Foreign Exchange Risk Hedging Policy: Evidence from France

Ghassen Nouajaa and Jean-Laurent Viviani

Abstract This paper examines foreign exchange risk hedging determinants for a sample of 82 French non-financial firms. Starting from the observation that firms, often, use both currency derivatives and foreign debt, we find evidence that foreign debt can be considered as hedging tool in addition to currency derivatives. Our results show that currency derivatives' hedging depends from firm size, financial distress risk, liquidity level, foreign sales and future growth opportunities. Foreign debt level depends from firm size, debt level, foreign sales and its future growth opportunities.

We demonstrate, further, that foreign debt and currency derivatives are quite different hedging tools. Our results show that the level of operational hedging with foreign debt seems to be loosely correlated with that of currency derivatives.

Keywords Foreign exchange risk · Hedging · Currency derivatives · Foreign debt

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1 Introduction

The theory of corporate FX[1] risk hedging is quiet diverse, and there are various empirical studies that investigate about determinants of this policy. In this content, we distinguish between "classical" studies (e.g. Nance et al., 1993) that believe that hedging is limited to the use of financial derivatives and other more recent studies (e.g. Eliott et al., 2003) that take into account other FX risk hedging tools such as foreign debt. Starting with Géczy et al. (1997), these studies assume that we must consider relation between financial hedging with derivatives and firm capital structure to define all dimensions of FX risk hedging. This hypothesis supposes that financial hedging depends from firm other financial policies such as the debt structure.

We hypothesize that FX risk hedging policy has two main components; the first is financial hedging with currency derivatives and the second one is hedging using foreign debt. This implies that both of these hedging instruments can, eventually, be interdependent since currency derivatives' use influences firm's capital structure and so is the debt and vice versa.

There are many reasons to believe that financial hedging with derivatives is not the only way for the firm to hedge FX risk. First, the optimal hedging theory, by Smith and Stulz (1985), assumes that the higher firm financial distress risk is, the more are its incentives to hedge to reduce probability of default. This implies positive relationship between debt level and hedging. As we know that foreign debt is part of firm's total debt and an increase in its level raises total value of debt, we assume that foreign debt can have an impact on firm financial hedging with derivatives. In this same pattern, Clark and Judge (2008) demonstrate that foreign debt use influences the relationship between firm financial distress risk and FX risk hedging with currency derivatives. Second, foreign debt itself can be used as a FX risk hedging tool. For a firm with sales abroad, FX risk arises when foreign currency exchange rate goes down. This can be hedged even with currency derivative contract (e.g. a currency forward or future contract, etc.) or with foreign debt issuance for the same amount of the transaction. Thus, foreign debt can be used as an operational hedging tool of FX risk other than currency derivatives. Besides, foreign debt, as part of firm total debt, is related to derivatives. Fazillah et al. (2008) argue that distress cost reduction due to financial hedging increases debt capacity of the firm. As there is tax savings in the debt, firms will go, further, into debt, and this raises financial distress probability. Consequently, they will have to increase, over, hedging using derivatives. Moreover, Schiozer and Saito (2009) empirical findings confirm foreign debt role in currency derivatives' hedging. Their results demonstrate that the decision to issue foreign debt leads to that of using currency derivatives.

Recent empirical studies on FX risk hedging determinants (e.g. Eliott et al., 2003; Clark & Judge, 2008; Schiozer & Saito, 2009) emphasize the role of foreign debt

[1] FX is an abbreviation for foreign exchange.

as hedging instrument in addition to currency derivatives. They consider that there is interdependence between currency derivatives' usage and level of foreign debt since corporate FX risk hedging includes derivatives and foreign currency funds. We notice that results of these studies do not converge about the nature of this relationship (whether these hedging tools are complements or substitutes) or even confirm each one of them, possibly, determines or not the use of the other. Eliott et al. (2003) find that foreign debt and currency derivatives act as substitutes as there is a negative relationship between them. On the other hand, Clark and Judge (2008) find that foreign debt constitutes a real motive for hedging with currency derivatives since it increases total debt level, so financial distress risk that makes firm increase FX risk hedging.

As both of these hedging tools are different in terms of employment, hedging purpose and prevalence, [2] empirical studies suggest different determinants for each one. Most of these studies refer to optimal hedging theory (by Smith & Stulz, 1985; Nance et al., 1993) empirical study for determinants of derivatives' hedging to test factors that influence currency derivatives' hedging. The factors, often used, are firm size, financial distress risk, liquidity level, exposure to FX risk and firms' future growth opportunities. For firm foreign debt use, the main determinants are firm size, debt level, profitability rate, level of exposure to FX risk and future growth opportunities.

Our paper aims to study factors that influence decision and level of both financial and operational FX risk hedging and to check about possible link between them. This paper adds to FX risk hedging theory in different ways. First, it questions about the existence of interdependence between currency derivatives and foreign debt as hedging instruments rather than "classical" approach limited to financial hedging with derivatives. Besides, it is the first empirical work to check for a more realistic definition of FX risk hedging and gives findings about French firms. Also, we use a new methodology comparing the use of one of these hedging tools in addition to the other. Our empirical results support evidence that currency derivatives and foreign debt hedging are two separate hedging instruments.

This paper is organized as follows: Sect. 2 discusses about factors that determine currency derivatives and foreign debt hedging. Our dataset and methodology are presented in Sect. 3. Empirical results are detailed in Sect. 4. We conclude in Sect. 5.

[2] Aabo (2006) study examines determinants of the relative importance of foreign debt to currency derivatives. Results demonstrate that foreign debt is, often, used as an alternative for currency derivatives' hedging and most firms tend to prefer foreign debt to derivatives when hedging long-term exposure.

2 Determinants of FX Risk Financial and Operational Hedging

As we assumed, FX risk hedging cannot be limited to financial hedging with currency derivatives. Recent empirical studies confirm that operational hedging using foreign debt is an important component of corporate FX risk hedging policy. In what follows, we explain the impact of firm financial characteristics on hedging policy using derivatives and foreign debt.

2.1 Currency Derivatives' Hedging Determinants

The theory of corporate risk management suggests that hedging level depends, mainly, from firm size, financial distress risk, exposure to FX rate risk, its growth opportunities and the level of liquidity.

2.1.1 Firm Size

According to Nance et al. (1993), large firms benefit more from scale economies that give them opportunity to implement a hedging policy at lower costs compared to smaller ones. Most empirical researches on FX risk hedging determinants (e.g. Géczy et al., 1997) find a positive relationship between firm size and currency derivatives' use. Thus, we hypothesize that the larger is the firm, the higher is the level of FX risk hedging with currency derivatives. We expect a positive relationship between firm size and currency derivatives' hedging. We choose natural logarithm of total assets as a proxy for size of the firm.

2.1.2 Financial Distress Risk

Optimal hedging theory suggests that distress risk is positively related to hedging. Smith and Stulz (1985) assume that higher financial distress costs give firm a reason to hedge to reduce the variability of its future value, so lowering the probability of bankruptcy. This implies that firms with higher financial distress risk tend to hedge more their FX risk with derivatives. However, empirical studies' results are not consistent about this relationship because some studies (e.g. Davies et al., 2006; Gonzalez et al., 2010) find no significant effect. In our study, we use two variables to proxy for firm financial distress risk: the debt-to-total assets ratio and fixed charge

coverage ratio.[3] The debt-to-total assets ratio represents leverage of the firm. Fixed charge coverage ratio is defined as earnings before interest and taxes divided by interest expenses and preferred dividends. This variable represents the number of times firm's earnings can cover its fixed charges (interests and preferred dividends). So, the greater is the firm fixed charge coverage, the lower is the default probability and the less are the incentives to hedge. We hypothesize, then, that the higher is the firm debt level and/or the lower is its fixed charge coverage, the higher will be the currency derivatives' hedging.

2.1.3 Exports Level

Level of exports measures for firm's international sales exposed to foreign exchange rate variations.[4] Most empirical studies (such as Goldberg et al., 1998; Géczy et al., 1997) find a positive relationship between firm's exposure level and currency derivatives' hedging. It is common that firm with higher level of sales abroad tends to hedge more its FX risk using currency derivatives to reduce variability in value of its sales. To measure exposure level for our sample firms in the study period,[5] we construct our own *foreign sales ratio* because exports of French companies in the eurozone do not generate direct exchange rate risk.

For every firm and every year, we collect data about geographical segments sales, and we compute total value of international sales out of the eurozone. We, then, divide this value by the total net sales to obtain exports level measure. Therefore, we assume that there is a positive relationship between firm exports level and currency derivatives' hedging.

2.1.4 Growth Opportunities

Myers (1977) argue that, for firms with higher growth opportunities, agency conflicts (between shareholders and bondholders) occur when shareholders forego future investment projects if profits could go, first, to bondholders. This situation is defined as the underinvestment problem. Bessembinder (1991) affirms that firm can resolve this problem and assure bondholders about fixed claims payment by hedging. Therefore, we assume that firms with higher growth opportunities tend to hedge more with derivatives to assure funds for future investment opportunities and

[3] Fixed charge coverage ratio is as follows: earnings before interest and taxes/((interest expense on debt + preferred dividends)/(1−tax rate)). DataStream data type WC08251.

[4] The foreign sales ratio, here, is manually computed using data about international sales by different geographical areas in DataStream (not as presented with data type WC08731 in the same database, which includes sales in the eurozone). It is equal to the sum of international sales out of the eurozone divided by the total of net sales for each firm and each year of the study period.

[5] The euro common currency is, officially, adopted since 1999.

to face higher underinvestment costs. In line with these assumptions, we suppose that there is a positive relationship between firm's future growth opportunities and currency derivatives' hedging. The market-to-book ratio is used as a proxy for growth opportunities.

2.1.5 Liquidity

Firm financial policy suggests that it should invest in more liquid assets in order to reduce the probability of default. Nance et al. (1993) assume that firms with more liquid assets are less likely to engage in risk management because liquidity can be used as a substitute for hedging. In line with this assumption, we suppose that there is a negative relationship between liquidity level and currency derivatives' hedging. As a proxy for firm liquidity, we use the ratio of cash to total assets. We notice that firm cash level is defined as money and equivalents available for use in the current operations.

2.2 Foreign Debt Use Determinants

Recent empirical studies on FX risk hedging (e.g. Eliott et al., 2003; Schiozer & Saito, 2009) emphasize the role of foreign debt, in addition to currency derivatives, in hedging. In what follows, we analyse firm characteristics that can explain firm foreign debt use for hedging.

2.2.1 Firm Size

It is supposed to have a positive relation with the probability and level of foreign debt use. In fact, firms must benefit from economies of scale to have access to foreign loan markets since foreign debt issue can be an expensive hedging method for smaller ones. We assume, then, that there is a positive relation between firm size and foreign debt use. We notice that Eliott et al. (2003) and Aabo (2006) find a positive relationship between firm size and foreign debt. These findings are consisting with the assumption of scale economies' role in hedging using foreign debt. We chose natural logarithm of total assets as a proxy for firm size.

2.2.2 Debt Level

There is a specific relationship between firm debt level and foreign debt. First, firms with higher level of debt (so higher financial distress risk) can hedge FX risk with foreign debt to reduce bankruptcy costs, as it has the same role as derivatives in hedging. Moreover, foreign debt is a component of firm's total debt, and firms

with higher level of debt are more likely to use foreign debt than firms with lower level as they, probably, have relatively higher level of foreign currency debt. Most empirical studies find a positive relationship between firm's debt level and foreign debt use; Aabo (2006) finds that foreign debt is positively related to firm debt ratio. In addition, Eliott et al. (2003) find a positive relationship between firm's debt ratio and level of foreign debt. We suppose that there is a positive relationship between firm debt level and foreign debt use. As a proxy for debt level, we use the debt-to-total assets ratio.

2.2.3 Profitability

There are two possible effects of firm profitability on its foreign debt use. The first is that highly profitable firms have better and easier access to foreign loan markets. In this case, there is a positive effect of profitability rate on foreign debt issue. The second hypothesis, as detailed by the pecking order theory (by Myers & Majluf, 1984 [6]), is that firm tends to use internally generated resources (e.g. profits) rather than costly external financing. In line with Myers and Majluf (1984) assumption, we suppose that there is a negative relationship between firm's ability to generate internal resources and foreign debt use. We choose the return-on-assets ratio as a proxy for firm profitability level.

2.2.4 Exposure to FX Risk

This variable is the main factor that can explain firms going on foreign indebtedness. The level of international sales to total sales is as follows: firm yearly international sales out of the eurozone divided by total net sales (the same method as for exports level measure in the previous subsection). This ratio represents better firm exposure to FX risk because it sizes up level of its activity running this risk. Most empirical studies find a positive effect of foreign sales level on the decision (Gelos, 2003; Keloharju & Niskanen, 2001; Nguyen & Faff, 2006) and on the level of foreign debt (Eliott et al., 2003; Gonzalez et al., 2010). Therefore, we assume that there is a positive relationship between exposure to FX risk and foreign debt use. As a proxy for exposure level, we choose the foreign sales ratio as described above.

2.2.5 Growth Opportunities

Optimal hedging theory (as by Smith & Stulz, 1985) affirms that firms go on hedging to reduce variability of future cash flows or revenues. This assumption

[6] Myers, S., Majluf, N., 1984. "Corporate financing and investment decisions when firms have information that investors do not have". Journal of Financial Economics. 13 (2), 187–222

highlights firm derivatives' role in reducing volatility of future revenues to, finally, pay lower taxes and/or reduce default payment probability. This hypothesis concerns firm financial hedging with derivatives in relation with its growth opportunities and cannot be, necessarily, true for other hedging ways such as foreign debt use. In fact, foreign debt is defined as an external funding and possibly a hedging instrument. Myers and Majluf (1984) argue that firm with greater growth opportunities, so with future investment projects' cash flows, gives priority to internally generated funds over debt because of uncertain future investments' performance and the relative expensive cost of external financing. Thus, we assume that there is a negative relationship between firm's future growth opportunities and its foreign debt use. We choose the market-to-book ratio as a measure for future growth opportunities.

2.2.6 Information Asymmetries

It is supposed that firms with foreign business face less information asymmetries if it has more foreign investors or shareholders compared to the other ones. Kedia and Mozumdar (2003) demonstrate that firms with greater operations abroad (e.g. with foreign subsidiaries) benefit from less informational disadvantage and obtain more foreign financing. In fact, the existence of information asymmetries makes more difficult for the firm to have access to foreign currency debt. We argue that firms with more foreign investors (more capital foreign investments) have less of this asymmetry, so they hedge more using foreign debt. We choose the foreign holdings ratio as a proxy for lower information asymmetries. This ratio represents the percentage of firm shares held by foreign investors to total shares. We suppose, then, that there is a positive relationship between foreign holdings ratio and foreign debt use.

3 Dataset and Methodology

3.1 Dataset

Our study focuses on analysing the determinants of FX risk hedging with derivatives as well as foreign debt for French non-financial firms. Data about currency derivatives' contracts and foreign debt (out of currency derivatives' hedging) are hand collected from firms' published annual reports. The rest of our data, concerning firms' financial characteristics, are collected from both DataStream and Thomson One Banker databases. We choose French firms listed in the SBF 120 with complete data during the study period (2004–2012). We exclude financial firms from the first sample because of the different nature of their business activities and their eventual use of derivatives for speculative purpose. The final sample consists of 82 French non-financial firms with a set of 568 firms' year observations.

3.2 Methodology

Our aim is, first, to check which factors have an influence on FX risk hedging using currency derivatives and foreign debt, separately. Then, we try to test whether these hedging instruments are interdependent.

To estimate determinants of currency derivatives' hedging, we implement the following model:

$$\begin{aligned} \text{FCDeriv}_{i,t} = {} & \alpha_0 + \alpha_1 \text{Size}_{i,t} + \alpha_2 \text{DebtTA}_{i,t} + \alpha_3 \text{FixCh}_{i,t} + \alpha_4 \text{FSales}_{i,t} \\ & + \alpha_5 \text{MTBV}_{i,t} + \alpha_6 \text{CashTA}_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where FCDeriv_i represents firm currency derivatives' hedging (probability or level). Size_i is the size of firm $_i$ calculated by the natural logarithm of total assets. DebtTA_i is the ratio of total debt to total assets. FixCh_i is the fixed charge coverage ratio (as explained in footnote 2). FSales_i is the foreign sales ratio. MTBV_i is the market-to-book ratio. CashTA_i represents firm's cash level divided by total assets.

To estimate determinants of foreign debt hedging, we implement the following model:

$$\begin{aligned} \text{FDebt}_{i,t} = {} & \beta_0 + \beta_1 \text{Size}_{i,t} + \beta_2 \text{DebtTA}_{i,t} + \beta_3 \text{ROA}_{i,t} + \beta_4 \text{FSales}_{i,t} \\ & + \beta_5 \text{MTBV}_{i,t} + \beta_6 \text{ForHol}_{i,t} + \delta_{i,t} \end{aligned} \tag{2}$$

where FDebt_i represents firm foreign debt hedging (probability or level). Size_i is the size of firm $_i$ calculated by the natural logarithm of total assets. DebtTA_i is the ratio of total debt to total assets. ROA_i is the return-on-assets ratio. FSales_i is the foreign sales ratio. MTBV_i is the market-to-book ratio.ForHol_i is firm percentage of shares held by foreign investors.

To test whether there is interdependence between currency derivatives and foreign debt hedging, we run a two-stage regression estimation model.

The following equations detail this regression method:

$$\begin{aligned} \text{FCDeriv}_{i,t} = {} & \lambda_0 + \lambda_1 \text{Size}_{i,t} + \lambda_2 \text{DebtTA}_{i,t} + \lambda_3 \text{FixCh}_{i,t} + \lambda_4 \text{FSales}_{i,t} \\ & + \lambda_5 \text{MTBV}_{i,t} + \lambda_6 \text{CashTA}_{i,t} + \lambda_7 \widehat{\text{FDebt}}_{i,t} + \omega_{i,t} \end{aligned} \tag{3}$$

where FCDeriv_i represents firm currency derivatives' hedging level measured by nominal value of currency derivatives to total sales. $\widehat{\text{FDebt}}_i$ is the forecasted value foreign debt level estimated by eq. (2).

$$\begin{aligned} \text{FDebt}_{i,t} = {} & \theta_0 + \theta_1 \text{Size}_{i,t} + \theta_2 \text{DebtTA}_{i,t} + \theta_3 \text{ROA}_{i,t} + \theta_4 \text{FSales}_{i,t} + \theta_5 \text{MTBV}_{i,t} \\ & + \theta_6 \text{ForHol}_{i,t} + \theta_7 \widehat{\text{FCDeriv}}_{i,t} + \upsilon_{i,t} \end{aligned} \tag{4}$$

where $FDebt_i$ represents firm foreign debt hedging level measured by value of foreign debt to total assets. $\widehat{FCDeriv}_i$ is the forecasted value currency derivatives' level estimated by eq. (1).

Our empirical analysis for determinants of FX risk hedging consists, first, of studying determinants of probability of using only currency derivatives and that of using currency derivatives combined with foreign debt. For this, we implement a multinominal logit model whose dependent variable is equal to 0 if firm does not use currency derivatives, 1 if it uses only currency derivatives and 2 if it uses currency derivatives combined with foreign debt. We do the same method for estimation of determinants of foreign debt use probability. The multinominal logit model dependent variable is equal to 0 if firm does not use foreign debt, 1 if it uses only foreign debt and 2 if it uses foreign debt combined with currency derivatives. Second, we study determinants of FX risk hedging level using currency derivatives and foreign debt, separately. For this, we use three different empirical models: tobit, OLS (ordinary least square) and GLS (generalized least square) models. The last step of our empirical analysis will be to test whether there is interdependence between currency derivatives and foreign debt hedging methods.

4 Empirical Results

4.1 Univariate Analysis

Descriptive statistics for determinants of currency derivatives and foreign debt are presented in Table 1. We notice that firms of our sample have an average size of 8.865. This indicates that most of our sample firms are quiet large. The debt level represents, on average, 24.8% of our sample firms' total assets, and fixed charge coverage ratio mean and median values are equal to 22.94 and 6.01, respectively. These statistics show the low level of financial distress risk among French exporting firms. Liquidity level measured by the ratio of cash to total assets has a mean value of 6.2% and that of return-on-assets is equal to 5.06. This result shows, strangely, low liquidity level among our sample firms despite the high level of profitability. This can be interpreted by important level of fixed costs for our sample firms.

We notice, further, that exports level mean and median values are relatively high. On average, 41.3% of French firms' total sales are out of the eurozone. The percentage of shares held by foreign investors has a mean value of 6.6%. This low level of foreign capital investments could reflect high information asymmetries and, probably, a more restricted access to foreign loan markets. The average value of the market-to-book ratio is equal to 2.24, and median value is equal to 1.81. This result indicates the high level of future growth opportunities for our sample firms.

Table 2 reports Student test mean comparison results for determinants of currency derivatives' hedging. Results show that firms that use currency derivatives have, on average, higher level of exports (out of the eurozone). This finding

Table 1 Descriptive statistics

	N	Mean	Median	Minimum	Maximum	SD
Firm size	569	8.865	8.877	5.239	12.415	1.527
Debt to total assets	569	0.248	0.232	0	0.613	0.129
Fixed charge ratio	569	22.949	6.014	−33.125	1562.5	105.89
Cash to total assets	569	0.062	0.05	0.002	0.383	0.05
Return on assets	569	5.065	4.806	−16.343	49.251	5.211
Foreign holdings	569	0.066	0	0	0.75	0.107
Foreign sales ratio	569	0.413	0.397	0	1	0.193
Market to book value	568	2.244	1.815	0.22	43.39	2.339

This table reports summary descriptive statistics of currency derivatives and foreign debt explanatory variables. Currency derivatives' explanatory variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; fixed charge ratio, which is the ratio of earnings before interest and taxes by interests on debt and firm preferred dividends multiplied by (1−tax rate); cash to total assets, which is firm cash and equivalents divided by total assets; foreign sales ratio, which is international sales divided by total sales; and market to book value, which is the ratio of firm market to book value. The sample consists of 82 French non-financial firms for the period 2004–2012

N represents the number of observations. SD is the standard deviation

highlights the importance of exposure to FX risk in currency derivatives' hedging decision. Results of the same table show, also, that firms that use currency derivatives in combination with foreign debt are larger and have higher level of debt. This result shows the important role of scale of economies (measured by firm size) and financial distress risk in the choice of a FX risk hedging policy including both currency derivatives and foreign debt.

Results of Student test mean comparison for determinants of foreign debt hedging are presented in Table 3. Results of this test show that firms that use foreign debt, compared to other firms that do not use it, are more indebted and have lower level of future growth opportunities. Our results indicate that firms with more debt tend to hedge using foreign debt and/or those with higher average level of growth opportunities tend to not use foreign debt.

Results of the same table indicate that firms that use foreign debt in combination with currency derivatives are on average larger and lower indebted and have higher exports than those that use only foreign debt. This finding indicates the importance of economies of scales and lower level of debt charges in the choice of both foreign debt and currency derivatives to hedge FX risk. The higher mean value of exports for firms' hedging with both of these tools emphasizes the relative importance of currency derivatives (compared to foreign debt) to hedge higher exposure level. We notice, also, that firms that use both foreign debt and currency derivatives have higher growth opportunities compared to firms that use only foreign debt. This reflects the important role of firm's future growth opportunities in the choice of currency derivatives in combination with foreign debt.

Table 2 Student mean test for determinants of currency derivatives' hedging

	Currency derivatives' non-users ($N = 71$)		Only currency derivatives' users ($N = 35$)		Currency derivatives' and foreign debt users ($N = 463$)		Only currency derivatives' users–currency derivatives' non-users	Currency derivatives' and foreign debt users–only currency derivatives' users
	Mean	SD	Mean	SD	Mean	SD	t statistic (p-value)	t statistic (p-value)
Firm size	7.453	1.246	7.601	0.822	9.177	1.434	−0.729 (0.233)	−10.221 (0.000)
Debt to total assets	0.321	0.173	0.286	0.16	0.234	0.114	1.003 (0.159)	1.887 (0.033)
Fixed charge ratio	17.702	51.942	22.781	51.215	23.766	114.7	−0.477 (0.317)	−0.096 (0.461)
Cash to total assets	0.061	0.038	0.063	0.047	0.062	0.052	−0.244 (0.403)	0.073 (0.471)
Foreign sales ratio	0.288	0.237	0.451	0.106	0.429	0.184	−4.886 (0.000)	1.097 (0.138)
Market to book value	2.393	1.551	2.508	1.269	2.201	2.497	−0.406 (0.342)	1.258 (0.106)

This table reports the mean and standard deviation statistics for currency derivatives' explanatory variables. Student test of mean is between currency derivatives' users and non-users and between currency derivatives and foreign debt users and only currency derivatives users. Explanatory variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; fixed charge ratio, which is the ratio of earnings before interest and taxes by interests on debt and firm preferred dividends multiplied by (1−tax rate); cash to total assets, which is firm cash and equivalents divided by total assets; foreign sales ratio, which is international sales divided by total sales; and market to book value, which is the ratio of firm market to book value. The sample consists of 82 French non-financial firms for the period 2004–2012

N represents the number of observations. SD is the standard deviation

Table 3 Student mean test for determinants of foreign debt use

	Foreign debt non-users ($N = 69$)		Only foreign debt users ($N = 37$)		Foreign debt and currency derivatives' users ($N = 463$)		Only foreign debt users–non-users	Foreign debt and currency derivatives' users–only foreign debt users
	Mean	SD	Mean	SD	Mean	SD	*t* statistic (*p*-value)	*t* statistic (*p*-value)
Firm size	7.419	1.038	7.656	1.264	9.177	1.434	−0.98 (0.165)	−6.964 (0.000)
Debt to total assets	0.294	0.179	0.338	0.147	0.234	0.114	−1.377 (0.086)	4.203 (0.000)
Return on assets	5.446	4.121	4.84	3.737	5.026	5.457	0.767 (0.222)	−0.28 (0.39)
Foreign holdings	0.075	0.133	0.054	0.078	0.065	0.105	1.011 (0.157)	−0.806 (0.787)
Foreign sales ratio	0.33	0.195	0.363	0.254	0.429	0.184	−0.683 (0.751)	−1.546 (0.065)
Market to book value	2.688	1.619	1.951	0.945	2.201	2.497	2.956 (0.001)	−1.287 (0.10)

This table reports the mean and standard deviation statistics for foreign debt explanatory variables**.** Student test of mean is between foreign debt users and non-users and between foreign debt and currency derivatives' users and only foreign debt users. Explanatory variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; return-on-assets ratio; foreign holdings, which is firm percentage of shares held by foreign investors; foreign sales ratio, which is international sales divided by total sales; and market to book value, which is the ratio of firm market to book value. The sample consists of 82 French non-financial firms for the period 2004–2012

N represents the number of observations. SD is the standard deviation

4.2 Multivariate Analysis

4.2.1 FX Risk Hedging Probability

Table 4 reports empirical results for determinants of currency derivatives' hedging probability using multinominal logit model. Results show that firm size has a significant positive impact on probability of hedging using currency derivatives and that of using both currency derivatives and foreign debt. This result is in line with Nance et al. (1993) empirical results of scale of economies' positive effect on probability of hedging using derivatives. French larger firms benefit from scale of economies to implement a FX risk hedging using either currency derivatives or both of currency derivatives and foreign debt. Results of the same table show that financial distress risk has a negative significant effect on probability of hedging with currency derivatives and foreign debt compared to that with only currency derivatives (column 1 in the middle of Table 4). The sign of debt-to-total assets ratio coefficient is not in accordance with optimal hedging theory assumption of positive effect of distress risk on hedging. Therefore, we suppose that there is non-linearity in the distribution of the debt ratio, and we introduce squared value of the debt-to-total assets ratio as an explanatory variable in our model. Results of this new regression are presented in column II of Table 4. We notice that the more firm is indebted, the higher is the probability of use of foreign debt in addition to currency derivatives to hedge. It is obvious that French firms with higher financial distress risk use more foreign debt in order to attenuate default risk. Results of Table 4 show, also, that exports level has a significant positive impact on currency derivatives' hedging probability. This result is consistent with most empirical studies' results (e.g. Géczy et al., 1997; Davies et al., 2006) about positive relationship between exposure to FX risk and the use of currency derivatives.

Results about determinants of foreign debt use probability are reported in Table 5. Our results show that firm size has a significant positive effect on probability of hedging with foreign debt in combination with currency derivatives compared to hedging with foreign debt only. This finding confirms the importance of scale of economies in hedging with both of these instruments compared to only foreign debt use. Besides, we find that firm debt level has a significant positive effect on the probability of foreign debt use (columns I and II in the left of Table 5). This result is in accordance with our assumptions of positive relationship between financial distress risk and hedging with foreign debt. We find, further, that debt level has a negative impact on probability of hedging with foreign debt and currency derivatives compared to that of foreign debt use only. As we have supposed for determinants of currency derivatives' hedging (non-linearity in the distribution of the debt ratio), we introduce squared value of the debt-to-total assets ratio as an explanatory variable in the model. Results for this variable (column II in the middle of Table 5) show that probability of hedging with both foreign debt and derivatives is positively related to firm debt level. Our result show that the more firm is indebted, the higher will be the

Table 4 Multinomial logit model estimates for currency derivatives' hedging decision

		Only currency derivatives' use		Currency derivatives and foreign debt use		Currency derivatives and foreign debt use	
		compared to non-use of currency derivatives				compared to only use of currency derivatives	
		(I)	(II)	(I)	(II)	(I)	(II)
	Expected sign	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value
Firm size	+	0.46 (0.013)	0.486 (0.009)	1.485 (0.000)	1.55 (0.000)	1.024 (0.000)	1.064 (0.000)
Debt to total assets	+	−1.89 (0.248)	2.783 (0.539)	−6.338 (0.000)	11.354 (0.011)	−4.448 (0.006)	8.57 (0.053)
(Debt to total assets)^2	±		−6.714 (0.377)		−30.974 (0.000)		−24.259 (0.005)
Fixed charge ratio	−	−0.0003 (0.619)	0.0013 (0.52)	−0.0011 (0.11)	0.0015 (0.433)	−0.0007 (0.318)	0.0002 (0.827)
Cash to total assets	−	−4.246 (0.437)	−4.745 (0.372)	1.821 (0.646)	1.592 (0.665)	6.067 (0.236)	6.338 (0.197)
Foreign sales ratio	+	6.207 (0.000)	6.125 (0.000)	6.764 (0.000)	6.193 (0.000)	0.556 (0.477)	0.067 (0.934)
Market to book value	+	0.019 (0.786)	0.032 (0.699)	0.011 (0.897)	0.094 (0.335)	−0.0087 (0.908)	0.061 (0.526)
	(I)			(II)			
Wald chi^2	154.66			125.9			
Prob > chi^2	0.000			0.000			
Pseudo R^2	0.328			0.358			
N	568			568			

The dependent variable is equal to 0 if the firm does not use currency derivatives, 1 if it uses only currency derivatives and 2 if it uses currency derivatives and foreign debt. Independent variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; (debt to total assets)^2, which is debt-to-total assets ratio squared; fixed charge ratio, which is the ratio of earnings before interest and taxes by interests on debt and firm preferred dividends multiplied by (1−tax rate); cash to total assets, which is firm cash and equivalents divided by total assets; foreign sales ratio, which is international sales divided by total sales; and market to book value, which is the ratio of firm market to book value. The sample consists of 82 French non-financial firms for the period 2004–2012

(I) and (II) denote currency derivatives' use multinomial logit model separate eqs. *N* represents the number of observations

Table 5 Multinomial logit model estimates for foreign debt use decision

		Only foreign debt use		Foreign debt and currency derivatives' use		Foreign debt and currency derivatives' use	
		Compared to non-use of foreign debt				Compared to only use of foreign debt	
		(I)	(II)	(I)	(II)	(I)	(II)
	Expected sign	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value
Firm size	+	0.062 (0.73)	0.04 (0.824)	1.335 (0.000)	1.394 (0.000)	1.272 (0.000)	1.354 (0.000)
Debt to total assets	+	4.054 (0.029)	8.625 (0.084)	−5.226 (0.000)	11.807 (0.003)	−9.28 (0.000)	3.182 (0.574)
(Debt to total assets)^2	±		−8.817 (0.235)		−31.66 (0.000)		−22.843 (0.028)
Return on assets	−	0.024 (0.34)	0.033 (0.268)	−0.068 (0.006)	−0.053 (0.062)	−0.093 (0.001)	−0.087 (0.003)
Foreign holdings	+	−3.473 (0.192)	−2.659 (0.287)	1.496 (0.315)	3.123 (0.049)	4.97 (0.055)	5.782 (0.033)
Foreign sales ratio	+	1.945 (0.131)	1.857 (0.144)	5.306 (0.000)	4.538 (0.000)	3.361 (0.012)	2.681 (0.051)
Market to book value	−	−0.402 (0.008)	−0.396 (0.011)	−0.011 (0.904)	0.089 (0.361)	0.39 (0.012)	0.485 (0.004)
	(I)			(II)			
Wald chi^2	140.86			121.39			
Prob > chi^2	0.000			0.000			
Pseudo R^2	0.321			0.351			
N	568			568			

The dependent variable is equal to 0 if the firm does not use foreign debt, 1 if it uses only foreign debt and 2 if it uses foreign debt and currency derivatives. Independent variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; (debt to total assets)^2, which is debt-to-total assets ratio squared; return-on-assets ratio; foreign holdings, which is firm percentage of shares held by foreign investors; foreign sales ratio, which is international sales divided by total sales; and market to book value, which is the ratio of firm market to book value. The sample consists of 82 French non-financial firms for the period 2004–2012
(I) and (II) denote foreign debt use multinomial logit model separate eqs. *N* represents the number of observations

probability of use of both of these hedging tools but financial distress risk mitigates the impact.

Results of the same table show that return-on-assets ratio has a significant negative effect on probability of hedging with foreign debt and currency derivatives compared to that of foreign debt use only. Firms with higher level of profitability give up currency derivatives and foreign debt hedging as they have more funds to face exposure to FX risk. We find, also, that firm's capital foreign holdings have a significant positive effect on probability of hedging with foreign debt and currency derivatives compared to that of foreign debt. This supposes that foreign investors prefer a combined hedging policy rather than hedging with foreign debt only. This result is in contradiction with our hypothesis of negative relationship between information asymmetries (represented by lower value of capital foreign investors) and foreign debt use. Exports level has a significant positive effect on probability of hedging with foreign debt and currency derivatives' use. This is in line with our assumptions and with results of most empirical research studies on determinants on foreign debt use (e.g. Eliott et al., 2003) and on currency derivatives hedging (e.g. Géczy et al., 1997; Davies et al., 2006). We notice, also, that exports level ratio coefficients are positive and almost significant for probability of foreign debt use only. Firm future growth opportunities measured by the market-to-book ratio have significant negative impact on probability of hedging with foreign debt. This is in line with pecking order theory (by Myers & Majluf, 1984) hypothesis. It is obvious, here, that firms with higher future growth opportunities prefer to use internally generated funds rather than external costly financing. Moreover, our results show that firm growth opportunities have significant positive effect on hedging with foreign debt and currency derivatives compared to that of foreign debt use only. This is in accordance with Nance et al. (1993) empirical results of positive relationship between firm growth opportunities and use of derivatives.

4.2.2 FX Risk Hedging Level

Results for determinants of currency derivatives' hedging level (with tobit, [7] OLS and GLS models) are presented in Table 6. Results show that firm size is positively related to the level of currency derivatives' hedging. An increase in firm size by 1% leads to an increase in currency derivatives' level by 0.094%. This result is in line with Nance et al. (1993) finding about economies of scale role in hedging using derivatives. Larger firms, as they benefit from scale economies, can more hedge using currency derivatives at lower cost compared to smaller ones.

We notice that debt-to-total assets ratio coefficient sign is not consistent with optimal hedging theory assumption about financial distress risk impact on hedging. We explain this by non-linear distribution of debt-to-total assets ratio. To resolve this, we add squared value of debt ratio as an explanatory variable in our empirical

[7] The tobit model is left censored (censored at zero).

Table 6 Currency derivatives' level determinants empirical estimates

		Tobit model		OLS model		GLS model	
	Expected sign	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value
Firm size	+	0.094 (0.000)	0.095 (0.000)	0.073 (0.000)	0.075 (0.000)	0.069 (0.000)	0.069 (0.000)
Debt to total assets	+	−0.427 (0.001)	−0.708 (0.025)	−0.313 (0.000)	−0.982 (0.000)	−0.046 (0.629)	0.008 (0.977)
(Debt to total assets)^2	±		0.51 (0.377)		1.196 (0.005)		−0.101 (0.845)
Fixed charge ratio	−	−6.4e-06 (0.94)	−0.00002 (0.73)	4.88e-06 (0.955)	−0.00004 (0.513)	0.00001 (0.88)	0.00001 (0.862)
Cash to total assets	−	0.766 (0.008)	0.76 (0.009)	0.705 (0.012)	0.689 (0.014)	0.463 (0.014)	0.463 (0.014)
Foreign sales ratio	+	0.354 (0.000)	0.356 (0.000)	0.236 (0.000)	0.247 (0.000)	0.176 (0.014)	0.176 (0.014)
Market to book value	+	0.008 (0.002)	0.008 (0.004)	0.009 (0.000)	0.008 (0.002)	0.004 (0.136)	0.004 (0.137)
		p-value 0.000	0.000	*p*-value 0.000	0.000	*p*-value 0.00	0.000
		Pseud R^2 0.475	0.477	R^2 0.198	0.2	R^2 0.174	0.172
		N 568	568	*N* 568	568	*N* 568	568

The dependent variable is represented by the ratio of nominal value of currency derivatives to total sales. Independent variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; (debt to total assets)^2, which is debt-to-total assets ratio squared; fixed charge ratio, which is the ratio of earnings before interest and taxes by interests on debt and firm preferred dividends multiplied by (1−tax rate); cash to total assets, which is firm cash and equivalents divided by total assets; foreign sales ratio, which is international sales divided by total sales; and market to book value, which is the ratio of firm market to book value. The sample consists of 82 French non-financial firms for the period 2004–2012

R^2 represents the *R*-squared obtained from the model. *N* represents the number of observations

models. Results show negative effect of debt-to-total assets ratio and positive effect of squared value of the same ratio. We can conclude that the more the firm is indebted, the lower will be the level of currency derivatives' hedging and financial distress risk attenuates this effect.

Surprisingly, firm cash level has significant positive effect on currency derivatives' level. An increase of firm cash level by 1% raises currency derivatives' hedging level by 0.766%. Our result is not in line with Nance et al. (1993) assumption about negative relationship between liquidity level and derivatives' use. This can be interpreted by the fact that French firms with more liquid assets profit from the situation to increase their currency derivatives' level as the liquidity expended can be recovered, afterwards, from additional derivatives purchased at their maturity dates. Exports level has significant positive effect on currency derivatives' hedging level. A 1% increase in international sales raises currency derivatives' hedging by 0.354%. This is in line with most empirical studies' (e.g. Davies et al., 2006) findings about positive relationship between exports and hedging. In fact, foreign sales increase raises FX risk transactions exposure, thus making firms increase their currency derivatives' hedging level. Moreover, we find that firm's future growth opportunities have significant positive impact on currency derivatives' hedging level. An increase of 1% in the market to book value of the firm leads to an increase of 0.008% on currency derivatives' level. Our result is in the same line with Bessembinder (1991) assumptions and with Nance et al. (1993) finding about positive relationship between growth opportunities and derivatives' use.

Table 7 reports empirical results for determinants of foreign debt level (using tobit, [8] OLS and GLS models). Results show that firm size has significant positive effect on level of foreign debt. This is in the same line with most empirical studies in the subject (e.g. Kedia & Mozumdar, 2003; Eliott et al., 2003). Economies of scale allow French firms to have easier access to foreign capital markets and at lower costs compared to smaller ones. Debt-to-total assets ratio coefficient is positive and that of its squared value is negative. This finding indicates that the more the firm is indebted, the higher foreign debt level will be and financial distress risk mitigates this effect. We notice, here, that positive effect of firm debt level on foreign debt is in accordance to our assumptions and to Clark and Judge (2008) finding of positive link between financial distress risk and foreign indebtedness. Exports level has significant positive effect on foreign debt level. An increase of foreign sales ratio by 1% leads to an increase of 0.125% in foreign debt level. Our result confirms the assumption that foreign debt is, often, used for hedging purpose. It is, also, in accordance with most empirical studies on foreign debt determinants (e.g. Eliott et al., 2003). Three out of six of the market-to-book ratio coefficients are significant. This result is in the same line with Myers and Majluf (1984) assumption of negative relationship between firm's future growth opportunities and external financing. Our result confirms that French firms with higher growth opportunities prefer to finance

[8] The tobit model is left censored (censored at zero).

Table 7 Foreign debt level determinants empirical estimates

	Expected sign	Tobit model		OLS model		GLS model	
		Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value
Firm size	+	0.008 (0.000)	0.007 (0.000)	0.006 (0.000)	0.005 (0.000)	−0.001 (0.658)	−0.001 (0.602)
Debt to total assets	+	0.157 (0.000)	0.416 (0.000)	0.145 (0.000)	0.327 (0.000)	0.106 (0.000)	0.178 (0.001)
(Debt to total assets)^2	±		−0.474 (0.001)		−0.331 (0.006)		−0.129 (0.149)
Return on assets	−	0.0004 (0.323)	0.0006 (0.145)	0.0004 (0.272)	0.0006 (0.148)	−0.00004 (0.884)	−0.00002 (0.927)
Foreign holdings	+	0.004 (0.862)	0.013 (0.558)	−0.001 (0.946)	0.005 (0.773)	−0.011 (0.435)	−0.01 (0.473)
Foreign sales ratio	+	0.125 (0.000)	0.118 (0.000)	0.103 (0.000)	0.098 (0.000)	0.032 (0.012)	0.031 (0.014)
Market to book value	−	−0.001 (0.062)	−0.001 (0.093)	−0.001 (0.049)	−0.0009 (0.116)	0.0007 (0.15)	−0.0008 (0.14)
		p-value 0.000	0.000	*p*-value 0.000	0.000	*p*-value 0.00	0.000
		Pseud R^2 –0.09	−0.11	R^2 0.19	0.21	R^2 0.11	0.12
		N 582	568	*N* 568	568	*N* 568	568

The dependent variable is presented by the ratio of foreign debt to total assets value. Independent variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; (debt to total assets)^2, which is debt-to-total assets ratio squared; return-on-assets ratio; foreign holdings, which is firm percentage of shares held by foreign investors; foreign sales ratio, which is international sales divided by total sales; and market to book value, which is the ratio of firm market to book value. The sample consists of 82 French non-financial firms for the period 2004–2012

R^2 represents the *R*-squared obtained from the model. *N* represents the number of observations

their activities at lower costs by internally generated resources rather than the use of foreign debt.

4.2.3 Currency Derivatives and Foreign Debt Interdependence

Our empirical results, so far, confirm the assumption of foreign debt use as a hedging instrument in addition to currency derivatives. We demonstrate that firm exports level has significant positive effect on probability and level of foreign debt use. In what next, we try to check for possible interdependence between currency derivatives and foreign debt hedging levels. For this, we run a two-stage regression procedure as detailed in Sect. 3. Results for this empirical regression method are presented in Table 8. We notice, first, that firm size has significant positive effect on currency derivatives and foreign debt levels. This confirms what we have, previously, found for determinants of currency derivatives' hedging and foreign debt in Tables 6 and 7, respectively. Larger firms benefit from scale of economies to increase level of currency derivatives' hedging and that of foreign debt. Results of Table 8 show, also, that firm foreign debt is positively related to total debt level and to foreign sales. Our finding about positive impact on total debt confirms Clark and Judge (2008) result of positive effect of financial distress risk on hedging using foreign debt. In addition, the positive relationship between exports level and that of foreign debt is in accordance with our result in Table 6 and confirms, once more, the use of foreign debt as an instrument for FX risk hedging.

Results of Table 8 show, further, that foreign debt level has no significant effect on that of currency derivatives. Similarly, currency derivatives have no significant effect on foreign debt level. Although non-significant, both of the predicted explanatory variable coefficients are negative and their p-values are not so far from 10% limit. Our result is interpreted by the fact that each one of these hedging tools is independent from the other. It is obvious, so far, that currency derivatives and foreign debt are different in terms of the access to costs and maturity. In this same line of reasoning, Géczy et al. (1997) find that transactions abroad (imports and exports) have positive effect on the choice of currency forwards rather than swap contracts. We can deduce that exposure to FX risk in the short term is different from that for long term. Corporate short-term FX risk can be hedged by currency derivatives, and long-term FX risk (concerning foreign investments and assets) can be hedged by currency swaps and/or foreign debt.

5 Conclusion

Our paper presents a new empirical approach in the study of determinants of FX risk hedging policy for French non-financial firms. We follow recent empirical studies'

Table 8 2SLS model estimates results for dependence between currency derivatives and foreign debt

	Currency derivatives' hedging determinants		Foreign debt level determinants	
	Expected sign	Coefficient (*p*-value)	Expected sign	Coefficient (*p*-value)
Firm size	+	0.128 (0.007)	+	0.011 (0.014)
Debt to total assets	+	1.008 (0.305)	+	0.112 (0.000)
Fixed charge ratio	−	−0.00008 (0.521)		
Cash to total assets	−	0.181 (0.753)		
Return on assets			−	0.00008 (0.859)
Foreign holding			+	0.011 (0.644)
Foreign sales ratio	+	1.278 (0.113)	+	0.126 (0.000)
Market-to-book ratio	+	−0.0009 (0.93)	−	−0.0003 (0.683)
Foreign debt (predicted)	±	−9.596 (0.186)		
Currency derivatives (predicted)			±	−0.081 (0.198)
Wald chi^2 (7)	30.48		123.76	
Prob > *F*	0.000		0.000	
R^2	NA		0.013	
N	568		568	

The first equation concerns currency derivatives' hedging where the dependent variable is represented by the ratio of nominal value of currency derivatives to total sales. Independent variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; fixed charge ratio, which is the ratio of earnings before interest and taxes by interests on debt and firm preferred dividends multiplied by (1−tax rate); cash to total assets, which is firm cash and equivalents divided by total assets; foreign sales ratio, which is international sales divided by total sales; market to book value, which is the ratio of firm market to book value; and foreign debt (predicted), which is the estimated value of foreign debt from first-stage regression of 2SLS model. The second equation concerns foreign debt level determinants. The dependent variable is presented by the ratio of foreign debt to total assets value. Independent variables are firm size, which is a natural logarithm of total assets; ratio of debt to total assets; return-on-assets ratio; foreign holdings, which is firm percentage of shares held by foreign investors; foreign sales ratio, which is international sales divided by total sales; and market to book value, which is the ratio of firm market to book value. Currency derivatives (predicted) are the estimated value of currency derivatives from first-stage regression of 2SLS model. The sample consists of 82 French non-financial firms for the period 2004–2012

R^2 represents the *R*-squared obtained from the model. *N* represents the number of observations

definition of firm hedging policy, which combines currency derivatives and foreign debt use.

The empirical analyses consist of studying FX risk hedging determinants and testing for eventual interdependence between currency derivatives and foreign debt hedging for French non-financial firms. The main assumption is that firm hedging policy is composed of financial hedging with currency derivatives and hedging using foreign debt. Empirical results show that currency derivatives' hedging and foreign debt use are positively related to firm size and exports level. This finding indicates the importance, of both, of scale of economies and transactions exposure in firm FX risk hedging policy. Our results show, also, that financial hedging with currency derivatives depends from financial distress risk, liquidity level and future growth opportunities. The more the firm is indebted, the lower is hedging with currency derivatives as more debt generates higher financial costs. The higher liquidity level and/or growth opportunities is/are, the more important is currency derivatives' level.

We find, also, that foreign debt level is positively related to level of debt and negatively related to firm's future growth opportunities. In fact, financial distress risk makes firms hedge FX risk with foreign debt and firms with higher growth opportunities prefer to use internally generated funds, rather than foreign indebtedness. Our results show, further, that French firms' operational (with foreign debt) and financial (with currency derivatives) hedging are two weakly related hedging tools.

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