Online Appendix A: A Stylized Model about Earnings Pressure Effect

We assume that management optimizes the following objective, which is a combination of current earnings and future competitiveness.

$$\text{Objective}_t(x_t|\mathbf{m}, \delta) = E_t(x_t|\mathbf{m}) + \delta * C_{t+1}(x_t|\mathbf{m})$$

where:

$\{\mathbf{m}\}$ – a set of parameters representing market conditions, considered exogenous to the management problem, such as market size, demand elasticity, competitive structure, cost structure, etc.

x_t – competitive behavior of the firm at the first period, where higher x represents more aggressive behavior.

δ – implicit discounting of future competitiveness relative to current earnings. $0 < \delta < \frac{1}{1+r}$, where r = WACC, or optimal discounting.

$E_t(x_t|\mathbf{m})$ – current earnings

$C_{t+1}(x_t|\mathbf{m})$ – NPV of future earnings, based on market conditions $\{\mathbf{m}\}$ and competitive behavior at first period x.

For given $\{\mathbf{m}\}$, we assume that $E_t(x_t|\mathbf{m})$ is smooth, and concave on x (i.e., $E'' < 0$, there is an optimal behavior that maximizes current earnings). For given $\{\mathbf{m}\}$, we assume that $C_{t+1}(x_t|\mathbf{m})$ is smooth and either linear or concave on x (more aggressive behavior in the first period increases future competitiveness either linearly or at a decreasing rate).

Let's define: $\hat{x}^E(\boldsymbol{m}) = \mathit{argmax}\ E_t(x_t|\mathbf{m})$ the optimal behavior if only optimizing current earnings.

We assume that the function $C_{t+1}(x_t|\mathbf{m})$ either is continuously increasing, or if it has a maximum, it is greater than $\hat{x}^E(\boldsymbol{m})$. The intuition is that if the company were to select competitive behavior in the initial period in order to optimize competitiveness, it would be more competitive than $\hat{x}^E(\boldsymbol{m})$: if there exist $\hat{x}^C(\boldsymbol{m}) = \mathit{argmax}\ C_{t+1}(x_t|\mathbf{m}))$ then $\hat{x}^C(\boldsymbol{m}) > \hat{x}^E(\boldsymbol{m})$.

Then the range of x can be divided in three zones:

- For $x_t < \hat{x}^E(\boldsymbol{m})$: $E'>0$; $E''<0$; $C'>0$; $C''=<0$
- For $\hat{x}^E(\boldsymbol{m}) < x_t < \hat{x}^C(\boldsymbol{m})$: $E'<0$; $E''<0$; $C'>0$; $C''\leq 0$
- For $x_t > \hat{x}^C(\boldsymbol{m})$: $E'<0$; $E''<0$; $C'<0$; $C''\leq 0$

In the space $\hat{x}^E(\boldsymbol{m}) < x_t < \hat{x}^C(\boldsymbol{m})$, we state that the company faces "inter-temporal trade-offs", since $E' < 0$, but $C' > 0$. That is, increasing competition more than optimal for current earnings would reduce current earnings but increase competitiveness.

For the range $x < \hat{x}^E(\boldsymbol{m})$, there is no trade-off since changes in competitive behavior that improves current earnings would also improve competitiveness.

Let's define $x^*(\boldsymbol{m}, \delta) = argmax$ Objective $(\boldsymbol{m}|x, \delta)$. The optimum will be such that

$$\mathrm{E_t}' + \delta \mathrm{C_{t+1}}' = 0.$$

We can show that:

- $x^*(\boldsymbol{m}, \delta) \geq \hat{x}^E(\boldsymbol{m})$ (i.e., a manager optimizing a combination of current earnings and future competitiveness would be more aggressive than one only optimizing current earnings).

  $x^*(\boldsymbol{m}, \delta)$ cannot be strictly below $\hat{x}^E(\boldsymbol{m})$, since in that range, both $\mathrm{E_t}$ and $\mathrm{C_{t+1}}$ would have a positive slope. Therefore, a manager increasing competitive behavior would be able to increase both current earnings and future competitiveness, without facing a trade-off.

- $x^*(\boldsymbol{m}, \delta)$ is increasing on δ (i.e., positive derivative of $x^*(\boldsymbol{m}, \delta)$ with respect to δ
  $x^*(\boldsymbol{m}, \delta)$ fulfills the first order condition that $\mathrm{E_t}' + \delta \mathrm{C_{t+1}}' = 0$. For levels of x_t above $\hat{x}^E(\boldsymbol{m})$, then $\mathrm{E_t}' \leq 0$ and $\mathrm{C_{t+1}}' \geq 0$, at least for the range $\hat{x}^E(\boldsymbol{m}) < x_t < \hat{x}^C(\boldsymbol{m})$. Given the assumption of concavity of $\mathrm{E_t}$ and linearity or concavity of $\mathrm{C_{t+1}}$, $\mathrm{E_t'}$ will be negative and non-increasing in that range, while $\mathrm{C_{t+1}}'$ will be positive and non-increasing in that range. As the discount rate decreases, the product $\delta \mathrm{C_{t+1}}'$ (representing the present value of an increase on competitiveness) will decrease, and the equilibrium will take place at a point where $\mathrm{E_t'}$ is higher (i.e., the loss of current earnings is less negative). Given the concavity assumption, which implies that $\mathrm{E_t'}$ is non-increasing on x_t, this would move $x_t{}^*$ leftwards towards $\hat{x}^E(\boldsymbol{m})$. As δ converges towards zero, then $x^*(\boldsymbol{m}, \delta)$ would converge to $\hat{x}^E(\boldsymbol{m})$. That is, as future competitiveness becomes less important, then behavior converges towards current earnings optimization.

For an illustration with specific functional forms, using quadratic equations for $\mathrm{E_t}$ and $\mathrm{C_{t+1}}$:

$$\mathrm{E_t}(x_t|\,\boldsymbol{m}) = a_m + b_m \cdot x - c_m \cdot x^2,\ a_m\,,\ b_m\,,\ c_m\,, x > 0$$

$$\mathrm{C_{t+1}}(x_t|\,\boldsymbol{m}) = \alpha_m + \beta_m \cdot x - \gamma_m \cdot x^2,\ \alpha_m\,,\ \beta_m\,,\ x > 0,\ \gamma_m\ \geq 0$$

For simplicity, we drop the m subscripts.

$$Objective\ (\boldsymbol{m}|\, x, \delta) = (a_m + b_m \cdot x - c_m \cdot x^2) + (\alpha_m + \beta_m \cdot x - \gamma_m \cdot x^2)$$

$$\hat{x}^E(\boldsymbol{m}) = \frac{\mathrm{b}}{2\mathrm{c}}$$

$$\hat{x}^C(\boldsymbol{m}) = \frac{\beta}{2\gamma}\ \ if\ \gamma > 0, or\ \infty\ if\ C_{t+1}\ is\ linear$$

We assume $\hat{x}^C(\boldsymbol{m}) > \hat{x}^E(\boldsymbol{m}), which\ implies\ \frac{\beta}{2\gamma} > \frac{\mathrm{b}}{2\mathrm{c}}, if\ \gamma > 0$

$$x^*(\boldsymbol{m}, \delta) = \frac{b + \delta\beta}{\alpha(c + \delta\gamma)} \; if \; \gamma > 0, or \; \frac{b + \delta\beta}{\alpha c} \; if \; \gamma = 0$$

We see that the numerator is increasing on δ, but so is the denominator (unless $\gamma = 0$). To find out whether $x^*(\boldsymbol{m}, \delta)$ is increasing or decreasing on δ, we calculate the derivative w.r.t. x:

$$\frac{\partial x^*(\boldsymbol{m}, \delta)}{\partial x} = \frac{\beta c - b\gamma}{\alpha(c + \delta\gamma)^2} \; if \; \gamma > 0, or \; \frac{\beta c}{\alpha c^2} \; if \; \gamma = 0$$

If $\gamma > 0$: $\frac{\beta c - b\gamma}{\alpha(c+\delta\gamma)^2} > 0$ because $\alpha(c + \delta\gamma)^2 > 0$, and $\beta c - b\gamma > 0$ since $\frac{\beta}{2\gamma} > \frac{b}{2c}$ $implies\ that\ \beta c > b\gamma$

$If\ \gamma = 0$: $\frac{\beta c}{\alpha c^2} > 0$ since all terms are >0.

Online Appendix B: Sample Airlines and Sample Attrition

These are the companies that were included in the full sample for dynamic panel data regression models.

DOT classification	DOT Reporting Airline	DOT Code	Ticker	Mean dedicated ownership	Mean unvested (mil. $)	Mean transient ownership	Mean vested (mil. $)
Major	Alaska Airlines, Inc.	AS	ALK	10.77%	0.27	17.68%	1.66
Major	American Airlines, Inc.	AA	AMR	20.59%	24.41	20.15%	7.99
Major	Continental Air Lines, Inc.	CO	CAL	27.68%	17.54	39.71%	9.74
Major	Delta Air Lines, Inc.	DL	DAL	22.25%	2.84	14.50%	8.91
Major	Northwest Airlines, Inc.	NW	NWAC	31.38%	0.07	5.70%	5.66
Major	Southwest Airlines, Co.	WN	LUV	10.31%	64.96	11.19%	61.92
Major	United Air Lines, Inc.	UA	UAL	30.49%	14.55	24.34%	22.15
Major	US Airways, Inc.	US	UAIR	20.82%	25.78	16.64%	29.09
Regional	Continental Express Airline	RU	CAL	27.68%	17.54	39.71%	9.74
Regional	Horizon Air	QX	ALK	10.77%	0.27	17.68%	1.66
Regional	US Air Shuttle	TB	UAIR	20.82%	25.78	16.64%	29.09

The sample used for the Difference-in-Differences analysis included more firms, since we could also look at the pricing behavior of private firms, or public firms that did not reported financials, as long as they competed in a duopoly market with firms that did. Here are the firms included in that sample:

DOT Classification	DOT Reporting Airline	DOT code	Ticker	Publicly-listed?	Main Sample?
Major	Alaska Airlines, Inc.	AS	ALK	Public	Yes
Major	America West Airlines, Inc.	HP	AWA	Public	
Major	American Airlines, Inc.	AA	AMR	Public	Yes
Major	Continental Air Lines, Inc.	CO	CAL	Public	Yes
Major	Delta Air Lines, Inc.	DL	DAL	Public	Yes
Major	JetBlue Airways	B6	JBLU	Public	
Major	Northwest Airlines, Inc.	NW	NWAC	Public	Yes
Major	Southwest Airlines, Co.	WN	LUV	Public	Yes
Major	Trans World Airways, Llc	TW	TWA	Public	
Major	United Air Lines, Inc.	UA	UAL	Public	Yes
Major	US Airways, Inc.	US	UAIR	Public	Yes
National	American Trans Air Inc.	TZ			
National	Hawaiian Airlines, Inc.	HA	HA	Public	
National	Markair Inc.	BF			
National	Morris Air Corporation	KN			

National	Spirit Air Lines	NK			
National	Sun Country Airlines	SY			
National	Vanguard Airlines, Inc.	NJ	VNGD	Public	
National	Western Pacific Airlines	W7	WPAC	Public	
Regional	Air South Inc.	WV			
Regional	Aloha Airlines Inc.	AQ			
Regional	Carnival Air Lines Inc.	KW			
Regional	Continental Express Airline	RU	CAL	Public	Yes
Regional	Harmony Airways	HQ			
Regional	Horizon Air	QX	ALK	Public	Yes
Regional	Midway Airlines Inc.	JI			
Regional	Midwest Airlines, Inc.	YX	MEH	Public	
Regional	Nations Air Express Inc.	N5			
Regional	Pro Air Inc.	P9			
Regional	Trans States Airlines	9N			
Regional	Tristar Airlines Inc.	T3			

We also want to explain how the different data availability conditions for analysis influenced sample attrition. The table below explains the different subsamples, going from the full data available from DOT for 1994-2000, to the final sample, in terms of number of observations, and number of passengers associated with these observations. The first two conditions (that lagged DVs are available and markets are not monopoly) restricted the number of firm-quarters and observations moderately, but had little effect on the number of firms in the sample. As the table shows, the main attrition in terms of number of firms is due to missing financials and missing earnings pressure data, such as the missing of either institutional investor ownership (e.g., Hawaiian Airlines) or stock-based incentive (e.g., America West Airlines) information.

	# of firms	**# firm-quarters**	**#obs.**	**# passengers**
DOT 1994-2000	24	663	336528	2569127442
keeping incumbents>=2	23	427	296052	2271143971
taking lags of DV	21	356	211599	2007740818
missing earnings pressure	18	276	191479	1827036132
missing financials, ownership, incentives	11	186	151165	1495749709
final sample net outlier	11	177	145355	1456930957

Online Appendix C: Validity of potential earnings estimate and earnings pressure measurement

a. Effectiveness of potential earnings estimate vs. analysts' earnings forecast in predicting actual earnings

Variables	**Deviation1: (Potential - Actual)/Stock Price**	**Deviation2: (Analyst-Actual)/Stock Price**	
N	599	599	
Distribution			
1 percentile	-0.4122	-0.1138	
10 percentile	-0.0530	-0.0182	
25 percentile	-0.0188	-0.0044	
Median	0.0037	0.0035	
75 percentile	0.0279	0.0267	
90 percentile	0.0723	0.0859	
99 percentile	0.3623	0.4705	
Std. Dev.	0.3138	0.3177	
Hypotheses Tested*	**H_0: Mean (Deviation1) = 0**	**H_0: Mean (Deviation2) = 0**	**H_0: Mean (Deviation1) = Mean (Deviation2)**
Mean	0.0195	0.0413	-0.0217
Std. Error	0.0128	0.0130	0.0046
t-value	1.5247	3.1780 †††	-4.7131 †††

† *p<0.10*, †† *p<0.05*, ††† *p<0.01, 1-sided*

*: The first two tests are one-sample t-tests; the third is a two-sample paired t-test.

b. Association between earnings pressure measurement, downward revision of analysts' earnings forecasts, and future earnings decline

		N	**Mean**	**s.d.**	**1)**	**2)**	**3)**	**4)**	**5)**	**6)**
1)	**Earnings pressure**	599	0.0059	0.04		*0.38*	*0.15*	*0.30*	*0.03*	*0.03*
2)	**Earnings pressure dummy (=1 if pressure>0)**	599	0.5175	0.50	0.39		*0.21*	*0.20*	*0.04*	*0.03*
3)	**Downward revision dummy (=1 if analyst revise downward)**	599	0.6244	0.48	0.16	0.21		*0.39*	*0.19*	*0.18*
4)	**Downward revision**	599	0.3133	0.85	0.32	0.18	0.40		*0.22*	*0.36*
5)	**Future earnings decline dummy (=1 if future earnings declines)**	599	0.5109	0.50	0.03	0.03	0.19	0.21		*0.67*
6)	**Future earnings decline**	599	0.0795	1.17	0.03	0.02	0.18	0.37	0.66	

Note: Correlations in italics are *within-group* correlations by firm.

Online Appendix D: Definition of control variables in dynamic panel data models

Variable Name	Definition
Financial constraint	KZ index (Kaplan and Zingales, 1997): $KZ_{it} = -1.002\frac{CF_{it}}{A_{it-1}} - 39.368\frac{DIV_{it}}{A_{it-1}} - 1.315\frac{C_{it}}{A_{it-1}} + 3.139LEV_{it}$ where CF_{it} / A_{it-1} is cash flow over lagged assets, DIV_{it} / A_{it-1} is cash dividends over lagged assets, C_{it} / A_{it-1} is cash balances over assets, and LEV_{it} is leverage.
Financial performance	Return on Assets in the previous quarter
% round trip tickets	Percentage of round trip tickets of all of a firm's tickets on the airline route
% high class	Percentage of first and business class tickets on the airline route
% direct flights	Percentage of passengers flying direct (without connections) on the airline route
Cost	Standard Industry Fare Level (SIFL) divided by market distance
Market size	Square root of total number of passengers traveling the market with any airline
Potential entrants	Number of potential entrants (firms present at both ends of the city-pair route but do not serve the city-pair)
Market Herfindahl	Herfindahl-Hirshman index of concentration at city-pair
Airport Herfindahl	Average of the Herfindahl-Hirshman index of concentrations of total enplanements at both end-cities

Online Appendix E: Market-level Analyses

Since earnings pressure may change the competitive behavior not only of the firm experiencing it, but also its market rivals, we explored the aggregate impact of earnings pressure shocks on market-level outcomes such as average prices or total frequencies in duopoly markets. In addition to the substantive insights from observing market-level outcomes, the specification helps reduce omitted variable bias by comparing independent and dependent variables at different levels of analysis. We followed the approaches employed by Chevalier (1995a, b) and contrasted the changes in market-level average prices and total frequencies in duopoly markets under three different conditions: (a) a control scenario where both duopolists remain without earnings pressure for both periods, (b) a treatment scenario, similar to the difference-in-differences above, where only one firm experiences an earnings pressure shock in the second period, and (c) a different treatment scenario where both duopolists experience earnings pressure shocks in the second period. These comparisons provide insight on the market-level competitive dynamics affected by earnings pressure.

We found in the duopoly market sample, market average prices rise when one of the firms became under earnings pressure in the second quarter (2.02% vs. -0.11%, $t = 5.59$), and rise even more when both firms became under earnings pressure in the second quarter (7.03% vs. -0.11%, $t = 17.63$). We also find total market frequencies did not change when only one firm experienced earnings pressure, but dropped when both firms experienced earnings pressure in the second quarter (-0.72% vs. 0.95%, $t = 4.96$). This suggest that when only one company experiences earnings pressure, the market price increases slightly (probably because the firm that does not experience pressure follows along with price increases), but the frequency reduction by the pressured firm is balanced by the frequency increase by the non-pressured competitor. In contrast, when both competitors experience earnings pressure at the same time, the softening of competitive behavior is aligned among them, leading to higher prices but lower frequencies in the market. The market-level analysis, together with the DiD analysis, although using a smaller subsample of duopoly markets, provided insights and evidence in a quasi-experimental setting that is aligned with the statistical associations found in the panel data regressions.