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Incentive Properties of Pricing Modifications P74 & P78

Introduction

This paper focuses on the incentives to over or under contract inherent in the present arrangements and modification proposals P74 and P78. For simplicity, the analysis only considers the position of a supplier (generators must also consider the risk of plant breakdown and the potential for of bids/offers to be accepted and alter cash flows).

Existing Arrangements

When a participant sells energy, they gain the benefit of the Power Exchange Price, but take on a liability to SBP if they are subsequently short, and lose the income from SSP if they are long. The costs and benefits are reversed for a participant buying energy.

Defining P^s = the probability that the participant is ultimately short against their account, this can be expressed as:

$$\text{Gain} = PXP - P^s SBP – (1- P^s) SSP$$

Logically, a participant will trade up the point where there is no gain from further trading, i.e.

$$PXP - P^s SBP – (1- P^s) SSP = 0$$

Implies: $PXP - P^s SBP – SSP + P^s SSP = 0$

$$PXP-SSP = P^s (SBP – SSP)$$

$$P^s = \frac{PXP-SSP}{SBP-SSP} = \frac{1-(SSP/PXP)}{(SBP/PXP) – (SSP/PXP)}$$

The final version lends itself to a graphical representation using two variables: SBP expressed as a factor of PXP and SSP expressed as a factor of PXP. (See Figure 1) This illustrates how the current arrangements provide a strong incentive for participants to avoid being “short” so long as SBP is markedly greater than PXP. Figure 2 shows the same graph, viewed from above, and marked up with data points representing the actual half-hourly values of SBP, SSP and PXP for April 2002.

As an estimate of the optimum strategy for the month as a whole, the average of SBP, SSP and PXP were calculated (ignoring the periods when either imbalance price was set by the defaulting rules) and fed into the above equation for P^s. The resulting value for the probability of a supplier going short in April was equal to 0.26.

P74 Analysis

This time the value of the cash out prices depends on market length i.e. if the market is short both surpluses and deficits are cashed out at SBP, whilst if the market is long, both are cashed out at SSP. This makes the analysis more complex.

The following analysis assumes that probability of the market as a whole being short is independent of the strategy adopted by a single player. This ignores the second order effect that as an individual participant increases their length, they will drive up the probability of the market as a whole being long. A participant altering their length will also alter the imbalance prices. (This latter point also applies equally well to the current arrangements and P78)

Defining P^{ms} = the probability that the market as a whole is short, the equation for a supplier selling energy now becomes:

$$\text{Gain} = PXP - P^{s} P^{ms} SBP – (1- P^{s}) P^{ms} SBP – (1- P^{s}) (1- P^{ms}) SSP - P^{s} (1- P^{ms}) SSP$$

$$= PXP - P^{ms} SBP - (1- P^{ms}) SSP$$

Or, in words, the participant is driven by overall market length with no incentive to balance their own position. The second order affects described above will, however, provide some incentive to balance, for example as a participant spills increasing volumes, they will tend to drive down the imbalance price and increase the likelihood that the overall market will be long. P74 will therefore act to reduce the current market length, but will tend to be less stable as participants individually forecast market imbalance and then act to reduce it.

P78 Analysis

Again the analysis has to cover different cash out prices. In this case surpluses against a short market and deficits against a long market are cashed out at the market price. For simplicity, in this analysis, the market price has been considered as equal to PXP.

$$\text{Gain} = PXP - P^{s} P^{ms} SBP - (1- P^{s}) (1- P^{ms}) SSP – P^{s} (1- P^{ms}) PXP - (1- P^{s}) P^{ms} PXP$$

As for the existing arrangements, a participant will trade until the gain is zero, i.e.

$$0 = PXP - P^{s} P^{ms} SBP - (1- P^{s}) (1- P^{ms}) SSP – P^{s} (1- P^{ms}) PXP - (1- P^{s}) P^{ms} PXP$$

Multiplying out the brackets:

$$0 = PXP - P^{s} P^{ms} SBP – SSP + P^{s} SSP + P^{ms} SSP - P^{s} P^{ms} SSP – P^{s} PXP + P^{s} P^{ms} PXP - P^{ms} PXP + P^{s} P^{ms} PXP$$

Implies that:

$$PXP - SSP + P^{ms} SSP - P^{ms} PXP = P^{s} P^{ms} SBP - P^{s} SSP + P^{s} PXP + P^{s} P^{ms} SSP – P^{s} P^{ms} PXP - P^{s} P^{ms} PXP$$

$$(PXP – SSP)(1- P^{ms}) = P^{s} (P^{ms} SBP - SSP + PXP + P^{ms} SSP – P^{ms} PXP - P^{ms} PXP)$$

$$P^{s} = \frac{(PXP – SSP)(1- P^{ms})}{}$$

$$P^{ms}\,SBP - (1- P^{ms})SSP + (1- 2P^{ms})PXP$$

Compared to the equivalent equation for the current arrangements, this contains a new variable P^{ms}. Hence it can be represented as a series of graphs. Each graph takes a particular value of P^{ms} and considers the impact of altering SBP and SSP; both expressed as a factor of PXP. (See Figure 3) This demonstrates that the incentives on an individual participant alter in response to variations in market length, in a manner that will tend to move the market closer to a balance. It can be seen that for the same market prices (SBP/PXP and SSP/PXP), as the market as a whole lengthens, the incentive on a participant to go short increases progressively. Thus P78 will act to reduce system imbalance.

The altered incentive properties can be demonstrated by applying the P78 regime to the actual price data from April 2002 and using a value of 0.15 for P^{ms} (the historical value from go-live up to the end of May 2002). The analysis shows that the optimum probability of a supplier going short moves from the current value of 0.26 up to 0.72. This indicates that against the long system such as existed in April there an incentive for participants to err on the side of going short. Such an incentive raises concerns that the pricing could become unstable. However, looking at Figure 3(c), it can be seen that the incentive properties of a market that is equally likely to be short or long (i.e. P^{ms}=0.5) are identical to the present arrangements. It follows that whilst the present length of the market will tend to make participants go shorter, a balanced market will recreate the present incentive to go long. This implies that the market will stabilise closer to balance than at present, but still with a tendency to go long.

Conclusions

This analysis considers the first-order incentives on suppliers under the current pricing regime and the two pricing modification proposals P74 and P78. The following conclusions can be drawn:

- The current arrangements provide a significant incentive on suppliers to over contract as means of avoiding exposure to SBP. This is illustrated by the fact that the optimal strategy for April 2002 would have been to operate with a probability of being under contracted equal to 0.26.

- Under P74, participants would be driven by their view of market length and not attempting to balance their own position. Second order affects would provide some incentive to balance. This would tend to reduce the current market length, but prices will tend to be less stable.

- Under P78, the incentives on suppliers to over or under contract vary as the length of the market as a whole varies. This change in incentive acts to bring the market closer to balance.

- If the P78 regime is applied to the data for April, the optimal probability of a supplier being under contracted moves from 0.26 to 0.72. This illustrates how P78 will tend to move the system closer to a balance.

- P78 is unlikely to drive the market short. This can be demonstrated by imagining a balanced market. Under these circumstances the incentives would resemble those at present and these are known to make participants go long.

Figure 1: Probability of a supplier going short under the present pricing rules

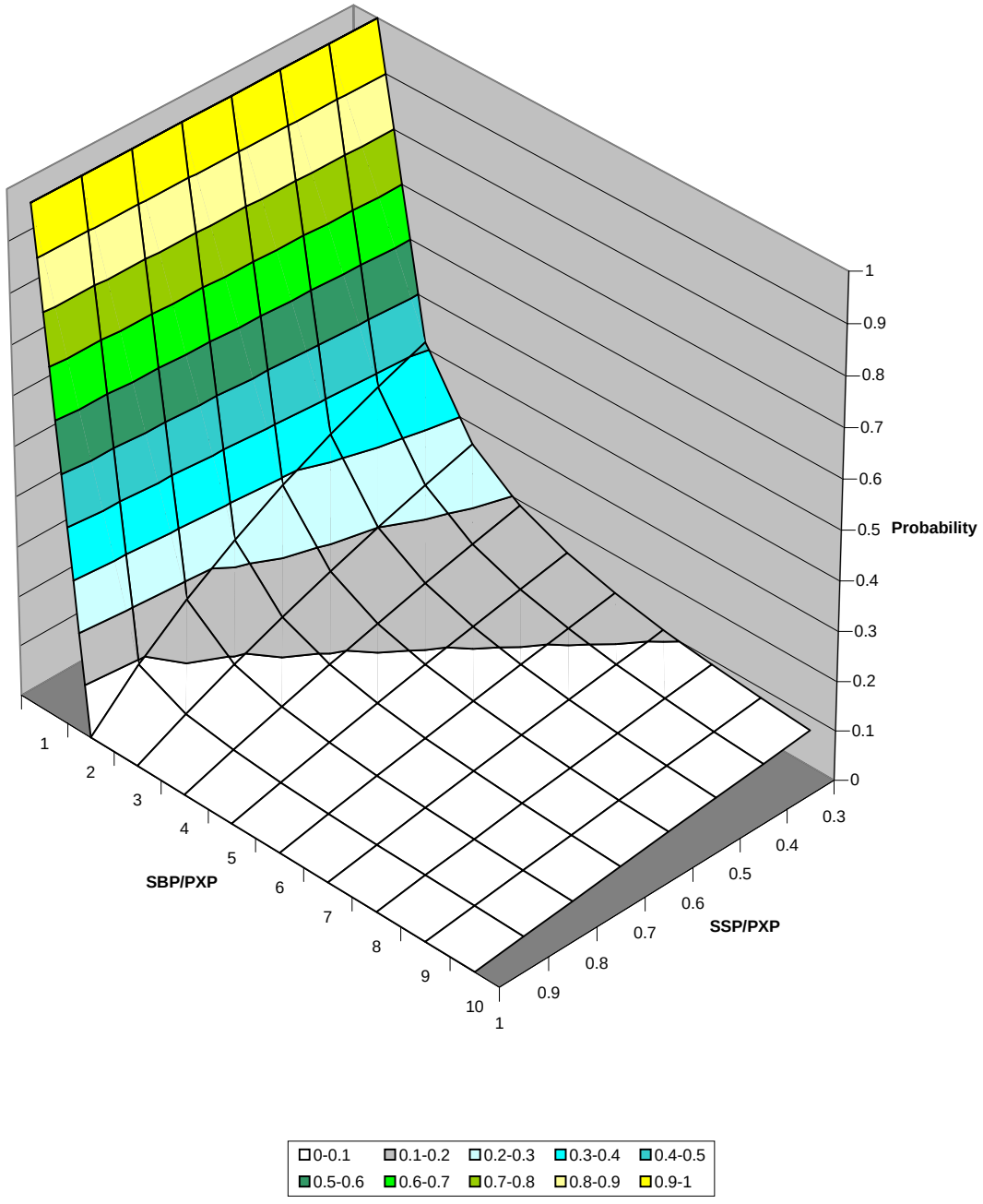

Figure 2: Probability of a supplier going short overlaid with SBP/SSP for April 2002

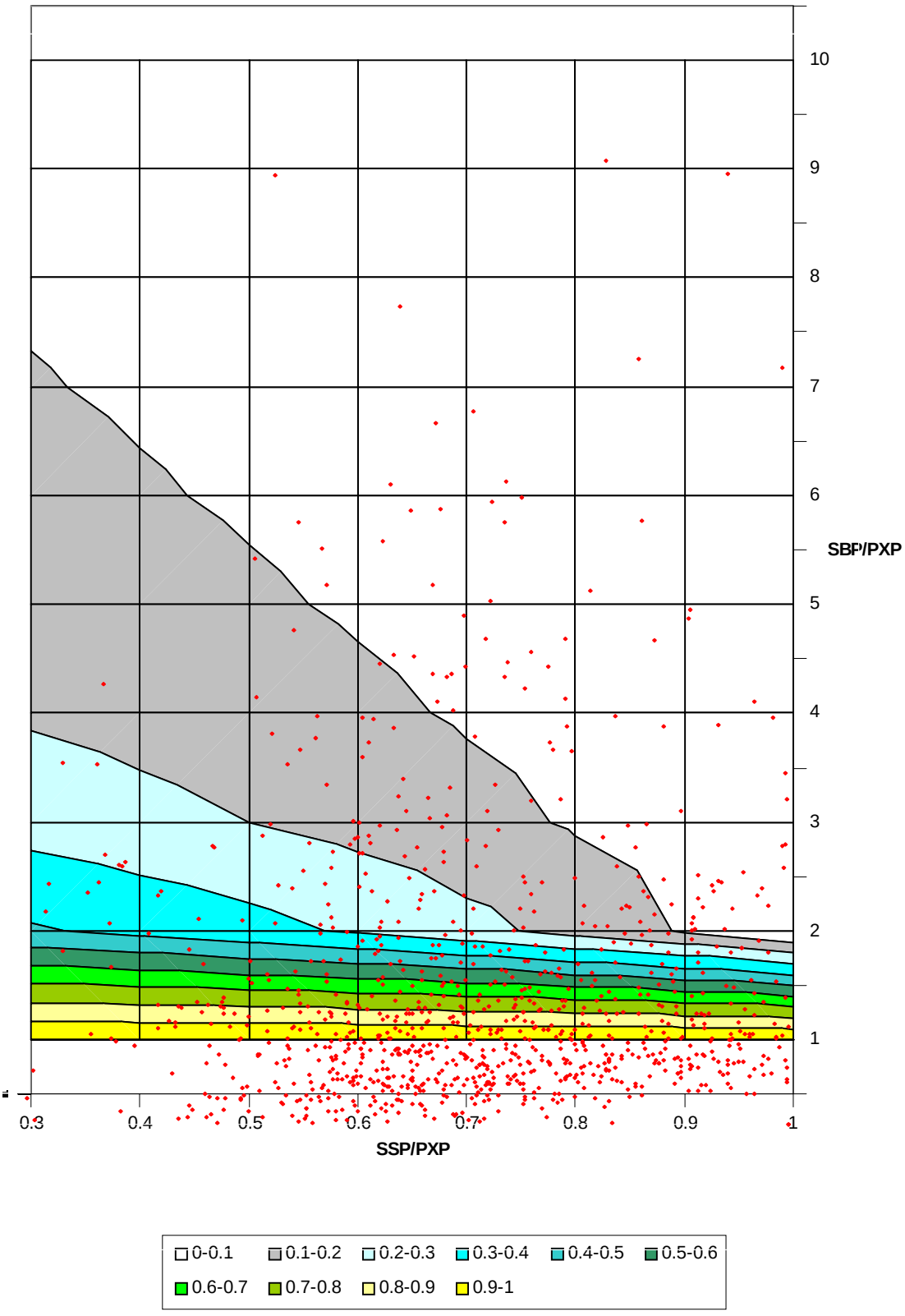

Figure 3(a): Probability of supplier going short under P78 with PMS = 0.1

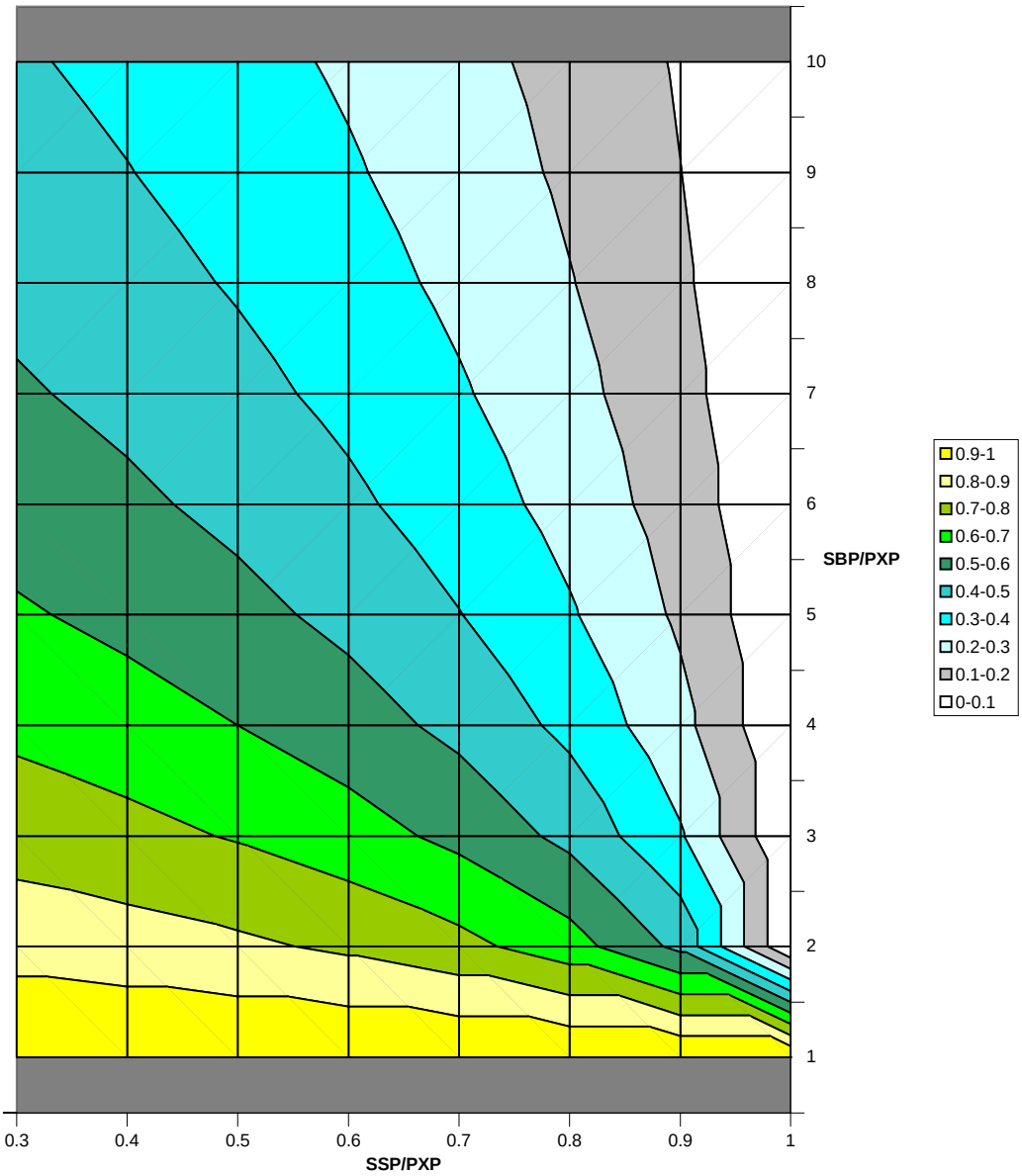

Figure 3(b): Probability of supplier going short under P78 with PMS = 0.3

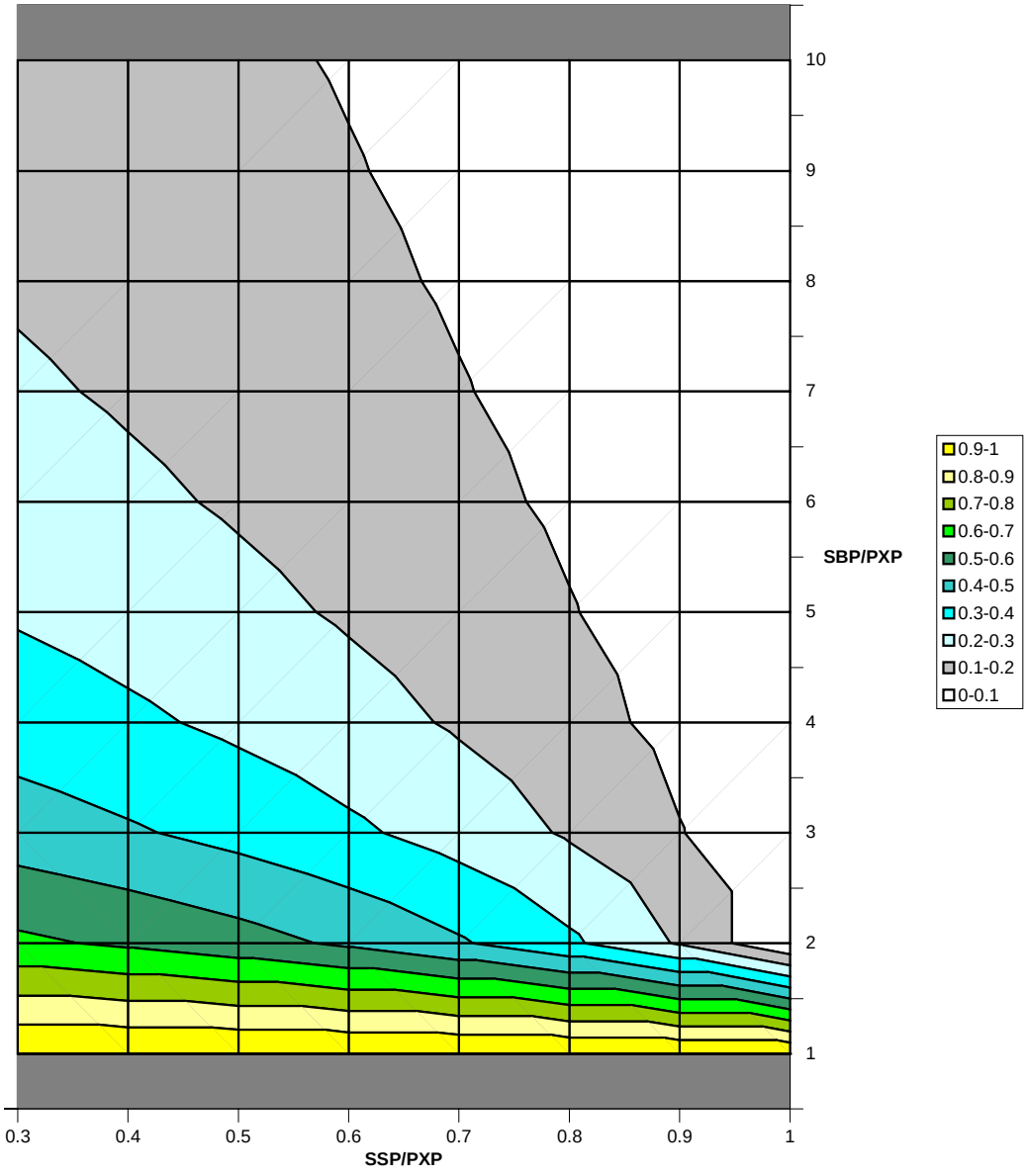

Figure 3(c): Probability of supplier going short under P78 with PMS = 0.5

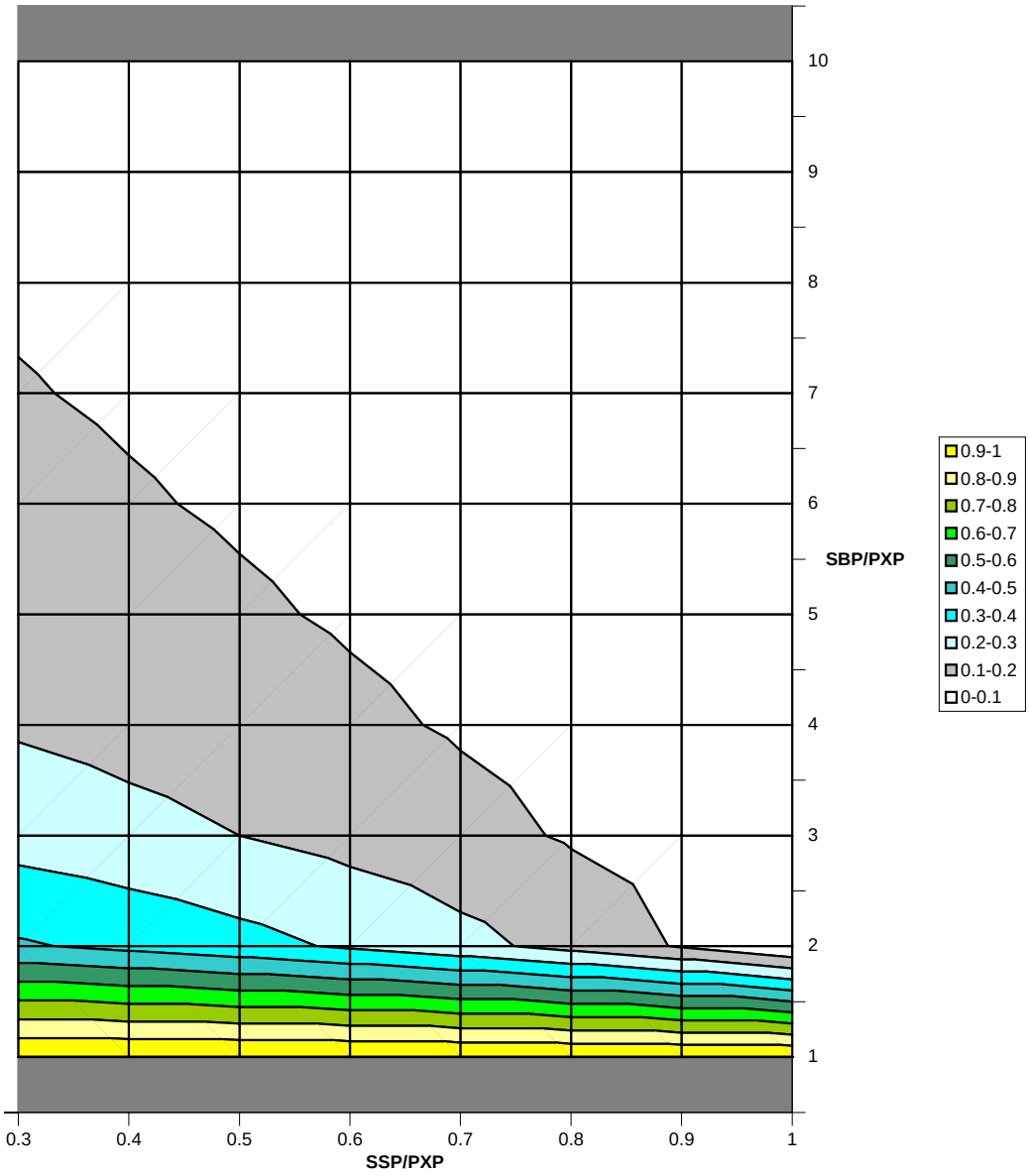

Figure 3(d): Probability of supplier going short under P78 with PMS = 0.7

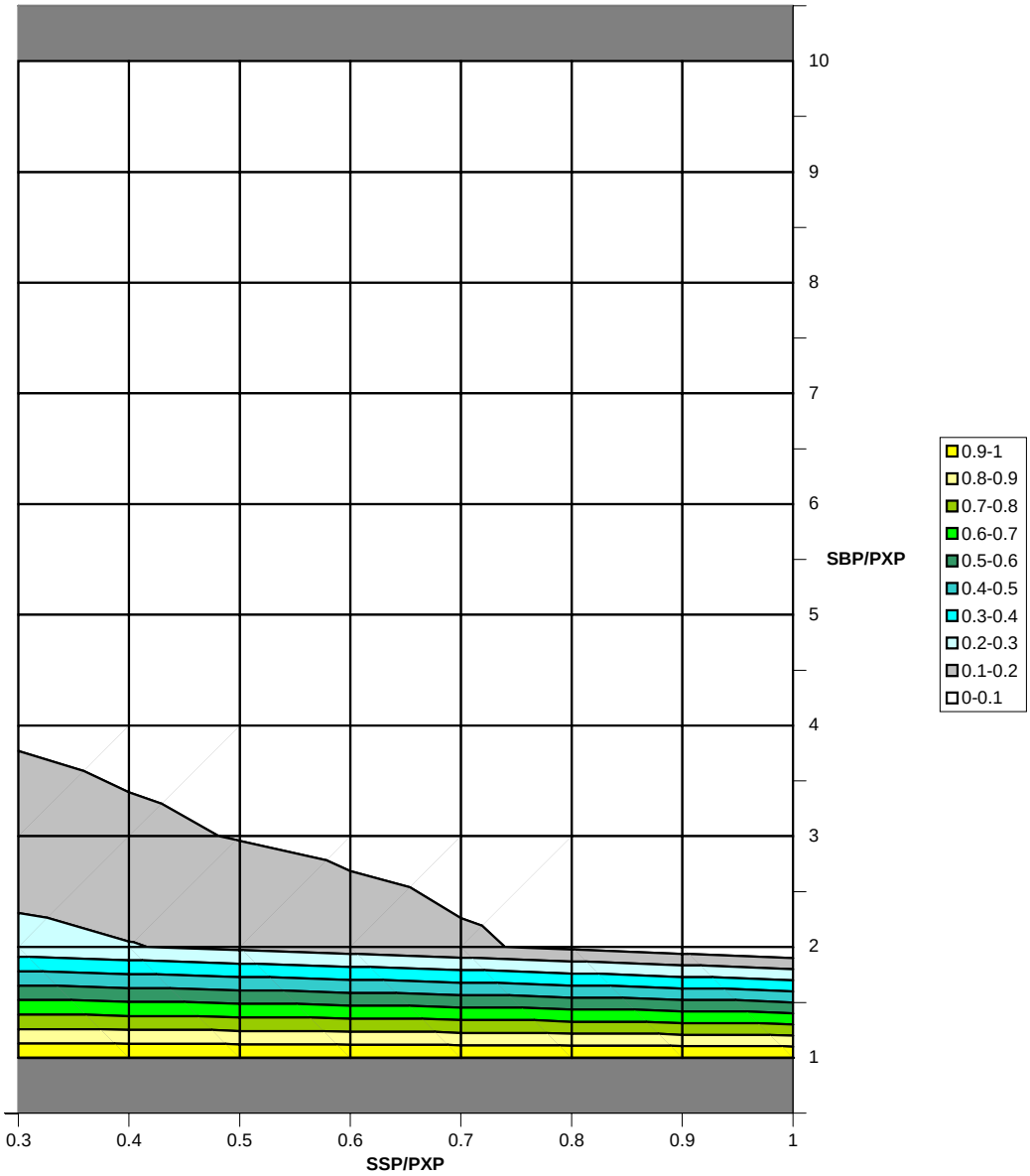

Figure 3(e): Probability of supplier going short under P78 with PMS = 0.9