Generalized linear competition: From pass-through to policy

Robert A. Ritz

University of Cambridge

(joint work with Christos Genakos and Felix Grey)

November 2020

Research motivation

- Economic policy and shifts in input market prices have significant impacts on firms' marginal costs and profits
  - Pricing of externalities (e.g. carbon emissions)
  - Labour market regulation (e.g. minimum wage)
  - Market-driven cost shocks (e.g. fracking technology)
- Cost shifts can prompt strategic responses by firms that are hard to predict and can have highly heterogeneous impacts across firms
- **This paper**: New reduced-form model "generalized linear competition" (GLC) to estimate *ex ante* profit (and welfare) impacts

Preview of results

- **GLC theory**:
  - GLC nests linear versions of many IO models:
    - Cournot, Bertrand, Salop, supply function equilibrium, two-stage strategic games, common ownership
    - Multiproduct competition, two-sided markets, multimarket competition on a network, oligopolistic price discrimination
  - Firm-level cost pass-through as sufficient statistic for profit impact
- **Empirical application**:
  - Carbon pricing for aviation: US domestic airline market
  - Substantial pass-through heterogeneity: Winners & losers
- **Extra results**:
  - Under additional assumptions, GLC gives welfare results
  - Use GLC structure & pass-through to endogenize carbon price

Statement of the problem

- Suppose firm i experiences marginal cost shock ΔMC_i
- Profit impact $\Delta\Pi_i$, in general, depends on:
  - Technology of firm i
  - Demand for i's (differentiated) product
  - Competitors: how many (n), their technologies, their cost shocks (ΔMC_{-i}), their strategies, degree of competitiveness
- We try to radically simplify the problem, by remaining agnostic about most of the above
- In the spirit of Sutton (2007): *"aim to build the theory in such a way as to focus attention on those predictions which are robust across a range of model specifications which are deemed 'reasonable'."*

The basic idea underlying GLC

- Consider firm i competing a la Cournot with differentiated products
  - Demand: $p_i = \alpha - \beta x_i - \delta X_{-i}$
  - Marginal cost: $MC_i = c_i + \tau$
  - FOC: Linear supply schedule $x_i = (1/\beta)(p_i - c_i - \tau)$
  - No assumptions on i's rivals' technologies or behaviour
- Suppose i's marginal cost increases by $d\tau$ e.g. due to regulation
  - Regulation τ may apply to all, some or none of i's rivals
  - Define i's rate of pass-through $\rho_i = (dp_i/d\tau)/(dMC_i/d\tau)$
    - By construction, firm-level pass-through captures margin impact
    - By linear supply schedule, sales impact is proportional to pass-through
- GLC: So i's pass-through = sufficient statistic for i's profit impact
  - Pass-through captures all relevant information about i's rivals
  - No information needed about (α, β, δ) or c_i
  - Also works with semi-linear $p_i = \alpha - \beta x_i - f(x_1, ..., x_j, ...x_n)$ for *any* $f(.)$
- Same GLC logic applies to many other IO models

Plan for this talk

1. Related literature
2. Theory: Generalized linear competition (GLC)
3. Empirical application: Carbon pricing for airlines
4. Conclusion

Related literature (1)

- **Structural IO**
  - Structural estimation of differentiated-products Bertrand-Nash competition with logit demand system (Berry, Levinsohn & Pakes 1995; Nevo 2001; Reiss & Wolak 2007)
  - **This paper**: Sidestep estimation of demand system, no equilibrium concept, lower computational burden
    But: Narrower research focus on impacts of cost shifts

- **Cost pass-through**
  - **Empirics**: e.g. De Loecker et al. 2016 ($< 100\%$); Fabra & Reguant 2014 ($= 100\%$); Miller, Osborne & Sheu 2017 ($> 100\%$)
  - **Pass-through as a tool**: Weyl & Fabinger 2013; Atkin & Donaldson 2015; Miller, Osborne & Sheu 2017 on incidence analysis
  - **This paper**: Shift from market-wide to firm-level pass-through, further simplification of incidence analysis (no conduct parameters)

Related literature (2)

- **Marked-based environmental policy**
  - Impact of carbon pricing on industry profits (Bovenberg & Goulder 2005; Hepburn, Quah & Ritz 2013; Bushnell, Chyong & Mansur 2013; Fowlie, Reguant & Ryan 2016)
  - **This paper**: Shift from electricity & heavy industry to differentiated products, highlight firm-level heterogeneity in profit impacts
- **Airline competition**
  - Competition and market structure in US airlines (Brander & Zhang 1990; Kim & Sengal 1993; Goolsbee & Syverson 2008; Ciliberto & Tamer 2009; Berry & Jia 2010)
  - **This paper**: New results on political economy of low-cost vs legacy carriers, special role of Southwest also in terms of pass-through

Model setup

Exposition here in terms of *regulation* τ that affects costs (e.g. input tax)

- Firm i sells quantity x_i at price p_i
- Let e_i be one of input into i's production technology
- Regulation τ imposes cost on each unit of i's input e_i
- In general, i's profits $\Pi_i = p_i x_i - C_i(x_i, e_i) - \tau e_i$
- Regulation τ may apply to all, some or none of i's rivals
  - Let $\mathbf{\Phi} = (\phi_k)_{k \in N}$ be scope of cost shift, where $\phi_k \in \{0, 1\}$ and $\phi_i = 1$

Same approach works for market-driven cost shifts, output tax, etc.

Generalized linear competition (GLC)

Four assumptions hold for firm i for all relevant $\tau \geq 0$:

A1. *Input price-taking*: i takes input prices, incl. regulation τ, as given

A2. *Cost-minimizing emissions*: i chooses inputs, including the regulated factor e_i, optimally so as to minimize its total costs $C_i(x_i, e_i) + \tau e_i$ of producing output x_i

A3. *Constant returns to scale*: i's optimized unit costs are linear in output $C_i(x_i, e_i) + \tau e_i = k_i(\tau) x_i$, with unit cost $k_i(\tau) = c_i(\tau) + \tau z_i(\tau)$

- Optimal use of regulated factor per unit of output $z_i \equiv e_i / x_i$
- A1–A3 imply $dk_i(\tau)/d\tau = z_i(\tau)$ by envelope theorem

A4. *Linear product market behaviour*: i's product market behaviour satisfies $x_i(\tau) = \psi_i[p_i(\tau) - k_i(\tau)]$

- Profit margin $[p_i(\tau) - k_i(\tau)] > 0$, where $\psi_i > 0$ is a constant

Key features of GLC

- Weaker assumptions than many standard oligopoly models
  - A1–A3 are very common assumptions, A4 is the main novelty of GLC
- No assumptions on technology or behaviour of i's rivals
- No assumptions on demand system or nature of consumer behaviour
  - Number of products
  - Substitutes vs complements
  - Strategic substitutes vs strategic complements
- No equilibrium concept
  - Market definition and market clearing
  - Behavioural departures from rationality, Nash, payoff-maximization (consumer and/or producers)
  - Rule of thumb behaviour

Special cases of GLC

Given A1–A3, A4 is satisfied by a wide range of (linear) IO models:

- Cournot-Nash with linear demand (including with firm-specific conjectural variations), Stackelberg leadership
- Bertrand & Cournot with horizontally and/or vertically differentiated products, spatial competition on Salop circle
- Two-stage models with linear competition in 2^{nd} stage
  - Strategic forward contracting (Allaz & Vila 1993)
  - Managerial delegation (Fershtman & Judd 1987)
- Supply function equilibrium (Klemperer & Meyer 1989)
- Sunk cost bias (Al-Najjar, Baliga & Besanko 2008)
- Common ownership of firms (Azar, Schmalz & Tecu 2018)

Profit impact of a cost shift

- **Profit change:** Let $\Pi_i(\tau; \mathbf{\Phi})$ be i's optimized profits so if regulation tightens from $\underline{\tau}$ to $\overline{\tau}$ then $\Delta\Pi_i(\overline{\tau}, \underline{\tau}; \mathbf{\Phi}) \equiv [\Pi_i(\overline{\tau}; \mathbf{\Phi}) - \Pi_i(\underline{\tau}; \mathbf{\Phi})]$

- **Static benchmark:** If i and its rivals do not change their behaviour in any way, then $\Delta\Pi_i(\overline{\tau}, \underline{\tau}; \mathbf{\Phi}) = -(\overline{\tau} - \underline{\tau})e_i(\underline{\tau}) < 0$

- **Pass-through definitions:**
  1. Marginal pass-through rate $\rho_i(\tau; \mathbf{\Phi}) \equiv \frac{dp_i(\tau;\mathbf{\Phi})/d\tau}{dk_i(\tau)/d\tau}$
  2. Average pass-through $\overline{\rho}_i(\overline{\tau}, \underline{\tau}; \mathbf{\Phi}) \equiv \frac{\Delta p_i(\overline{\tau},\underline{\tau};\mathbf{\Phi})}{\Delta k_i(\overline{\tau},\underline{\tau})}$

- **Factor substitution:** $g_i(\overline{\tau}, \underline{\tau}) \equiv [\int_{\tau=\underline{\tau}}^{\overline{\tau}} z_i(\tau)d\tau]/[(\overline{\tau} - \underline{\tau})z_i(\underline{\tau})] > 0$
  - More substitution away from regulated factor means lower $g_i(\overline{\tau}, \underline{\tau})$
  - Without any factor substitution, $g_i(\overline{\tau}, \underline{\tau}) = 1$

Main GLC result on profit impact

Proposition 1

Under A1–A4, regulation τ with scope $\mathbf{\Phi}$ affects profits Π_i according to:

(a) For a "small" tightening of regulation:

$$\Delta\Pi_i(\overline{\tau}, \underline{\tau}; \mathbf{\Phi})|_{\overline{\tau}\to\underline{\tau}} \simeq (\overline{\tau} - \underline{\tau}) \left. \frac{d\Pi_i(\tau; \mathbf{\Phi})}{d\tau} \right|_{\tau=\underline{\tau}} = -2[1 - \rho_i(\underline{\tau}; \mathbf{\Phi})](\overline{\tau} - \underline{\tau})e_i(\underline{\tau})$$

- Firm-level pass-through *alone* as sufficient statistic for profit impact of cost shift (no conduct parameters, demand elasticities, etc.)
  - Twoness: Profit margin and sales (by A4) decline if and only if $\rho_i < 1$
  - For given size, firm with lower pass-through has worse profit impact
- Same formula in terms of $\overline{\rho}_i$ for "large" tightening as long as (i) cost shift modest relative to price, (ii) limited factor substitution

Multidimensional GLC

- Multidimensional GLC has i compete on multiple components
  - **A1M–A3M** are straightforward extensions for each component $m \in M$
  - **A4M**. Firm i plays according to $x_{im}(\tau) = \psi_{im}\left[p_{im}(\tau) - k_{im}(\tau)\right]$
  - Firm i's multidimensional cost pass-through:

$$\rho_i^M(\tau; \mathbf{\Phi}) \equiv \sum_{m \in M} \omega_{im}(\tau)\rho_{im}(\tau; \mathbf{\Phi}) \qquad (1)$$

where the component weights $\omega_{im}(\tau) \equiv e_{im}(\tau)/e_i(\tau) \in (0, 1)$

Proposition 2

Under A1M–A4M, $\Delta\Pi_i \simeq -2(1 - \rho_i^M)(\overline{\tau} - \underline{\tau})e_i(\underline{\tau})$

- **Special cases:**
  - Multiproduct linear Cournot and Bertrand
    - Upgrades approach (Johnson & Myatt 2003, 2006)
    - Two-sided markets (Armstrong 2006)
  - Multimarket network competition (Elliott & Galeotti 2019)
  - Oligopoly 3rd degree price discrimination (Hazledine 2006; Kutlu 2017)

Empirical implementation of GLC

Three steps:

1. Identify scale τ and scope $\mathbf{\Phi}$ of cost shift, and obtain corresponding estimate of firm-level pass-through estimate for i
2. Verify GLC's assumptions as reasonable approximation to i's production technology and competitive environment
3. Use GLC's results to compute i's profit impact

Background on aviation and climate policy

- **Global aviation:**
  - CO_2 emissions are 2.5% of total – but 5% by impact
  - Set to rise to 25% by 2050 without new policies
- **Policy problem:**
  - Aviation is growing fast (...) but hard to decarbonize
  - Limited climate policy so far (EU emissions trading system since 2012, carbon taxes on aviation in some countries, CORSIA offset system)
- **US aviation:**
  - World's largest market: 30% of global aviation emissions
    - 2014: 172 million tons of CO_2, "value" \$5 billion at \$30/tCO_2
    - So far no carbon pricing...
  - Concentrated industry with significant market power
    - Complex firm heterogeneity in demand, costs, conduct

Empirical question & strategy

- What is the impact of carbon pricing on US airlines' profits?
  - Complete regulation ($\mathbf{\Phi} \equiv 1$), $\underline{\tau} = 0$, $\overline{\tau} = \$30/tCO_2$

- Product: a flight on carrier i on route j

- GLC: Aggregate profit impact on carrier i across its j routes:

$$\Delta\Pi_i \simeq -2(1 - \rho_i^M)\overline{\tau} e_i(0)$$

where $\rho_i^M = \sum_j \frac{e_{ij}(0)}{e_i(0)} \rho_{ij}$ is multidimensional pass-through rate

- Predict carbon pass-through by estimating fuel cost pass-through
  - Airlines cannot influence fuel price
  - Wide variation in fuel costs over time (factor of 5)
  - 1 gallon of jet fuel produces constant 0.00957 tons of CO_2

The data

- We use data from the US Bureau of Transportation Statistics
- Time period: 2004Q1 to 2013Q4
    - Avoid effects of 9/11 and mega-mergers in mid-2010s
- Average quarterly price p_{ijt} from a 10% sample of all tickets (DB1A)
    - One way (split returns), ignore direction
    - Exclude: international, frequent fliers, non-economy, prices >5 times 'standard', some others (common practice in literature)
- Per-passenger fuel cost k_{ijt} constructed from fuel expenditure by aircraft (Form 41), and aircraft share by route (T-100)

The data

- Keep all carrier-routes which are:
  - direct flights (standard in airlines literature)
  - at least 1,000 passengers per quarter (83 per week)
- Focus on 5 largest carriers:
  - Legacy carriers: American, Delta, United, US Airways
  - Low cost carrier: Southwest
- Resulting sample is an unbalanced panel with $N = 1,334$ carrier-routes over $T = 40$ quarters (35,650 observations)
  - Continuously operated routes give balanced panel with $N = 615$

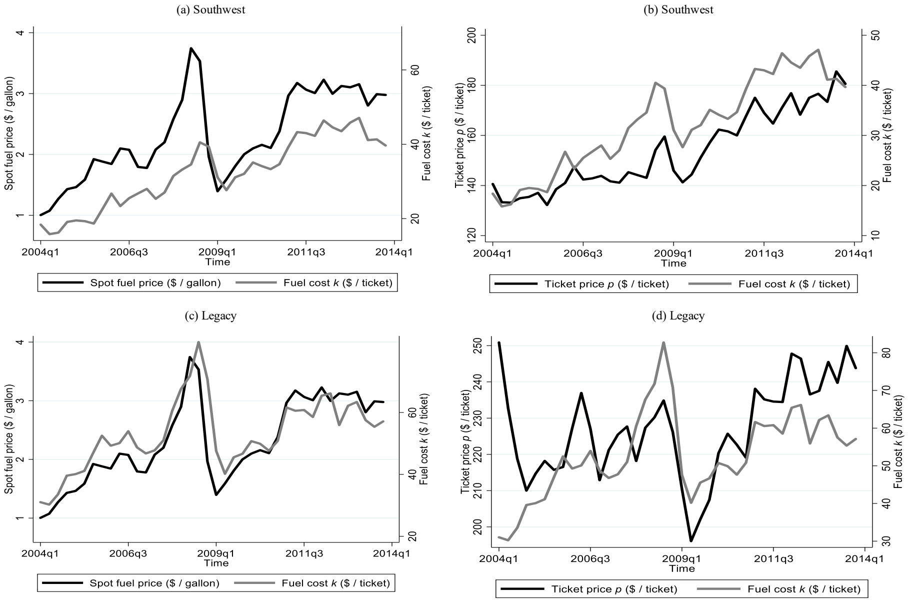
Descriptive statistics

TABLE 1 - SUMMARY STATISTICS

	Southwest				Legacy			
	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation	Min	Max
Quarterly av. statistics								
Price ($)	154.73	40.76	63.07	298.91	227.75	70.89	72.80	599.11
Fuel cost ($)	32.95	17.86	5.61	129.81	52.98	28.74	2.05	366.63
Distance (miles)	717	466	133	2,298	1,044	629	130	2,724
Emissions (tCO_2)	0.13	0.06	0.03	0.41	0.20	0.10	0.01	0.71
Emissions cost ($\$/tCO_2$)	4.00	1.84	1.03	12.44	6.02	2.89	0.18	21.22
Passengers (000s)	42	39	1	289	30.19	29.21	1.00	244.66
Competitors	2.24	2.40	0	16	2.82	2.29	0.00	16.00
LCC competitors	0.40	0.73	0	4	0.67	0.97	0.00	5.00
Revenue ($ million)	5.46	4.37	0.12	32.123	5.85	5.84	0.11	53.87
Whole sample statistics								
Revenue in sample (%)	56				43			
Observations	13,199				22,451			
Carrier-routes	416				918			

Notes: Price, fuel cost, emissions and emissions cost are per passenger. Emissions costs are calculated at a carbon price of $\$30/tCO_2$. Whole sample statistics are aggregated over all N and T. Revenue is sample is the proportion of all US aviation revenue (i.e. all flights on all airlines) in the sample over this period. The legacy carriers are American, Delta, United and US Airways. All averages are unweighted.
Source: Authors' calculations based on quarterly data from the US Bureau of Transportation Statistics for the period 2004Q1-2013Q4.

Fuel costs and ticket prices



Baseline regression specification

- Standard panel data regression, with interaction term:

$$p_{ijt} = \rho_S k_{ijt} \cdot S_i + \rho_L k_{ijt} \cdot L_i + X'_{ijt}\beta + \lambda_t + \eta_{ij} + \epsilon_{ijt} \qquad (2)$$

where:

- k_{ijt} is fuel cost
- S_i and L_i are dummies for Southwest and Legacy
- X_{ijt} is a vector of controls:
  - GDP growth
  - Non-fuel cost index
  - Number of competitors
  - Number of LCC competitors
  - Carrier size
- Year-quarter time effects (λ_t) and carrier-route fixed effects (η_{ij})

2SLS estimation approach

- Endogeneity: k_{ijt} constructed by dividing whole plane's fuel consumption by number of filled seats, which depends on p_{ijt}
- So use spot fuel price f_{ijt} as an instrument for k_{ijt}

First stage regressions:

$$k_{ijt} \cdot a_i = \sum_{q=0}^{3} \gamma_q f_{t-q} \cdot a_i + \sum_{q=0}^{3} \delta_q f_{t-q} \cdot a_i \cdot d_{ij} + X'_{ijt}\beta + \mu_t + \theta_{ij} + \omega_{ijt} \qquad (3)$$

for each $a_i \in \{S_i, L_i\}$

- d_{ij} is route distance, others controls X_{ijt} as before
- 2SLS uses resulting fitted values in Equation (2)

Pass-through estimates: Southwest vs Legacy

TABLE 2 - PASS-THROUGH ESTIMATES

	(1)	(2)	(3)	(4)
Estimation method	OLS	2SLS	2SLS	2SLS
Dependent variable	$Price_{ijt}$	$Price_{ijt}$	$Price_{ijt}$	$Price_{ijt}$
Sample		Baseline	Balanced panel	Common routes
Fuel cost × Southwest	1.145***	1.418***	1.485***	0.983***
	(0.119)	(0.121)	(0.129)	(0.152)
Fuel cost × Legacy	0.560***	0.661***	0.688***	0.518***
	(0.082)	(0.104)	(0.109)	(0.140)
Competitors	-2.372***	-2.171***	-2.255***	0.590
	(0.721)	(0.717)	(0.781)	(0.996)
LCC competitors	-7.834***	-7.808***	-8.137***	-9.890***
	(1.412)	(1.361)	(1.454)	(2.226)
Non-fuel cost index	7.248***	6.895***	7.400***	7.093**
	(2.684)	(2.580)	(2.809)	(2.993)
GDP growth	-1.374***	-1.341***	-1.620***	0.362
	(0.398)	(0.388)	(0.436)	(0.302)
Carrier size	-15.094***	-15.119***	-16.203***	-2.247
	(4.474)	(5.218)	(5.793)	(4.502)
Time FE	yes	yes	yes	yes
Carrier-routes FE	yes	yes	yes	yes
Observations	35,650	35,650	24,600	6,138
Clusters	1,334	1,334	615	183

Decomposition of pass-through heterogeneity

Baseline: Southwest pass-through 142% *vs* Legacy pass-through 66%

(1) Southwest flies shorter routes:

- Pass-through on all routes *vs* on common routes
- Explains 39% of the original difference

(2) Southwest is more fuel efficient on like-for-like routes:

- Fuel cost: $k_{Southwest} = \$30$ and $k_{Legacy} = \$41$
- If products are homogeneous, then $\frac{\rho_i}{\rho_j} = \frac{\Delta k_j}{\Delta k_i}$
- Explains 23% of original difference

(3) Southwest has a different demand profile on like-for-like routes:

- Differentiated-product demand-side asymmetries
- Pass-through heterogeneity even for a uniform cost shock
- Explains as residual remaining 38% of difference

Verifying GLC's assumptions

1. **A1M: Input price-taking**
   - Reasonable assumption for jet fuel price (similar for carbon price)
2. **A2M: Cost-minimizing inputs**
   - Fuel costs make up 20-50% of airline's total costs so strong incentive to minimize (similar for carbon costs)
3. **A3M: Constant returns to scale**
   - Airlines literature is inconclusive (fixed costs not crucial to GLC)
4. **A4M: Linear product market behaviour**
   - Two empirical tests for linear demand (implying A4M in IO models):
     1. Pass-through on monopoly routes indistinguishable from 50%
     2. No significant demand non-linearity in duopoly & triopoly markets

Profit impacts of carbon pricing for US airlines

- Southwest *gains* from carbon pricing while legacy carriers lose
  - Airlines industry collectively opposed to carbon pricing

	(1)	(2)	(3)
		Exogenous τ = $30	
	Southwest	Legacy	All
Pass-through, ρ	1.418	0.661	0.853
	(0.121)	(0.104)	(0.109)
Profit impact (in millions $), $\Delta\Pi$	98.3	-233.9	-135.6
	[41.4, 155.3]	[-377.4, -90.4]	[-337.6, 66.4]
Profit impact (in %), $\Delta\Pi$	1.55%	-1.60%	-0.65%
	[0.65, 2.45]	[-2.59, -0.62]	[-1.61, 0.32]
Consumer surplus (in millions $), ΔS			-394.8
			[-495.8, -293.8]
Total welfare (in millions $), ΔW			49.4
			[-51.6, 150.4]

Consumer surplus and social welfare

A5M. Consumer surplus $S = V(\mathbf{x}_1, ..., \mathbf{x}_n) - \sum_{i=1}^{n} \sum_{m \in M_i} p_{im} x_{im}$, where $V(\cdot)$ is gross consumer utility and consumers are utility-maximizers.

A6M. Environmental damages $D(E) \geq 0$ depend on aggregate industry-wide emissions $E = \sum_{i=1}^{n} \sum_{m \in M_i} e_{im}$ with $D'(\cdot), D''(\cdot) \geq 0$.

- Social welfare $W(\tau) = S(\tau) + \Pi(\tau) + \tau E(\tau) - D(E(\tau))$
- Industry-average pass-through $\widetilde{\rho}^M(\tau) \equiv \sum_{i=1}^{n} \frac{e_i(\tau)}{E(\tau)} \rho_i^M(\tau)$

Proposition 3

(a) If A1M–A3M (not A4M) hold for each firm $i \in N$ and A5M holds:

$$\Delta S(\overline{\tau}, \underline{\tau}) \simeq -(\overline{\tau} - \underline{\tau}) E(\underline{\tau}) \widetilde{\rho}^M(\underline{\tau}).$$

(b) If A1M–A4M hold for each firm $i \in N$ and A5M–A6M hold:

$$\Delta W(\overline{\tau}, \underline{\tau}) \simeq -(\overline{\tau} - \underline{\tau}) \left\{ [1 - \widetilde{\rho}^M(\underline{\tau})] E(\underline{\tau}) + [D'(E(\underline{\tau})) - \underline{\tau}] \left. \frac{dE(\tau)}{d\tau} \right|_{\tau = \underline{\tau}} \right\}.$$

Political economy and endogenous regulation

- GLC structure brings together two strands of literature:
  - Second-best emissions tax with market power (Buchanan 1969)
  - Lobbying government for sale (Grossman & Helpman 1994)
- Government payoff $U_{\text{gov}}(\tau) = W(\tau) + \lambda \sum_{i=1}^{n} K_i(\tau)$
  - $\lambda \geq 0$ is openness to lobbying, K_i is i's political contribution
- Define $\eta(\tau) \equiv \frac{d \ln E(\tau)}{d \ln \tau}$ as tax elasticity of industry emissions

Proposition 4

Suppose A1M–A4M hold for each firm $i \in N$ and A5M–A6M hold. The "political equilibrium" emissions price satisfies:

$$\tau^*(\lambda) = \left[\frac{D'(E(\tau))}{1 + \frac{(1+2\lambda)}{-\eta(\tau)}[1 - \widetilde{\rho}^M(\tau)]} \right]_{\tau=\tau^*(\lambda)} .$$

- For US airlines, we find $\tau^* = \$17.68/tCO_2$, 41% below Pigouvian rule

Welfare impacts of carbon pricing for US airlines

- Total welfare rises under endogenous carbon price τ^*
  - Market power & industry lobbying water down third-best carbon price
  - Environmental gains outweigh lower consumer & producer welfare

	(1)	(2)	(3)	(4)	(5)	(6)
	Exogenous τ = $30			Endogenous τ = $17.68		
	Southwest	Legacy	All	Southwest	Legacy	All
Pass-through, ρ	1.418	0.661	0.853	1.418	0.661	0.853
	(0.121)	(0.104)	(0.109)	(0.121)	(0.104)	(0.109)
Profit impact (in millions $), $\Delta\Pi$	98.3	-233.9	-135.6	58.0	-154.3	-79.9
	[41.4, 155.3]	[-377.4, -90.4]	[-337.6, 66.4]	[24.4, 91.5]	[-249.0, -59.6]	[-198.9, 39.1]
Profit impact (in %), $\Delta\Pi$	1.55%	-1.60%	-0.65%	0.91%	-0.94%	-0.38%
	[0.65, 2.45]	[-2.59, -0.62]	[-1.61, 0.32]	[0.38, 1.44]	[-1.52, -0.36]	[-0.95, 0.19]
Consumer surplus (in millions $), ΔS			-394.8			-232.7
			[-495.8, -293.8]			[-292.2, -173.2]
Total welfare (in millions $), ΔW			49.4			77.3
			[-51.6, 150.4]			[17.8, 136.8]

Conclusion

- Developed GLC as new, simple, flexible reduced form model of competition that nests many IO models as special cases
  - Firm-level cost pass-through alone sufficient statistic for profit impact
  - Additional assumptions for welfare results & endogenous regulation
- GLC can be put to use across different fields on other policy issues
  - Single industry with complex firm heterogeneity in demand, costs, and conduct (IO)
  - Cross-sectional studies which require consistent framework across many different industries (macro, international trade)
- GLC reduces complexity of incidence analysis without requiring commitment to particular model or notion of equilibrium