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**Airline Balance Sheet Strategies in
the Post-9/11 Environment:
An Application of Canonical
Correlation Analysis with Scores**

**Carl Scheraga
Fairfield University**

Balance Sheet Management

- Stowe, Watson and Robertson (1980) noted that unlike the behavior suggested by the traditional financial literature, one would expect to observe interdependencies between the two sides of the balance sheet. Several of these postulated interdependencies are relevant for airlines.
 - Firms may utilize hedging by which they seek to match the maturity of their assets and liabilities.
 - Some assets might be used as loan collateral.
 - Finally, firms that have become high-risk businesses might seek to manage risk by using less leverage (higher equity) and by maintaining larger liquidity balances.
 - Additionally, commodity-producing firms may finance inventories with accounts payable, while service firms have little of either inventories or accounts payable.

Crum, Lund and Van Auken (1987)

- Investigated the balance sheet structures of U.S. airlines for the period 1973-1980 to capture 1978 changes due to deregulation.
 - They found that as early as 1975, U.S. airlines began to finance more long-term assets with equity.
 - A strategy of more balance in the use of equity and long-term debt continued after deregulation as a means to reduce exposure to financial risk.
 - Additionally, in each year except 1973, there was a short-term matching of assets and liabilities - accounts receivables and inventory with accounts payable and other current liabilities.
 - Similarly, in each year except 1973, a hedging strategy of matching long-term accounts was used.

Corsi and Scheraga (1989)

- Examined pre- and post-deregulation balance sheet strategies in the motor carrier industry for the years 1977, 1985, and 1986.
- The particular industry segments examined were less-than-truckload general freight, truckload general freight, building materials, petroleum products, and refrigerated products.
 - Their results indicated a general trend for carriers to move to or maintain risk reduction strategies with regard to financial leverage, liquidity, and maturity matching of assets and liabilities.
 - An additional contribution of this study was the use of canonical scores to group individual motor carriers in each industry segment into financial strategy categories. This application of canonical scores was suggested by Corsi and Harvey, 1975. The strategy categories were then compared on the basis of financial performance measures. They found evidence to suggest that particular financial strategies were associated with better financial performance.

Table 1
Airline Sample

NAME	ICAO ID	COUNTRY	NAME	ICAO ID	COUNTRY
ACES	AES	COLOMBIA	HAWAIIAN AIRLINES	HAL	UNITED STATES
AERO CONTINENTE PERU	ACQ	PERU	IBERIA	IBE	SPAIN
AEROMEXICO	AMX	MEXICO	ICELANDAIR	ICE	ICELAND
AIR CANADA	ACA	CANADA	JAL	JAL	JAPAN
AIR CHINA	CCA	CHINA	JETBLUE AIRWAYS	JBU	UNITED STATES
AIR EUROPA	AEA	SPAIN	KENYA AIRWAYS	KQA	KENYA
AIR FRANCE	AFR	FRANCE	KLM	KLM	NETHERLANDS
AIR INDIA	AIC	INDIA	KOREAN AIR	KAL	KOREA
AIR LITTORAL	LIT	FRANCE	LOT	LOT	POLAND
AIR WISCONSIN	AWI	UNITED STATES	LUFTHANSA	DLH	GERMANY
AIRTRAN AIRWAYS	TRS	UNITED STATES	MALAYSIAN AIRLINES	MAS	MALAYSIA
ALAS DE VENEZUELA	LAV	VENEZUELA	MEXICANA	MXA	MEXICO
ALASKA	ASA	UNITED STATES	MID-WEST EXPRESS	MEP	UNITED STATES
ALL NIPPON AIRWAYS	ANA	JAPAN	NORTHWEST	NWA	UNITED STATES
ALOHA	AAH	UNITED STATES	OMAN AIR	OMA	OMAN
AMERICA WEST	AWE	UNITED STATES	PAL	PAL	PHILIPPINES
AMERICAN	AAL	UNITED STATES	PIA	PIA	PAKISTAN
AMERICAN TRANSAIR	AMT	UNITED STATES	RYANAIR	RZR	IRELAND
AUSTRIAN AIRLINES GROUP	AUA	AUSTRIA	SAS	SAS	SCANDINAVIA
AVIANCA	AVA	COLOMBIA	SHANDONG AIRLINES	CDG	CHINA
BRITISH AIRWAYS	BAW	UNITED KINGDOM	SHANGHAI AIRLINES	CSH	CHINA
BRITISH MED. AIRWAYS	LAJ	UNITED KINGDOM	SIA	SIA	SINGAPORE
BRITISH MIDLAND	BMA	UNITED KINGDOM	SOUTHWEST	SWA	UNITED STATES
CATHAY PACIFIC	CPA	CHINA-HONG KONG	SPANAIR	JKK	SPAIN
CHINA SOUTHERN AIRLINES	CSN	CHINA	SPIRIT AIRLINES	NKS	UNITED STATES
CHINA XINHUA AIRLINES	CXH	CHINA	SRILANKIAN AIRLINES	ALK	SRI LANKA
CONTINENTAL	COA	UNITED STATES	TACA	TAI	EL SALVADOR
CUBANA	CUB	CUBA	TAP AIR PORTUGAL	TAP	PORTUGAL
CZECH AIRLINES	CSA	CZECH REPUBLIC	TAROM	ROT	ROMANIA
DELTA	DAL	UNITED STATES	THAI AIRWAYS	THA	THAILAND
EASYJET AIRLINE	EZY	UNITED KINGDOM	THY	THY	TURKEY
EL AL	ELY	ISRAEL	TRANS STATES AIRLINES	LOF	UNITED STATES
ETHIOPIAN	ETH	ETHIOPIA	UNITED	UAL	UNITED STATES
FINNAIR	FIN	FINLAND	US AIRWAYS	USA	UNITED STATES
FLYBE.BRITISH EUROPEAN	JEA	UNITED KINGDOM	VIRGIN ATLANTIC	VIR	UNITED KINGDOM
FRONTIER AIRLINES	FFT	UNITED STATES	XINJIANG AIRLINES	CXJ	CHINA
GB AIRWAYS	GBL	UNITED KINGDOM	YUNNAN AIRLINES	CYH	CHINA
HAINAN AIRLINES	CHH	CHINA	ZHEJIANG AIRLINES	CJG	CHINA

**Table 2
Balance Sheet Variable Definitions**

ASSETS		LIABILITIES	
Current Assets	<ol style="list-style-type: none"> 1. Cash, bank balances and short-term investments 2. Current accounts and notes receivable 3. Other current assets 	Current Liabilities	<ol style="list-style-type: none"> 1. Accounts, traffic balances and notes payable 2. Air traffic liabilities 3. Other current liabilities
Flight Equipment and Operating Property	<ol style="list-style-type: none"> 1. Flight equipment owned 2. Ground property and equipment owned 3. Flight equipment under capital leases 4. Ground property and equipment under capital leases 	Long-Term Debt	<ol style="list-style-type: none"> 1. Long-term debt 2. Long-term obligations under capital leases
Other Non-Current Assets	<ol style="list-style-type: none"> 1. Special funds (investments in affiliated companies, equipment purchase funds, other special funds) 2. Non-operating property and equipment 3. Other assets (deferred charges, intangible assets, investments in associated companies, other assets) 	Other Non-Current Liabilities	<ol style="list-style-type: none"> 1. Advances from affiliated companies 2. Reserves 3. Other non-current obligations 4. Deferred Credits
		Stockholder Equity	<ol style="list-style-type: none"> 1. Capital stock 2. Capital surplus 3. Retained earnings

Table 3
Means and Standard Deviations of Balance Sheet Variables

Variable	Mean	Standard Deviation
Current Assets	0.3415	0.1802
Flight Equipment and Operating Property	0.4822	0.2139
Other Non-Current Assets	0.1762	0.1460
Current Liabilities	0.4116	0.2293
Long-Term Debt	0.3073	0.1849
Other Non-Current Liabilities	0.1393	0.1520
Stockholder Equity	0.1416	0.2339

Table 4a
Measures of Overall Model Fit for
Canonical Correlation Analysis

Canonical Function	Canonical Correlation	Canonical R²	F Statistic	Probability
1	0.7878	0.6206	13.56	<0.0001
2	0.4042	0.1634	4.62	0.0052

Table 4b
Multivariate Tests of Significance

Statistic	Value	F Statistic	Probability
Wilks' Lambda	0.3174	13.56	<0.0001
Pillai's Trace	0.7840	11.44	<0.0001
Hotelling-Lawley Trace	1.8308	15.89	<0.0001
Roy's Greatest Root	1.6355	29.03	<0.0001

Table 6
Canonical Structure for the Two Canonical Functions
(Varimax Rotation)

Correlations between the ASSET Variables and Their Canonical Variates

	Canonical Function #1	Canonical Function #2
Current Assets	0.9705	-0.2412
Flight Equipment and Operating Property	-0.8790	-0.4769
Other Non- Current Assets	0.0897	0.9960

Correlations between LIABILITY Variables and Their Canonical Variates

	Canonical Function #1	Canonical Function #2
Current Liabilities	0.8891	0.0596
Long-Term Debt	-0.8363	-0.2387
Other Non- Current Liabilities	-0.0695	0.9970
Stockholder Equity	-0.1650	-0.5168

Table 7b
Unexpected Matchings - First Canonical Function

NAME	ICAO CODE	BALANCE SHEET RELATIONSHIPS
AIR CANADA	ACA	Current Assets / Long Term Debt
AIR INDIA	AIC	Flight Equipment and Operating Property / Current Liabilities
AMERICA WEST	AWE	Current Assets / Long Term Debt
AMERICAN TRANSAIR	AMT	Current Assets / Long Term Debt
BRITISH MIDLAND	BMA	Flight Equipment and Operating Property / Current Liabilities
CHINA XINHUA AIRL.	CXH	Flight Equipment and Operating Property / Current Liabilities
ETHIOPIAN	ETH	Flight Equipment and Operating Property / Current Liabilities
FINNAIR	FIN	Flight Equipment and Operating Property / Current Liabilities
MEXICANA	MXA	Flight Equipment and Operating Property / Current Liabilities
MID-WEST EXPRESS	MEP	Flight Equipment and Operating Property / Current Liabilities
RYANAIR	RYR	Current Assets / Long Term Debt
SHANDONG AIRLINES	CDG	Flight Equipment and Operating Property / Current Liabilities
SPIRIT AIRLINES	NKS	Flight Equipment and Operating Property / Current Liabilities
TRANS STATES AIRL.	LOF	Flight Equipment and Operating Property / Current Liabilities
US AIRWAYS	USA	Flight Equipment and Operating Property / Current Liabilities
YUNNAN AIRLINES	CYH	Flight Equipment and Operating Property / Current Liabilities

Unexpected Matchings - Second Canonical Function

NAME	ICAO CODE	BALANCE SHEET RELATIONSHIPS
AERO CONTINENTE PERU	ACQ	Flight Equipment and Operating Property / Other Non-Current Liabilities
AEROMEXICO	AMX	Other Non-Current Assets / Stockholder Equity
AIR EUROPA	AEA	Flight Equipment and Operating Property / Other Non-Current Liabilities
AIR FRANCE	AFR	Flight Equipment and Operating Property / Other Non-Current Liabilities
AIR INDIA	AIC	Flight Equipment and Operating Property / Other Non-Current Liabilities
AIRTRAN AIRWAYS	TRS	Flight Equipment and Operating Property / Other Non-Current Liabilities
ALAS DE VENEZUELA	LAV	Flight Equipment and Operating Property / Other Non-Current Liabilities
ALASKA	ASA	Flight Equipment and Operating Property / Other Non-Current Liabilities
ALOHA	AAH	Flight Equipment and Operating Property / Other Non-Current Liabilities
AMERICA WEST	AWE	Other Non-Current Assets / Stockholder Equity
AMERICAN	AAL	Flight Equipment and Operating Property / Other Non-Current Liabilities
AMERICAN TRANSAIR	AMT	Flight Equipment and Operating Property / Other Non-Current Liabilities
CONTINENTAL	COA	Flight Equipment and Operating Property / Other Non-Current Liabilities
CUBANA	CUB	Flight Equipment and Operating Property / Other Non-Current Liabilities
DELTA	DAL	Flight Equipment and Operating Property / Other Non-Current Liabilities
EASYJET AIRLINE	EZY	Other Non-Current Assets / Stockholder Equity
EL AL	ELY	Flight Equipment and Operating Property / Other Non-Current Liabilities
FINNAIR	FIN	Flight Equipment and Operating Property / Other Non-Current Liabilities
FLYBE.BRITISH EUROPEAN	JEA	Flight Equipment and Operating Property / Other Non-Current Liabilities
IBERIA	IBE	Flight Equipment and Operating Property / Other Non-Current Liabilities
KLM	KLM	Other Non-Current Assets / Stockholder Equity
LOT	LOT	Other Non-Current Assets / Stockholder Equity
LUFTHANSA	DLH	Flight Equipment and Operating Property / Other Non-Current Liabilities
MEXICANA	MXA	Flight Equipment and Operating Property / Other Non-Current Liabilities
PIA	PIA	Flight Equipment and Operating Property / Other Non-Current Liabilities
SAS	SAS	Other Non-Current Assets / Stockholder Equity
SPIRIT AIRLINES	NKS	Flight Equipment and Operating Property / Other Non-Current Liabilities
TAP AIR PORTUGAL	TAP	Flight Equipment and Operating Property / Other Non-Current Liabilities
UNITED	UAL	Flight Equipment and Operating Property / Other Non-Current Liabilities
VIRGIN ATLANTIC	VIR	Flight Equipment and Operating Property / Other Non-Current Liabilities

Unexpected Relationships

- Some airlines were financing current assets with long-term debt. It would appear that these airlines cannot access more traditional financing sources such as retained earnings, and have pursued this mismatching strategy at the cost of increasing financial leverage.

Unexpected Relationships

- Another balance sheet mismatching was the financing of flight equipment and operating property with current liabilities. In this case, airlines seem to be increasing solvency risk.

Unexpected Relationships

- It was observed that some airlines had financed flight equipment and operating property with other non-current liabilities. While this does not necessarily represent a mismatching of assets and liabilities, it is atypical behavior that may increase leverage risk if non-current liabilities have shorter maturities than long-term debt.

Unexpected Relationships

- Finally, some airlines have used stockholder equity to finance other non-current assets. Again, this does not necessarily represent a mismatching of assets and liabilities, but it does represent the use of permanent equity capital to finance shorter-term maturity assets, as opposed to debt with matching maturities.

Table 9
Tukey's Studentized Range Test -
Differences in Performance Measures (= Significant at 5% Level)**

Group 1 = No Unexpected Matchings on Either Canonical Function
Group 2 = Unexpected Matchings on Either or Both Canonical Functions

Measure 1 = Operating Ratio
(Operating Revenues/Operating Expenses)

Measure 2 = Operating Result as a Percentage of Operating Revenues
(Operating Result = Operating Revenues - Operating Expenses)

	Mean Group 1	N Group 1	Mean Group 2	N Group 2	Significance Level
Measure 1	1.0467	36	0.9982	40	**
Measure 2	0.0358	36	-0.0114	40	**