Advances

Hamid Beladi*, Avik Chakrabarti and Sugata Marjit On Cross-Border Mergers and Product Differentiation

Abstract: We construct a general equilibrium model of an oligopolistic industry that allows us to capture the role of product differentiation in the incentives for and implications of cross-border mergers. We show that a rise in the degree of product differentiation will compress the extensive margins of trade and, at the same time, reduce the gains from cross-border mergers. We also demonstrate how cross-border mergers can mitigate the effect of product differentiation on the extensive margins of trade.

Keywords: general equilibrium, cross-border merger, international trade, oligopoly, GOLE, product differentiation, comparative advantage

JEL Classification: F10, F12, F33, L13

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1 Introduction

It is well known that cross-border mergers present opportunities for firms to intensify market power with international reach. This millennium's steady growth of cross-border mergers pulled up the value of cross-border mergers to a record high of \$1,637 billion in 2007 spanning a total number of 10,145 such transactions.¹ With this backdrop, it is not at all surprising that mergers across

1 Source: World Investment Prospects Survey (WIPS) 2009–2011, UNCTAD (2009).

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borders have been drawing increasing attention.² There has been a concurrent renewal of interest in horizontal mergers in markets characterized by product differentiation.³ How do exogenous changes in the degree of product differentiation affect the incentives for and implications of cross-border mergers?⁴ To answer this question, we construct a general equilibrium model of an oligopolistic industry that allows us to capture the role of product differentiation in cross-border mergers.

While the theoretical literature on cross-border mergers⁵ is still at its infancy, product differentiation merits far more attention than it has received in general equilibrium models of trade and mergers and the industrial organization approach to mergers in differentiated product industries has largely been limited to partial equilibrium analyses.⁶ Some notable contributions include the works of Farrell and Shapiro (1990), Barros and Cabral (1994), Long and Vousden (1995), Head and Ries (1997), Falvey (1998), Reuer, Shenkar, and Ragozzino (2004), Neary (2007) and Qiu (2010). While each of these landmark studies has pushed the boundaries of our understanding of mergers across borders, all of them have focused on industries producing a homogeneous product. Neary (2007) constructed the first analytically tractable general equilibrium model⁷ of cross-border mergers where he showed how trade liberalization can trigger international mergers since international differences in access to technology can generate incentives for bilateral mergers in which low-cost firms located in one country acquire high-cost firms located in another. In consequence, cross-border mergers facilitate specialization in the direction of a nation's comparative advantage. Our paper aims to recognize the importance of the effect of any exogenous change in the degree of product differentiation on cross-border mergers and international

² There are several reasons why it is interesting to examine mergers and acquisitions from an international perspective. First, cross-border mergers and acquisitions have fueled the growth in international production for more than a decade. Specifically, most foreign direct investment is carried out through the acquisition of foreign firms' assets rather than the creation of new firms, also known as greenfield investment. Second, there is evidence that economic integration affects mergers and acquisitions activity by increasing the incentives to undertake cross-border mergers and acquisitions and by forcing industries to restructure. This restructuring is often accomplished through mergers and acquisitions. Third, both cross-border mergers and mergers between domestic firms engaged in international trade pose challenges for competition policy. See Beladi, Chakrabarti, and Marjit (2010); Beladi, Chakrabarti, and Marjit (2013).

³ See Farrell and Shapiro (2010).

⁴ It may be noted that we are interpreting change in product differentiation in the conventional sense of an exogenous change in the degree of substitutability between products.

⁵ See Neary (2003, 2007).

⁶ See Batra (1972, 1974) and Khan (1976).

⁷ The foundations of Neary (2007) can be traced in Neary (2003).

trade. While we follow the footsteps of Neary (2007) in constructing a general equilibrium model linking cross-border mergers and international trade, our work is distinct from Neary (2007) to the extent that we incorporate the role of product differentiation in industries experiencing mergers across borders. As such, our construct of cross-border mergers and product differentiation preserves the key characteristics of a typical general equilibrium model⁸ of an oligopolistic industry (GOLE) to the extent that we are looking at a continuum of atomistic industries at the interior of which firms have market power and interact strategically.⁹ This structure has the advantage of providing us a setup in which the partial equilibrium analysis of industry structure from the industrial organization literature can be applied, at the same time, keeping the general equilibrium analysis tractable and allowing us to study specialization according to comparative advantage in the tradition of the neoclassical models of international trade. The main results, following from our construct, are

1. Extensive margins of trade shrink with an increase in the degree of product differentiation;
2. Gains from cross-border mergers are crowded out by an increase in the degree of product differentiation; and
3. Effects of product differentiation, on the extensive margins of trade, are mitigated by cross-border mergers.

In the next section, we present our model and propositions. In Section 3, we discuss the welfare implications of our construct and cover some caveats. In the final section, we draw key conclusions.

2 Model and propositions

Consider a stylized world containing two countries each with a continuum of atomistic industries, indexed by $z \in [0, 1]$. Each industry supports $N = (n + n^*)$ differentiated goods produced by n domestic firms competing ('à la Cournot) with n^* foreign firms: n and n^* are exogenous but can vary due to mergers and, as will be apparent,¹⁰ $N > 2$ would suffice for our results. For analytical

⁸ See Neary (2010).

⁹ A partial equilibrium approach, though convenient, would provide an incomplete basis for understanding cross-border mergers in the face of an economy-wide shock as the intensification of cross-border mergers continues to be facilitated by extensive financial liberalization policies and regional agreements.

¹⁰ See page 11.

tractability, we assume symmetric differentiation across all products. The total output of any industry $z \in [0, 1]$ is $\tilde{y}(z) = \left(\sum_{i=1}^n y_i(z) + \sum_{j=1}^{n^*} y_j^*(z) \right)$ where $y_i (i = 1, 2, \dots, n)$ is supplied by a home firm and $y_j^* (j = 1, 2, \dots, n^*)$ by a foreign firm. All firms, operating in industry z , in a given location have identical unit cost of production in a given location: $c(z)$ for home firms and $c^*(z)$ for foreign firms. We assume away any fixed cost which, otherwise, would provide a trivial rationale for mergers. Any difference in the unit cost of production is justified, as in the Dornbusch–Fischer–Samuelson (DFS) exposition of the Ricardian theory, by cross-country differences in unit labor requirements denoted by $\beta(z)$ and $\beta^*(z)$ with wages w and w^* at home and abroad respectively. For expositional convenience, we assume that $\beta(z)$ is increasing and $\beta^*(z)$ is decreasing in z which can then be interpreted as an index of foreign comparative advantage with home's relative productivity $\left(\frac{\beta^*(z)}{\beta(z)} \right) \in (0, \infty)$ decreasing as z increases.

Let the demand side be characterized by a two-tier utility function of consumption levels of all $N(z)$ goods produced in each industry z . The utility function is additive in a continuum of sub-utility functions, each corresponding to one industry

$$U \langle u[x_1(z), \dots, x_n(z), x_1^*(z), \dots, x_{n^*}^*(z)] \rangle = \int_0^1 u[x_1(z), \dots, x_n(z), x_1^*(z), \dots, x_{n^*}^*(z)] dz \quad [1]$$

Each sub-utility function, in turn, is quadratic

$$u[x_1(z), \dots, x_n(z), x_1^*(z), \dots, x_{n^*}^*(z)] = a \left[\sum_{i=1}^n x_i + \sum_{j=1}^{n^*} x_j^* \right] - \frac{1}{2} \left(\sum_{i=1}^n x_i^2 + \sum_{j=1}^{n^*} x_j^{*2} + 2\gamma \left(\sum_{\substack{i=1 \\ i \neq i'}}^n x_i x_{i'} + \sum_{\substack{j=1 \\ j \neq j'}}^{n^*} x_j^* x_{j'}^* + \sum_{i=1}^n \sum_{j=1}^{n^*} x_i x_j^* \right) \right)$$

There is a representative consumer, identical across countries, who maximizes (1) subject to the budget constraint

$$\int_0^1 \left[\sum_{i=1}^n p_i(z) x_i(z) + \sum_{j=1}^{n^*} p_j^*(z) x_j^*(z) \right] dz \leq I \quad [2]$$

where I is aggregate income which is exogenous in partial equilibrium but can change in general equilibrium due to change in wages and/or profits which, in turn, depend on tastes, technology and market structure.

The resulting inverse demand¹¹ for the $k(*)$ th differentiated product in industry z is

$$p_k^{(*)} = a - (1 - \gamma)x_k^{(*)} - \gamma \left(\sum_{l=1}^n x_l + \sum_{l=1}^{n^*} x_l^* \right) \quad [3]$$

where variables associated with the foreign firm are distinguished, by an asterisk, from those of the home firm: a measures the consumers' maximum willingness to pay, $x_k^{(*)}$ is the quantity demanded, and $p_k^{(*)}$ is the price. This specification parameterizes the degree of product differentiation by $\gamma \in [0, 1]$: $\gamma = 0$ when the demand for each good is completely independent of other goods; product differentiation declines as $\gamma \rightarrow 1$; and the goods are perfect substitutes (homogeneous) if $\gamma = 1$.

Equilibrium wages are determined by full employment conditions, equating the supply of labor (assumed exogenous) to the aggregate demand for labor (i.e. is the sum of labor demand from all sectors).

$$L = \int_0^{\tilde{z}^*} \beta(z)n\bar{y}(W, W^*, z, n, n^*)dz + \int_{\tilde{z}}^{\tilde{z}^*} \beta(z)n\bar{y}(W, W^*, z, n, n^*)dz \quad [4]$$

$$L^* = \int_{\tilde{z}}^1 \beta^*(z)n^*\bar{y}^*(W, W^*, z, n, n^*)dz + \int_{\tilde{z}^*}^{\tilde{z}} \beta^*(z)n^*\bar{y}^*(W, W^*, z, n, n^*)dz \quad [5]$$

where wages are normalized to $W = \lambda w$ and $W^* = \lambda w^*$ by choosing λ , the marginal utility of income, as the *numeraire*. L and L^* denote the supply of labor and $\tilde{z}$ and $\tilde{z}^*$ are the threshold sectors for the extensive margins of trade, at home and abroad respectively. In the home country's labor market, full employment ensures that home labor supply matches the sum of labor demands from sectors $z \in [0, \tilde{z}^*]$ in which home firms face no foreign competition (i.e. $n^* = 0$) and from the sectors $z \in [\tilde{z}, \tilde{z}^*]$ in which both home and foreign firms operate. Analogously, in the foreign country's labor market, full employment ensures that foreign labor supply matches the sum of labor demands from sectors $z \in [\tilde{z}, 1]$ in which foreign firms face no foreign competition (i.e. $n = 0$) and from the sectors $z \in [\tilde{z}^*, \tilde{z}]$ in which both home and foreign firms operate.

Each home firm, operating in industries $z \in [0, \tilde{z}]$ where $\tilde{z} \in [0, 1]$, will

$$\underset{\{y_i\}}{\text{Maximize}}: \Pi_i = \int_0^{\tilde{z}} (p_i - c)y_i(z)dz \quad \forall \quad i = 1, 2, \dots, n$$

¹¹ See Häckner (2000).

Each foreign firm, operating in industries $z \in [\tilde{z}^*, 1]$ where $\tilde{z}^* \in [0, 1]$, will

$$\text{Maximize: } \Pi_j^* = \int_0^{\tilde{z}^*} (p_j^* - c^*) y_j^*(z) dz \quad \forall \quad j = 1, 2, \dots, n^*$$

Within any given industry $z \in [0, 1]$, suppressing the notation z (for ease of exposition), the best-response functions of the domestic and foreign firms can be written as

$$y_i(n, n^*) = \frac{1}{2} \left(a - \gamma \left[\sum_{\substack{l=1 \\ l \neq i}}^n y_l + \sum_{j=1}^{n^*} y_j^* \right] - c \right) \quad \forall \quad i = 1, 2, \dots, n \quad [6]$$

$$y_j^*(n, n^*) = \frac{1}{2} \left(a - \gamma \left[\sum_{i=1}^n y_i + \sum_{\substack{l=1 \\ l \neq j}}^{n^*} y_l^* \right] - c^* \right) \quad \forall \quad j = 1, 2, \dots, n^* \quad [7]$$

In the pre-merger equilibrium, the domestic and foreign firms will produce

$$y_i(n, n^*) = \left(\frac{1}{2 - \gamma} \right) ((a - c) - \delta(a - \bar{c})) \quad \forall \quad i = 1, 2, \dots, n \quad [8]$$

$$y_j^*(n, n^*) = \left(\frac{1}{2 - \gamma} \right) ((a - c^*) - \delta(a - \bar{c})) \quad \forall \quad j = 1, 2, \dots, n^* \quad [9]$$

where $\bar{c} = \theta c + (1 - \theta)c^*$, $\theta = \frac{n}{N} \in (0, 1)$, and $\delta = \frac{N\gamma}{N\gamma + (2 - \gamma)} \in (0, 1)$.

The industry output is

$$\tilde{y}(n, n^*) = \left(\frac{1 - \delta}{2 - \gamma} \right) N(a - \bar{c}) \quad [10]$$

The prices of domestic and foreign varieties are

$$p_i = \left(\frac{1}{2 - \gamma} \right) (a - (1 - \gamma)c - \delta(a - \bar{c})) \quad \forall \quad i = 1, 2, \dots, n \quad [11]$$

$$p_j^* = \left(\frac{1}{2 - \gamma} \right) (a - (1 - \gamma)c^* - \delta(a - \bar{c})) \quad \forall \quad j = 1, 2, \dots, n^* \quad [12]$$

The profit each firm earns is

$$\Pi_i(n, n^*) = (y_i(n, n^*))^2 \quad \forall \quad i = 1, 2, \dots, n \quad [13]$$

$$\Pi_j^*(n, n^*) = (y_j^*(n, n^*))^2 \quad \forall \quad j = 1, 2, \dots, n^* \quad [14]$$

firms can compete and in region F only the foreign firms can compete. Region HF is a cone of diversification (in terms of the goods' origin) where both home and foreign firms can co-exist. The ZZ curve indicates how, given wages, the home and foreign costs vary across sectors. The downward slope is due to the assumption (see page 4) that $\beta(z)$ is increasing and $\beta^*(z)$ is decreasing in z . It follows directly that, given wages, $\frac{c}{a} = \frac{w\beta(z)}{a'}$ rises (falls) and $\frac{c^*}{a'} = \frac{w^*\beta^*(z)}{a'}$ falls (rises) as z increases (decreases). While this explains a movement along the ZZ curve, any change in wages would cause a shift in the ZZ curve. The threshold sectors pinning down the extensive margins of trade, denoted by $\tilde{z}$ and $\tilde{z}^*$ at home and abroad respectively, are determined (conditional on wages) by

$$W\beta(\tilde{z}) - \xi_0 a - (1 - \xi_0)W^*\beta^*(\tilde{z}^*) = 0 \quad [17]$$

$$W^*\beta^*(\tilde{z}^*) - \xi_0^* a - (1 - \xi_0^*)W\beta(\tilde{z}) = 0 \quad [18]$$

Given wages, the home country specializes in $z \in [0, \tilde{z}^*)$, the foreign country specializes in $z \in (\tilde{z}, 1]$, and production is diversified in $z \in [\tilde{z}, \tilde{z}^*]$. A lower degree of differentiation intensifies competition in the product market, for a given wage, and induces expansion in the output of each sector. When the degree of product differentiation falls, the regions of specialization (H and F) expand and the cone of diversification (HF) shrinks. As a result of this *competition effect*, the extensive margins of trade expand. The total demand for labor rises, pushing wages up to restore equilibrium in the labor market. The rise in wages causes ZZ to shift away from the origin. As a result of this induced *wage effect*, firms that expand (as goods become closer substitutes) are relatively efficient while the less efficient firms that contract. This tends to dampen the demand for labor, partially offsetting the competition effect. In other words, a decline in the degree of product differentiation will facilitate specialization toward the direction of comparative advantage (i.e. moving production and trade patterns closer to what would prevail in a competitive Ricardian world). Our first proposition follows.

Proposition I. The extensive margins of trade will expand (shrink) with a fall (rise) in the degree of product differentiation.

Let us now turn to the possibility of mergers. A merger, under conditions of free and frictionless trade (i.e. absent any tariff or transportation cost), effectively implies that one of the participating firms is closed down since there is no incentive for a firm to operate more than one plant. Closing down

$(n - \tilde{n})$ firms at home raises the output of the remaining firms (at home and abroad) by

$$y_i(\tilde{n}, n^*) - y_i(n, n^*) = y_j^*(\tilde{n}, n^*) - y_j^*(n, n^*) = \left(\frac{\gamma}{2 + \gamma(N - 1)} \right) (n - \tilde{n}) y_i(n, n^*)$$

$$\forall i = 1, 2, \dots, \tilde{n} \text{ and } j = 1, 2, \dots, n^*$$

Analogously, closing down $(n^* - \tilde{n}^*)$ foreign firms raises the output of the remaining firms (at home and abroad) by

$$y_i(n, \tilde{n}^*) - y_i(n, n^*) = y_j^*(n, \tilde{n}^*) - y_j^*(n, n^*) = \left(\frac{\gamma}{2 + \gamma(N - 1)} \right) (n^* - \tilde{n}^*) y_j^*(n, n^*)$$

$$\forall i = 1, 2, \dots, \tilde{n} \text{ and } j = 1, 2, \dots, n^*$$

The net gain from a merger between two home firms is

$$G_{HH} = (y_i(n, n^*))^2 \left[\left(\frac{\gamma}{2 + \gamma(N - 1)} \right)^2 - 2 \right] < 0 \quad \text{if } N > 2 \quad (i = 1, 2, \dots, n) \quad [19]$$

Analogously, the net gain from a merger between two foreign firms is

$$G_{FF} = (y_j^*(n, n^*))^2 \left[\left(\frac{\gamma}{2 + \gamma(N - 1)} \right)^2 - 2 \right] < 0 \quad \text{if } N > 2 \quad (j = 1, 2, \dots, n^*) \quad [20]$$

It follows, from (19) and (20), that $N > 2$ imposes a condition *sufficient* for removing any incentive for a merger between two firms within the same country. There is thus no incentive for firms to merge within border but for the trivial case of a duopoly when a merger to a monopoly is always profitable. Our result generalizes analogous conditions identified in the literature since Salant, Switzer, and Reynolds (1983) to the extent that our model nests varying degrees of product differentiation (with homogeneity as a special case) allowing, at the same time, the unit costs of firms within a merger to differ from the unit costs of firms outside the merger.¹² Starting from the pre-merger equilibrium

¹² Neary (2007) had shown that a merger between two firms, producing a homogeneous good, with the same unit cost (whether two home or two foreign firms) is never profitable provided $(n + n^*) > 2$. This result is more general than Salant, Switzer, and Reynolds (1983) to the extent that it allows the unit costs of firms within a merger to differ from the unit costs of firms outside the merger. Our result generalizes this further by allowing the degree of product differentiation to vary.

industrial structure, with n firms at home and n^* firms in the foreign country, consider now the incentives for mergers across borders. For expositional convenience, let

$$\varphi = \frac{1}{(2-\gamma)(\gamma N + (2-\gamma))^3} > 0$$

$$\rho = (2-\gamma) \left((\gamma(N-2))^2 + 4\gamma(N-2) + 2(2-\gamma^2) \right) > 0$$

$$\Delta = 16(1+\gamma+\gamma(1-\gamma)(1+16N+\gamma(nn^*+4n^2+2)) + \gamma^3 nn^*((n-1)+2(n^*-1))) \\ + 4\gamma^2 N^2 + 4\gamma^3 N + 3\gamma^2 nn^* + 4\gamma n^* + \gamma^3 n^{*3} + 2\gamma^3 n^* + 14\gamma^2 > 0$$

$$\Delta^* = 16(1+\gamma+\gamma(1-\gamma)(1+16N+\gamma(nn^*+4n^{*2}+2)) + \gamma^3 nn^*((n^*-1)+2(n-1))) \\ + 4\gamma^2 N^2 + 4\gamma^3 N + 3\gamma^2 nn^* + 4\gamma n + \gamma^3 n^3 + 2\gamma^3 n + 14\gamma^2 > 0$$

The net gain from a takeover of a home firm by a foreign firm is

$$G_{FH} = \varphi [c - \xi_1 a - (1 - \xi_1) c^*] y_i(n, n^*) \quad (i = 1, 2, \dots, n)$$

$$\text{where } 0 < \xi_1 = \frac{\rho}{\rho + \Delta} < \xi_0 < 1. \quad [21]$$

Our next proposition follows directly from eq. [21].

Proposition II. A takeover of a home firm by a foreign firm will be profitable *iff*

$$c > \xi_1 a + (1 - \xi_1) c^*$$

where $\frac{d\xi_1}{d\gamma} < 0$; and $\frac{d^2\xi_1}{d\gamma^2} < 0$.

Analogously, the net gain from a takeover of a foreign firm by a home firm is

$$G_{HF} = \varphi [c^* - \xi_1^* a - (1 - \xi_1^*) c] y_j^*(n, n^*) \quad (j = 1, 2, \dots, n^*) \quad [22]$$

where $0 < \xi_1^* = \frac{\rho}{\rho + \Delta^*} < \xi_0^* < 1$.

Our next proposition follows directly from eq. [22].

Proposition III. A takeover of a foreign firm by a home firm will be profitable *iff*

$$c^* > \xi_1^* a + (1 - \xi_1^*) c$$

where $\frac{d\xi_1^*}{d\gamma} < 0$; and $\frac{d^2\xi_1^*}{d\gamma^2} < 0$.

An increase in the incentives for cross-border mergers, due to a fall in the degree of product differentiation, induces expansion and contraction of sectors as high-cost firms in one country are bought out by low-cost foreign rivals in another. At any given wages, expanding firms will (a) increase their output by only a fraction of the output of the firms which are taken over and (b) have lower labor requirements per unit output than the contracting ones. Hence, the total demand for labor will fall pressing wages down to restore equilibrium in the labor market which, in turn, encourages hiring of labor at the intensive margin. The lower wages raise the profitability of high-cost firms, at the margin, placing them outside the reach of takeovers thereby dampening the initial incentives for mergers.

Figure 2: Product differentiation and post-merger trading equilibrium

On Figure 2, a merger-induced fall in wages causes the ZZ locus to shift toward the origin which expands the range of sectors that remain in the HF region. In other words, a cross-border merger will mitigate the effect of product differentiation on the extensive margins of trade.

Also, as illustrated in Figure 3 above, since $\frac{d\xi_0}{d\theta} > 0$ and $\frac{d\xi_0^*}{d\theta} < 0$, the effect of any exogenous change in the pre-merger concentration of domestic firms,

incentive for a merged firm to multiply product varieties. Merged firms can withdraw products or crowd products, since multiproduct firms do not gain from their products competing with each other, leaving the overall effects on variety ambiguous.

The overall welfare effect, of a cross-border merger, remains ambiguous as in a typical GOLE set up due to the conflicting impacts of cost-reduction and price-rise. Intuitively, mergers reduce wages since they reallocate output to more efficient firms. This dampens the effect of product differentiation on the cone of diversification because high-cost firms benefit from lower wages. The reduction in wages also reduces the share of sectors where takeovers are profitable, but does not reverse them. Therefore, allowing for mergers shifts the global economy to an equilibrium in which the share of sectors with only foreign firms expands. Hence, they induce specialization according to comparative advantage.

4 Conclusion

Cross-border mergers have increasingly evolved into an effective strategy used by a large number of companies with global presence. Notwithstanding the fact that a third of worldwide mergers involve firms from different countries, the vast majority of the academic literature on mergers has been primarily limited to intra-national mergers. We hope to have taken a step forward along the path of continued efforts to capture the incentives for and implications of cross-border mergers. We have shown how product differentiation can compress the gains from cross-border mergers. Gains from cross-border mergers, attributed to product differentiation, can vary with the relative market concentration between countries and the impact of cross-border mergers on the extensive margins of trade will shrink with an increase in the degree of product differentiation. Cross-border mergers will mitigate the effect of product differentiation on the extensive margins of trade. The empirical relevance of our results follows immediately, since it becomes imperative to ask if an observed relationship between exports and mergers is sensitive to the degree of product differentiation. Some interesting extensions of our model may involve including public firms,¹³ introducing costly technology transfers,¹⁴ and/or allowing urban unemployment.¹⁵

¹³ See Chao and Yu (2006).

¹⁴ See Jones and Ruffin (2008) for implications of uncompensated transfers of technology across borders.

¹⁵ See Chau and Khan (2001) and Oladi and Gilbert (2011).

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