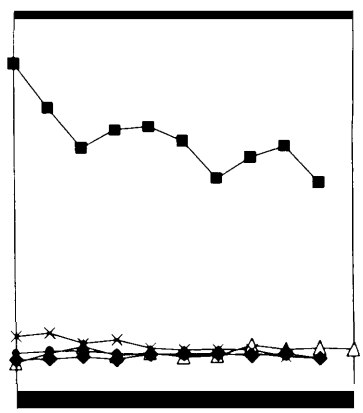
Part II: National Technology Innovation and Multinational Firms

Multinational enterprises (MNEs) are critical to the U.S. technology base. The most technologically sophisticated and economically significant sectors of the U.S. economy are marked by high degrees of foreign direct investment (FDI), global production, intrafirm trade (IFT), and complex forms of international financial and technological collaboration.[1] These sectors, including but not limited to semiconductors, electronics, chemicals, pharmaceuticals, telecommunications, and autos, are also marked by increasingly high research and development (R&D) requirements. The location and character of technology development by MNEs shapes the basic structure of competition and competitive advantage in these and related sectors.[2]

The analysis in Part 11 centers on a basic tension facing policymakers concerned with the U.S. technology base. Large firms are an important source of national innovative capacity. However, they are increasing y multinational, deploying strategies based on global economic and technological calculations. MNEs can and do move manufacturing plants, financial resources, technological assets, and even R&D activities on a global basis in response to international business opportunities. While policy makers are



[1] For an overview of the principal activities of MNEs, see: OTA, *Multinationals and the National Interest: Playing by Different Rules*, OTA-ITE-569 (Washington, DC: U.S. Government Printing Office, September 1993).

[2] In a number of sectors and important technologies, innovation by small and medlun~-sized enterprises is very robust and extremely important to the U.S. technology base. In the aggregate, however, large firms conduct the bulk of R&D activities in private enterprise. This assessment focuses exclusively on the activities of MNEs and the unique policy considerations they engender.

concerned primarily with the long-term health and regenerative capacity of the national technology base, MNEs are concerned primarily with the more immediate international competitiveness of the enterprise. The central challenge facing U.S. policy makers is to deploy national technology policy in a way that encourages the innovative activities of MNEs and, at the same time, directs the benefits of those activities to the U.S. economy and technology base.

In the aggregate, the innovative activities of MNEs remain highly centralized. Despite the globalization of production and the international availability of technologically intensive products, the means to innovate and generate new technology remain relatively localized in the home markets of MNEs in the advanced industrial states. In many respects, however, the globalization of production and commerce has expanded the international scope of technology. MNEs are conducting more research abroad and are transferring increasing amounts of technology across national borders. In addition, reduced transportation and communication barriers have promoted the rapid diffusion of new technologies in the form of technologically intensive goods and services.

Nevertheless, core technology development remains rooted in the parent operations of MNEs, which are themselves embedded in national and often subnational innovation systems. Consequently, assessing the technology development activities of MNEs and their significance for national competitiveness and technology policy requires understanding the structure and performance of the national innovation systems in which they base their global operations. To address these complex relationships, the analysis in Part II is conducted in two stages. Chapter 3 compares the distinctive structural features of national innovation systems across the advanced industrial nations. It also analyzes the most recent aggregate R&D and patenting data in order to compare the basic performance of each system, and to understand the critical role of business enterprises in those systems. Chapter 4 analyzes the technology development activities of MNEs. It focuses on where firms develop new technology and the extent to which they diffuse technology globally, as measured by overseas R&D activities, international technology trade, and trends in international technical alliances.

The evidence considered in Chapters 3 and 4 supports the following principal findings.

FINDINGS

1. Trends in both R&D spending by MNEs and technology trade indicate that technology development generally remains rooted in distinct national technology bases. At the same time, MNEs are a principal mechanism behind the globalization of technology. Higher rates of external patenting, more rapid diffusion of technology across borders, increasing rates of overseas R&D activity, and the growing prevalence of international technical alliances all point in this direction. However, close analysis of these trends indicates that the degree of internationalization is still relatively low.
2. Overseas R&D by affiliates remains quite limited when compared to both the R&D activities of the parent group and the more extensive internationalization of production and sourcing (see figure 4-9 in chapter 4). MNEs typically centralize basic research and product development in the home market. Research oriented toward customization and production process technology moves offshore slowly, as overseas production units become more deeply integrated into local markets. Only rarely do companies transfer or acquire basic research functions abroad.
3. Similarly, U.S. royalties and license fee data indicate that the majority of international technology trade takes place within MNE networks, and that technology flows principally from MNE parents to their overseas affiliates (see figures 4-12 and 4-13).
4. National innovation systems vary significantly across the Triad. The institutional structure of the Japanese and German innovation systems favors commercially relevant innovation within industry, while the structure of the U. K., French, and especially U.S. innovation sys-

terns gives more emphasis to defense and dual-use technologies, with weaker support for commercial technology development.

5. Across the advanced industrial states, industry conducts the largest percentage of national R&D, ranging from 59.2 percent in France to 71.4 percent in Germany (see figure 3-1 in chapter 3). However, recent trends show substantial variations across nations in the level of R&D investment by private enterprise. Although there have been large annual variances, between 1981 and 1992 business-financed R&D expenditures in Japan grew at an average rate of 8 percent. The average growth rate for U.S. firms was 3.9 percent, while industry-financed R&D in the France, Germany, and the United Kingdom, grew at average rates of 4.6, 3.9, and 1.6 percent, respectively (see figure 3- 13). In the context of comparatively short investment time horizons, U.S. firms are less likely to maintain long-term R&D investments than are many of their counterparts in Japan and Europe.
6. The nature and degree of overseas technology development and diffusion associated with MNEs varies by national origin as well as by industry sector. Aggregate patterns indicate that the magnitude and intensity of overseas R&D is the highest both for U.S. affiliates in Germa n y and the United Kingdom and for German and U.K. affiliates in the United States.[3] The magnitude and intensity of overseas R&D is the lowest both for U.S. affiliates in France and Japan and for French and Japanese affiliates in the United States (compare figure 4-2 with 4-7, and figure 4-5 with 4-8).
7. Approximately half of all R&D and 81 percent of the manufacturing R&D conducted by foreign affiliates in the United States is concentrated in three sectors-chemicals, pharmaceuticals, and electrical and nonelectrical machinery. German affiliates in the United States consistently have had the highest R&D intensity, which reflects the concentration of German affiliates in chemicals and pharmaceuticals (typically sectors with high ratios of R&D to sales). The comparatively low R&D intensity of Japanese affiliates in the U.S. reflects the relatively low percentage of Japanese foreign direct investment in the United States (FDIUS) directed to manufacturing. In 1992, 19 percent of Japan's FDIUS was in manufacturing industries and 34 percent in wholesale trade, compared with 47 percent and 8 percent, respectively, for European FDIUS.
8. Japanese firms acquire U.S. technology through different channels than European MNEs. Japanese firms buy an unusually large percentage of U.S. technology from unaffiliated firms. Since arms-length transactions impart a higher degree of control to the purchaser, Japanese firms in the aggregate retain a proportionately higher degree of control over the technology they purchase from the United States than do European firms. In addition, Japan accounts for over half of the U.S. trade surplus in industrial process technology (see figure 4-15). These patterns are consistent with the oft-noted tendency of Japanese firms to acquire overseas technology by buying it directly rather than by initiating R&D activities in foreign markets.

[3] R&D intensity is the ratio of R&D expenditures to sales, It is a standard measure for comparing the relative technological intensity of firms.