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**Article**

## Multinational firms, value chains, and vertical integration

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In 2010–12, Alfaro served as Minister of National Planning and Economic Policy in her native Costa Rica during a leave of absence from Harvard.

Alfaro's main research interests are in international economics, in particular international capital flows, sovereign debt, foreign direct investment, and multinational activity. Her recent research focuses on multinational activity, value chains, and vertical integration.

Alfaro earned her Ph.D. in economics in 1999 from the University of California, Los Angeles, from which she received a dissertation fellowship award. She received a Licenciatura from the Pontificia Universidad Católica de Chile in 1994, from which she graduated with highest honors, and a B.A. in economics with honors from the Universidad de Costa Rica in 1992.

She lives in Brookline, Massachusetts, with her husband and daughter. They spend a lot of time in Costa Rica and in Brazil, where her husband was born.

## Multinational Firms, Value Chains, and Vertical Integration

Laura Alfaro

In recent decades there has been a very rapid increase in flows of goods and capital between countries and between firms, driven by technological progress and falling cross-border restrictions. The rising ability to retain or outsource various production stages within firms and across country boundaries has fueled fragmentation of production and the emergence of global value chains. Cross-border production, investment, and trade in final and intermediate goods by multinational corporations (MNCs) are key drivers of this phenomenon.

In a series of papers combining new firm-level datasets and novel insights from trade and organizational economics, my colleagues and I have examined the characteristics and determinants of MNCs, value chains, and vertical production. We have found new patterns of foreign direct investment (FDI), and investigated the relationships among market conditions, vertical integration, and the effects of foreign capital.

We document the emergence of new MNC industrial clusters and their distinct agglomeration patterns. The organizational choices that firms make in structuring their value chains suggest that complex production and process decisions involving multiple stages explain intra-firm activity. Our work enhances understanding of the sources of productivity gains and resilience to external shocks afforded to host countries by MNC activity and cross-border vertical relations.

### Global Patterns of MNC Activity

#### *Agglomeration*

One strand of my research has examined the geographic concentration of the plants operated by MNCs,

and compared that concentration with the analogous pattern for domestic firms. Maggie Chen and I find evidence of MNC clusters, which we label agglomeration.<sup>1</sup> MNCs' offshore subsidiaries' higher productivity, vertically integrated production, and higher knowledge- and capital-intensities all suggest that their motives for agglomeration are different from those of domestic firms. We quantify patterns of spatial location by constructing an index of agglomeration that compares establishments at both the industry and plant levels.<sup>2</sup> The index quantifies the extent to which MNC establishments are more or less likely to agglomerate than their domestic counterparts. Dun and Bradstreet's WorldBase data enables us to compute this index based on plant-level observations. The dataset includes primary and secondary industries, ownership information, and plant-level physical location, which can be used to calculate the distance between pairs of establishments.

Our comparative analysis generates a rich array of new findings. MNC headquarters are, on average, the most agglomerative, meaning that they are most concentrated geographically. Headquarters facilities are followed by MNC foreign subsidiaries and domestic plants in their degree of concentration. The differences in the degree of agglomeration of these three different types of facilities suggest that MNC offshore clusters are not simply a reflection of domestic industrial ones.

Figure 1, on the following page, plots the distributions of pairwise industries' agglomeration densities, computed using a distance of 50 km to define "close" establishments for MNC foreign subsidiaries and domestic plants, respectively. MNC foreign sub-

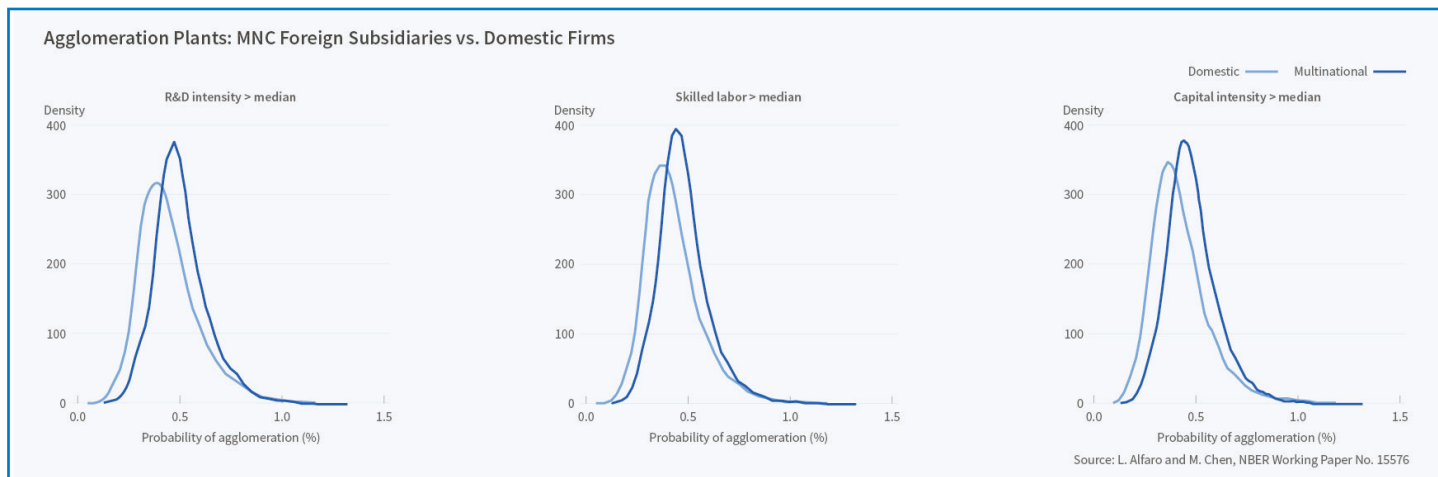


Figure 1

subsidiaries are more agglomerative than domestic plants in capital-, skilled labor-, and R&D-intensive industries. In industries with greater than median levels of capital intensity, the distribution of agglomeration indices is rightward-shifted for MNC foreign subsidiaries compared to domestic plants. This pattern is similarly observed for industries with greater than median levels of skilled labor and R&D intensities. We also evaluate how agglomeration economies, particularly input-output linkages, labor and capital goods market externalities, and technology diffusion, affect MNCs relative to domestic firms. We find that MNCs' choice of location is significantly influenced by technology diffusion and capital-good market externalities.

These findings are largely consistent with the MNCs' vertically integrated organizational form and substantial investment in technology and capital goods, as well as with the increasing segmentation of activities within firm boundaries and increasingly complex sourcing strategies.

### *Intra-Industry FDI*

Andrew Charlton and I show that large FDI flows across rich countries associated with these more complex strategies do not fit the tra-

ditional classification of horizontal FDI.<sup>3</sup> Although patterns of foreign investment are recognized as complex, the literature has traditionally, for analytical simplicity, distinguished between two forms of, and motivations for, locating activities abroad: horizontal — replicating a subset of activities or processes in another country, and vertical — fragmenting production by function. In general, market access models are favored empirically over comparative advantage models. Our results suggest that data limitations have led the prior studies to underestimate vertical FDI systematically.

We use a combination of four-digit, sector-level information from the WorldBase data together with input-output tables to distinguish between horizontal and vertical FDI. We classify a horizontal subsidiary as a plant in the same sector as its foreign parent owner, and a vertical subsidiary as a plant in sectors that are inputs to the foreign parent's product. As we do not observe interplant trade, this approach infers vertical relations from information about the goods produced in each establishment and their input-output relationships. While we acknowledge its limitations, this method yields a large amount of data for many countries and industries and avoids con-

cerns about transfer pricing affecting values.

We find that the bulk of MNC activity occurs between rich nations, but some of our plant-level findings provide a new perspective that goes beyond this traditional wisdom. Many vertical subsidiaries, which we find are larger than commonly thought, are located in sectors related to higher skill input in high-skill countries. These subsidiaries have been assumed to be market seeking.<sup>4</sup> We term such subsidiaries *intra*-industry vertical FDI and show them to be qualitatively different from vertical subsidiaries that cross two-digit industry codes, that is, *inter*-industry vertical FDI. Although both are vertical, *intra*-industry vertical FDI is more difficult to explain via standard theories that emphasize factor cost differences as the primary motivation for fragmentation. We argue that the patterns of vertical FDI and the motivation for sourcing an input within firm boundaries also involve the subsidiary's intended position in the production chain. We define a variable that captures the proximity of two four-digit sectors in a vertical production chain as the proportion of the intermediate product used directly in the final good; for example, less-processed materials have low proximity variables. We find proximity to be significantly

higher, on average, between two vertically related plants than between two randomly selected ones.

## Firm Boundaries and Organizational Choices

### Value Chains

Pol Antràs, Davin Chor, Paola Conconi, and I examine firms' organizational choices along value chains and their key decisions regarding which segments of the production process to own and which to outsource.<sup>5</sup> We combine WorldBase data on firm activities across many countries and industries with information from standard input-output tables to study the differences between value chains for integrated and non-integrated inputs. We construct an industry-pair specific measure of the position of different industries along the value chain that summarizes the extent to which a firm's integrated inputs tend to be more upstream compared to its non-integrated inputs.

We develop a rich theoretical framework of firm behavior amenable to estimation using firm-level data.<sup>6</sup> In an incomplete-contracts setup in which the manufacture of final goods entails a large number of production stages performed in a predetermined order, suppliers engaged in different stages undertake relationship-specific investments. The division of surplus between the final-good producer and each supplier is governed by bargaining after inspection of the completed stage. We allow for heterogeneity in the importance of inputs for production as well as in suppliers' marginal cost of production at different points along the value chain.

We find that a firm's propensity to integrate upstream inputs depends critically on the elasticity of demand for its final good and the elasticity of substitution across its production stages. When demand is elastic or inputs are not particularly substitutable, input investments are sequential complements; the greater the upstream supplier's investments, the greater that supplier's marginal incentive to undertake relationship-specific investments. In this case, it is optimal to contract at arm's length to incentivize upstream suppliers' investment efforts and integrate the stages furthest downstream to capture surplus. When demand is inelastic or inputs are sufficiently substitutable, input investments are instead sequential

tional arrangements to elicit the right incentives from suppliers positioned at early stages. We construct a measure of input contractibility for each industry and find that a greater degree of contractibility of upstream inputs increases the likelihood that a firm facing high elasticity of demand will integrate upstream inputs. These empirical patterns provide strong evidence that the position of inputs in the production process and contractual frictions critically shape a firm's integration choices.

### Prices and Vertical Integration

The impact of market conditions, in particular prices, on firms' organizational choices is a long-standing

question in organizational economics. In a recent paper, Conconi, Harald Fadinger, Andy Newman, and I find strong support for the view that output prices are a key determinant of vertical integration.<sup>7</sup> This result stems from managers not only having a stake in the organizational goal, but also standing to derive private, non-contractible benefits.<sup>8</sup> Suppose that integration increases productivity, but at a cost; improved coordination among suppliers, for example, could engender administrative costs independent of output and product price. A price-taking firm would choose to integrate only if the benefits of increased profitability outweigh the cost of integrating. At low prices, productivity gains from integration are seldom sufficiently valuable to justify the cost. As the market price rises, the tradeoff resolves in favor of more integration.

Testing whether product prices affect organizational design requires

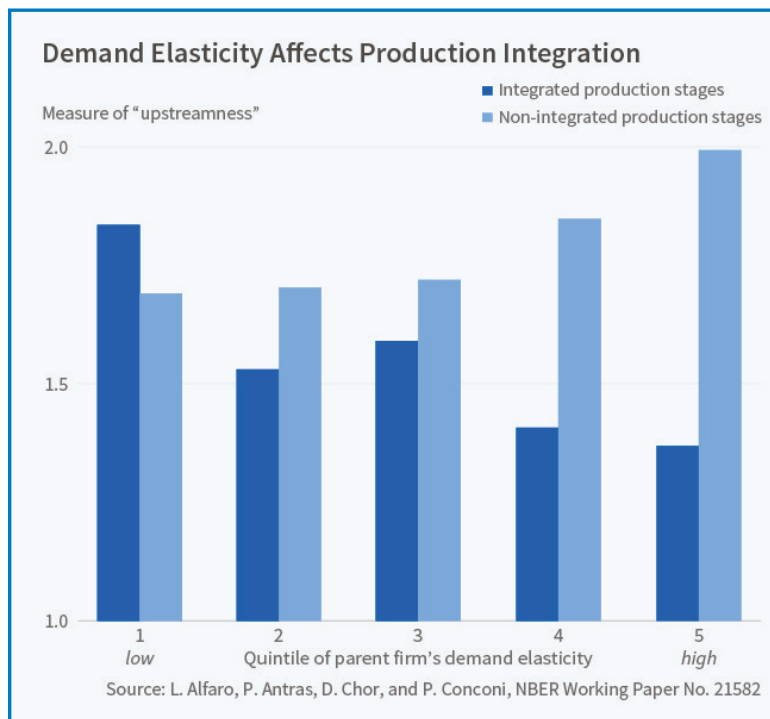


Figure 2

substitutes. In this case, firms choose to integrate relatively upstream stages and outsource downstream suppliers. Figure 2 illustrates these patterns for different quintiles of the parent firm's elasticity of demand.

In our model, greater upstream use of contract arrangements reduces a firm's need to rely on organiza-

an exogenous source of price variation. Trade policy provides one such source, since the degree of trade protection obviously affects equilibrium prices, but it is unlikely to be influenced by firms' vertical integration decisions. Under the most favored nation (MFN) principle set out in the General Agreement on Tariffs and Trade (GATT), member countries agree not to discriminate among trading partners, with some exceptions. Long-term multilateral trade negotiations render MFN tariffs less responsive to domestic political pressure. Reverse causality is also unlikely to be a concern in our analysis as the MFN tariffs that firms faced in 2004, the year we examine, were determined during the Uruguay Round of multilateral trade negotiations (1986–94). Combining information on firms' production activities drawn from WorldBase with input-output tables, we construct firm-level vertical integration indices that measure the fraction of inputs used in the production of a final good that can be produced in-house.

We find that the higher the tariff on imports of a given product, and thus the higher the domestic price, the more vertically integrated are the firms that produce the product in that country. The effect is larger precisely where organizational decisions ought to be more responsive to import tariffs — for firms that serve only the domestic market and in sectors in which tariffs have a greater impact on domestic prices. We rule out several alternative mechanisms that could generate a positive correlation between tariffs and vertical integration, such as competition and credit constraints. Our estimates imply that price changes can have large effects on firm boundaries. Contrary to the direction of causality suggested by foreclosure theories, whereby vertical integration raises prices as firms integrate with their suppliers to reduce competition, our analysis suggests that higher prices may induce more vertical integration.

## Effects of Multinational Firms Productivity, Selection, and Reallocation

The impact of MNCs on their host countries has been widely studied.<sup>9</sup> Positive gains from MNC activity are often attributed to within-firm productivity improvements resulting from productivity spillover from foreign MNCs to domestic firms, or from self-upgrading by domestic firms. But MNC production can also precipitate more intense competition in product and factor markets, as well as reallocation of resources from domestic to multinational firms and from less productive to more productive domestic firms. Although both channels imply aggregate productivity gains, they represent two distinct margins. Within-firm productivity improvement operates through an “intensive margin” where foreign production increases the productivity of domestic firms that persist, while between-firm selection and market reallocation operates at an “extensive margin” where foreign competition induces the exit of the least productive firms. The implications for domestic economies are also sharply different: growth or contraction of domestic industries.

My recent work with Chen disentangles the two channels in determining aggregate productivity gains from MNC production.<sup>10</sup> We investigate the ways market reallocation and knowledge spillovers influence potential gains from MNC competition, and their relative importance, using a general analytical framework based on a standard model of MNC production and heterogeneous firms, accounting for self-selection of MNCs. Our predictions of how variation in these channels influences the distribution of domestic firms along the dimensions of productivity, revenue, employment, and survival enable us to distinguish between the two channels. We empirically evaluate these predictions using Bureau van Dijk's Orbis, a large, cross-country-

panel compilation of financial, operating, and ownership information for companies.

We find within-firm productivity improvement and between-firm selection to be significant but distinctly different sources of gains from MNC production. We also explore the possibility of between-industry productivity spillover through vertical production linkages and find linkages to affect less and more productive firms differently. The data are consistent with both between-firm selection and market reallocation. Ignoring them could bias estimates of the origin and magnitude of productivity gains from MNC production.<sup>11</sup>

## Foreign Ownership, Vertical Linkages, and Resilience

Firms' integration choices across borders can also affect a host country's performance. MNCs' ability to shift production back home likely results in more volatile performance for horizontal subsidiaries while intra-firm demand may help absorb negative demand shocks in the host country, resulting in more resilient responses to crises.

Chen and I examine the differential performance of establishments, with particular emphasis on the role of foreign ownership during the 2008–09 global financial crisis. This crisis was notable for its speed, severity, and international span.<sup>12</sup> We provide micro-evidence on the role of production and financial linkages in influencing how foreign ownership affects an establishment's resilience to economic crisis. We construct a direct measure of production linkages by examining the input-output relationship between the primary products of subsidiaries and parent firms. We also consider how MNCs' internal capital markets lower subsidiaries' dependence on host country credit conditions, an advantage particularly important during credit crunches. In order to disentangle the effect of for-

foreign ownership from the effects of other observable and unobservable establishment and macroeconomic factors, we match MNC subsidiaries with local plants in the same country and industry on the basis of similarity in characteristics, using WorldBase's data. We infer the effect of foreign ownership from divergences in the performance paths of MNC subsidiaries and their local matches. We compare the effect of foreign ownership between the non-crisis years 2005–06 and the crisis period, 2007–08.

Our results shed light on why foreign ownership could lead to divergent performance. On average, foreign subsidiaries were more resilient than their domestic counterparts through the crisis. Establishments with stronger vertical production linkages exhibited more resilience, especially in host countries with greater negative demand shocks. Horizontally linked establishments, in contrast, performed no better than the control establishments. The role of vertical production linkages and the role of financial linkages, especially in host countries with worsening credit conditions, also were related to performance only during the crisis period.

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<sup>1</sup> L. Alfaro and M. Chen, "The Global Agglomeration of Firms," NBER Working Paper No. 15576, December 2009, and *Journal of International Economics*, 94(2), 2014, pp. 263–76.

[Return to text](#)

<sup>2</sup> We extend the methodology of G. Duranton and H. Overman, "Testing for Localization Using Micro Geographic Data," *Review of Economic Studies*, 2(4), 2005, pp. 1077–106.

[Return to text](#)

<sup>3</sup> L. Alfaro and A. Charlton, "Intra-Industry Foreign Direct Investment," NBER Working Paper No. 13447, September 2007, and *American Economic Review*, 99(5), 2009, pp. 2096–119.

[Return to text](#)

<sup>4</sup> That firm-level trade data for the United States, for example, shows a high proportion of intra-firm trade between developed countries is further evidence of the importance of rich countries' MNC vertical activity. For further analysis of flows between rich and poor countries, see L. Alfaro, S. Kalemli-Ozcan, and V. Volosovych, "Why Doesn't Capital Flow from Rich to Poor Countries? An Empirical Investigation," NBER Working Paper No. 11901, December 2005, and *The Review of Economics and Statistics*, 90(2), 2008, pp. 347–68; L. Alfaro, S. Kalemli-Ozcan, and V. Volosovych, "Capital Flows in a Globalized World: The Role of Policies and Institutions," NBER Working Paper No. 11696, October 2005, and in S. Edwards, ed., [Capital Controls and Capital Flows in Emerging Economies: Policies, Practices and Consequences](#), Chicago, Illinois: University of Chicago Press, 2007, pp. 19–72; L. Alfaro, S. Kalemli-Ozcan, and V. Volosovych, "Sovereigns, Upstream Capital Flows and Global Imbalances," NBER Working Paper No. 17396, September 2011, and *Journal of the European Economic Association*, 12(5), 2014, pp. 1240–84.

[Return to text](#)

<sup>5</sup> L. Alfaro, P. Antràs, D. Chor, and P. Conconi, "Internalizing the Global Value Chains: A Firm-Level Analysis," NBER Working Paper No. 21582, September 2015.

[Return to text](#)

<sup>6</sup> P. Antràs and D. Chor, "Organizing the Global Value Chain," NBER Working Paper No. 18163, June 2012, and *Econometrica*, 81(6), 2013, pp. 2127–204.

[Return to text](#)

<sup>7</sup> L. Alfaro, P. Conconi, H. Fadinger, and A. F. Newman, "Do Prices Determine Vertical Integration?" NBER Working Paper No. 16118, June 2010, and *Review of Economic Studies*, 83(3), 2016, pp. 855–88.

[Return to text](#)

<sup>8</sup> For theoretical work, see P. Legros and A. Newman, "A Price Theory of Vertical and Lateral Integration," *Quarterly Journal of Economics*, 128(2), 2013, pp. 725–70.

[Return to text](#)

<sup>9</sup> The literature has identified important roles for the institutional environment and policy in terms of FDI and capital flowing into, in particular, poor countries, see L. Alfaro, S. Kalemli-Ozcan, and V. Volosovych, "Why Doesn't Capital Flow from Rich to Poor Countries? An Empirical Investigation," *The Review of Economics and Statistics*, 90(2), 2008, pp. 347–68; and L. Alfaro, S. Kalemli-Ozcan, and V. Volosovych, "Capital Flows in a Globalized World: The Role of Policies and Institutions," in S. Edwards, ed., [Capital Controls and Capital Flows in Emerging Economies: Policies, Practices and Consequences](#), Chicago, Illinois: University of Chicago Press, 2007, pp. 19–72.

Evidence has shown positive effects of FDI conditional on local conditions, in particular local financial markets, see L. Alfaro, A. Chanda, S. Kalemli-Ozcan, and S. Sayek, "How Does Foreign Direct Investment Promote Economic Growth? Exploring the Effects of Financial Markets on Linkages," NBER Working Paper No. 12522, September 2006, and *Journal of Development Economics*, 91(2), 2010, pp. 242–56; and L. Alfaro, A. Chanda, S. Kalemli-Ozcan, and S. Sayek, "FDI and Economic Growth: The Role of Local Financial Markets," *Journal of International Economics*, 64(1), 2004, pp. 89–112.

[Return to text](#)

<sup>10</sup> L. Alfaro and M. Chen, "Selection and Market Reallocation: Productivity Gains from Multinational Production," NBER Working Paper No. 18207, July 2012.

[Return to text](#)

<sup>11</sup> These results echo the growing literature that emphasizes effects of resource misallocation across establishments. See also L. Alfaro, A.

Charlton, and F. Kanczuk, "Plant-Size Distribution and Cross-Country Income Differences," NBER Working Paper No. 14060, June 2008, and in J. Frankel and C. Pissarides, eds., [NBER International Seminar on Macroeconomics 2008](#), Chicago, Illinois: University of Chicago

Press, 2009, pp. 243–72; and L. Alfaro and A. Chari, "Deregulation, Misallocation, and Size: Evidence from India," NBER Working Paper No. 18650, December 2012, and *Journal of Law and Economics*, 57(4), 2014, pp. 897–936.  
[Return to text](#)

<sup>12</sup> L. Alfaro and M. Chen, "Surviving the Global Financial Crisis: Foreign Ownership and Establishment Performance," NBER Working Paper No. 17141, June 2011, and *American Economic Journal: Economic Policy*, 4(3), 2012, pp. 30–55.  
[Return to text](#)