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# Inside the Taiwan Miracle

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Women pick tea leaves in this 1953 image. Agriculture was the primary driver of the economy during Qing dynasty and Japanese colonial rule over Taiwan. (File Photo)

*The central government and private enterprises have been instrumental in helping Taiwan grow into today's economic powerhouse.*

With a land area similar in size to that of the Netherlands, Taiwan is a relatively small island with a population of just 23 million, yet it plays a leading role in the international high-tech industry and was ranked as the world's 25th-largest economy in 2009. The island's economy has developed with surprising speed, as agriculture was the dominant sector as late as the 1950s, while today the service industry powers the domestic market and information technology products constitute the bulk of exports.

## **Focus on Agriculture**

Economic development accelerated when Taiwan was a Japanese colony (1895–1945), as the tea trade begun under Qing dynasty governance of the island (1683–1895) continued to grow, while local farmers also started growing rice and sugar cane. In the latter years of the Japanese era,

fertilizer and textile manufacturing played a prominent role. Living standards improved for most people in Taiwan under Japanese rule, but the average local family remained poor, since a substantial portion of surplus industrial revenue was remitted to Japan.

Under Japanese rule, Taiwan's economic development was largely led by the government, which focused on designing appropriate development strategies, mobilizing capital and establishing financial institutions. In 1899, for example, the Japanese established a fundamental pillar of the island's economy by creating a central bank called the Bank of Taiwan. By issuing currency, which was first silver-based and then gold-based, the bank established a standard unit of exchange, greatly easing all financial transactions.

Immediately after World War II, the Japanese surrendered to the Republic of China (ROC) government in Nanjing, mainland China. In Taiwan, the ROC government took ownership of all former Japanese capital, both public and private. Because Japanese capital had been spread throughout all economic sectors except for rice farming, the extent of ROC ownership was likewise pervasive after the handover, with the government assuming control of the majority of the island's capital and land holdings.

The ROC central government relocated from the mainland to Taiwan in 1949. Over the ensuing decade, the government first concentrated on the reconstruction of infrastructure damaged during World War II, then turned its focus to economic development. Due to its extensive involvement in industry and commerce, the state continued to set the direction of the economy.



Women operate weaving machines at a textile factory in this 1959 photo. The ROC government relied on textile production to shift the economy from agriculture to manufacturing. (Joint Commission on Rural Reconstruction)

## **Encouraging Enterprise**

There were major differences, however, between the ROC's management of the economy and that of the Japanese. Before World War II, Japan controlled Taiwan's economy through direct ownership and indirectly through state-owned businesses. While such control continued under ROC rule, the government also started encouraging greater participation by private enterprise.

The ROC government's first economic development plan was aimed at transforming Taiwan's agriculture-based economy into one focused on manufacturing, a farsighted strategy that contributed greatly to Taiwan's modernization. The shift to manufacturing was successful largely because economic planners chose to focus on the textile and apparel industry, a sector known for playing a large role in the early development of countries such as the United Kingdom, the United States and Japan. Textile and apparel manufacturing is recognized as an important driver of economic growth in developing countries because making fabrics is the most labor-intensive of all major industries, and such countries typically possess a large amount of unskilled labor.

Although Taiwan's labor force was capable of transitioning from agriculture to textile and apparel production, the government also recognized the need to establish an economic environment conducive to the industry's development. In June 1949, therefore, the government implemented an import substitution policy that called for the island to become self-sufficient in manufactured goods. This policy would prove crucial to the growth of textile and apparel manufacturing in the 1950s.

Whereas Taiwan had plenty of labor, the main resource required by the textile and apparel industry, extensive capital and investment were required to develop the manmade fiber sector. The government played a key role in promoting the sector by helping companies acquire capital and capital goods. In 1954, for example, the state oversaw the creation of a rayon manufacturing plant to boost the use of fibers other than cotton.

Next, as a part of the ROC's First Four-Year Economic Plan (1953–1956), a state-owned bank initiated a joint venture in which local textile businesses cooperated with a US-based manmade fiber company. A new firm called China Manmade Fiber Corp. was therefore established in Taiwan in early 1957, with the US partner providing licensed technology and imported machinery.



A visitor to a 1962 electronics exhibition checks out early transistor radios. Consumer electronics manufacturing began in Taiwan in 1948. (Joint Commission on Rural Reconstruction)

After an international agreement regulating the textile trade known as the Long Term Arrangement (LTA) came into force in 1962, the ROC government accelerated the restructuring of the domestic textile and manmade fiber industries. Under the guidance of the Second Four-Year Economic Plan (1957–1960), in 1962 the state directed the China Manmade Fiber Corp. and China Development Corp., a state-run finance agency, to create the United Nylon Corp.

With employment in the textile and apparel manufacturing sector reaching as high as 20 percent during the 1950s, it was obvious that the industry was growing, but limited domestic demand soon made it equally obvious that the export market would have to be tapped to continue that growth. Exports were also seen as the best way to gain the foreign currency reserves needed for purchasing imported capital goods and raw materials. The government's strategy to boost exports

was therefore set out in the Third Four-Year Economic Plan (1961–1964) through incentives such as tax benefits, tariff rebates, low-interest loans and other measures. The export promotion strategy led to two-digit real economic growth in the 1960s and trade surpluses after 1970. Revenues from exports also helped Taiwan accumulate a larger supply of domestic capital, which greatly facilitated investment.

As the manmade fiber industry grew, its production increased from 80 metric tons in 1957 to 151,100 metric tons in 1987, making Taiwan the world's third-largest supplier that year behind the United States and Japan. By 1989, Taiwan had surpassed Japan to become the world's second-largest manmade fiber exporter.

### **Dawn of a New Era**

The successful development of Taiwan's consumer electronics industry was also guided by the government. Consumer electronics manufacturing got underway in Taiwan in 1948 when merchants started assembling radios using imported vacuum tubes and other parts. Local companies made the jump to transistor radios in 1961, which led to large consignment orders, mainly from Japanese trading firms that exported the radios to the United States. The burgeoning consignment orders and construction of extensive facilities required to fulfill them marked the dawn of a new industrial era in Taiwan.

Consumer electronics manufacturers expanded into assembling televisions for the Taiwan market by acquiring technologies from large Japanese companies through licensing agreements and joint ventures. Meanwhile, local companies also used the direct investment of US-based firms to build facilities dedicated to assembling televisions for the American market.



Workers assemble integrated circuit boards in 1972 at a factory established by US-based RCA Co. Local licensing of RCA's chip technology helped Taiwan enter the global semiconductor industry. (File Photo)

While the local assembly of radios and televisions accelerated in the 1960s and early 1970s, Taiwan's consumer electronics industry did not then have the ability to manufacture individual components. To stimulate the growth of the domestic electronic components industry, the ROC

government imposed local content requirements for electronic products sold in Taiwan. The requirements had the effect of forcing Japanese television makers to transfer technologies to their Taiwanese partners or local parts makers.

By and large, however, in the 1960s and early 1970s the core of the domestic electronics industry remained small firms that copied or licensed technologies from multinational corporations. Due to the perception that locally produced electronics items were of inferior quality, Taiwanese firms targeted emerging markets in Southeast Asia, the Middle East and Latin America. Revenues from those exports subsequently enabled the companies to reach economies of scale and generate the revenue required for investing in modern production equipment.

Improvements in quality and manufacturing know-how in Taiwan's consumer electronics sector set the stage for the rise of the semiconductor industry, the island's next major driver of economic growth. The origins of the industry on the island can be traced back to 1964, when a semiconductor lab was established at National Chiao Tung University in Hsinchu, northern Taiwan. The lab was responsible for training many of the engineers who went on to form the backbone of Taiwan's semiconductor industry.

The nascent semiconductor manufacturing sector received little outside help for the first few years, as multinational corporations hesitated to invest in production facilities in Taiwan. One reason for their reticence was that such lines typically entail a large capital commitment while offering no guarantee that end products will ever reach stable quality control standards. The island's semiconductor industry finally received an external boost in 1967, when Philco Corp. initiated the local assembly of integrated circuits (IC).

The accumulation of engineering and manufacturing know-how in the semiconductor industry proceeded slowly until 1974, when the state-owned Electronics Research and Services Organization (ERSO) was established near National Chiao Tung University. Assisted by a group of veteran specialists from the United States, ERSO moved to acquire the complementary metal oxide semiconductor (CMOS) technology used in IC chips from US-based RCA Corp. In retrospect, it can be seen that licensing RCA's CMOS technology served as Taiwan's admission ticket to the global semiconductor industry. In 1976, RCA began transferring CMOS chip technology to ERSO as well as training ERSO staff in chip processing and design, among other areas. ERSO set up an experimental plant to put the RCA technology to work in 1980.





Semiconductor production at TSMC, which was established by the government in 1987 and has gone on to become the world's largest dedicated semiconductor foundry (Photo Courtesy of TSMC)

Also in 1980, ERSO produced its first spinoff company, a privately operated firm named United Microelectronics Co. (UMC). UMC received 60 percent of its initial capital investment from private investors, with the remaining 40 percent coming from the government. UMC went on to become Taiwan's focal point for accumulating chip technologies, training local engineers and providing foundry services, thereby laying the foundation for the rise of the island's IC design houses.

### **IC Design Takes Off**

A design house is a knowledge-based operation that focuses on IC design and development while outsourcing actual manufacturing to downstream vendors. Although minimal capital is required to start an IC design house, quality foundry services must be available for such a house to succeed. Syntek, Taiwan's first IC design house, was established in 1982 under the leadership of a former ERSO manager and his colleagues. To take advantage of the island's seemingly endless supply of talented local engineers, in the mid-1980s a flock of multinational electronics firms also established their own IC design houses in Taiwan.

The boom in IC design services made it obvious, however, that Taiwan faced a serious shortage of foundry services. UMC was the only foundry on the island at the time, but it was focused on producing its own designs and was reluctant to devote too much of its capacity to making chips for design houses. In 1987, the government stepped in by establishing Taiwan Semiconductor Manufacturing Co. (TSMC) to focus on foundry services.

TSMC's strategy of manufacturing IC chips for outside companies soon proved to be a major success. The company gained business not only from local IC design houses, but also from overseas designers. TSMC's quick rise encouraged UMC to embark on its first major expansion in 1989, when it invested NT\$6 billion (US\$227.3 million at the exchange rate then) to establish its second fabrication line. The new line was mainly devoted to the production of static random access memory (SRAM), a fast, relatively expensive and power-conserving type of semiconductor memory. By the end of 1990, there were eight IC manufacturing firms in Taiwan, most of which were locally owned.

In 1988, ERSO spun off its photomasking operations, which involve using light to define circuit patterns for semiconductors and ICs. The spinoff of Taiwan Photomask completed the vertical integration of Taiwan's semiconductor industry.



A group of tourists from Fujian province, mainland China visits Taiwan in September 2008. Tourism plays a key role in Taiwan's growing service sector. (Photo by Central News Agency)

In terms of products, the major remaining gap in Taiwan's semiconductor manufacturing lineup was dynamic random access memory (DRAM), which is less expensive than SRAM and serves as the main memory of most personal computers. That gap was filled in 1989, when Taiwan's Acer Inc. formed a DRAM joint venture with US-based Texas Instruments Inc. At that point, however, DRAM production technology in Taiwan still lagged behind international industry leaders by three to five years.

In 1992, ERSO transferred DRAM and SRAM manufacturing technologies to UMC and TSMC, which soon established their own production lines. By 1995, the gap between Taiwan and international IC industry leaders had shortened to about one year. Technical innovation fueled an investment rush in the sector, and by October 1995, 14 firms had announced plans to join the ranks of the island's semiconductor makers.

Despite the growth of textile and high-tech manufacturing, by 1987 the service industry had become Taiwan's largest economic sector. The shift toward the service industry continued in the 2000s as Taiwan's manufacturers shifted labor-intensive production to countries with lower wages.

By 2008, the service industry was contributing more than 70 percent of Taiwan's gross domestic product.

Closer economic ties between Taiwan and mainland China in the wake of the June 2010 signing of the Economic Cooperation Framework Agreement could provide a further boost to Taiwan's service industry, particularly the tourism sector. Since the ban on tourists from mainland China was lifted in 2008, their numbers have surged, reaching 1.6 million in 2010.

The increasing number of tourists has led to wider government recognition of the importance of the service sector. One cooperative tourism effort by the central and local governments aims to develop historic centers with user-friendly tourist signs in Taiwan's townships and villages, while other plans focus on boosting agricultural, medical, cycling, culinary and cultural tourism.

Over the past 100 years, the main driver of Taiwan's economy has shifted from agriculture to the service industry, although high-tech manufacturing still plays a vital role. Those trends indicate that Taiwan's economy is developing in an environmentally friendly manner while continuing to yield high incomes and a good standard of living.

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