000					
Capex to sales	-0.058	-0.078*	0.058	-0.128*	-0.050	0.095*	1.000				
R&D to sales	0.411*	0.129*	0.011	0.054	-0.302*	-0.263*	0.021	1.000			
Advertising to sales	0.162*	0.221*	0.074*	0.065*	0.044	0.049	-0.085*	-0.013	1.000		
Diversification dummy	-0.047	-0.026	0.149*	-0.053	0.089*	0.080*	0.016	-0.069*	-0.110*	1.000	
Foreign sales to total sales	0.078*	0.287*	0.018	0.050	-0.014	-0.042	0.085*	0.171*	0.064*	-0.064*	1.000

Table 4
The Effect of Foreign Currency Hedging on Firm Value:
Foreign Currency Hedging is Strictly Exogenous

This table presents the results for one-step system GMM regressions of the effect of foreign currency hedging on firm value assuming foreign currency hedging is strictly exogenous. The sample includes nonfinancial COMPUSTAT firms with assets greater than \$500 million and foreign sales for 1996 to 2000. *Tobin's Q* is the book value of assets minus the book value of common equity plus the market value of common equity, all divided by the book value of assets. *Total FX derivatives to assets* is the total notional value of foreign currency forward and option contracts divided by the book value of total assets. *Firm size* is the natural logarithm of the book value of total assets. *ROA* is the ratio of net income to the book value of total assets. *Dividend dummy* is a dummy variable set equal to one if the firm paid dividends on common equity during the fiscal year, and zero otherwise. *Debt to assets* is the ratio of total debt to the book value of total assets. *Capex to sales* is the ratio of capital expenditure to total sales. *R&D to sales* is the ratio of research and development expenditure to total sales. *Advertising to sales* is the ratio of advertising expenditure to total sales. *Diversification dummy* is a dummy variable equal to one if the firm operates in more than one business segment, and zero otherwise. *Foreign sales to total sales* is the ratio of foreign sales to total sales. The regressions include year dummies and credit quality controls (regressions 2 and 4 only), whose coefficient estimates are suppressed. The coefficient of the intercept is also suppressed. In parentheses are *p*-values based on standard errors adjusted for heteroskedasticity and within firm correlation. Variables significant at the 5% level or less are in bold.

Dependent variable: Tobin's Q_t	(1)	(2)
Tobin's Q_{t-1}	0.789 (0.000)	0.673 (0.000)
Total FX derivatives to assets _{<i>t</i>}	1.310 (0.002)	0.634 (0.080)
Firm size _{<i>t</i>}		0.024 (0.494)
ROA _{<i>t</i>}		2.368 (0.036)
Dividend dummy _{<i>t</i>}		-0.137 (0.165)
Debt to assets _{<i>t</i>}		-0.643 (0.003)
Capex to sales _{<i>t</i>}		-0.516 (0.105)
R&D to sales _{<i>t</i>}		3.998 (0.000)
Advertising to sales _{<i>t</i>}		1.958 (0.036)
Diversification dummy _{<i>t</i>}		0.107 (0.090)
Foreign sales to total sales _{<i>t</i>}		0.028 (0.835)
Number of observations	1483	1469
AR(1) test (<i>p</i> -value)	0.001	0.001
AR(2) test (<i>p</i> -value)	0.103	0.074
Hansen's <i>J</i> statistic (<i>p</i> -value)	0.179	0.110

Table 5
Testing Whether Foreign Currency Hedging is Strictly Exogenous

This table presents the results of testing whether foreign currency hedging is strictly exogenous using first-differenced regressions. The sample includes nonfinancial COMPUSTAT firms with assets greater than \$500 million and foreign sales for 1996 to 2000. Δ is the first-difference operator. *Tobin's Q* is the book value of assets minus the book value of common equity plus the market value of common equity, all divided by the book value of assets. *Total FX derivatives to assets* is the total notional value of foreign currency forward and option contracts divided by the book value of total assets. *Firm size* is the natural logarithm of the book value of total assets. *ROA* is the ratio of net income to the book value of total assets. *Dividend dummy* is a dummy variable set equal to one if the firm paid dividends on common equity during the fiscal year, and zero otherwise. *Debt to assets* is the ratio of total debt to the book value of total assets. *Capex to sales* is the ratio of capital expenditure to total sales. *R&D to sales* is the ratio of research and development expenditure to total sales. *Advertising to sales* is the ratio of advertising expenditure to total sales. *Diversification dummy* is a dummy variable equal to one if the firm operates in more than one business segment, and zero otherwise. *Foreign sales to total sales* is the ratio of foreign sales to total sales. The regressions include year dummies and credit quality controls (regression 2 only), whose coefficient estimates are suppressed. The coefficient of the intercept is also suppressed. In parentheses are *p*-values based on standard errors adjusted for heteroskedasticity and within firm correlation. Variables significant at the 5% level or less are in bold. The coefficient on Total FX derivatives to assets, equals zero under the null hypothesis of strict exogeneity.

Dependent variable: Δ Tobin's Q_t	(1)	(2)
Total FX derivatives to assets,	0.941	0.997
	(0.024)	(0.016)
Δ Total FX derivatives to assets,	-1.926	-2.039
	(0.178)	(0.153)
Δ Firm size _{<i>t</i>}		-0.018
		(0.923)
Δ ROA _{<i>t</i>}		1.427
		(0.018)
Δ Dividend dummy _{<i>t</i>}		0.250
		(0.127)
Δ Debt to assets _{<i>t</i>}		-0.882
		(0.027)
Δ Capex to sales _{<i>t</i>}		-0.575
		(0.161)
Δ R&D to sales _{<i>t</i>}		-1.818
		(0.207)
Δ Advertising to sales _{<i>t</i>}		-2.076
		(0.547)
Δ Diversification dummy _{<i>t</i>}		0.181
		(0.027)
Δ Foreign sales to total sales _{<i>t</i>}		0.309
		(0.207)
Number of observations	1483	1467

Table 6
The Effect of Foreign Currency Hedging on Firm Value:
Foreign Currency Hedging is Sequentially Exogenous

This table presents the results for one-step system GMM regressions of the effect of foreign currency hedging on firm value when foreign currency is sequentially exogenous. The sample includes nonfinancial COMPUSTAT firms with assets greater than \$500 million and foreign sales for 1996 to 2000. *Tobin's Q* is the book value of assets minus the book value of common equity plus the market value of common equity, all divided by the book value of assets. *Total FX derivatives to assets* is the total notional value of foreign currency forward and option contracts divided by the book value of total assets. *Firm size* is the natural logarithm of the book value of total assets. *ROA* is the ratio of net income to the book value of total assets. *Dividend dummy* is a dummy variable set equal to one if the firm paid dividends on common equity during the fiscal year, and zero otherwise. *Debt to assets* is the ratio of total debt to the book value of total assets. *Capex to sales* is the ratio of capital expenditure to total sales. *R&D to sales* is the ratio of research and development expenditure to total sales. *Advertising to sales* is the ratio of advertising expenditure to total sales. *Diversification dummy* is a dummy variable equal to one if the firm operates in more than one business segment, and zero otherwise. *Foreign sales to total sales* is the ratio of foreign sales to total sales. The regressions include year dummies and credit quality controls (regressions 2 and 4 only), whose coefficient estimates are suppressed. The coefficient of the intercept is also suppressed. In parentheses are *p*-values based on standard errors adjusted for heteroskedasticity and within firm correlation. Variables significant at the 5% level or less are in bold.

Dependent variable: Tobin's Q_t	(1)	(2)	(3)
Tobin's Q_{t-1}	0.791 (0.000)	0.675 (0.000)	0.678 (0.000)
Total FX derivatives to assets _{<i>t</i>}	1.398 (0.227)	0.599 (0.603)	0.871 (0.327)
Firm size _{<i>t</i>}		0.023 (0.516)	
ROA _{<i>t</i>}		2.378 (0.032)	2.351 (0.031)
Dividend dummy _{<i>t</i>}		-0.133 (0.170)	-0.137 (0.168)
Debt to assets _{<i>t</i>}		-0.674 (0.003)	-0.662 (0.002)
Capex to sales _{<i>t</i>}		-0.551 (0.103)	-0.511 (0.103)
R&D to sales _{<i>t</i>}		3.970 (0.000)	3.922 (0.000)
Advertising to sales _{<i>t</i>}		1.985 (0.089)	1.861 (0.090)
Diversification dummy _{<i>t</i>}		0.110 (0.087)	0.064 (0.083)
Foreign sales to total sales _{<i>t</i>}		0.011 (0.952)	
Number of observations	1483	1469	1469
AR(1) test (<i>p</i> -value)	0.001	0.001	0.001
AR(2) test (<i>p</i> -value)	0.103	0.074	0.074
Hansen's <i>J</i> statistic (<i>p</i> -value)	0.366	0.255	0.322
Difference in Hansen (<i>p</i> -value)	0.605	0.559	

Table 7
Robustness Tests

This table presents several robustness tests for one-step system GMM regressions of the effect of foreign currency hedging on firm value when foreign currency is sequentially exogenous. The sample includes nonfinancial COMPUSTAT firms with assets greater than \$500 million and foreign sales for 1996 to 2000. Panel A compares firms with low foreign sales (defined as the ratio of foreign sales to total sales \leq 50th percentile) to firms with high foreign sales (defined as the ratio of foreign sales to total sales $>$ 50th percentile). Panel B compares firms with a low distance to default (defined as distance to default \leq 50th percentile) to firms with a high distance to default (defined as distance to default $>$ 50th percentile). *Tobin's Q* is the book value of assets minus the book value of common equity plus the market value of common equity, all divided by the book value of assets. *Total FX derivatives to assets* is the total notional value of foreign currency forward and option contracts divided by the book value of total assets. The regressions include the following control variables, whose coefficient estimates are suppressed: the natural logarithm of the book value of total assets; the ratio of net income to the book value of total assets; a dummy variable set equal to one if the firm paid dividends on common equity during the fiscal year, and zero otherwise; the ratio of total debt to the book value of total assets; the ratio of capital expenditure to total sales; the ratio of research and development expenditure to total sales; the ratio of advertising expenditure to total sales; a dummy variable equal to one if the firm operates in more than one business segment, and zero otherwise; the ratio of foreign sales to total sales; year dummies; and credit quality controls. The coefficient of the intercept is also suppressed. In parentheses are *p*-values based on standard errors adjusted for heteroskedasticity and within firm correlation. Variables significant at the 5% level or less are in bold.

Panel A: Foreign Sales		
Dependent variable: Tobin's Q_t	Low Foreign Sales	High Foreign Sales
Tobin's Q_{t-1}	0.718 (0.000)	0.637 (0.000)
Total FX derivatives to assets _{<i>t</i>}	2.151 (0.331)	2.309 (0.157)
AR(2) test (<i>p</i> -value)	0.385	0.275
Hansen's <i>J</i> statistic (<i>p</i> -value)	0.171	0.324

Panel B: Distance to Default		
Dependent variable: Tobin's Q_t	Low Distance to Default	High Distance to Default
Tobin's Q_{t-1}	0.539 (0.001)	0.414 (0.001)
Total FX derivatives to assets _{<i>t</i>}	1.271 (0.099)	-2.060 (0.308)
AR(2) test (<i>p</i> -value)	0.072	0.109
Hansen's <i>J</i> statistic (<i>p</i> -value)	0.248	0.218