

Market Risk For Foreign Currency Options: Basle's Simplified Model

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ABSTRACT

We show that capital charges for foreign currency options estimated using a standardized model proposed by Basle are not consistently related to value at risk (VAR). A standardized incremental model (SM) and a standardized value at risk (SVAR) model are proposed and compared to an internal model based on J.P. Morgan's RiskMetrics. We conclude it is possible to construct a standardized model that is as effective as an internal model, especially for small portfolios. Since inaccurate forecasting under internal models are now subject to penalties, some banks may prefer standardized models.

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EXECUTIVE SUMMARY

As banks world-wide expand beyond traditional lending activities, regulators have become concerned with banks' exposure to market risk. Market risk is defined as trading book losses resulting from changes in interest rates, exchange rates, and equity and commodity prices. In 1992, the Basle Committee on Banking Supervision of the Bank for International Settlements, in conjunction with banking regulators from the major industrialized countries, proposed setting aside capital to offset market risk that arises from trading fixed income, equity, foreign exchange, and commodities and their derivatives, in addition to charges already imposed for credit risk. Our paper focuses on the standardized model that Basle has proposed to measure the market risk of foreign currency options. Banks have generally been opposed to the use of standardized models. They have argued that their own internal models, which are specifically tailored to their portfolios' composition, are superior. In this paper, we propose and compare a standardized model tailored to portfolio characteristics with Basle's standardized model and also to an internal model based on J.P. Morgan's (1995) Risk Metrics. We conclude that it is possible to design a standardized model that is simple to apply but, like the internal model, can be tailored to specific portfolios.

One implication of our results is that banks should not reject the use of standardized models without careful consideration. Standardized models can be easier to use and less expensive to apply than internal models, and could be as effective as an internal model. New regulations by the Federal Reserve Board (1996) penalize banks that use internal models if they inaccurately forecast VAR. However, when a standardized model is applied, the burden of forecasting market risk is shifted to regulators, thus offering an additional benefit to banks.

Basle now permits the use of internal models that are pre-approved by local regulators. However, it is not clear whether the use of complex internal models in place of simpler standardized models will benefit banks by providing better VAR estimates and/or generating lower capital requirements. Since it is possible to construct options by using a combination of two or more assets, any capital required for options should also apply to synthetic options. We estimate capital charges for options and their synthetic equivalents for varying exchange rates. Our analysis identifies several

inconsistencies in Basle's model: (1) options and synthetic options with identical payoffs have different capital charges; (2) capital charges are not always systematically related to VAR; and (3) capital charges for puts and calls with the same VAR differ. We propose two alternative models, the standardized incremental model (SIM) and the standardized value at risk model (SVAR), that consistently relates capital charges to VAR. In the SIM model, charges equal a fixed proportion of a contract's current payoffs. Although this model is relatively simple, its usefulness is limited, because inputs are restricted to an option's current intrinsic or market value, with no consideration of expected future prices. The SVAR model is nearly as simple as the SIM model, yet it incorporates a forecast of future option prices.

To determine whether the Basle, SIM or SVAR models charges differ significantly, we compare them an internal model based on J.P. Morgan's RiskMetrics, which is a popular model used to measure VAR. Comparison of the three models also clarifies whether standardized models significantly differ from internal ones. Capital charges are estimated for a hypothetical option portfolio, where the underlying asset is the British pound and charges are generated from market data supplied by J.P. Morgan as well as newspaper prices. The results show that capital charges estimated under Basle's simplified model are the highest, while SIM's are the lowest. SVAR model charges are very similar to those estimated under the internal model. We conclude it is possible to construct a standardized model that is as effective as an internal model, thus offering some banks the opportunity to benefit from standardized models.

Market Risk For Foreign Currency Options: Basle's Simplified Model

In 1988, the Basle (Switzerland) Committee on Banking Supervision of the Bank for International Settlements established minimum capital requirements for credit risk for financial institutions. Their objectives were to (a) strengthen the safety and soundness of the international banking system, and (b) to ensure a level playing field among international banks (see Basle, 1988).

One risk of major concern to regulators that was not addressed in the 1988 Accord was market risk, the losses resulting from adverse market moves such as changes in interest rates, exchange rates, and equity and commodity prices.¹ To address this concern, beginning in 1992, Basle began the process of establishing guidelines that require banks to set aside capital to protect against market risk. According to these guidelines, implemented in December 1997, banks must choose either a standardized model proposed by Basle or their own internal model to determine capital requirements.

Because corporate use of FX currency derivatives to manage exchange risk exposure has increased over the years, with banks dominating the over-the-counter (OTC) markets (see Bodnar et.al., 1995, 1996, and Phillips, 1995), our paper focuses on one of Basle's standardized models, the simplified model, for estimating capital charges for over-the-counter foreign currency (FX) options.²

Basle originally proposed the use of standardized models only, which were strongly criticized by banks. Banks claimed their sophisticated internal models provided more reliable forecasts of market risk or value at risk (VAR). It was only after receiving these and other public comments did Basle permit the use of internal models as long as they were approved by local regulators. Consequently, the Federal Reserve Board (Fed), in a 1996 ruling, required all U.S. banks to use internal models for estimating market risk. The new ruling requires banks with trading activity exceeding either 10% of their assets or in excess of one billion dollars to develop their own internal models (See Federal Reserve System, Press Release, August 1996). Although the Fed's ruling eliminated the use of standardized

¹ Two other risks of concern to regulators not covered in the 1988 Accord are interest rate risk and payments system risk.

² Basle expects the model to be used primarily by banks that are option buyers. They have also proposed two intermediate models, the delta-plus and scenario models, to be used by banks that write options and/or hold complex option portfolios. See Basle, 1993, 1995, and 1996 for a description of these models for determining capital charges.

models, with a minor exception for estimating specific risk for debt and equity instruments, local regulators in other countries, including Canada, Japan and the European Union, permit the use of standardized models. One advantage offered by standardized models is that the burden of modeling VAR is borne by regulators, not banks. New backtesting rules for internal models, which penalize banks for inaccurate forecasting of VAR, could encourage banks to reexamine the benefits of standardized models.

Our paper shows that Basle's current simplified model for foreign currency options does not systematically relate capital requirements to market risk. We offer two alternative models, the Simplified Incremental model (SIM) and the Simplified Value at Risk Model (SVAR). We compare these models to an internal model based on RiskMetrics (RM), a risk management system developed by J.P. Morgan (1995) to measure and manage market risk and show that it is possible to develop a standardized model that can be as effective as an internal model.

In Section 1, we describe Basle's guidelines for setting capital requirements for foreign currency options and show that charges are not consistently related to VAR. In Section II, we define the SIM and SVAR models. In Section III we compare the three models to an internal model. Section IV concludes the paper with a discussion of the results.

I. Capital Requirements for Foreign Currency Options: Basle's Simplified Model

In this section, we explain how capital charges are estimated under Basle's simplified model. Banks that use the simplified model can combine the underlying currency with a long put or call when estimating capital charges, or they can consider each position separately. In parts A and B, we describe how capital charges are estimated when cash positions and naked options are considered separately. In part C, we demonstrate how charges are estimated when the positions are considered together. Part D shows that changes and VAR are not consistently related.

A. Capital Requirements for Underlying Cash Positions

Estimation of capital charges for cash positions in foreign currency first requires the bank to determine its net position in each currency after the foreign currency is translated into local currency.

Net long (short) positions are then summed across currencies and a capital charge of 8% is levied on the larger of the two positions.

For example, assume a bank is net long \$150 million in Japanese yen (Y), \$300 million in German marks (DM), and is net short \$200 million in British pounds (£) and \$125 million in Swiss francs (fr-), for a total net long position of \$450 million and a total net short position of \$325 million. Basle requires a capital charge of 8% on \$450 million, the higher of the two amounts, i.e. \$36 million.

A positive feature of this method is that it recognizes that changes in the values of long and short positions in the same currencies offset one another. However, this method also assumes that the correlation across currencies within each long or short group is plus one, which could be unrealistic.

B. Capital Requirements for Long (Naked) Call and Put Options

If the bank holds only long positions in options which are not part of a hedged position, i.e. they are naked, the associated capital charges are the lesser of 8% of the market value of the underlying currency or the market value of the option (see Table 1). Capital charges levied on options are added to the charges on the underlying positions in foreign currency, if any.

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Table 1. Breakdown of Payoffs and Capital Charges for Long (Naked) Call and Put Options and their Equivalents as specified under Basle's April 1995 Proposals for the Simplified Model.

Capital charges are as follows: Long Call, lesser of $[(0.08 * S), V + \Psi]$; Long Underlying and Long Put (call equivalent), greater of $[(0.08 * S) - V, 0]$; Long Put, lesser of $[(0.08 * S), V + \Psi]$; Short Underlying and Long Call (put equivalent), greater of $[(0.08 * S) - V, 0]$; The charges in the table are based on a time premium of 0, so that market prices and intrinsic values are equal.

Cash Value	Long Call		Call Equivalents		Long Put		Put Equivalents	
	Payoff	Capital Charge	Payoff	Capital Charge	Payoff	Capital Charge	Payoff	Capital Charge
$S < X/1.08$	0	0	X	0	X-S	0.08*S	-S	0.08*S
$X/1.08 \leq S < X$	0	0	X	$0.08 * S - (X - S)$	X-S	X-S	-S	0.08*S
$X \leq S < X/.92$	S-X	S-X	S	0.08*S	0	0	-X	$0.08 * S - (S - X)$
$S \geq X/.92$	S-X	0.08*S	S	0.08*S	0	0	-X	0

S = the spot price of the underlying currency

X = the exercise price of the option

$V + \Psi$ = the option's market value

V = option's intrinsic value: Max (S-X,0) for calls and Max (X-S,0) for puts

Ψ = is the option's time premium.

C. Capital Requirements for Carved Out Positions

Under the simplified model, banks can choose to separate options and matching cash positions from the rest of their currency portfolios, i.e. "carve out" their positions to estimate their capital

requirements. Banks are permitted to carve out long puts with matching long currency positions and long calls with matching short positions in currency, essentially hedging the cash position with options. The payoffs of the hedged positions mimic those of a naked call and put, respectively, and are referred to in our paper as "call equivalents" or "put equivalents." Capital charges are based on this carved out position, rather than on the risk of the two individual positions. For combined positions, capital charges are the largest of 8% of the market value of the underlying currency minus the option's intrinsic value or zero (See Table 1). Banks can choose not to carve out if capital charges are lower when estimated separately for the option and underlying currency (See Huckins and Rai, 1996 for details). Also, banks can decide not to carve out if they hold long calls (puts) and are long (short) the underlying currency.

D. Problems with Basle's Simplified Model

Although the simplified model is easy to use because it bases capital charges either on a position's intrinsic value, its market value, or a combination thereof, it presents three problems. For equal increments in current market values or payoffs, options and option equivalents have different capital charges, capital charges are not monotonic, and absolute levels of capital charges for puts, calls, and their equivalents are not equal.

1. Options and Option Equivalents Have Different Capital Charges

We illustrate the differences in capital charges for calls and call equivalents in Figure 1. We base our graph on the numerical example shown in Table 2. In the example, we assume that a foreign currency (FC) contract with an exercise price of \$1.50 has a notional value of FC 100,000. For clarity, we assume the options' time premiums equal zero. This assumption is relaxed in Section III.

A comparison of Columns 4 and 8 in Table 2 shows that the payoffs of call options and call equivalents differ by a constant amount, \$150,000 (X). For the call equivalent, X represents a constant payoff obtained by exercising the in-the-money put embedded in the combined position. The put places a lower bound of \$150,000 on the position's payoff, which then becomes insensitive to market risk. As a result, the market risk of calls and call equivalents is the same, given equal incremental payoffs.

Note that in our paper, incremental payoffs equal the difference between a position's market or intrinsic value and its lower bound. Figure 1 shows that when $X \leq S \leq X/0.92$, charges for long calls increase dollar for dollar with payoffs (slope=1.0), charges for call equivalents increase by \$0.08 (slope=0.08). When $X/1.08 \leq S \leq X$, charges for long calls are zero and those for call equivalents increase by \$1.08 per dollar change in the spot (Table 2, Columns 7 and 10) even as payoffs remain constant.

Similar problems occur for puts and put equivalents. In put equivalents, the call places a bound of $-X$ on the cost of covering the short position. If the call is in the money ($S > X$), risk from adverse changes in the market is zero. Whenever $S < X$, incremental payoffs are $X-S$ because $-X$ is never exposed to market risk. As shown in Figure 2, when $X < S \leq X/0.92$, charges for long puts are zero, but because payoffs vary inversely with the spot, those for put equivalents decline by $-\$0.92$. When $X/1.08 \leq S < X$, charges for long puts decrease dollar for dollar with decreasing payoffs, but those for put equivalents increase at a rate of \$0.08. Inexplicably, when $S \leq X/1.08$, capital charges for put and put equivalents increase at a rate of \$0.08 when payoffs are failing.

One source of the difference in charges for options and option equivalents is Basle's inclusion of counterparty risk when $X \leq S < X/0.92$ for calls and $X/1.08 \leq S < X$ for puts.³ In this range, charges for option equivalents are based on the positions' total, not incremental, payoffs. To illustrate this for calls, Table 2, Column 6, shows charges based on the total payoffs of call equivalents. Note that when $S = X$, capital charges in Columns 6 and 7 are equal. However, for $S < X$, capital charges in Column 7 are lower, because counterparty risk is not considered. If Basle's intention is to include counterparty risk, it is not clear why it should be considered for a limited price range.

2. Capital Charges Are Not Monotonic

The second problem with the Basle proposal is that for the same incremental change in payoffs, capital charges for long options and option equivalents do not increase monotonically in every price range. As Table I and Figure I show, capital charges for options and option equivalents jump at two different points without any economic rationale. For long calls (puts), charges jump from 0 to $S-X$

$(X-S)$ at $S=X$, and a second time to $0.08*S$ when $S>X/.92$ ($S<X/1.08$). For call equivalents, capital charges jump from zero to $0.08*S - (X-S)$ at $S=X/1.08$ and to $0.08*S$ when $S=X$. Similarly, capital charges for put equivalents jump from zero to $0.08*S - (S-X)$ at $S=X/.92$ and to $0.08*S$ when $S=X$.

3. Absolute Level of Capital Charges Differ Between Puts and Calls

A third problem is that the absolute levels of capital required for puts, calls and their equivalents can differ even when the difference between a position's market value and its lower bound are equal ($S-X$ equals $X-S$). When $X/1.08 < S < X/.92$, the current model systematically requires more capital for calls and call equivalents than it does for puts and put equivalents. Thus, the bank is not equally protected against potential losses.

II. Alternatives to Basle's Simplified Model

In this section, we propose two alternatives to Basle's Simplified Model, which resolve the inconsistencies described earlier. Both models maintain the simplicity of Basle's model. These two models and Basle's model are compared to J.P. Morgan's RiskMetrics, a popular internal model.

A. The Simplified Incremental Model (SIM)

The SIM model ensures that capital charges are consistently related to VAR. As in the Basle model, VAR equals a contract's marked to market value, a definition also used by the derivatives market to estimate margin requirements. In the SIM, capital charges equal a fixed proportion (α) of a contract's marked-to-market value. The charges are shown in Table 2, Columns 5 and 9, where we assume the time premium equals zero and α is fixed at 8%, as is assumed by Basle. Capital charges for in-the-money long calls and call equivalents are equal and proportional to $S-X$, which is each position's incremental payoff (from its lower bound). When calls are out of the money and the incremental loss is zero, capital charges also equal zero. Similarly, we can show that when capital charges for in-the-money puts and put equivalents equal $\alpha (X-S)$, charges for out-of-the money puts and put equivalents equal zero. Therefore, capital charges under this model are consistently related to VAF and charges for options and option equivalents are equal. ideally, the parameter (α) should be determined by individual

³ Counterparty risk is considered under the 1988 Basle Accord in which banks are required to set aside capital for off-balance sheet and derivative instruments (see Basle, 1988). As of August 1995, limited

banks, be a function of a portfolio's risk, and range from zero to one. Thus, the SIM model offers the advantage of simplicity, but its efficacy depends on a bank's choice of (α).

B. The Simplified Value at Risk Model

The SVAR model extends the SIM by incorporating both price and volatility risk so that charges reflect the nonlinear characteristics of options, as required by Basle. Since price risk varies with an option's moneyness, we use X/S as a proxy for price risk, where X equals an option's exercise price, and S represents the currency's spot price. As a proxy for volatility risk, we use the standard deviation of the underlying currency (α). In the SVAR model, we link capital charges and contract specific risk by setting $\alpha = X/S * \sigma$. Defining α in this manner ensures that capital charges increase with the underlying currency's volatility and decrease as a proportion of contract value as the option's moneyness rises. The results are presented in Table 3 and will be discussed in Section 111.

C. J.P. Morgan RiskMetrics' (RM) Internal Model

We assess the effectiveness of the SIM, SVAR and Basle models by comparing their charges to those determined by an internal model, which serves as a benchmark for comparison. Internal models are tailored to each institution's portfolio, incorporate a relatively complex measure of VAR, and must satisfy Basle's quantitative and qualitative standards.

The simplified and internal models are further differentiated by their definitions of VAR. In internal models, VAR equals a position's expected maximum loss for a given probability over a specified period of time, but in the simplified models, VAR equals a contract's marked-to-market value.⁴

Basle's qualitative standards pertain to the procedural aspects of risk management. The quantitative standards pertain to market risk measurement. Since our paper focuses on risk measurement, we discuss only quantitative standards.

Briefly, Basle's quantitative standards for options require banks to estimate VAR on a daily basis, using a 99th percentile, one-tailed confidence interval, i.e., a loss of a given magnitude should occur only 1% of the time. VAR estimates must also be based on a ten-day holding period that must be approximated from at least one year of data. Data sets must be updated at least once every three months.⁵

Banks are also required to recognize the nonlinear characteristics of option contracts. Specifically, models must incorporate an option's price and volatility risk by examining the underlying currency's risk characteristics.

The internal model estimated here is based on a parametric model presented in the 1995 J.P. Morgan RiskMetrics' Technical Document. Parametric models make distributional assumptions and require the use of an option pricing model such as the Black-Scholes (1973) model. Nonparametric models, which are distribution free, simulate expected future losses under different scenarios.

In our paper, we use the Garman-Kohlhagen, (1983) model, a modified Black-Scholes model, to estimate FX option prices. According to the Garman-Kohlhagen model, an FX option's value depends on: the price (S) and volatility (σ^2) of the underlying currency, the option's exercise price (X),

⁴ For different views on the definition and measurement of VAR, see Dimson and Marsh, 1995; Hendricks, 1996; Mahoney, 1996; Marshall and Siegel, 1997; and Simons, 1996.

⁵ See Federal Reserve System, Press Release August 1996, for a detailed description of quantitative standards.

its maturity ($T-t$), and the difference in the foreign (r_f) and domestic (r_d) risk-free interest rates ($r_d - r_f$).

Specifically, a call option's price equals:

$$C = Se^{-rf(T-t)}N(d_1) - Xe^{-rd(T-t)}N(d_2)$$

Where

$$d_1 = \frac{\ln(S/X) + [(r_d - r_f) + .5 * \sigma^2] * (T-t)}{\sigma * \sqrt{T-t}}$$

Although the expected change in an option's value can be expressed as a function of all five parameters, Basle specifically requires that price and volatility risk be considered. A RiskMetrics' model which captures both risks shows the change in an option's value (dV) equals:

$$dV = \delta * dS + 1/2 * \Gamma * dS^2 + \Lambda * d\sigma \quad (2)$$

where dS = the expected change in the underlying currency's price
 $d\sigma$ = the expected change in the underlying currency's volatility
 $\delta = \delta V / \delta S$
 $\Gamma = \delta^2 V / \delta S^2$
 $\Lambda = \delta V / \delta \sigma$

The parameters δ , Γ , and Λ are derived from Equation (1). Specifically, $d\sigma$ is set to 0.01 and

$$dS = [\sigma / (250)^{.5}] * S \quad (3)$$

$$\delta = e^{-rf(T-t)} * N(d_1) \quad (4)$$

$$\Gamma = [N'(d_1) * e^{-rf(T-t)}] / [S * \sigma * (T-t)^{.5}] \quad (5)$$

$$\Lambda = e^{-rf(T-t)} * N'(d_1) * S * (T-t)^{.5} \quad (6)$$

III. Comparison of the Basle, SIM, SVAR and RM Models

We first compare the Basle and SIM models to the RM model by expanding the example from Section 1. The new example appears in Table 3. In the example, the British pound (£) replaces the general FC contract. The currency option we consider has a strike price of \$1.50 and a notional value of £100,000. The value of the underlying currency ranges from \$1.30 to \$1.70. We add estimates of

volatility, domestic and foreign interest rates, and time to expiration to the example, resulting in a positive time premium. Time to maturity is held constant at 0.25 years. We approximate interest rates by the one- year Eurosterling rate and the one- year Eurodollar rate, obtained from the *Financial Times* on January 7, 1998 ($r_f=7.3\%$, $r_d=5.7\%$). Sixty days of volatility estimates (from October 10, 1997 through January 2, 1998) for the British pound were obtained from J.P. Morgan's RiskMetrics regulatory set, which meets Basle's quantitative standards. J.P. Morgan bases these estimates on rolling ten-day holding periods, updates them daily, and multiplies them by 2.33. For this example, we obtain a sixty-day average volatility of 0.38 by dividing the daily estimates by 2.33 and averaging them. All Garman-Kohlhagen call prices and corresponding RM model charges appear in Table 3, Columns 4 and 8, respectively, and in Figure 3, together with the charges for the Basle, SIM, and RM models.⁶ Basle's charges are for long calls only. Charges for call equivalents remained unchanged from Table 2.

For every spot price, Basle's charges are highest and SIM charges are lowest. Basle's charges are equal to the contract's value until its value exceeds $0.08*S$. In contrast, RM model charges are always less than the contract's value (Column 5), but increase steadily as contract values rise. RM model charges are high relative to contract value when the option is out of the money, and decline proportionately as contract values rise, ranging from 70% of value ($S=\$1.30$) to 33% of value ($S=\1.70). The decreasing proportion reflects the reduction in the volatility of option returns as the option moves deeper into the money.

Although Basle's charges also decrease as a proportion of contract value when charges equal $0.08*S$, the charges themselves are no longer linked to the option's price and volatility risk. The magnitude of Basle's charges and the sizable difference between Basle's charges and RM model charges suggests that Basle model users set aside too much capital for market risk.

SIM model charges always equal 8% of the contract's value regardless of the option's price and volatility risk, and are significantly lower than RM model charges. Thus, setting an equal to a constant in the SIM might not be an effective method of estimating capital charges, nor does it appear that Basle's parameter of 8% is economically justified.

⁶ For Table 3, we re-estimate the simplified model and SIM charges to include a time premium. While inclusion of a time premium increases the charges, it has no impact on the earlier analysis.

Results are similar for put options and option equivalents. Figure 4 shows charges estimated under the Basle, SfM, and RM models. Again, Basle's charges are substantially higher than those from the other two models, even in the price ranges where charges vary inversely with VAR- SIM model charges are the lowest.

The model comparisons suggests SIM is only effective if a can vary with a position's price and volatility risk. Charges should rise with the contract's value but decrease proportionately as the option's moneyness increases. The SVAR model alleviates these problems.

Figure 3 and Table 3, Column 9, show the charges estimated under SVAR. For out-of-the-money options, SVAR model charges lie between SIM and RM model charges, with SIM charges substantially lower than the others. Differences in RM and SVAR charges decline as the option's moneyness increases. SVAR charges range from approximately 44% ($S=1.30$) to 34% ($S=1.70$). Redefining appears to increase the SVAR model's usefulness, because its charges then most closely approximate those of the RM model.

Figure 4 shows the similarity in put and call results. SVAR model charges are closer to RM model charges than are those from any other model. SVAR model charges are higher than RM model charges for out-of-the-money puts, but the differences decline as the option's moneyness increases.

Although linking a to price and volatility risk improves the SIM model, it is not clear how robust the measure is to changes in the determinants of option prices. Marshall and Siegel (1997) note that VAR estimates for FX options are sensitive to underlying parameter estimates for both parametric and nonparametric models.⁷ Therefore, we re-estimated RM and SVAR model charges and compared them over a range of values for volatility and for time to maturity. The results, which are not shown here, indicate that RM model charges are significantly higher than SVAR model charges when volatility is low, and that the differences diminish as volatility rises. On the other hand, SVAR model charges increase

⁷ Marshall and Siegel (1997) estimate VAR using a parametric model in which δ is held constant across all currency rates. RiskMetrics' models do not use a constant δ .

relative to RM model charges as time to maturity increases. In all cases, SVAR model estimates are closer to RM model estimates than are those from the SIM, which continue to be significantly lower.

IV. Conclusions

This paper shows that Basle's simplified model for estimating capital charges for FX options suffers from three problems. For equal changes in incremental payoffs, capital charges for options and option equivalents are not equal, capital charges are not monotonic, and the absolute level of capital charges differs for puts and calls.

We propose two alternatives to Basle's simplified model, the Simplified Incremental Model (SIM) and the Simplified Value at Risk (SVAR) model. The SIM modifies Basle's model by basing capital charges on a constant proportion of a contract's marked-to-market value. The SIM model alleviates the problems presented in the Basle model by systematically relating capital charges and VAR. The SVAR model links price and volatility risk to capital charges, using easily obtained parameters. The Basle, SIM and SVAR models are compared to an internal model, which is based on a J.P. Morgan's RiskMetrics' parametric model. We show that charges under the Basle model are substantially higher than those determined under the RM model. SIM charges are substantially lower than the RM or Basle model charges. In contrast, SVAR model charges approximate internal model charges better than do the charges from either the Basle model or the SIM.

One advantage of a standardized model is that its use shifts the burden of modeling VAR to regulators. This is particularly important if banks are penalized for inaccurate VAR forecasts due to new rules on backtesting. We conclude it is possible to construct a standardized model that is as effective as an internal model, thus offering some banks the opportunity to benefit from standardized models.

Although the example presented in this paper is for a single currency option, the results suggest that a well-designed, simplified model can be as effective as an internal model. Thus, it can be worthwhile for the banking industry and the Fed to re-examine their rejection of standardized models

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Table 2. Comparison of Capital Charges for Long Calls and Call Equivalents under the 1995 Basle Simplified Model, Total Payoff Model and the Standardized Incremental Model (SIM).

Long Calls = Naked calls. Call Equivalents = Long Underlying (Cash Positions) + Long Puts. The 1995 Basle simplified model is specified in Table 1. Total Payoff and SIM models are specified in Section 1, parts D and E, respectively. The following assumptions are used to derive the capital charges for a contract with a notional amount of 100,000 units of foreign currency (FC): Exercise price (X) = \$1.50 per unit of FC; time premium = 0, and $\alpha=0.08$ for Total Payoffs and SIM models.

			<i>CALL EQUIVALENTS</i>			<i>LONG CALLS</i>		
<i>Spot</i>	<i>Strike</i>	<i>Payoffs</i>	<i>Capital Charges: SIM Model</i>	<i>Capital Charges: Total Payoffs Model</i>	<i>Capital Charges: Basle Model</i>	<i>Payoffs</i>	<i>Capital Charges: SIM Model</i>	<i>Capital Charges: Basle Model</i>
<i>S < X/1.08</i>	<i>\$1.30</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$0.00	\$0.00	\$0.00
	<i>\$1.32</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$0.00	\$0.00	\$0.00
	<i>\$1.34</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$0.00	\$0.00	\$0.00
	<i>\$1.36</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$0.00	\$0.00	\$0.00
	<i>\$1.38</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$0.00	\$0.00	\$0.00
<i>X/1.08 ≤ S < X</i>	<i>\$1.3889</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$0.00	\$0.00	\$0.00
	<i>\$1.40</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$1,200.00	\$0.00	\$0.00
	<i>\$1.42</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$3,360.00	\$0.00	\$0.00
	<i>\$1.44</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$5,520.00	\$0.00	\$0.00
	<i>\$1.46</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$7,680.00	\$0.00	\$0.00
<i>X ≤ S < X/0.92</i>	<i>\$1.48</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$9,840.00	\$0.00	\$0.00
	<i>\$1.50</i>	<i>\$1.50</i>	\$150,000.00	\$0.00	\$12,000.00	\$12,000.00	\$0.00	\$0.00
	<i>\$1.52</i>	<i>\$1.50</i>	\$152,000.00	\$160.00	\$12,160.00	\$12,160.00	\$2,000.00	\$160.00
	<i>\$1.54</i>	<i>\$1.50</i>	\$154,000.00	\$320.00	\$12,320.00	\$12,320.00	\$4,000.00	\$320.00
	<i>\$1.56</i>	<i>\$1.50</i>	\$156,000.00	\$480.00	\$12,480.00	\$12,480.00	\$6,000.00	\$480.00
	<i>\$1.58</i>	<i>\$1.50</i>	\$158,000.00	\$640.00	\$12,640.00	\$12,640.00	\$8,000.00	\$640.00
<i>S ≥ X/0.92</i>	<i>\$1.60</i>	<i>\$1.50</i>	\$160,000.00	\$800.00	\$12,800.00	\$12,800.00	\$10,000.00	\$800.00
	<i>\$1.62</i>	<i>\$1.50</i>	\$162,000.00	\$960.00	\$12,960.00	\$12,960.00	\$12,000.00	\$960.00
	<i>\$1.6304</i>	<i>\$1.50</i>	\$163,043.48	\$1,043.48	\$13,043.48	\$13,043.48	\$13,043.48	\$1,043.48
	<i>\$1.64</i>	<i>\$1.50</i>	\$164,000.00	\$1,120.00	\$13,120.00	\$13,120.00	\$14,000.00	\$1,120.00
	<i>\$1.66</i>	<i>\$1.50</i>	\$166,000.00	\$1,280.00	\$13,280.00	\$13,280.00	\$16,000.00	\$1,280.00
	<i>\$1.68</i>	<i>\$1.50</i>	\$168,000.00	\$1,440.00	\$13,440.00	\$13,440.00	\$18,000.00	\$1,440.00
	<i>\$1.70</i>	<i>\$1.50</i>	\$170,000.00	\$1,600.00	\$13,600.00	\$13,600.00	\$20,000.00	\$1,600.00

Table 3. Comparison of Capital Charges for Long Calls under the 1995 Basle Simplified Model, Standardized Incremental Model (SIM), J.P. Morgan's RiskMetrics Model (RM) and the Standardized Value at Risk Model (SVAR).¹

Table 3 differs from Table 2 because we use the Gorman-Kohlhagen (G-K) Model to estimate call prices, i.e. the time premium is positive. J.P. Morgan's RiskMetrics and SVAR models are specified in Section II, parts A and B, respectively. The absolute value of capital charges are based on the following assumptions: Notional value = £100,000, exercise price = \$1.50/£, volatility (σ)=0.38 (estimate obtained from J.P. Morgan's RiskMetrics database), time to maturity = 0.25, foreign risk-free rate (r_f)= 7.3%, domestic risk-free rate (r_d)=5.6% (all interest rates obtained from the *Financial Times* (January 7, 1998)).

Capital Charges for both Long Calls and Call Equivalents								
	Spot	Strike	Call Price G-K	Value Long Calls	Capital Charges SIM Model	Capital Charges Basle Model	Capital Charges RM Model	Capital Charges SVAR Model
$S < X/1.08$	\$1.30	\$1.50	\$0.033	\$3,274.63	\$261.95	\$3,274.63	\$2,312.13	\$1,435.71
	\$1.32	\$1.50	\$0.038	\$3,787.96	\$303.04	\$3,787.96	\$2,566.03	\$1,635.71
	\$1.34	\$1.50	\$0.044	\$4,353.68	\$348.29	\$4,353.68	\$2,830.15	\$1,851.94
	\$1.36	\$1.50	\$0.050	\$4,973.14	\$397.25	\$4,973.14	\$3,103.15	\$2,084.33
	\$1.38	\$1.50	\$0.056	\$5,647.57	\$451.81	\$5,647.57	\$3,383.62	\$2,332.69
$X/1.08 \leq S < X$	\$1.40	\$1.50	\$0.064	\$6,377.88	\$510.23	\$6,377.88	\$3,670.11	\$2,596.71
	\$1.42	\$1.50	\$0.072	\$7,164.66	\$573.17	\$7,164.66	\$3,961.20	\$2,875.95
	\$1.44	\$1.50	\$0.080	\$8,008.16	\$640.65	\$8,008.16	\$4,255.44	\$3,169.90
	\$1.46	\$1.50	\$0.089	\$8,908.34	\$712.67	\$8,908.34	\$4,551.44	\$3,477.92
	\$1.48	\$1.50	\$0.099	\$9,864.89	\$789.19	\$9,864.89	\$4,847.88	\$3,799.31
$X \leq S < X/0.92$	\$1.50	\$1.50	\$0.109	\$10,877.13	\$870.17	\$10,877.13	\$5,143.51	\$4,133.31
	\$1.52	\$1.50	\$0.119	\$11,944.16	\$955.53	\$11,944.16	\$5,437.16	\$4,479.06
	\$1.54	\$1.50	\$0.131	\$13,064.85	\$1,045.19	\$12,320.00	\$5,727.78	\$4,835.69
	\$1.56	\$1.50	\$0.142	\$14,237.89	\$1,139.03	\$12,480.00	\$6,011.44	\$5,202.31
	\$1.58	\$1.50	\$0.155	\$15,461.77	\$1,236.94	\$12,640.00	\$6,296.29	\$5,577.98
	\$1.60	\$1.50	\$0.167	\$16,734.78	\$1,338.78	\$12,800.00	\$6,572.64	\$5,961.76
$S \geq X/0.92$	\$1.62	\$1.50	\$0.181	\$18,055.09	\$1,444.41	\$12,960.00	\$6,842.88	\$6,352.72
	\$1.64	\$1.50	\$0.194	\$19,420.78	\$1,553.66	\$13,120.00	\$7,106.53	\$6,749.91
	\$1.66	\$1.50	\$0.208	\$20,829.84	\$1,666.39	\$13,280.00	\$7,363.23	\$7,152.42
	\$1.68	\$1.50	\$0.223	\$22,280.21	\$1,782.42	\$13,440.00	\$7,612.71	\$7,559.36
	\$1.70	\$1.50	\$0.238	\$23,769.79	\$1,901.58	\$13,600.00	\$7,854.78	\$7,969.87

¹Note that under the SIM, J.P. Morgan's RiskMetrics and SVAR models, charges are the same for long call and call equivalents. Charges for long calls and call equivalents are the same under Basle only when $S > X/0.92$.

FIGURE 1**Comparison of Capital Charges for Long Calls and Call Equivalents under the 1995 Basle Simplified Model**

The estimation of capital charges under the 1995 Basle simplified model is specified in Table 1. Long Calls = Naked calls. Call Equivalents = Long Underlying (Cash Positions) + Long Puts. The capital charges below are similar to Table 2 where the following assumptions are used: 100,000 units of foreign currency (FC), exercise price = \$1.50 per unit of FC, and time premium = 0.

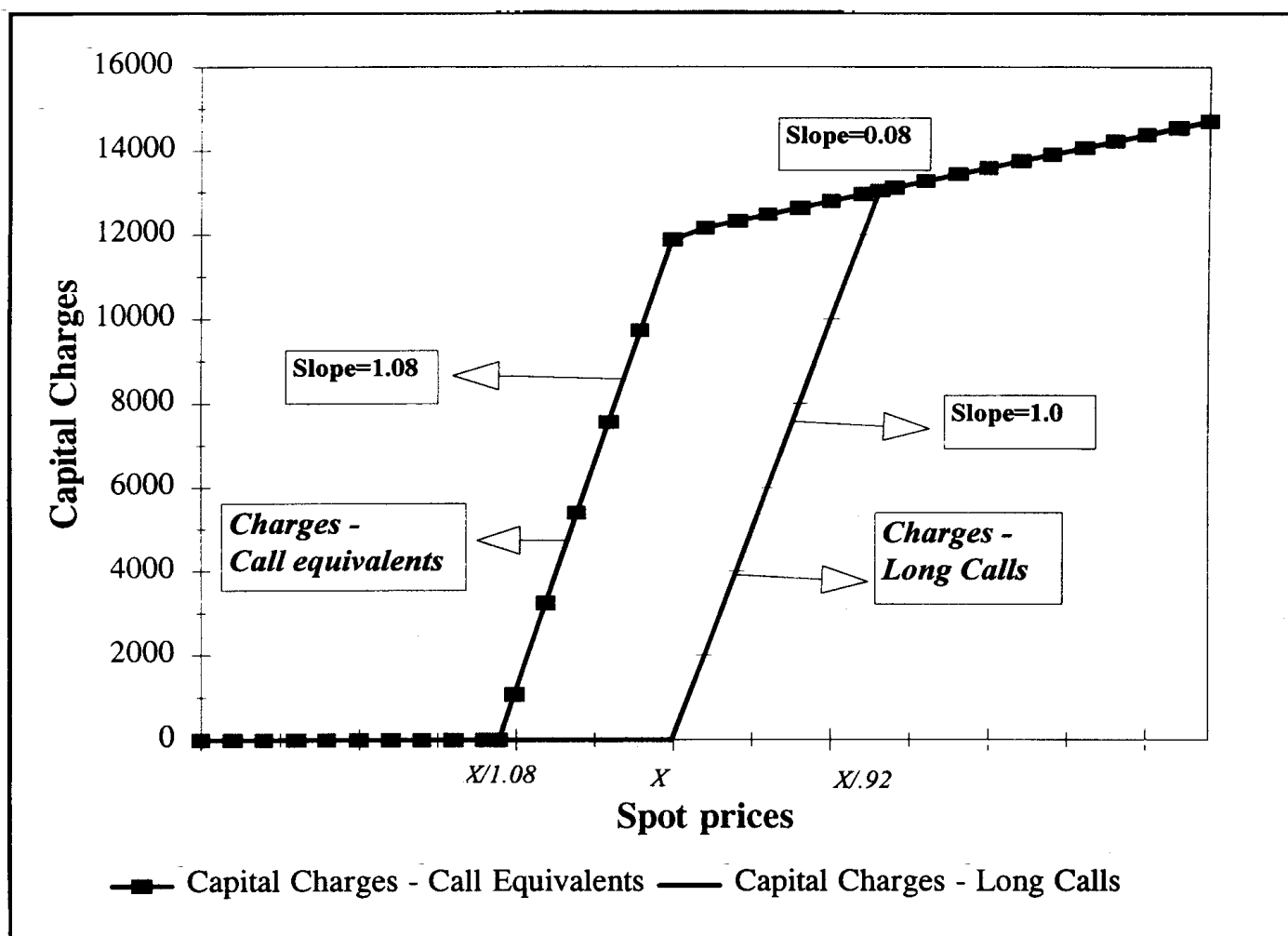


FIGURE 2**Comparison of Capital Charges for Long Puts and Put Equivalents under the 1995 Basle Simplified Model**

The estimation of capital charges under the 1995 Basle simplified model is specified in Table 1. Long Puts = Naked puts. Put Equivalents = Short Underlying (Cash Positions) + Long Calls. The capital charges below are based on the following assumptions: 100,000 units of foreign currency (FC), exercise price = \$1.50 per unit of FC and time premium = 0.

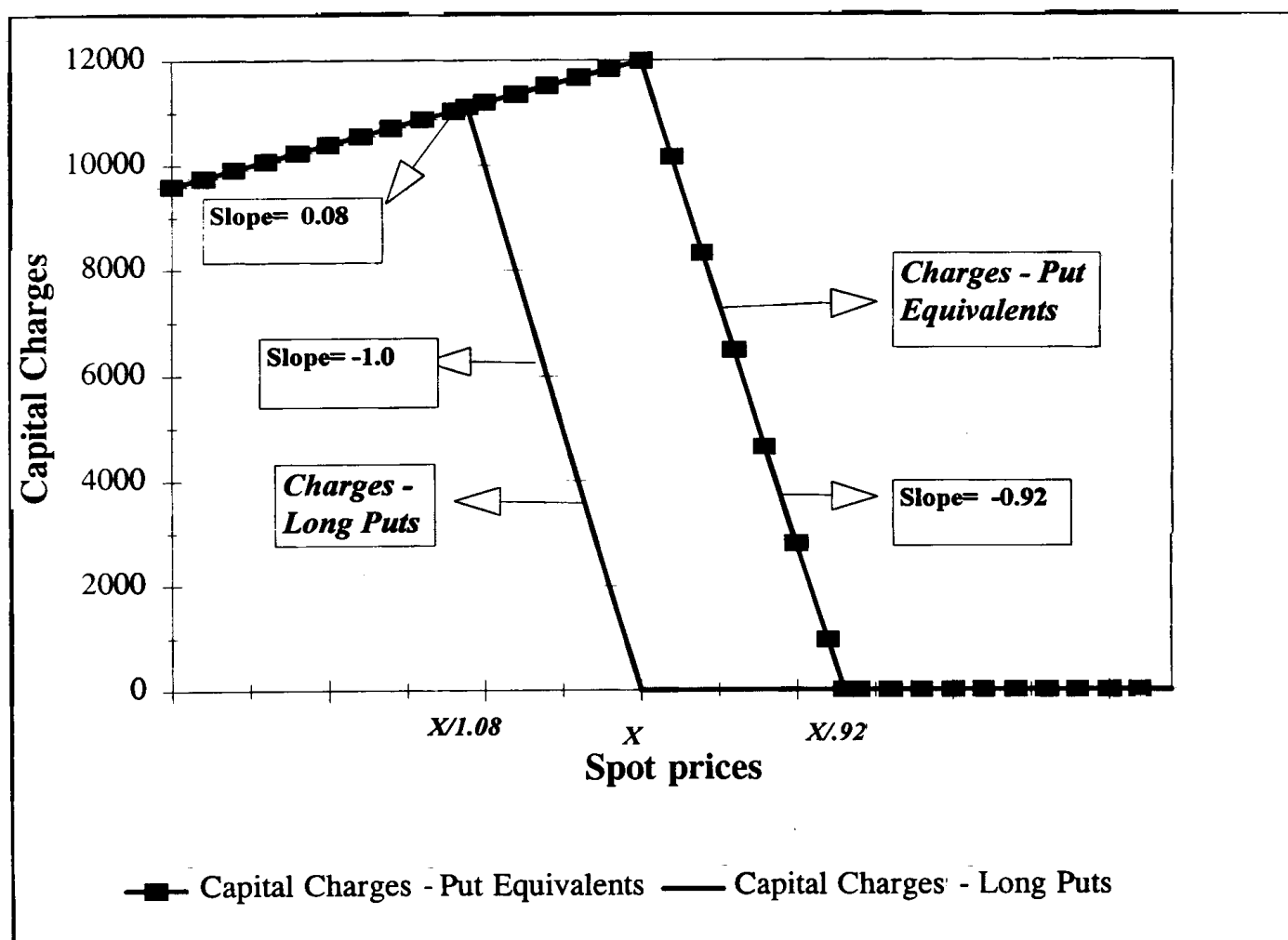


Figure 3

Comparison of Capital Charges for Long Calls under the 1995 Basle Simplified Model, Standardized Incremental Model (SIM), J.P Morgan's RiskMetrics Model (RM) and the Standardized Value at Risk (SVAR).

Figure 3 is based on Table 3. We use the Gorman-Kohlhagen (G-K) Model to estimate call prices, i.e. the time premium is assumed positive for all models. RM and SVAR models are specified in Section II, parts A and B, respectively. The absolute value of capital charges are based on the following assumptions: Notional value = £100,000, exercise price = \$1.50/£, volatility (σ) = 0.38 (estimate obtained from J.P. Morgan's RiskMetrics database), time to maturity = 0.25, foreign risk-free rate (r_f) = 7.3%, domestic risk-free rate (r_d) = 5.6% (all interest rates obtained from the *Financial Times* (January 7, 1998)).

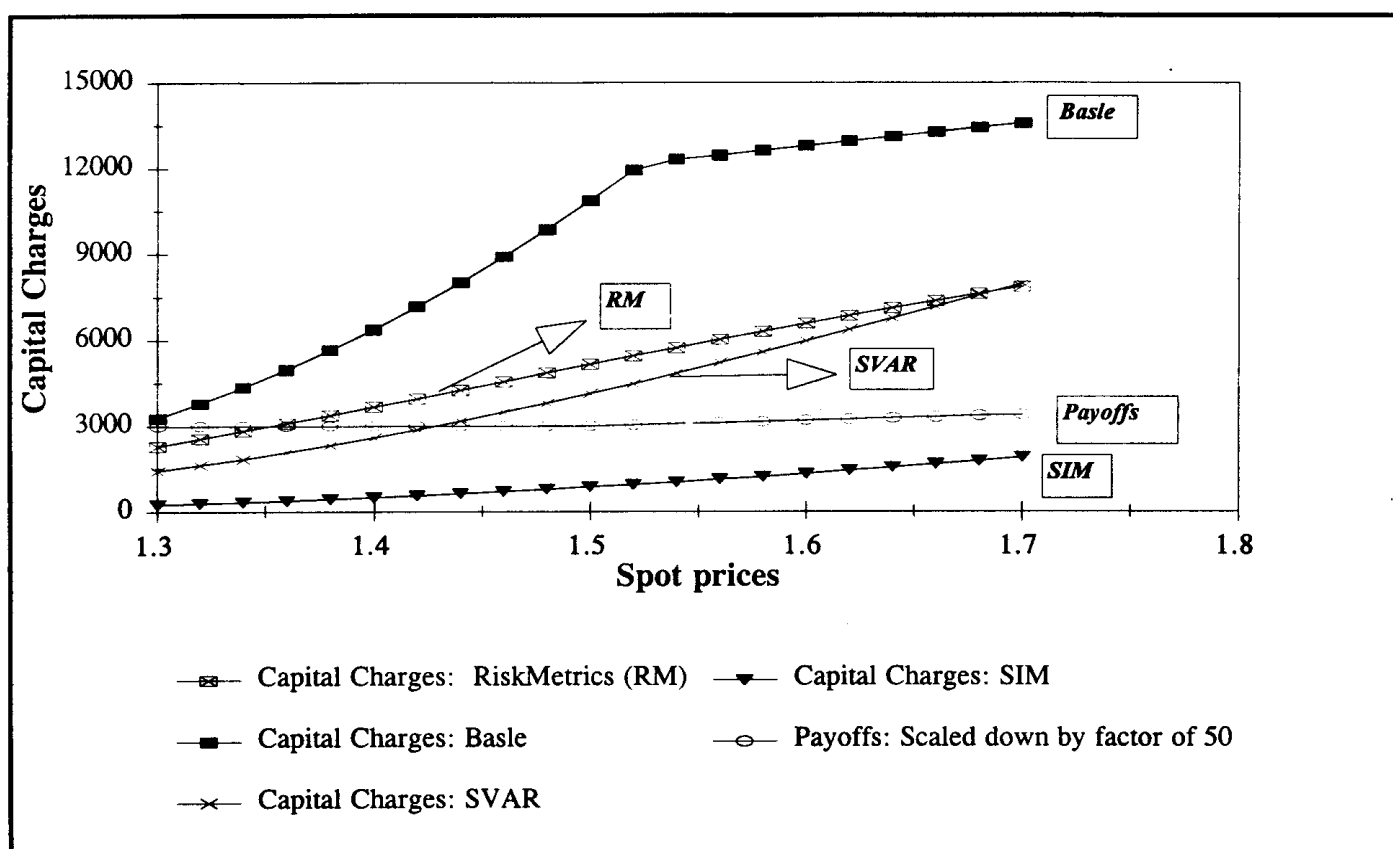


Figure 4

Comparison of Capital Charges for Long Puts under the 1995 Basle Simplified Model, Standardized Incremental Model (SIM), J.P. Morgan's RiskMetrics Model (RM) and the Standardized Value at Risk (SVAR).

We use the Gorman-Kohlhagen (G-K) Model to estimate put prices, i.e. time premium is assumed positive for all models. RM and SVAR models are specified in Section II, parts A and B, respectively. The absolute value of capital charges are based on the following assumptions: Notional value = £100,000, exercise price = \$1.50/£, volatility (σ)=0.38 (estimate obtained from J.P. Morgan's RiskMetrics database), time to maturity = 0.25, foreign risk-free rate (r_f)= 7.3%, domestic risk-free rate (r_d) = 5.6% (all interest rates obtained from the *Financial Times* (January 7, 1998)).

