Bank Trading Revenues, VaR, and Market Risk

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Literature on Market Stability and Current Paper

1. Recent literature

   1.1. Risk taking and risk management by banks and other institutional traders are said to contribute to market instability. One important source is the use of VaR for risk management.

   1.2. Arguments are primarily theoretical. Episodic evidence offered from financial market crises.

   1.3. References: Persaud (2000), Basak and Shapiro (2001), Danielson, Shin, and Zigrand (2002).

2. There is little systematic evidence on bank market risk taking or risk management.

3. In this study we attempt to characterize bank exposures to market risk and the relation of VaR to market volatility. We use daily trading revenues and VaRs for 7 large trading banks.

Methodology

1. To identify market risks, we apply a linear market-factor model to banks' daily trading revenues.

2. Factor models have been extensively applied to identifying portfolio return market risks. Style analysis applications to mutual fund portfolios (Sharpe 1992) is the closest to what we do.

3. For banks, the linear and constant coefficient features of the model are strong assumptions.

4. Supplemental tests are done for non-linearity and time varying factor coeffcients.

5. We further test for forecasts of near-term market volatility implied by the banks' VaRs.

Trading Revenue, VaR, and Factor Data

1. Daily trading revenue and VaR data

| Bank	Dates	Observ	Mean TR/SD
1	Jan 98 – Dec 00	762	1.05
2	Jan 98 – Sept 00	711	.79
3	Jan 98 – Dec 03	1524	.77
4	Jan 98 – Dec 03	1544	.90
5	Jan 98 – Dec 03	1551	.62
6	Jan 98 – June 02	1166	.72
7	Oct 98 – Mar 01	626	.39

2. Trading revenue = gains and losses on positions + fee and spread income + net interest income.

3. VaRs

   1.1. Estimated daily from internal models with a 1-day horizon.
   1.2. 99th percentile forecasts for the distribution of unexpected trading portfolio gains and losses.

Figure 1. Kernel Densities of Bank Trading Revenue
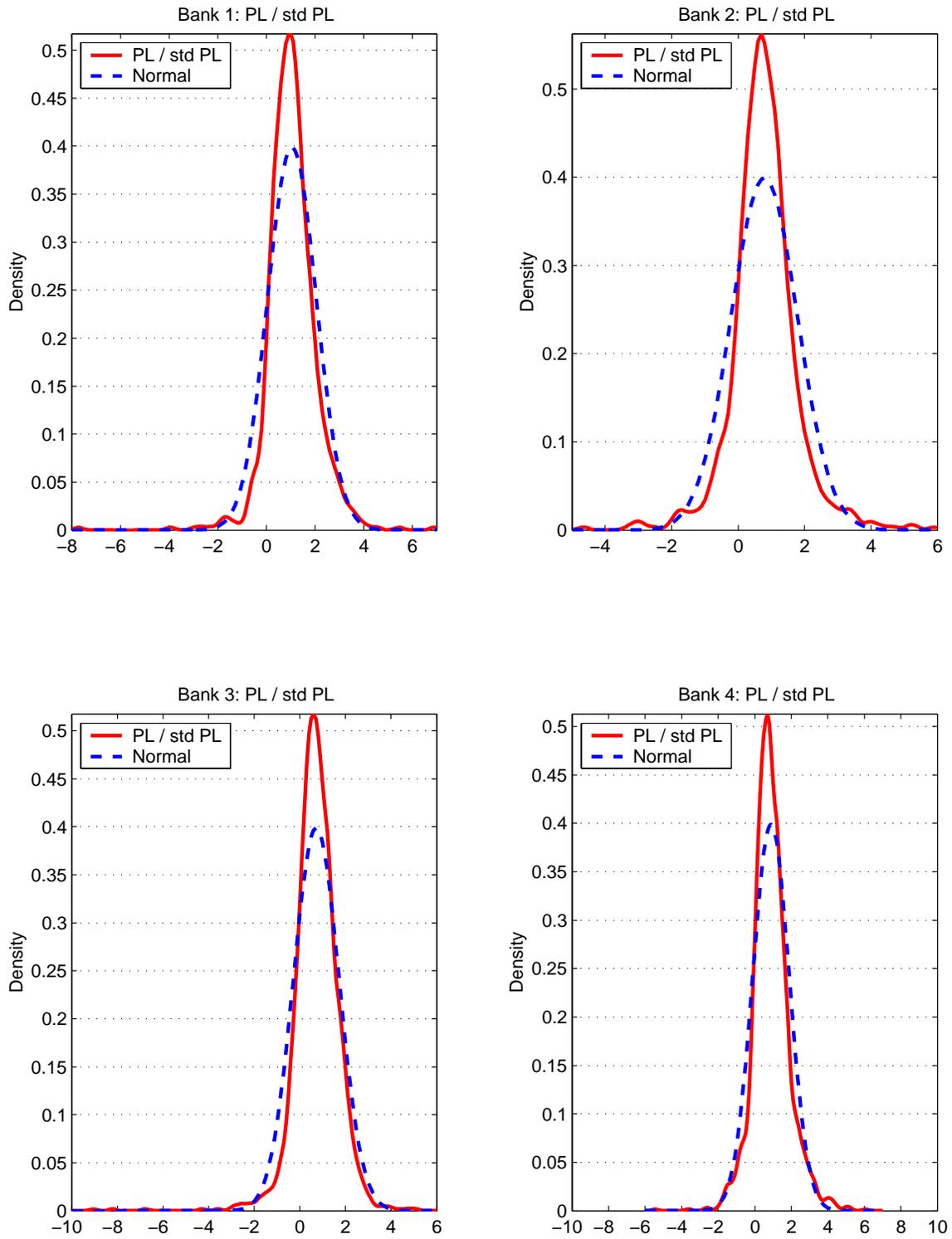
4. Market factors

    4.1. Eleven market indices covering four broad market categories.

    4.2. Four regional exchange rates; 2 equity returns; 2 interest rates; 3 credit spreads.

5. Daily equity market trading volume (detrended) is also used as a measure of market trading volume, to recognize income related to the volume of market-making activity.

Linear Factor Model

$$R(t) = \sum_{k=1}^{K} v_k r_k(t) + fx(t) + u(t)$$

Regression Results

1. Basic results (Tables 3a and 3b)

    1.1. For market factors, F-values are jointly significant and significant by market categories across banks.

    1.2. R-squares are low.

    1.3. Equity market trading volume has positive and significant effects on trading revenue.

2. Characterization of banks' market factor risks:

Market Factor Coefficients X 2 Std Dev

Factor	Bank						
	1	2	3	4	5	6	7
xwe	0.0562	0.0900	0.0834	0.0954	-0.0648	0.0426	-0.0503
xee	0.1094	0.0289	0.2530	0.0393	0.0666	0.0233	-0.4235
xap	-0.2831	-0.1366	-0.0579	0.0313	-0.0121	0.0206	-0.0396
xsa	-0.0564	-0.1706	0.0825	0.1044	-0.0862	0.1215	-0.0248
nyse	-0.2851	-0.2904	0.0814	0.3175	-0.1420	-0.0645	-0.0274
nasdaq	0.1408	0.2195	0.0533	-0.0977	0.0508	-0.0528	0.0736
r6m	-0.1450	-0.0157	-0.0860	0.0182	-0.0879	-0.2346	-0.0167
r10y	-0.2086	-0.0216	-0.2961	-0.0698	-0.1488	-0.0542	-0.1995
mdy spd	-0.0382	0.1560	-0.1666	0.0688	0.0007	0.1153	-0.0728
hy spd	-0.0438	0.0833	-0.2021	-0.0498	-0.1426	-0.2907	-0.1491
swap spd	-0.0090	0.0369	0.0453	0.0013	0.0426	-0.0145	0.1187
volume	0.4930	0.3663	0.2528	0.5923	0.0670	0.3266	0.0892

Test for Non-linearity

1. Test where positions vary with market factors
    1.1. Test for U-shaped, inverse U-shaped, and 1-sided hedging (portfolio insurance).
    1.2. These shapes can reflect portfolio management that is dependent on market factor changes.

2. Test for non-linearity at market category level.
    2.1. For each category, days are sorted for high returns, low returns, and average returns.
    2.2. Mean and median trading returns are then determined for each category sorting.

3. Results for 7 banks (Table 5):
    3.1. Non-linearities are not detected for non-interest rate categories.
    3.2. Trading returns exhibit asymmetry for interest rate category for four banks.

Testing for Time-Varying Exposures

1. Sample is split in two: 1998 – 2000 and 2001-2003. Linear factor model is applied to banks 3, 4, 5, and 6 for each sub-period (Tables 6a and 6b).

   1.1. Results re-enforce full sample regressions: (i) market factors significant in each sub-period; (ii) exposures differ across banks and across factors; (ii) factor sensitivities generally small.

   1.2. Evidence of time-varying market exposures: (i) coefficients on interest rate and credit spreads substantially higher in 2001 – 2003; (ii) Chow test rejects null that factor coefficients are unchanged for 2 to 3 of the 4 banks depending on significance criterion.

Bank VaRs and Market Factors

1. VaRs are correlated with absolute 1-day ahead trading revenues.

2. We consider whether VaRs have forecast power for 1-day ahead market volatility.

3. For each market category, days of high volatility and days of low volatility are determined using factor absolute values as a measure of volatility.

4. Note: bank trading revenues consistently more volatile on days of high market volatility (Table 7).

5. However, bank VaRs are at most weakly related to near-term market volatility (Table 8).

Overall Conclusions

1. Bank market risk exposures tend to be relatively modest and vary across markets and across factors within markets.

2. Bank dealers have long exposures to interest rates but exposures across banks vary for other market factors. Hence banks are not homogenious in their market risk exposures.

3. Significance of (equity) market trading volume consistent with the hypothesis that market-making revenue depends on trading volume.

4. Exposures are time varying. While limited, our results do not give much evidence that exposures vary with market factors.

5. Bank VaRs are at most weakly related to near-term market volatility.