Domestic Rivalry and Export Performance: Theory and Evidence from International Airline Markets

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Abstract: The much-studied relationship between domestic rivalry and export performance consists of those supporting a national-champion rationale, and those supporting a rivalry rationale. While the empirical literature generally supports the positive effects of domestic rivalry, the national-champion rationale actually rests on firmer theoretical ground. We address this inconsistency by providing formal theoretical backing to the rivalry rationale that illustrates three paths via which domestic rivalry translates into enhanced international exports. Furthermore, empirical tests on the world airline industry elicit the existence of one particular path – an enhanced firm performance effect – that connects domestic rivalry with improved international exports.

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I. INTRODUCTION

The impact of domestic market structure on export performance has received a good deal of scholarly attention since the 1970s. The literature was sparked by White (1974) and has been fanned by the work of a number of well regarded scholars (e.g., Caves, 1982; Audretsch & Yamawaki, 1988; Porter, 1990). At the risk of oversimplifying, the literature can essentially be reduced to two camps: those supporting a national-champion rationale, and those supporting the salubrious impact of domestic rivalry. Supporters of the national-champion rationale (Pagoulatos & Sorensen, 1976; Marvel, 1980; Krugman, 1984; Chou, 1986) argue that large domestic operations – enabled by domestic market concentration – provide national firms with economies, and these economies allow firms to earn large shares and profits in export markets. Supporters of the rivalry rationale (Ray, 1981; Audretsch & Yamawaki, 1988; Porter, 1990; Clark *et al.*, 1992; Kim & Marion, 1997; Sakakibara & Porter, 2001; Hollis, 2003) argue that domestic competition – disabled by domestic market concentration – provides national firms with vigorous and real pressures to improve and innovate, and these improvements allow firms to earn large shares and profits in export markets.

The majority of empirical studies – particularly those that take a pan-industry perspective – support the rivalry rationale; hence, low domestic concentration appears to generally be the means to enhance the exports of national industries.[1] Interestingly, however, the literature on domestic market structure and export performance appears to have a scarcity of formal theoretical work in support of the rivalry rationale. We were able to find only four studies (White, 1974; Clark *et al.*, 1992; Kim & Marion, 1997; Hollis, 2003) that explicitly model the beneficial impact of domestic market competition on export performance. All the more striking when you consider Martin's (1999) observation that the national-champion rationale – though empirically less robust – falls on more solid theoretical foundations than the rivalry rationale.

[1] Some industry-based studies (e.g., Parsons & Ray, 1975 with the steel industry; and Clougherty, 2000, 2002a with the airline industry) find a positive relationship between domestic concentration and national exports; but only Pagoulatos and Sorensen (1976) find a statistically significant positive relationship between domestic concentration and exports while employing cross-industry data. In short, the majority of cross-industry studies appear to support the rivalry rationale over the national-champion rationale.

Furthermore, the few studies that formally model the positive impact of domestic competition on export performance suffer some shortcomings. White's (1974) work is inspirational, but the analysis only allows domestic market concentration to impact exports via price-discrimination and dumping as he restricts his market settings to perfect competition and monopoly. Clark *et al*. (1992) build a dominant firm model with a competitive fringe in an integrated world market: here when the fringe increases output (i.e., a larger number of domestic fringe firms), the dominant firm's price is lowered thus increasing exports.[2] Accordingly, both frameworks do not allow for either imperfect competition or economies between domestic and international production: both of which are generally regarded today as appropriate for policy-relevant international markets (Martin, 1999). Kim and Marion (1997) and Hollis (2003) do formulate oligopolisitic models – respectively employing a conjectural variations approach and a Cournot approach – to understand the effect of domestic rivalry on export performance; yet, the enhanced exports in these settings are simply due to the strategic effect of having multiple national competitors in world markets. In essence, their rivalry effect involves equivalence between domestic competitors and the number of national competitors in export markets.

Beyond the observation that the formal theoretical backing behind the rivalry rationale lacks both scale and substance rests some concerns we have with the empirical literature. The empirical work is almost universally undertaken at a broad level-of-analysis: where some measure of export performance (e.g., world market share, net exports, export revenue) is regressed on some measure of domestic concentration or rivalry (e.g., four-firm concentration ratio, Herfindahl-Hirschman-Index, instability in market shares) at the industry-wide level of analysis.[3] The broad level-of-analysis makes it difficult then to elicit out the different paths via which domestic rivalry might impact export performance. For instance, the number-of-competitors effect – focused on by Kim and Marion (1997) and Hollis (2003) – is an important conduit, yet additional paths may connect domestic rivalry to export performance: 1) the impact of domestic rivalry on the size of firms' domestic operations may affect export performance when there

[2] If there is more than one firm in the dominant group, Clark *et al.* (1992) assume that these multiple firms are able to collude and choose a cartel price. This cartel price also falls as the fringe increases output.
[3] Most commonly, the industry data is at the four-digit SIC code level.

are joint-economies of production between domestic and international output; 2) domestic rivalry may also pressure firms to innovate and upgrade, thus spurring product and service innovation that spills over and enhances the competitiveness of home firms in international markets (Porter, 1990). All of these effects are likely to be part of the net-effect which the empirical literature finds between domestic concentration and rivalry, but the previous empirical approaches are unable to tease out the different effects due to the broad level-of-analysis.

Motivated by the above three points – the scarcity and limits to the theoretical literature and the broad nature of the empirical work on the rivalry rationale – we attempt to provide a formal theoretical backing for the rivalry rationale that draws out the different paths via which domestic rivalry might impact export performance. We focus on the three effects already mentioned: a number-of-competitors effect, a joint-economies of production effect, and an enhanced-performance of competitors effect. We pay particular attention to the enhanced-performance of competitors effect (what might be referred to as a pure rivalry effect), as this is oft-quoted as a motivating rationale but also oft-neglected in both the empirical and theoretical literatures. For instance, both Kim and Marion (1997) and Hollis (2003) motivate their analysis with the potential for rivalry to enhance firm competitiveness; yet, their theoretical constructs focus only on the number-of-competitors effect. Accordingly, an important contribution by this piece is the formalization of what scholars often consider to be the heart of the rivalry rationale: domestic rivalry requires firms to innovate and improve.[4]

We also attempt to link theory to empirics; and as with our special emphasis on enhanced firm performance in the theoretical section, we also focus on that same neglected – but important – path in the empirical section. We empirically test for the impact of rivalry on firm performance while abstracting away from the number-of-competitors effect, and while holding constant any joint-economies of production effect. The proposed rivalry rationale is tested on comprehensive data covering the international airline markets between nineteen nations over the 1987-1992 period. We find evidence that

[4] See for instance Bloom & Van Reenen's (2006) recent evidence that product market competition eliminates poor managerial practice.

domestic rivalry (as measured by both concentration and market-share-instability) does indeed enhance airline-specific exports in international markets; i.e., we empirically elicit the positive impact of domestic rivalry on firm-level international performance.

In order to support our analysis, the structure of the paper is as follows. Section II sets the basic theoretical model. Section III considers the three different paths via which domestic rivalry may impact exports and generates a testable proposition. Section IV provides explanation of the world airline industry data. Section V discusses the econometric issues, while section VI presents the empirical results. Section VII concludes.

II. THE BASIC THEORETICAL MODEL

We consider a model with two markets – one domestic and one international – and one industry: this is likely to be the simplest structure in which our main problem can be addressed. There are *n* home firms that sell their output and compete in both the domestic and international markets (referred to as 'home-international' firms). They also encounter competition in the domestic market from *m* other home firms, which sell their output only in the domestic market (referred to as 'home-domestic' firms). In the international market, the *n* home firms compete with *f* foreign firms, each of whom may come from different countries other than the home country. Note that in this set-up, the domestic market is served only by home firms: a set-up that is not crucial for our insights to go through, but is indicative of the airline industry where we empirically test.[5]

Within each of the three groups (home-international, home-domestic, and foreign firms), we consider the firms to produce homogeneous output. Denote aggregate quantities in the domestic market by X (for home-international) and Y (for home-domestic), where $X = x_1 + x_2 + \cdots + x_n$ and

[5] As discussed below, nations generally do not import airline services in the sense that domestic routes are the exclusive prerogative of home-nation airlines; yet, the international airline service markets between nations are usually served by both home and foreign airlines. In airline terminology, 'cabotage' – the right to provide air services between points within a single foreign country – has traditionally been almost non-existent.

$Y = y_1 + y_2 + \cdots + y_m$, and corresponding prices by p^x and p^y. The (inverse) demand functions faced by the two groups of firms may be written as $p^x(X,Y)$ and $p^y(X,Y)$, which satisfy

$$p_x^x(X,Y)(\equiv \partial p^x(X,Y)/\partial X) < 0, \qquad p_y^y(X,Y) < 0 \tag{1}$$

$$p_y^x(X,Y) < 0, \qquad p_x^y(X,Y) < 0 \tag{2}$$

where, as noted, the subscripts denote partial derivatives. Inequality (1) says that the demands are downward-sloping, whereas (2) says that the two groups of firms produce substitutes.

In the international market, variables are denoted by a 'hat'; hence, the aggregate quantities by $\hat{X} = \hat{x}_1 + \hat{x}_2 + \cdots + \hat{x}_n$ and $\hat{Z} = \hat{z}_1 + \hat{z}_2 + \cdots + \hat{z}_f$ (for foreign firms), and the prices by $\hat{p}^x$ and $\hat{p}^z$. The demand functions are then given by $\hat{p}^x(\hat{X},\hat{Z})$ and $\hat{p}^z(\hat{X},\hat{Z})$, which satisfy

$$\hat{p}_x^x(\hat{X},\hat{Z})(\equiv \partial \hat{p}^x(\hat{X},\hat{Z})/\partial \hat{X}) < 0, \qquad \hat{p}_z^z(\hat{X},\hat{Z}) < 0 \tag{3}$$

$$\hat{p}_z^x(\hat{X},\hat{Z}) < 0, \qquad \hat{p}_x^z(\hat{X},\hat{Z}) < 0. \tag{4}$$

Inequalities (3) and (4) are similarly interpreted as those for the domestic market.

Total costs of a home-domestic firm and a foreign firm are $\alpha_y y_j$ and $\hat{\alpha}_z \hat{z}_k$ respectively, with α_y, $\hat{\alpha}_z$ being the constant marginal costs. To illustrate the joint-economies effect, we consider the following quadratic cost for a home-international firm,

$$c(x_i,\hat{x}_i) = \alpha_x x_i + \hat{\alpha}_x \hat{x}_i - (\beta_x x_i^2 + 2\theta x_i \hat{x}_i + \hat{\beta}_x \hat{x}_i^2)/2, \qquad i = 1,2,\cdots,n \tag{5}$$

In (5), $\alpha_x, \hat{\alpha}_x > 0$ and parameters $\beta_x, \hat{\beta}_x, \theta$ may generally take either sign.[6] Thus, the home-international's marginal costs for domestic and international output are, respectively,

[6] Note that these total-cost specifications are not subject to a constant term (fixed cost). The addition of such a term won't affect the results reported in this paper, however.

$$c_x(x_i, \hat{x}_i) = \alpha_x - \beta_x x_i - \theta\hat{x}_i, \qquad c_{\hat{x}}(x_i, \hat{x}_i) = \hat{\alpha}_x - \theta x_i - \hat{\beta}_x \hat{x}_i$$

and we have constant marginal costs when $\beta_x, \theta, \hat{\beta}_x = 0$. Further,

$$c_{x\hat{x}}(x_i, \hat{x}_i)(\equiv \partial^2 c(x_i, \hat{x}_i)/\partial x_i \partial \hat{x}_i) = c_{\hat{x}x}(x_i, \hat{x}_i) = -\theta. \tag{6}$$

For a home-international firm it is said, based on (6), that there are joint-economies of production (or economies of scope) across the domestic and international markets if $\theta > 0$, i.e., an increase in the output for one market reduces the marginal cost for the other market.[7] Furthermore, there are dis-economies of production if $\theta < 0$, whereas there are no-relations in production if $\theta = 0$.

Given these demands and costs, each firm's profit can be written as:

$$\pi^i = p^x(X,Y)x_i + \hat{p}^x(\hat{X},\hat{Z})\hat{x}_i - c(x_i, \hat{x}_i), \qquad i = 1,2,\cdots,n \tag{7}$$

$$\pi^j = p^y(X,Y)y_j - \alpha_y y_j, \qquad j = 1,2,\cdots,m \tag{8}$$

$$\pi^k = \hat{p}^z(\hat{X},\hat{Z})\hat{z}_k - \hat{\alpha}_z \hat{z}_k, \qquad k = 1,2,\cdots,f \tag{9}$$

Multi-market competition is modeled as a Cournot game:[8]

$$\underset{x_i,\hat{x}_i}{Max}\ \pi^i, \qquad \underset{y_j}{Max}\ \pi^j, \qquad \underset{\hat{z}_k}{Max}\ \pi^k.$$

Here, the domestic and international markets are 'segmented' in the sense that a home-international firm chooses distinct quantities, x_i and $\hat{x}_i$, for each market (Brander, 1981; Brander & Krugman, 1983).[9] In

[7] Note that when the domestic and foreign outputs are homogeneous, joint-economies imply declining marginal costs of production $c''(\cdot) < 0$. Declining marginal costs have been used in the airline literature (e.g., Brueckner & Spiller, 1991) to model density economies. See Section IV for further discussion on this issue.

[8] Brander and Zhang (1990, 1993), for example, find some empirical evidence that rivalry between oligopoly airlines is consistent with Cournot behavior.

[9] With segmented markets, the firms are allowed to price discriminate across domestic and international markets. Accordingly, prices won't necessarily be equalized by international trade as in the case of an 'integrated' world market. In the context of our empirical work, the domestic and international airline markets are segmented due to regulatory restrictions. Kim and Marion (1997) assumed segmented markets, whereas Clark *et al.* (1992) and Hollis (2003) used integrated markets; White (1974) discussed both cases.

the present model, however, the fact that the markets are segmented does not necessarily imply these firms choose the profit-maximizing quantities for each market separately, since generally there are cost-side interactions. The cost-side interaction will be absent if $\theta = 0$; only in that case, will the two markets be independent of each other and the equilibrium quantities of the domestic and international markets be determined by two separated sets of equations (one set for the domestic market, the other for the international market).

The Cournot equilibrium ($x_i, y_j, \hat{x}_i, \hat{z}_k$) is characterized by first-order conditions:

$$p^x + x_i p_x^x - \alpha_x + \beta_x x_i + \theta \hat{x}_i = 0, \qquad i = 1,2,\cdots,n \tag{10}$$

$$\hat{p}^x + \hat{x}_i \hat{p}_x^x - \hat{\alpha}_x + \theta x_i + \hat{\beta}_x \hat{x}_i = 0, \qquad i = 1,2,\cdots,n \tag{11}$$

$$p^y + y_j p_y^y - \alpha_y = 0, \qquad j = 1,2,\cdots,m \tag{12}$$

$$\hat{p}^z + \hat{z}_k \hat{p}_z^z - \hat{\alpha}_z = 0, \qquad k = 1,2,\cdots,f \tag{13}$$

Notice that within each of the three groups, the firms are symmetric in demand and cost. As a result, at equilibrium $x_i = X/n$, $y_j = Y/m$, $\hat{x}_i = \hat{X}/n$ and $\hat{z}_k = \hat{Z}/f$, and so the Cournot equilibrium can be obtained by solving for ($X, Y, \hat{X}, \hat{Z}$). To do this, we aggregate first-order conditions (10) over the *n* firms, yielding

$$p^x + \frac{p_x^x}{n} X - \alpha_x + \frac{\beta_x}{n} X + \frac{\theta}{n} \hat{X} = 0.$$

A useful way to express the above equation is:

$$\Pi_X^X(X, Y, \hat{X}) \equiv p^x + \frac{p_x^x}{n} X - \alpha_x + \frac{\beta_x}{n} X + \frac{\theta}{n} \hat{X} = 0 \tag{14}$$

where $\Pi_X^X(\cdot)$ may be roughly interpreted as the aggregate marginal profit of the home-international firms' domestic output. Similarly, aggregating (12), (11) and (13) yields, respectively,

$$\Pi_Y^Y(X,Y) \equiv p^y + \frac{p_y^y}{m} Y - \alpha_y = 0, \tag{15}$$

$$\Pi_{\hat{X}}^{\hat{X}}(X,\hat{X},\hat{Z}) \equiv \hat{p}^x + \frac{\hat{p}_x^x}{n} \hat{X} - \hat{\alpha}_x + \frac{\theta}{n} X + \frac{\hat{\beta}_x}{n} \hat{X} = 0, \tag{16}$$

$$\Pi_{\hat{Z}}^{\hat{Z}}(\hat{X},\hat{Z}) \equiv \hat{p}^z + \frac{\hat{p}_z^z}{f} \hat{Z} - \hat{\alpha}_z = 0. \tag{17}$$

Equations (14)-(17) then jointly determine the equilibrium ($X, Y, \hat{X}, \hat{Z}$). We assume

$$(n+1)p_x^x + Xp_{xx}^x + \beta_x < 0, \quad (m+1)p_y^y + Xp_{yy}^y < 0, \quad (n+1)\hat{p}_x^x + \hat{X}\hat{p}_{xx}^x + \hat{\beta}_x < 0,$$

$$(f+1)\hat{p}_z^z + \hat{Z}\hat{p}_{zz}^z < 0 \tag{18}$$

which form part of the conditions for the existence and uniqueness of the multi-market Cournot equilibrium.[10] Regularity conditions will also be imposed so that the equilibrium is stable.

Finally, as indicated earlier, the outputs of competing firms are substitutes in both domestic and international markets. Following the standard practice in models of quantity competition (e.g., Tirole, 1988), we further assume that in each market a firm's marginal profit declines when the output of a competitor rises:

$$p_y^x + (X/n)p_{xy}^x < 0, \qquad p_x^y + (Y/m)p_{yx}^y < 0 \tag{19}$$

$$\hat{p}_z^x + (\hat{X}/n)\hat{p}_{xz}^x < 0, \qquad \hat{p}_x^z + (\hat{Z}/f)\hat{p}_{zx}^z < 0. \tag{20}$$

Inequalities (19) and (20) imply that the outputs are 'strategic substitutes' in the domestic and international markets, respectively (Bulow *et al.*, 1985).

III. EFFECTS OF RIVALRY ON EXPORT MARKET SHARE

[10] See, e.g., Zhang and Zhang (1996). When there is only one market and the firms produce homogenous output, these conditions reduce to the ones examined in Collie (1992) for instance.

Following the existing literature, we use domestic concentration as a measure of the intensity of domestic rivalry. A decrease in an industry's domestic concentration can correspond to an increase in the number of home firms in that industry: which in our context will be in the form of an increase in *n*, an increase in *m*, or both.[11] Treating *n* and *m* as parameters, equations (14)-(17) can be written as:

$$\Pi_X^X(X,Y,\hat{X};n)\equiv 0,\quad \Pi_Y^Y(X,Y;m)\equiv 0,\quad \Pi_{\hat{X}}^{\hat{X}}(X,\hat{X},\hat{Z};n)\equiv 0,\quad \Pi_{\hat{Z}}^{\hat{Z}}(\hat{X},\hat{Z})\equiv 0 \qquad (21)$$

where the identities arise because $X = X(n,m)$, $Y = Y(n,m)$, $\hat{X} = \hat{X}(n,m)$ and $\hat{Z} = \hat{Z}(n,m)$ denote the equilibrium quantities (which are functions of n,m).

Effects of domestic rivalry on export market share are obtained by conducting comparative statics of system (21). We first examine the effect of an increase in *n*: the number of home-international firms. Differentiating the four identities in (21) with respect to *n*, we have

$$\begin{bmatrix} \Pi_{XX}^X & \Pi_{XY}^X & \Pi_{X\hat{X}}^X & 0 \\ \Pi_{YX}^Y & \Pi_{YY}^Y & 0 & 0 \\ \Pi_{\hat{X}X}^{\hat{X}} & 0 & \Pi_{\hat{X}\hat{X}}^{\hat{X}} & \Pi_{\hat{X}\hat{Z}}^{\hat{X}} \\ 0 & 0 & \Pi_{\hat{Z}\hat{X}}^{\hat{Z}} & \Pi_{\hat{Z}\hat{Z}}^{\hat{Z}} \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \\ \hat{X}_n \\ \hat{Z}_n \end{bmatrix} = \begin{bmatrix} -\Pi_{Xn}^X \\ 0 \\ -\Pi_{\hat{X}n}^{\hat{X}} \\ 0 \end{bmatrix} \qquad (22)$$

where, e.g., $\Pi_{XX}^X \equiv \partial\Pi_X^X(X,Y,\hat{X};n)/\partial X$, $\Pi_{Xn}^X \equiv \partial\Pi_X^X(X,Y,\hat{X};n)/\partial n$, and $\hat{X}_n \equiv \partial\hat{X}(n,m)/\partial n$.

To examine the impact of *n* on exports, we solve (22) for $\hat{X}_n$:

$$\hat{X}_n = \frac{-\Pi_{\hat{Z}\hat{Z}}^{\hat{Z}}}{\Delta}\left(\Delta_1\Pi_{\hat{X}n}^{\hat{X}} - \Pi_{YY}^Y\Pi_{\hat{X}X}^{\hat{X}}\Pi_{Xn}^X\right) \qquad (23)$$

where Δ is the determinant of the 4-by-4 matrix in (22), and Δ_1 is the determinant of its top-left 2-by-2 sub-matrix (i.e., $\Delta_1 = \Pi_{XX}^X\Pi_{YY}^Y - \Pi_{XY}^X\Pi_{YX}^Y$). Both Δ and Δ_1 are positive by the stability conditions.[12]

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[11] Our discussion will focus on an increase in *n* and *m* (entries into the domestic market), but the analysis applies equally to a decrease in *n* or *m*.

[12] $\Delta_1 > 0$ is related to stability of the sub-market—namely the domestic market, whereas $\Delta > 0$ is related to the multi-markets stability (e.g., Zhang & Zhang, 1996).

Further, we have that $\Pi^{\hat{Z}}_{\hat{Z}\hat{Z}} = ((f+1)\hat{p}^z_z + \hat{Z}\hat{p}^z_{zz})/f < 0$ and $\Pi^Y_{YY} = ((m+1)p^y_y + Yp^y_{yy})/m < 0$ by (18), and that $\Pi^X_{Xn} = (-p^x_x X - \beta_x X - \theta\hat{X})/n^2$ is, by (1), positive for non-positive β_x, θ or for small positive β_x, θ. Similarly, $\Pi^{\hat{X}}_{\hat{X}n} = (-\hat{p}^x_x \hat{X} - \hat{\beta}_x \hat{X} - \theta X)/n^2$ is likely to be positive.

There are two terms on the RHS of equations (23). Given $\Pi^X_{Xn} > 0$ and $\Pi^{\hat{X}}_{\hat{X}n} > 0$, the first term is positive, whereas the second term has the same sign as that of $\Pi^{\hat{X}}_{\hat{X}X} = \theta/n$ or equivalently, θ. To help interpret the second term, we consider $\theta > 0$; we can show in this case that $X_n > 0$, i.e., an increase in *n* results in a domestic output expansion by the home-international firms as a whole.[13] This output expansion will, given joint-economies, spill over to the firms' sales in the international market – a 'joint-economies of production' effect (Clougherty & Zhang, 2005). On the other hand, increased output in the domestic market will lead to less (no change in) international sales if there are dis-economies (no-relations) in the production of domestic and international output.

The interpretation of the first term in (23) can be most clearly illustrated by assuming $\theta = 0$, hence the second term (the joint-economies of production effect) vanishes. Here, the positive first term – and thereby positive $\hat{X}_n$ – indicates that a country's exports increase in the number of its firms competing in the international market.[14] Moreover, this result can extend to export market share as well. From (22) we have

$$\hat{Z}_n = -(\Pi^{\hat{Z}}_{\hat{Z}\hat{X}} / \Pi^{\hat{Z}}_{\hat{Z}\hat{Z}})\hat{X}_n$$

[13] Solving (22) we obtain $X_n = -\Pi^Y_{YY}\left(\Delta_2 \Pi^X_{Xn} - \Pi^{\hat{Z}}_{\hat{Z}\hat{Z}} \Pi^X_{X\hat{X}} \Pi^{\hat{X}}_{\hat{X}n}\right)/\Delta$, where Δ_2 is the determinant of the bottom-right 2-by-2 sub-matrix in (22) and is positive by stability of the sub-market – namely the international market. Thus $X_n > 0$.

[14] Since there are no imports in the present model, 'exports' or 'export market share' are, throughout the paper, equivalent to 'net exports' or 'net export market share'.

which has an opposite sign to that of $\hat{X}_n$, since $\Pi^{\hat{Z}}_{\hat{Z}\hat{X}} = \hat{p}^z_x + (\hat{Z}/f)\hat{p}^z_{zx} < 0$ by the strategic-substitutes condition (20). Thus, when $\hat{X}_n > 0$, we have $\hat{Z}_n < 0$. For homogenous output, the export market share by the home firms as a whole is given by

$$\hat{S} = \hat{X}/(\hat{X} + \hat{Z}).$$

Differentiating $\hat{S}$ with respect to *n* yields

$$\hat{S}_n = \frac{\hat{Z} + (\Pi^{\hat{Z}}_{\hat{Z}\hat{X}} / \Pi^{\hat{Z}}_{\hat{Z}\hat{Z}})\hat{X}}{(\hat{X} + \hat{Z})^2}\hat{X}_n$$

and so $\hat{S}_n$ has the same sign as $\hat{X}_n$. Consequently, the first-term on the RHS of (23) captures the 'number of competitors' effect: when firms compete in strategic-substitutes fashion (à la Cournot), an increase in the number of home firms competing in the international market increases the country's export share. As indicated earlier, this increased-competitors effect has been analyzed in Kim and Marion (1997) and Hollis (2003).[15]

Accordingly, our model can be used to illustrate the positive impact of more home competitors on export market shares; yet, we will not be testing this number-of-competitors effect with our data for a few reasons. First, our data are firm-based – as opposed to the industry-based data employed in the previous empirical studies – in order to elicit out the enhanced firm performance effect we described in the introductory statements. In the above analysis, although the export market share for the home firms as a whole goes up following an increase in *n*, one can show that the export market share per home firm may

[15] Effects similar to this increased-competitors effect have also been analyzed by a number of scholars in the context of merger/competition policy and international trade (e.g., Dixit, 1984; Ordover & Willig, 1986; Barros & Cabral, 1994; Bliss, 1997; Horn & Levinsohn, 2001; Huck & Konrad, 2004). The effect is related to a well-known result found by Salant *et al.* (1983): in a Cournot market, a merger of two firms into one entity reduces the participants' profit (unless the merger leads to a monopoly). By internalizing part of the effect that a firm's quantity decision has on the rivals' profits, the merged entity sets its quantity too low, thereby yielding market share to the non-participating firms. In the case of international competition, market share would be yielded to foreign firms when two home firms merge.

or may not go up.[16] Accordingly, the number-of-competitors effect yields no clear prediction vis-à-vis firm-based market shares. Second, our data contain a relatively high number of entries/exits by home-domestic firms as compared to home-international firms; thus, requiring an analysis of an increase in *m* – the number of home-domestic firms. As is to be seen below, the analysis with respect to *m* also allows us to produce export performance predictions that are firm-specific, which will facilitate our empirical tests.

The number-of-competitors effect outlined above is important and currently represents the state of the art for modeling the rivalry rationale; however, we think the essence of the rivalry rationale rests elsewhere. The analysis – both theoretical and empirical – we begin presenting here will abstract from the increased-competitors effect. In the theoretical analysis, this is done by increasing *m* – a decrease in domestic concentration – but holding *n*, the number of home participants in the international market, constant. More specifically, differentiating the four identities in (21) with respect to *m*, we have

$$\begin{bmatrix} \Pi^X_{XX} & \Pi^X_{XY} & \Pi^X_{X\hat{X}} & 0 \\ \Pi^Y_{YX} & \Pi^Y_{YY} & 0 & 0 \\ \Pi^{\hat{X}}_{\hat{X}X} & 0 & \Pi^{\hat{X}}_{\hat{X}\hat{X}} & \Pi^{\hat{X}}_{\hat{X}\hat{Z}} \\ 0 & 0 & \Pi^{\hat{Z}}_{\hat{Z}\hat{X}} & \Pi^{\hat{Z}}_{\hat{Z}\hat{Z}} \end{bmatrix} \begin{bmatrix} X_m \\ Y_m \\ \hat{X}_m \\ \hat{Z}_m \end{bmatrix} = \begin{bmatrix} 0 \\ -\Pi^Y_{Ym} \\ 0 \\ 0 \end{bmatrix}. \tag{24}$$

To examine the impact of *m* on exports, we solve (24) for $\hat{X}_m$:

$$\hat{X}_m = \frac{-\Pi^{\hat{Z}}_{\hat{Z}\hat{Z}}}{\Delta} \Pi^{\hat{X}}_{\hat{X}X} \Pi^X_{XY} \Pi^Y_{Ym} \tag{25}$$

where, again, $\Delta > 0$ and $\Pi^{\hat{Z}}_{\hat{Z}\hat{Z}} < 0$. In addition, we have $\Pi^X_{XY} = p^x_y + (X/n) p^x_{xy} < 0$ by (19) (strategic substitutes) and $\Pi^Y_{Ym} = -Yp^y_y / m^2 > 0$ by (1) (downward-sloping demand). Therefore, $\hat{X}_m$ has the

[16] Using $\hat{s}_i$ to denote the export market share per home firm, then $\hat{s}_i = \hat{x}_i / (\hat{X} + \hat{Z}) = \hat{S}/n$. Further, $d\hat{s}_i / dn = -\hat{S}(1-\varepsilon)/n^2$, where $\varepsilon \equiv (n/\hat{S})\hat{S}_n$ is the elasticity of changes in the home firms' aggregate export share with respect to *n*. Thus, $d\hat{s}_i / dn > 0$, $= 0$ and < 0 if $\varepsilon > 1$, $= 1$ and < 1, respectively. In particular, while overall export share rises as the number of home competitors increases ($\varepsilon > 0$), the export share of a particular home firm actually falls when $\varepsilon < 1$.

opposite sign to that of $\Pi^{\hat{X}}_{\hat{X}X} = \theta / n$, or θ. Thus if there are joint-economies, an increase in m – a decrease in domestic concentration – reduces exports.

While both the increased-competitors effect and the joint-economies effect discussed earlier point to a negative relationship between domestic concentration and export performance, the above result suggests a *positive* concentration/exports connection. The economic intuition behind this result is as follows. An increase in home-domestic firms will, holding other factors constant, crowd out some of the output from each home-international firm, as one can show – by solving (24) – that $X_m = (1/\Delta)\Pi^X_{XY}\Pi^Y_{Ym} < 0$. If there are joint-economies, the output contraction at home further leads to an export contraction by each home firm. In essence, this dynamic reflects the national champion rationale where large domestic operations – enabled by domestic concentration – allow firms to reap economies for international competition. Note that the opposite obtains if there are dis-economies in production across the markets.

Furthermore, an increase in the number of home-domestic firms can reduce each home-international firm's market share in the domestic market.[17] Facing such a threat to its competitive position, each home-international firm may respond by, for instance, economizing on costs, eliminating poor managerial practice, or improving quality of its product. Porter (1990) argues that more intense domestic rivalry pressures firms to innovate and upgrade while fostering positive static and dynamic externalities in the local business environment (e.g., supplier availability, easier access to technology and market information, specialized human resource development). Enhanced local rivalry not only gives rise to positive externalities, but creates stronger competitive incentives together with greater pressures to upgrade productivity since local rivals neutralize advantages due to input costs and other local business

[17] This is shown by noting $Y_m = -(\Pi^Y_{YX} X_m + \Pi^Y_{Ym}) / \Pi^Y_{YY} > 0$ and by considering homogenous output. It is also worth noting that while in this case home-international firms produce less, the output expansion by home-domestic firms outweighs that reduction – hence the price falls in the domestic market.

conditions (Sakakibara & Porter, 2001).[18] Porter's theory suggests that a high degree of domestic rivalry would spur product and service innovation (increasing the firm's demand) and improvement in productivity (reducing the firm's costs).

Thus, increased domestic rivalry – in our case, an increase in home-domestic firms – may change home-international firms' behavior, which in turn would reduce their costs and/or increase the demands they face. Given the various possible channels through which this behavior might be impacted, we shall capture this rivalry hypothesis by simply introducing a variable *r*, which increases in *m* and satisfies

$$p_r^x (\equiv \partial p^x / \partial r) \geq 0, \quad c_{xr} (\equiv \partial c_x / \partial r) \leq 0 \tag{26}$$

$$\hat{p}_r^x \geq 0, \quad c_{\hat{x}r} \leq 0 \tag{27}$$

with strict inequality holding for at least one of the two effects in (26) and (27). Inequality (26) indicates that an increase in *r* would lead to an outward shift in domestic demand faced by a home-international firm, and/or to a downward shift in its domestic marginal cost. Inequality (27) is concerned with the effect on the firm's demand and marginal cost in the international market.[19]

Under the rivalry hypothesis, therefore, the export effect of rivalry can be obtained by differentiating the following (28) with respect to *m*:

$$\Pi_X^X (X, Y, \hat{X}; n, r(m)) \equiv 0, \ \Pi_Y^Y (X, Y; m) \equiv 0, \ \Pi_{\hat{X}}^{\hat{X}} (X, \hat{X}, \hat{Z}; n, r(m)) \equiv 0, \ \Pi_{\hat{Z}}^{\hat{Z}} (\hat{X}, \hat{Z}) \equiv 0 \tag{28}$$

where, again, $X, Y, \hat{X}, \hat{Z}$ denote the equilibrium quantities, and *r* is treated as a function of *m*, with $r'(m) > 0$. The expression is as follows:

$$\hat{X}_m = \frac{-\Pi_{\hat{Z}\hat{Z}}^{\hat{Z}}}{\Delta} \left(\Pi_{\hat{X}X}^{\hat{X}} \Pi_{XY}^X \Pi_{Ym}^Y - \Pi_{YY}^Y \Pi_{\hat{X}X}^{\hat{X}} \Pi_{Xm}^X + \Delta_1 \Pi_{\hat{X}m}^{\hat{X}} \right). \tag{29}$$

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[18] Furthermore, in this theory, rivalry among domestic firms offers greater benefits to competitive upgrading than either imports or limited foreign direct investment.

[19] Note that intensified domestic rivalry may also conceivably affect the home-domestic firms' behavior and performance; however, incorporating this change won't alter our analytical results below. To be concise, we shall not consider this rivalry impact further.

There are three terms on the RHS of equation (29). If the second and third terms dropped out, then (29) would reduce to (25). The second and third terms are, therefore, unique to the rivalry hypothesis. Since $\Pi^{X}_{Xm} = (p^{x}_{r} - c_{xr})r'(m) > 0$ by (26), the second term has the same sign as that of $\Pi^{\hat{X}}_{\hat{X}X} = \theta / n$ or θ, thus the opposite sign of the first term – recall from the discussion of (25) that the first term has the opposite sign to that of θ. Here, increased rivalry – due to entry by home-domestic firms – improves home-international firms' domestic performance in terms of a demand increase and/or a cost reduction. Such improvement has a positive impact on their domestic output, which in turn improves their exports if there are joint-economies across markets.

While the first two terms in (29) produce opposite forces on home exports, the last term is always positive since $\Pi^{\hat{X}}_{\hat{X}m} = (\hat{p}^{x}_{r} - c_{\hat{x}r})r'(m) > 0$ by (27). The intuition behind the rivalry hypothesis is straightforward: increased rivalry due to entry by home-domestic firms improves – via inducing demand and supply side upgrades to a firm's competitiveness – home-international firms' performance in the international market, which in turn increases exports. Notice that when $\theta = 0$ – i.e., any joint-economies effect is turned off – the first two terms in (29) vanish. In this case, $\hat{X}_{m} > 0$ is due solely to the last term. This last term – the tendency for domestic rivalry to increase export market share through the rivalry effect – may be termed the 'enhanced-performance of competitors' effect.

Moreover, since from (24) $\hat{Z}_{m} = -(\Pi^{\hat{Z}}_{\hat{Z}\hat{X}} / \Pi^{\hat{Z}}_{\hat{Z}\hat{Z}})\hat{X}_{m}$ and hence $\hat{Z}_{m}$ has an opposite sign to that of $\hat{X}_{m}$, the above results with respect to exports can extend to export market share as well. The above discussion leads to the following:

> *Proposition 1*: (a) In the absence of a rivalry rationale, an increase in home-domestic firms – a decrease in domestic concentration – would reduce, increase, or not-effect each home-international firm's export market share if there are respectively joint-economies, dis-economies, or no-relations in the production of domestic and international output.

(b) Under the rivalry rationale, an increase in home-domestic firms would – in the absence of the joint-economies effect – increase each home firm's export market share.

Proposition 1 is useful for our empirical testing. To illustrate, we rewrite equation (29) as:

$$\frac{d\hat{x}_i}{dm} = n\frac{-\Pi^{\hat{Z}}_{\hat{Z}\hat{Z}}}{\Delta}\left(A\frac{\theta}{n} + \Delta_1\Pi^{\hat{X}}_{\hat{X}m}\right) \tag{29'}$$

where $\hat{x}_i$ denotes exports of a typical home-international firm, and $A \equiv \Pi^{X}_{XY}\Pi^{Y}_{Ym} - \Pi^{Y}_{YY}\Pi^{X}_{Xm}$ represents the 'net' effect of the combined first and second terms in (29) on exports. This net effect may be positive, negative, or zero, depending on which effect from increased rivalry dominates: the immediate 'crowding out' effect (which corresponds to a national-champion type rationale), or the enhanced-performance of competitors effect vis-à-vis domestic competition. In particular, if $A = 0$, then the first term in (29') is zero. This term also equals zero if $\theta = 0$, i.e., there are no-relations in production across the markets. In either case, $d\hat{x}_i / dm$ will be given by the second term (i.e., the last term in (29)), which is always positive regardless of the signs of A or θ. As indicated above, the positive sign of this term captures the international competitive gains driven by the pressure for firms to innovate and upgrade resulting from increased domestic rivalry: the enhanced-performance of competitors effect.[20] Consequently, this term yields a key insight that helps generate and formalize empirical tests. In particular, we shall test the enhanced-performance of competitors effect while controlling for the joint-economies of production effect.

IV. WORLD AIRLINE INDUSTRY DATA

[20] Further note that the second term in (29') is weighted by $\Pi^{\hat{X}}_{\hat{X}m} = (\hat{p}^{x}_{r} - c_{\hat{x}r})r'(m)$; hence, the greater the competitive response following increased domestic rivalry – in terms of a greater $(\hat{p}^{x}_{r} - c_{\hat{x}r})r'(m)$ – the greater the international-market-share gain.

We employ data from the world airline industry to test the impact of domestic rivalry on international export performance. The airline industry represents a good setting to consider the relationship between domestic rivalry and exports for a few reasons: 1) the ability to isolate the domestic rivalry effects; 2) the conformity of the airline industry to an idealized setting for the national champion rationale; 3) the presence of joint-economies of production.

First, domestic and international airline markets are segmented due to regulatory restrictions: e.g., nations generally do not import airline services in the sense that domestic routes are the exclusive prerogative of home-nation airlines. Accordingly, home rivalry effects are purely domestic in that foreign airlines do not constitute any part of the domestic competitive environment. This results in a strong version of Porter's (1990) idea that foreign rivals do not have an equivalent effect to that of home rivals. Furthermore, the international airline service markets between nations – where both home and foreign airlines compete for the passengers flying between the two nations – represent the idealized third-country market for exports that the theoretical work uses as a basic set-up (e.g., Brander & Spencer, 1985; Krugman, 1984).

Second, the airline industry has been characterized as one that exhibits the correct conditions for the tractability of the national champion rationale (Norman & Strandenes, 1994). The segmentation of international from domestic markets, the network economies from matching domestic with international routes and the imperfectly competitive nature of international airline markets fulfill Krugman's (1984) three conditions for the national-champion rationale to hold. Furthermore, the prior that large domestic airlines perform better in international markets has also found empirical support (Clougherty, 2002b, 2006). Accordingly, the international airline industry represents a tough case to find empirical support for the rivalry hypothesis since the national-champion rationale has been evident in the world airline industry.

Third, the presence of economies between domestic production and international production in the airline industry indicates that the airline industry exhibits the condition of joint-economies in production. In other words, domestic output provides economies for airlines competing in international markets. These economies are founded in part on the presence of substantial density economies in the airline industry (fixed costs on a particular route are quite high, but the marginal cost of an additional passenger is quite low) which suggests that the matching of routes with a hub-and-spoke system can generate substantial economies via the feeding of traffic from one route to another. See Levine (1987), Brueckner and Spiller (1991, 1994), Brueckner *et al.* (1992), and Borenstein (1992) for how density economies played a role in the rise of domestic airline networks and concentration. These same principles apply to the matching of domestic with international operations (see Weisman, 1990; Oum *et al.*, 1993; Dresner, 1994; Clougherty, 2002b, 2006); hence, large domestic airlines generally have an advantage in international markets vis-à-vis airlines with small domestic operations. As noted in the theoretical section, joint-economies can be a key conduit between domestic rivalry and enhanced exports.

The actual data for the empirical tests derive from two series compiled by the International Civil Aviation Organization: the ‘Traffic’ (TRF) series, and the ‘Traffic by Flight Stage’ (TFS) series. The TRF series provides data on domestic traffic levels for the airlines competing in the international country-pair markets. By compiling this data, we were able to create measures of domestic rivalry – the main concept of interest – and additional control variables. The TFS series provides data on passenger traffic in international city-pair airline segments. By compiling this data, we were able to create market share measures in order to capture exports in international airline service markets.

The TFS international-segment data unfortunately include passengers flying between international city-pairs that have origins and/or destinations beyond the international segment city-pairs. While origin-and-destination (O&D) data best reflect airline industry competition (Morrison & Winston, 1987), O&D data simply do not exist for non-US international air routes over the period of study. Hence, the TFS international city-pair segment data represent the best available alternative for studying the population of international airline markets. Nevertheless, we have attempted to reduce the measurement error involved with employing TFS data by aggregating the international city-pair segment data into international country-pair data. Clougherty (2006) argues that the hubbing-bias is less pronounced at the country-pair level of analysis. For instance, Continental may have a very large market share in the Houston-Frankfurt city-pair due to its Houston hub, but at the country-pair level (e.g., US-Germany) Continental's market share better reflects that airline's actual export performance relative to competing airlines.

The data are structured on an airline's performance in a particular country-pair market for a particular year; i.e., observations are at the airline/route/year level of analysis. Accordingly, within the total 1,889 observations the data set contains 433 specific airline-routes (i.e., panels). In order to give further details on the data beyond the total number of observations and panels, consider that the data consist of thirty-seven airlines from nineteen nations over the 1987-1992 period.[21] The above clearly suggest the unbalanced nature of the panels; unsurprising, in light of airline practice to both enter and exit markets. Table 1 provides some summary statistics on the variables that are defined in more detail below.

Our concept of principal interest – i.e., the dependent variable – is an airline's competitive performance in an international market. We use an airline's share of the revenue passengers in a particular international country-pair market as the measure of airline competitive performance (hereafter referred to as International-Market-Share). To the degree that an airline competes in different country-pair markets, we have then multiple measures of airline competitive performance: different markets at different time periods.

Our concept of principal explanatory interest – i.e., the main explanatory variable – is the domestic market rivalry experienced by a particular airline. Concentration measures have been almost universally employed in the literature to capture the concept of rivalry: with higher concentration levels clearly corresponding to less rivalry. The four-firm concentration ratio has been most frequently employed (e.g., Marvel, 1980; Ray, 1981; Koo & Martin, 1984; Audretsch & Yamawaki, 1988; Yamawaki & Audretsch, 1988; Clark *et al*., 1992; Kim & Marion, 1997; Hollis, 2003); though, some studies employ the Herfindahl-Hirschman-Index (e.g., Glejser *et al*., 1980; Chou, 1986). We use the domestic Herfindahl-Hirschman-Index (HHI) as our principal measure of domestic market rivalry (hereafter referred to as

[21] The data actually extends back to 1984, but observations for dependent variable measures from 1984-1986 do not go in to the estimations in order to accommodate the various lag structures for the different regression techniques.

Domestic-Concentration or HHI). We expect higher levels of domestic rivalry (i.e., reduced concentration) to lead to enhanced export performance (i.e., higher international-market-shares).

We also employ an alternate measure of domestic rivalry influenced by Sakakibara and Porter's (2001) more recent empirical study where they depart from the norm of employing a contemporaneous measure of concentration (be it four-firm or HHI). Sakakibara and Porter attempt to go below the structural level involved with employing concentration ratios in order to measure rivalry by considering behavioral outcomes. In particular, they develop a measure of domestic rivalry based on the lagged instability of market shares.[22] In keeping with the Sakakibara and Porter approach, we construct an alternative to the above HHI concentration measure of domestic rivalry that is based on market share instability. This measure (hereafter referred to as Market-Share-Instability) is constructed as follows: $\sum_{j=1}^{2}(S_{t-j-1} - S_{t-j})$, where *S* is the domestic market share of a focal airline.[23] Accordingly, higher levels of this measure indicate a worsening domestic competitive position (enhanced rivalry), while lower measures indicate an improving domestic competitive position (reduced rivalry). Again, we expect higher levels of domestic rivalry (whether measured by reduced concentration or a worsening domestic competitive position) to lead to enhanced export performance (i.e., higher international-market-shares).

Beyond the two main variables of interest, it behooves us to control for other potential drivers of international market share in order to yield more robust causal inferences on the domestic-rivalry/export relationship: airline domestic market share, airline domestic network size, domestic merger activity, competitor network size, and number of home and foreign competitors. While we discuss the importance of these variables below, it is important to note that the first two control variables – airline domestic market share and airline domestic network size – help us control for the joint-economies of production

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[22] See also Barla (1999) for a good discussion of employing market-share-instability measures in the context of the airline industry; and Sandler (1988) as well.

[23] To put it less succinctly, the measure is created by summing the two lagged measures of a focal airline's change in domestic market share and multiplying by negative one. This slight alteration of the Sakakibara-Porter approach (where they treat market share gains and losses equally – i.e., they take the absolute value of a market-share change) is necessary, as we have a level of analysis based on firm performance and not on national industry performance. Accordingly, for a focal airline the trend in its domestic market share yields an indication of an improving or worsening competitive position vis-à-vis domestic rivals.

effect. Any HHI induced changes in the size of an airline's domestic operations are held constant by the domestic market share (relative size) and the domestic network size (absolute size) variables. Hence, the coefficient estimate for the domestic concentration variable can be interpreted as eliciting the effect of domestic rivalry on firm performance in international markets and not the effect of rivalry on international-market-share via altering an airline's domestic operation size (the joint-economies of production effect). Accordingly, a particular airline's share of the total number of domestic passengers in its home domestic market (hereafter referred to as Domestic-Market-Share) and an airline's total number of domestic departures (hereafter referred to as Domestic-Network) represent two important control variables.

While we have made the observation that the airline industry involves a joint-economies of production effect, we outline here in more specificity why we might expect a positive relationship between the above two variables and international-market-share. First, airlines with a large presence (market share) in domestic markets may also have a large presence in international markets. The monopolization of domestic routes allows airlines to take better advantage of density economies in these routes, but domestic routes also represent an input into international service; thus, efficient monopolization of domestic routes leads to enhanced efficiency in international operations. In support of this conjecture, Clougherty (2006) finds airlines dominant in domestic markets to perform better in international markets.[24] Second, airlines also derive advantages from having large domestic networks: large domestic networks allow airlines to gather more passenger traffic to feed international route operations. Increasing the flow of passengers onto international flights allows airlines to then better take advantage of density economies, and thereby earn a greater share of the traffic and profits in international

[24] Furthermore, the inclusion of domestic-market-share helps elicit better causal inference on the domestic rivalry variable. By holding domestic-market-share constant, we control for a likely relationship between HHI and a focal airline's domestic market presence. Thus, we can interpret the effect of HHI on a focal airline's international-market-share as representing the structural conditions for domestic rivalry amongst the home competitors. By measuring the structural conditions for rivalry amongst the other domestic competitors, we abstract away any potential inferences that spikes in HHI also indicate an increased (or possibly decreased) domestic market share for a particular airline.

routes (Oum *et al.*, 1993; Clougherty, 2002b, 2006). In sum, the relative and absolute size of a particular airline's domestic operation may generate important international competitive advantages.

The inclusion of the domestic-network-size and domestic-market-share variables is driven both by the immediate rationales from the literature noted above, and by the desire to elicit the effect of rivalry on firm performance in international markets. Yet there is an additional implication of including these two variables: by attempting to independently capture any advantages airlines may hold by having large domestic networks or a large domestic presence, we are not necessarily setting up a national-champion versus rivalry rationale empirical test: the contending theories set-up is often the norm in the empirical literature. Instead of testing competing theories, we allow both rationales to empirically manifest themselves – a common-sense approach if one assumes that both theories exist for a reason. In other words, we can interpret the impact of rivalry (measured in both structural and behavioral terms) while holding constant two core forces (an airline's domestic market presence and network size) that are also behind the national-champion contention.

Third, airline mergers may generate rationalizations that involve an independent effect – beyond simply the domestic-presence and domestic-network effects – on international market shares. In support of this, Clougherty (2002b, 2006) finds airlines engaging in domestic mergers to have improved international competitive performance as compared to airlines not engaging in domestic mergers. We employ the data compiled by Clougherty (2006) that identifies and codes the international airlines engaging in domestic mergers over the 1984-1992 period. Thus, we include a merger dummy variable (hereafter referred to as Merger) that is coded 1 for the year when an airline first engages in a domestic merger within the period of study and for all subsequent years. Note that non-domestic mergers and transactions (e.g., the acquisition of PanAm's international operations by different carriers) are not considered domestic mergers under this classification.

Fourth, it behooves us to control for some of the properties of other home competitors in the domestic market in which a particular airline is embedded. For instance, while there may be advantages to being based in a very large domestic market (e.g., ability to generate substantial network economies via both the supply and the demand side), large domestic markets may also allow home competitor airlines to draw upon substantial network economies. In short, the network size of home competitor airlines (both home-domestic and home-international) may represent a competitive threat to a focal airline. Accordingly, we control for the total number of domestic departures for all the other home competitors that an airline faces in its home domestic market. The total number of domestic departures for all home competitors is hereafter referred to as Domestic-Competitor-Network.

Fifth, it is imperative to control for the number of competitors (both home and foreign) an airline faces in an international country-pair market. The number of home-based and foreign-based competitors (hereafter respectively referred to as Home-Competitors and Foreign-Competitors) captures a very basic driver of an airline's actual international-market-share in a particular country-pair market. Note that this number-of-competitors effect is different to that in the theoretical section, as we abstract away from how the number of home-nation competitors may enhance national exports by simply looking at the exports of one particular airline. But nevertheless, a particular airline's market share will still be a function of the number of competitors it faces. For instance, it would be reasonable to expect an airline facing one competitor to have a much higher market-share as compared to an airline facing five competitors. Moreover, we will also employ the natural-logs of the home and foreign competitors, as these constructs are prone to be non-linear in functional form.[25] Consider, for instance, what would likely happen to market share for an airline in a homogenous-products environment when faced with zero, one and two competitors: i.e., market-share would be 100%, 50%, and 33% on average – thus exhibiting substantial non-linearities.

V. ECONOMETRIC ISSUES

Properly analyzing the panel data on airline performance in international country-pair markets requires consideration of a number of econometric issues. This section considers and focuses on the

[25] In order to ease any problems with logarithmic transformation of zero values for the number of home and foreign competitors, we add 1 to both variables in the empirical estimations. Note further that the natural log of 1 is conveniently 0.

following econometric issues: model-specification; time trends, panel data approach, serial correlation and heteroskedasticity, and endogeneity of both the lagged dependent variable and the primary explanatory variable.

First, the empirical tests employ a dynamic panel-data model – a model where the lagged dependent variable is included as an explanatory variable – to estimate the appropriate coefficient estimates. Finkel (1995) notes that such an approach is appropriate when the dependent variable is not created anew each period. Wooldridge (2002: 307) also notes that such an approach is often "intended to simply control for another source of omitted variable bias." The autoregressive dynamics in our case are surely influenced by both of the above, and by the intuition that autoregressive dynamics allow us to estimate the effect of the primary causal variables while holding constant any prior market advantages an airline will have in a particular country-pair market. Consequently, causal-variable coefficient estimates measure short-term – not long-term – effects on the dependent variable. Furthermore, empirical work has found the dynamic panel approach to be both appropriate and conservative when analyzing the determinants of airlines' international market shares (e.g., Clougherty, 2002b, 2006).

Second, international airline markets have been subject to a number of changes over the period of study. Liberalization of international markets, increasing competitiveness of airlines, and the demise of cartel-like arrangements – are all examples of gradual changes in the international airline environment. Furthermore, sudden changes (e.g., the travel recession of the first Gulf War) may also impact the international airline environment. Both gradual and sudden changes to the international airline environment may create time-specific data trends that affect causal inferences; hence, we employ fixed period effects in all the estimations to ensure that the coefficient estimates do not pick up any time-specific shifts.

Third, panel data often requires a choice between the fixed-effects method and the random-effects method. Random-effects models tend to be more efficient than fixed-effects, but come with the big assumption of zero correlation between the observed explanatory variables and the unobserved panel effect. Fixed-effects have the advantage of not imposing a specified panel relationship, and not assuming zero correlation between the observed explanatory variables and the unobserved panel effect (Wooldridge, 2002); though, they do come at the cost of requiring significant degrees of freedom. Fixed-effects models are often called for when the panel-specific effects are unique and unrelated to other panels (Hsiao, 1986; Greene, 1990), and international country-pair airline markets also contain unique panel characteristics that are difficult to control. In support of the above conjecture, Hausman (1978) tests favor the use of the more conservative – though less efficient – fixed-effects method. In short, the tests suggest that the relatively strong assumptions behind the random-effects estimator do not hold, and that fixed-effects yields more consistent coefficient estimates. In order to be sure that readers have a firm grasp on the actual regression estimations being considered, we represent here the fixed panel-and-period effects regression model:

$$\text{International-Market-Share}_{it} = b_0 + b_1 * (\text{International-Market-Share})_{it-1} + b_2 * (\text{International-Market-Share})_{it-2} + b_3 * (\text{Domestic-Concentration})_{jt} + b_4 * (\text{Domestic-Market-Share})_{kt} + b_5 * (\text{Domestic-Network})_{kt} + b_6 * (\text{Merger})_{kt} + b_7 * (\text{Domestic-Competitor-Network})_{kt} + b_8 * (\text{Home-Competitors})_{it} + b_9 * (\text{Foreign-Competitors})_{it} + \varepsilon_{it} + \alpha_i + \gamma_t$$

where i indexes an airline’s international country-pair market (433 of them), j indexes the nineteen countries, k indexes the thirty-seven airlines, t indexes time, α_i represents the fixed panel-specific effect, and γ_t captures the fixed period-specific effect. Nevertheless, we will report random-effects results in addition to fixed-effects results in order to underscore the robustness of the empirical findings.

Fourth, the inclusion of a lagged dependent variable – while appropriate – also leads to additional econometric issues, as exogeneity simply cannot hold in an autoregressive environment. Wooldridge (2002: 313) notes that when using lagged dependent variables “it is a good idea … to use a full GMM approach that efficiently accounts for these.” In order to directly address the endogeneity of the lagged dependent variable, we undertake a Generalized Method of Moments (GMM) estimation in order to properly account for autoregressive dynamics. We employ the Arellano-Bond GMM two-step estimator where the model is treated as a system of equations. Though asymptotically more efficient, the standard error estimates from the two-step procedure tend to be downward biased as compared to the one-step procedure (Arellano & Bond, 1991; Blundell & Bond, 1998); hence, we also make use of Windmeijer’s

(2005) correction for the two-step covariance matrix.[26] Two assumptions must hold for the consistency of such GMM system measures: 1) the disturbances must be serially uncorrelated – i.e., no second-order serial correlation can be present in the first-differenced residuals; 2) the instrumental variables must be uncorrelated with the first-differenced residuals.[27] We report the Hansen (1982) test for overidentification in all GMM estimations, and the results consistently suggest the validity of the instruments and the correctness of the model specification. We also report the Arellano-Bond test for second-order serial correlation in first-differences in all GMM estimations. These results suggest no second-order serial correlation in first-differences once a second lagged dependent variable is introduced; hence, our autoregressive dynamics will consistently involve two lags of the dependent variable.[28]

Fifth, it behooves us to ensure that any additional arbitrary serial correlation or heteroskedasticity does not impinge upon confidence in the empirical results. Wooldridge (2002) notes that heteroskedasticity in the residuals is always a potential problem, but that serial correlation is particularly important in certain applications: our autoregressive panel dynamics is certainly a case where serial correlation is of principal concern. Accordingly, we also employ a robust variance matrix estimator (Huber/White standard errors for estimated coefficients) to account for possible heteroscedasticity and autocorrelation in the regression estimations that do not employ the Windmeijer correction.

Lastly, and most importantly, it is imperative that we have confidence that our main explanatory variable – domestic concentration – exhibit exogeneity and consistency in coefficient estimates. Our prior is that domestic HHI is indeed exogenous and would best act as its own instrument. This prior owes in part to reciprocal causation being an unlikely source of endogeneity, since the market-share in a particular international country-pair market (at a relatively fine level of analysis) should not robustly impact domestic-concentration (a variable at a relatively more aggregate level of analysis). In short, an airline's

[26] Note that all empirical results are robust to simply employing the Arellano-Bond one-step procedure.
[27] The variables employed as instruments begin with the lagged values of domestic-concentration, domestic-market-share, domestic-network, domestic-competitor-network, merger, and home & foreign competitors, as well as the GMM procedures to take advantage of lagged values for the endogenous variables.
[28] Note that all the empirical results are robust to simply having one lagged dependent variable; though, it is important to ensure that we conform to the assumptions of GMM estimation.

share in one particular international country-pair market unlikely impacts domestic-market wide variables such as HHI in a large way. Furthermore, we have some confidence that our efforts to minimize measurement error and capture other important time-varying explanatory variables – the two other sources of contemporaneous correlation between residuals and explanatory variables – were generally successful. In order to test this prior, we take as a base the above GMM estimations where the lagged dependent variables are treated as endogenous, and then run an additional GMM estimation where both the lagged dependent variables and domestic HHI are considered endogenous. Akin to the Durbin-Wu-Hausman (DWH) test (see Davidson & MacKinnon, 2004), we consider whether the coefficient estimate for HHI under the GMM treatment where HHI acts as its own instrument converges to the coefficient estimate for HHI under the GMM treatment where HHI is instrumented for. The DWH test does support our prior that HHI is exogenous and the advisability of efficiently employing HHI as its own instrument.[29]

Four different estimation methods are presented in Table 2 to reflect the econometric concerns noted above. Regression #1 reports the random-effects procedure, while regression #2 reports the fixed-effects procedure that was supported by a Hausman test. Regression #3 reports the GMM estimation procedure where the two lagged dependent variables are treated as endogenous. Regression #4 reports the GMM estimation procedure where the two lagged dependent variables and domestic HHI are treated as endogenous.

VI. EMPIRICAL RESULTS

We will discuss the empirical results from Table 2 taking a variable-by-variable approach as the results tend to be both significant and consistent across the different estimation techniques. First off, the model appears to be reasonably well specified in the sense that the random-effects and fixed-effects estimations yield relatively high R^2s: 0.92 and 0.73 respectively in Regressions' #1 & #2. Furthermore,

[29] Unfortunately, we are unable to perform similar tests for the instability measure of rivalry (market-share-instability) as this measure involves lags from period t-1 to t-3; hence, attempting to instrument for this measure becomes difficult both in terms of observation numbers and in terms of finding instruments that are uncorrelated with the error terms.

and as already noted, the Hansen tests for overidentification for the GMM estimations (Regression #3 & #4) suggest the validity of the instruments and the correctness of the model specification. Davidson and MacKinnon (2004) note that a rejection of the null hypothesis for the Hansen test may owe either to instruments being correlated with the error terms, or to an incorrectly specified model with incorrect instruments; hence, these tests also suggest the appropriateness of the regression model. Below, we first discuss the results of the various control variables before considering the results for the explanatory variable of principal interest: domestic-concentration.

The coefficient estimate for an airline's domestic market share is consistently positive per expectation and significant at the 1% level in all four regression estimations. Taking the more conservative coefficient estimate of 0.058 from Regression #3 suggests that an airline increasing its domestic market share by 17 percentage points might find its market shares in various international country-pair markets to increase by 1 percentage point on average.

The coefficient estimate for an airline's domestic network size is also consistently positive per expectation and significant in three out of the four regression estimations: only non-significant in regression #4 where domestic-concentration is instrumented for. Taking the reasonably-conservative coefficient estimate of 2.11 from Regression #3 suggests that an airline increasing its domestic network size by a half million annual domestic departures might find its market shares in various international country-pair markets to increase by over 1 percentage point on average.

The coefficient estimate for the merger dummy variable is also consistently positive per expectation and significant in three out of the four regression estimations: non-significant in the fixed effects (regression #2) estimation. The coefficient estimate for the dummy variable ranges from 0.91 in regression #2 to 2.76 in regression #3; thus, tentatively suggesting that airlines completing domestic mergers enhance their market shares in various international country-pair markets by at least 1 percentage point per year on average. Accordingly, it appears that airline's engaging in domestic merger activity reap additional gains in international country-pair markets beyond the domestic network-size and market-share effects.

The coefficient estimate for the domestic network of home competitors is less consistent than the variables discussed above; though, it is negative per expectation and significant in three out of the four regression estimations – only in the fixed-effects (regression #2) estimation do we elicit a positive but insignificant coefficient estimate. For consistency, we take the coefficient estimate of 51.1 from regression #3 (regression #4 yields a more conservative but comparable estimate) which suggests that airlines with home competitors experiencing an increase in their domestic networks of some 1 million departures might find their market shares in various international country-pair markets to decrease by about a half percentage point on average.

The coefficient estimates for home-competitors and foreign-competitors both conform to expectation with negative signs and are significant in all four regression estimations. Recall that these variables are expressed in their natural logs in order to account for non-linearities in their effect. Furthermore, it is important to point out that the results suggest that an additional home-competitor has a more robust negative effect on a focal airline's international market share than does an additional foreign competitor. In short, home competitors represent more of a threat to an international competitive position than do foreign competitors.

Finally, our variable of principal concern – domestic concentration – yields coefficient estimates that are consistently negative per expectation and significant in all four regression estimations. The coefficient estimates for domestic concentration range from -.00036 in regression #3 to -.00086 in regression #2. We again take the more conservative coefficient estimate from regression #3 – where the GMM system estimation is employed but HHI acts as its own instrument – for interpretation purposes. This coefficient estimate suggests that an increase in HHI by a 1000 (reduced rivalry) may lead to a drop in an airline's market shares in various international country-pair markets by over one-third of a percentage point on average. In order to better grasp the economic meaning of this finding, we take some actual changes and comparisons in HHI to factor the significance of this effect. For instance, the Canadian domestic airline market went from an HHI of 2618 in 1984 to 5000 in 1992; thus, suggesting that the decreased structural conditions for rivalry in the Canadian domestic market might result in almost a 1 percentage point decrease in market shares for Canadian airlines in their various international country-pair markets. Furthermore, the HHI in the US averaged just a little under 1100 over this period of study while the French domestic market averaged around 6500; thus, suggesting that US carriers would generally have a 2 percentage point advantage as compared to French carriers in international country-pair markets due to the greater rivalry in US domestic markets.

The empirical results discussed above suggest that domestic concentration does play a role in explaining airline performance in international markets. In other words, domestic rivalry – or at least the structural conditions for rivalry – can lead to the enhancement of airline-specific exports. Recall, however, that we also intend to perform estimations that employ an alternate measure of domestic rivalry that better reflects behavioral indications of vigorous rivalry. Table 3 presents the results of empirical estimations that employ the market-share-instability measure of rivalry that draws from the work of Sakakibara and Porter (2001). Table 3 consists of three regressions that mimic the first three regressions in Table 2 except that domestic-concentration is replaced by market-share-instability. Recall that we are unable to estimate the equivalent of regression #4, as the lagged structures involved with the market-share-instability measure create difficulties in finding suitable lags for instrumental variables that are uncorrelated with the error term while also holding on to a relevant number of observations.[30]

In general the empirical results in Table 3 conform to the empirical results from Table 2 where the structural measure of rivalry was employed. We again first consider the control variables. The coefficient estimate for an airline's contemporaneous domestic-market-share is positive and statistically significant, as it was in the earlier estimations. The coefficient estimate for an airline's domestic-network-size is positive and statistically significant in all three estimations; thus, conforming to the previous results. The coefficient estimate for the merger dummy variable is positive in all three equations; though, only significant in regression #1. The coefficient estimate for competitors-domestic-network is negative in regressions #1 & #3 and positive in regression #2. This also conforms to the previous results; though, the

[30] Note that we already face a drop in observations from 1889 to 1453 when we estimate the more simple GMM system where the clearly endogenous lagged dependent variables are instrumented for.

positive coefficient estimate in the fixed effects estimations was not significant in the previous results. Further, both home-competitors and foreign-competitors elicit negative coefficient estimates with the negative impact of an additional home competitor being stronger than the negative impact of an additional foreign competitor; though, we should point out that these results were not statistically robust in regression #3.

The above results suggest that replacing the structural rivalry variable (domestic-concentration) with the behavioral rivalry variable (market-share-instability) does not significantly alter the model specification. Thus, we can turn now to analyzing the performance of the alternate rivalry variable. The coefficient estimates for market-share-instability are positive and significant in all three regression estimations per expectation. These findings indicate that airlines facing more domestic rivalry – in the sense that they experience downward domestic market shares in the 'one to three years prior' period – tend to have higher market shares in international country-pair markets. For interpretation purposes, we employ the more conservative coefficient estimate of 0.049 from regression #1. This estimate suggests that British Airways (which experienced pronounced erosion of its domestic competitive position over this time period) would have a one-quarter of a percentage point advantage over Alitalia (which experienced a stable domestic competitive position) in terms of rivalry-induced enhanced performance in international airline markets. Furthermore, comparing British Airways (BA) to Canadian Airlines (which experienced a pronounced improvement in its domestic competitive position) suggests BA would hold a three-quarters of a percentage point advantage over Canadian in international country-pair markets due to the greater rivalry it faced in its domestic markets. In short, competitive threats in the domestic market appear to spur firm-level responses that lead to superior performance in international markets.

VII. CONCLUSION

In sum, we empirically find domestic rivalry – measured both in structural and behavioral terms – to positively impact the international market shares of airlines. Accordingly, airlines that experience substantial domestic rivalry tend to perform better in export markets. While empirically finding a positive relationship between domestic rivalry and exports does not represent a substantial new finding (the majority of empirical scholarship finds a positive relationship between domestic rivalry and export performance), our results are unique in that we do not simply capture a net-effect for domestic rivalry where a number of different paths might connect domestic-concentration with exports. We instead use firm-level market data to elicit an enhanced-performance of competitors effect: what most scholars consider to be the heart of the rivalry rationale. We find domestic rivalry to improve the performance of firms while abstracting away from the number of competitors effect and holding constant the joint-economies of production effect – two effects that lurk behind previous empirical work. Furthermore, finding the rivalry rationale to be empirically robust in the context of the world airline industry is noteworthy, as this industry has traditionally supported the national champion rationale.

Despite the importance of the empirical results, we find that our main contribution resides in the theoretical analysis. While the rivalry camp seems to have won the empirical debate with most studies finding domestic rivalry to boost international competitive performance, this conformity in the empirical literature is not met by a great deal of substantive theoretical support. The theoretical literature backing the rivalry rationale is limited both in scale and depth: we found only a few studies analyzing the problem in an imperfectly competitive setting, and no studies positing any connection between domestic and international production. We attempted then to improve the theoretical backing for the rivalry rationale by analyzing in an imperfectly competitive setting with the potential for joint-economies of production between domestic and international markets three specific paths – a number-of-competitors effect, a joint-economies of production effect, and an enhanced-performance of competitors effect – via which domestic rivalry may affect exports. By doing so, we hope to add substance to the theoretical literature with regard to the rivalry rationale.

The analysis here nevertheless suffers from some omissions and deficiencies that further scholarly work may be able to address. First, while we empirically test the enhanced-performance of competitors effect, we do not test for the other two causal paths via which domestic rivalry may lead to international exports. For instance, we do not know to what degree a change in domestic network size is due to a change in domestic concentration – we simply hold constant domestic network size. Accordingly, further work that attempts to nest all three rivalry effects in an econometric treatment would be of merit. Second, a number of factors might mediate the enhanced-performance of competitors effect. For instance, the domestic institutional environment (degree of domestic deregulation) might alter the impact of rivalry on exports; also, the relatedness of the domestic and international markets might effect the domestic-rivalry/export connection. Accordingly, further theoretical and empirical work that attempts to understand moderating factors would be of merit. Third, empirical testing beyond the airline industry would be merited; though, cross-industry studies may have reached their limit with respect to yielding additional insights. We think that firm-level analysis – as in this exercise – holds the potential for better teasing out the different paths via which domestic rivalry might influence exports.

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TABLE 1: Descriptive Statistics—Domestic Merger Activity, Number of Observations & Variable Means by Airline

			Variable Means						
Airlines	*Year of 1st Merger*	# of Obs.	International-Market-Share	Domestic-Concentration	Domestic-Market-Instability	Domestic-Market-Share	Domestic-Network	Competitor-Domestic-Network	Home / Foreign Competitors
Aerl. Argentinas	1990	8	36.81	5142	0.72	63.94	53562	42832	0.00 / 1.75
AeroMexico	--	10	10.63	5133	-0.21	45.10	60705	60869	1.00 / 7.90
Air Canada	--	48	39.26	4357	-0.15	48.50	111438	147340	0.71 / 3.33
Air France	1988	118	43.94	6453	3.23	14.62	23940	156542	0.14 / 2.05
Air UK	--	26	9.32	4063	-0.71	9.32	34033	191050	3.27 / 1.08
AirNewZealand	--	16	48.93	10000	0.00	100	43048	0	0.00 / 1.63
Alitalia	--	124	46.76	4117	0.63	37.08	47471	88955	0.16 / 1.44
American	1987	62	11.98	1061	-1.73	15.77	747061	5216265	6.53 / 1.94
Brit Airways	1987	136	44.43	3837	5.70	57.10	83293	154121	1.69 / 1.77
Brit Caledonia	--	22	4.16	4576	1.82	6.30	9615	151654	3.00 / 2.18
Brit Midland	--	24	9.17	3937	0.15	18.99	38593	190937	3.25 / 1.08
Britannia	1988	4	12.37	4303	-0.56	0.56	620	235287	3.5 / 1.00
Canadian	1986	42	43.27	4574	-10.13	46.20	113986	137944	0.29 / 3.10
Continental	1986	52	15.91	1062	-0.37	7.83	450450	5513583	5.31 / 1.62
Cruziero	--	2	26.40	2317	-1.03	18.45	45705	324552	1.00 / 1.00
Delta	1986	52	9.75	1051	-2.19	15.83	841395	5126570	6.67 / 1.96
Eastern	--	12	5.38	974	3.58	5.22	267961	5715313	7.83 / 2.00
Finnair	--	43	60.84	6606	9.26	78.90	33668	24427	0.00 / 1.05
Iberia	--	114	50.06	4794	7.22	65.64	96722	73704	0.19 / 1.71
JAL	--	54	37.82	3538	-0.86	23.55	52581	339878	0.52 / 2.09
KLM	1988	108	59.28	9501	-0.40	96.82	3980	338	0.00 / 1.73
Ladeco	--	14	21.38	4369	4.88	48.63	11206	13647	0.71 / 1.29
LanChile	--	4	28.77	4045	-1.43	42.97	9529	12899	1.00 / 1.50
Lufthansa	--	138	49.29	9658	0.94	98.25	138856	6769	0.34 / 1.83
Mexicana	--	4	40.76	5291	-9.89	61.65	57005	46483	1.00 / 8.00
Northwest	1986	56	11.03	1035	-1.36	8.14	476803	5503213	6.18 / 1.82
Olympic	--	92	46.68	10000	0.00	100	55758	0	0.00 / 1.11
PanAm	--	72	19.00	984	-0.11	1.67	76798	5922437	3.96 / 1.61
Qantas	1992	32	50.98	3283	0.00	0.00	0	184212	0.00 / 2.00
SwissAir	1991	78	56.44	6233	2.19	74.82	19177	12185	0.12 / 1.50
TAP	--	36	54.77	6910	1.43	80.91	16047	8085	0.06 / 1.42
TWA	1986	93	18.13	1023	0.11	4.89	273722	5709359	3.28 / 1.32
United	--	48	16.62	1043	-0.57	12.92	628285	5360362	5.71 / 1.71
US Air	1987	14	9.20	1044	-1.88	11.00	758732	5206735	8.57 / 2.00
UTA	--	8	2.39	6440	0.00	0.00	0	183250	1.00 / 7.13
Varig	--	108	43.46	2218	-0.26	30.81	77722	307610	0.09 / 1.19
Virgin	--	15	5.90	4102	0.00	0.00	0	228681	2.13 / 5.20
All Airlines		1889	37.35	4678	1.05	44.68	158876	1426286	1.69 / 1.80

Table 2: Regression Results

- Dependent Variable (Y): International-Market-Share
- All Regressions include fixed period-effects.

Explanatory Variables	Regression #1: Random Effects	Regression #2: Fixed Effects	Regression #3: GMM, Instrument for Lagged Y Variables	Regression #4: GMM, Instrument for Lagged Y & HHI Variables
Domestic-Concentration (HHI)	-0.00054*** (0.00017)	-0.00086*** (0.00027)	-0.00036* (0.00019)	-0.00043* (0.00023)
Domestic-Market-Share	0.095*** (0.015)	0.126*** (0.040)	0.058*** (0.022)	0.073*** (0.018)
Domestic-Network (mlns. of dom. departures)	2.69* (1.51)	11.8*** (3.12)	2.11* (1.17)	1.01 (1.09)
Merger	1.52*** (0.49)	0.91 (0.67)	2.76*** (0.83)	2.17*** (0.61)
Domestic-Competitor-Network (mlns. of dom. departures)	-74.6*** (26.0)	1.48 (1.31)	-51.1*** (14.0)	-41.1*** (14.9)
Home-Competitors (natural log)	-3.22*** (0.42)	-2.85*** (0.51)	-3.15** (1.58)	-2.97*** (0.97)
Foreign-Competitors (natural log)	-2.47*** (0.54)	-2.03*** (0.89)	-1.38** (0.70)	-1.79*** (0.68)
International-Market-Share $_{t-1}$	0.687*** (0.045)	0.502*** (0.049)	0.835*** (0.087)	0.838*** (0.059)
International-Market-Share $_{t-2}$	0.026 (0.040)	-0.036 (0.040)	-0.047 (0.040)	-0.071* (0.041)
Constant	12.84*** (1.60)	17.42*** (2.86)	9.23** (4.21)	9.67*** (2.85)
R-square	0.92	0.73		
Arellano.Bond test that average auto covariance in residuals of order 2 is 0			z = -0.13 Pr > z = 0.895	z = 0.22 Pr > z = 0.824
Hansen Test of over-identifying restrictions			chi2(53) = 49.92 Prob > chi2 = 0.60	chi2(82) = 87.70 Prob > chi2 = 0.31
Observations	1889	1889	1889	1889

( ) = Robust or Corrected Standard Errors; *** = 1% Signif, ** = 5% Signif, * = 10% Signif

Table 3: Regression Results for Alternative Rivalry Measure

- Dependent Variable (Y): International-Market-Share
- All Regressions include fixed period-effects.

Explanatory Variables	Regression #1: Random Effects	Regression #2: Fixed Effects	Regression #3: GMM, Instrument for Lagged Y Variables
Market-Share-Instability	0.049** (0.024)	0.058* (0.033)	0.151*** (0.059)
Domestic-Market-Share	0.064*** (0.011)	0.075** (0.039)	0.015** (0.008)
Domestic-Network (mlns. of dom. departures)	4.02*** (1.52)	14.7*** (3.15)	3.54*** (85.9)
Merger	1.36*** (0.49)	0.73 (0.67)	0.68 (0.67)
Domestic-Competitor-Network (mlns. of dom. departures)	-57.8** (24.9)	2.56* (1.32)	-39.6*** (11.5)
Home-Competitors (natural log)	-3.24*** (0.43)	-3.04*** (0.50)	-0.41 (0.81)
Foreign-Competitors (natural log)	-2.55*** (0.55)	-2.06** (0.90)	-0.65 (0.50)
International-Market-Share $_{t-1}$	0.688*** (0.045)	0.501*** (0.049)	1.03*** (0.047)
International-Market-Share $_{t-2}$	0.027 (0.041)	-0.041 (0.040)	-0.095*** (0.034)
Constant	11.00*** (1.46)	14.19*** (3.05)	2.17 (2.22)
R-square	0.92	0.56	
Arellano.Bond test that average auto covariance in residuals of order 2 is 0			z = 0.72 Pr > z = 0.47
Hansen Test of over-identifying restrictions			chi2(60) = 49.24 Prob > chi2 = 0.84
Observations	1889	1889	1453

( ) = Robust or Corrected Standard Errors; *** = 1% Signif, ** = 5% Signif, * = 10% Signif