SECTION TWO: STATE INTERVENTION IN THE TECHNOLOGICAL PRODUCTION INDUSTRY AS A NATIONAL INTEREST

This section is dedicated to a discussion of whether Israel should formulate a policy regarding investment in technology in light of its needs and an assessment of future national security. The working assumption is that it is not Israel's place to advance legislation on the level of the American or European legislation. However, given the global trends, Israel's current situation, and the exponential pace of development of technology, the private sector and market forces alone are insufficient for ensuring Israel's standing as a hightech power over time; therefore, it is desirable and recommended to examine current government policy on the issue.

Government intervention in the economy of liberal democratic regimes is a controversial approach. Historically, states have adopted an "industrial policy"; that is, intervention for the purpose of providing preferential treatment to a particular sector in the name of national interests, in cases where the state has an interest in promoting a certain industry in which the private sector has no business interest in operating.⁵⁵ In most cases, countries chose to fund initial investment in research and development or to help finance risk in order to encourage private entrepreneurs and investors to join, while they then reduce their involvement and their investments in the industries to only tax subsidies and duties.

Both the technology market in Israel and the high-tech sector clearly illustrate the advantages of this approach. However, this success stems partly from the fact that Israeli high-tech concentrates on a relatively limited range of software-based technological fields that do not demand a high level of government investment in research and development. Without understating the value and importance of the defense industries and the developments of the lion's share of the start-up companies, this model is unsustainable given the pace and type of technological changes in hardware, which is a necessary basis for the entire industry. Furthermore, Israel's standing as an innovative country that is ready to absorb future technologies is already eroding.⁵⁶

The COVID-19 pandemic and the Russia–Ukraine war have led to a serious supply chain crisis; they have increased the importance of local production plants and have broken the global trade model. This is a unique development not only because a model in place for 70 years has changed before us, but also because it expresses a deeper shift in the innovation processes of the tech industry. The ecosystem needed for innovation is a diverse mix that combines research and development capabilities with local production capabilities. Israel cannot and should not aspire to become a production powerhouse, but it should formulate and examine the steps that will bring it closer to advanced production capabilities and thus maintain its standing as a leading technology power in the world.

Future technology is based more than ever on cooperation between tech entrepreneurs, academia, and cutting-edge computing infrastructure, necessitating advanced production technologies and chips. These foundations—technology production infrastructure and education—are the "national resource" of our time. Achieving the envisioned breakthrough in each sphere requires capital and risk on a magnitude that surpasses the capacity of the private investors alone and underscores the need for government assistance. In an age in which semiconductors are a core component of every technological product and advanced chips are what enable the use of artificial intelligence and the communications infrastructure that serves data transfer on the internet and the IoT (the internet of things), it is no wonder that the chip is called "the crude oil of the 21st century." If the chip is similar to a natural resource such as crude oil, then countries working to locate natural resources in their territory or striving for energy independence need to formulate policy in areas related to hardware and chips.

The Technological Production Industry in Israel: The Contribution of Government Investment to Global Success

Israel is known as one of the most innovative countries in the world and as a center of high-tech entrepreneurship. The high-tech sector includes the research and development sector in an enormous range of fields, as well as a manufacturing sector (electronics, biotechnology) and services sector (computer programming, information security, artificial intelligence). Israel's mix of companies and industries and its combined sectors have provided innovative technological solutions to the country's needs and challenges. For example, in 1958 the Science Corps became Rafael Armament Development Authority, which has been considered a defense industry that produces highquality weapons and elite technology, and in 1965 the company Netafim was established, which developed and produced drip irrigation technology and later provided advanced agriculture technology in areas where water sources were limited.

The key to the success of the Israeli high-tech industry can be generally explained by a combination of "technological strength" and a free-market policy. The knowledge accumulated in both academia and the defense industries served as a basis for private initiative that enjoyed tax benefits and minimal to no intervention by the government. The Israeli approach is similar to that of a private venture capital fund that covers the heavy investment costs and enables the leap toward profitability. But upon the merger or sale (the exit), unlike private venture capital funds that collect their profits, the state loses a productive asset and the potential for future profits. In most cases, the majority of the company's business activity leaves Israeli territory, in a way that indirectly contributes to inequality and social gaps.

Although the combination of innovative thinking, the processes of privatization, and the opening of the market to foreign investments have enabled Israel to attain unprecedented economic achievements, the significant achievements of the tech industry can also be explained as the result of government policy instituted until the middle of the 1990s.⁵⁷ According to this approach, Israel became a "start-up nation" thanks to defined government policy and legislation that balanced between the private and public interest. The free-market approach that has been more fully instituted in the past two decades has created the illusion that the private sector is capable of "taking care of" the public interest, but times of crisis (the COVID-19 outbreak, internal conflicts) have illustrated this model's sensitivity to shocks and the risks in relying on the free market as a policy.

Starting in the 1970s, the "industrial policy," which was expressed in defining national objectives and policy, and government institutions joining forces with associations of entrepreneurs and manufacturers, constituted a necessary engine for development efforts and for the establishment of the technological industries whose success Israel takes pride in today. The joining of forces was large-scale and included Ministry of Finance plans and investments in industrial research and development, based on the assumption that Israeli firms would not be able to bear the financial risk alone. This policy was also supported a government committee that was established under the leadership of Prof. Shimon Yiftah in 1984, which encouraged the advancement of "a coordinated national technology policy."58 This committee recognized the fact that government intervention in the economy would be unusual, but without it, it would not be possible to implement change at the scale necessary for ensuring growth. This included talk of increasing government investment in universities for the purposes of basic research in a wide variety of technological fields. Over the years, the connections between the universities and scientific institutes and the private sector strengthened, greatly advancing the research and development of cutting-edge technologies.

The Office of the Chief Scientist, which later became the Innovation Authority, was established during those years for the purpose of implementing this approach. This institution received powers and a budget with which it implemented the government's technology policy. In 1984 the Encouragement of Research and Development in Industry Law was passed, by virtue of which the Innovation Authority has operated to this day. The funds established during those years provide incentives from the state to finance research and development processes in groundbreaking initiatives. The height of government intervention during that time was the establishment of a \$100 million government investment fund called the Initiative Program. This fund was the source of inspiration for private funds that were established, according to the governmental logic, to encourage Israeli companies to operate in the high-risk technological environment. The Israeli success in technological innovation attracted international companies that established research and development centers in Israel, recruiting outstanding engineers into their ranks. A three-way relationship emerged between scientists, entrepreneurs, and foreign investors and became a necessary condition for advancing the economy.

From Government Support to a Free-Market Model

The hyper-inflation crisis that Israel experienced in the 1980s pushed for a change in policy and a transition from a centralized and supervised economy to an open and modern market economy. Simultaneously, the growth of the cheap goods industry in Asia encouraged the government, like many countries in the West—chiefly the United States—to prefer cheap imports over investment in expensive domestic production in Israel. The Israeli government intentionally brought about the end of the era of independent production and thus, in effect, Israel joined the processes of globalization. At the beginning of the 1990s with the fall of the Soviet Union, hundreds of thousands of Soviet Jews immigrated to Israel. Most were highly skilled engineers and scientists, who integrated in civilian technological research and development and contributed enormously to converting Israel from a manufacturing economy to an R&D-focused economy.

The rise of the internet and the leap forward in the software layer and in the demand for applications has created a new realm of opportunities for Israeli entrepreneurs in a way that furthers R&D-intensive companies based on human capital, which do not need large manufacturing facilities or other large-scale production capabilities. While advanced countries had difficulty integrating into the industry, Israel succeeded at leading the software technologies with initiative and creativity and encouraged more foreign companies to increase their investments. As a result, there has been a built-in preference for the services sector in Israel, particularly the information and communications technologies (ICT), while the manufacturing industries have been pushed to the sidelines.

Until the beginning of the 2000s, the recipients of government grants that succeeded in completing the research and development process were obligated to conduct the manufacturing process in Israel, even though it was apparent that it was more profitable to produce in other places, especially in Asia. Furthermore, companies that received government grants were prohibited from selling or transferring the activity to companies operating outside of the country's borders. These restrictions, which were meant to directly strengthen the industry, increase the number of jobs, and strengthen infrastructure, led to the growth of Israeli-grown tech giants that also established factories, especially in the country's periphery.

At the beginning of the 2000s, the prohibition on transferring intellectual property outside of the country's borders was reduced as was the obligation to produce inside Israel. This change was the result of a struggle led by the venture capital funds in Israel, who protested the fact that the export restrictions kept away foreign investors and harmed the growth of start-up companies. The attitude of the venture capital funds was that the free market was a necessary condition for growth, and the removal of the restrictions would enable the entry of foreign capital that was essential for the economy's growth. However, this change threatened the overall national interest, as it caused the government to lose control of assets that maintained Israel's social and demographic fabric. Manufacturers' organizations warned of the potential harm, and the restrictions themselves turned into a system of fines for companies that chose to sell ownership of the property. This system did not deter entrepreneurs, however, who included the fine in the cost of the sale or found other ways to convert it into other investments.

This change in legislation led to the large-scale entry of multi-national companies in Israel. While they were already in Israel before, a reality emerged in which Israeli hardware companies did not have an interest to complete an entire industrial process. Israeli entrepreneurs, who were supported mainly by private venture capital funds, aspired to sell their companies at the proof-of-concept stage, which would provide maximum profits, without a need to invest in the production costs.

As a result of the expansion of foreign investments, Israel grew stronger and became a technological power and an international start-up incubator. Israeli human capital reached historic breakthroughs and allowed the industry to attain unprecedented achievements. But after the outbreak of the COVID-19 pandemic in 2020, and according to figures published by the Israel Innovation Authority in its 2022 report, Israel is now in the middle of an alarming changing trend. Despite the peaks attained in recent years for the State of Israel (including a record \$27 billion of capital raised, 40 Israeli companies crossing the threshold of \$1 billion in value, and 75 Israeli companies that have gone public), this is not sufficient for ensuring continued global leadership and the growth of the industry (see Figures 9 and 10). Technology creates global changes; when the pace of development accelerates and is accompanied by enormous investments, the global balance of power shifts, enabling countries that keep up with the pace of research and development to become influential global powers. Countries that do not manage to invest the necessary capital in innovation are left behind economically, socially, and militarily.59



FIGURE 9. LEADING NATIONS IN THE GLOBAL INNOVATION INDEX 2021

Source: Israel Innovation Authority, "Annual Innovation Report - State of High-Tech, 2022."

Among the challenges presented by the Israel Innovation Authority in its report is the increasing shortage of skilled workers for development jobs, which leads to the transfer of R&D activities to other countries, thus weakening the labor market in Israel, and even worse, the innovation potential. Even though the total investment in R&D in Israel (a figure that also relates to private sector investments) is the highest in the world—over 5% of GDP—in practice, it is concentrated in a relatively narrow range of technologies, chiefly software and cyber(see Figures 11 and 12), in a way that makes it difficult for the country to expand and to develop in additional technological fields. In this respect, it is worth mentioning that Israel's decline in the Global Innovation Index in 2015 (see Figure 10) stemmed from a standstill in the level of government investments in research and development compared to a rise in investments by countries in Europe and Asia, while the correction made in this context

since then has improved Israel's situation. Another figure that intensifies the concern regarding the diversification and diffusion of risks in this context is the decline in the number of new start-up companies in Israel for the past several years. It seems that only 4% of the companies that raised capital in 2021 (\$1.1 billion) progressed to the seed stage. Over half of the capital raised by private technology companies in Israel in 2021 reached only three sectors, all of them software-based (see Figure 11).⁶⁰

FIGURE 10. ISRAEL'S RATING IN THE GLOBAL INNOVATION INDEX (2009–2022)



Source: Israel Innovation Authority, "Annual Innovation Report – State of High-Tech, 2022."

FIGURE 11. DISTRIBUTION OF PRIVATE HIGH-TECH INVESTMENTS BY MARKET SECTOR



Source: Israel Innovation Authority, "Annual Innovation Report - State of High-Tech, 2022."

FIGURE 12. INVESTMENT IN R&D AS PERCENTAGE OF GDP AND PERCENTAGE OF GOVERNMENTAL R&D INVESTMENT



Source: Israel Innovation Authority, "Annual Innovation Report - State of High-Tech, 2022."

Technological legislation worldwide indicates an increasing public sector and private sector investment in hardware production and chips, in particular, partly due to an understanding that this is necessary for innovation in the current era of machine learning and artificial intelligence. In the past, tech giants preferred to establish their development centers in places where they could recruit brains, but today an opposite approach is gaining ground that advocates proximity between manufacturing plants and development centers as a condition for innovation. While it is difficult to move manufacturing plants from place to place, development centers are considered almost "virtual" and rootless. Studies conducted on this topic among the tech giants indicate that a significant portion of a company's development is learning the production processes and the application of the technologies being developed.⁶¹ Therefore, to ensure success, the entire value chain needs to be in one place.⁶² This is referred to in the famous example of Kodak. Despite being a technological leader in the field of producing cameras, it failed at leading the digital photography revolution. When the company's executives needed to explain the failure, they claimed that the company engaged in research and development of digital cameras years before the revolution, but, in fact, the production line was transferred to Japan and the development center in the United States transitioned to the development of video technology. The resulting disconnect between R&D and production caused the company to fail, leaving it no choice but to pay a heavy price and move the development center to Japan and to join the market late.

These studies do not necessarily purport to claim that in every technological industry, development and production should take place in the same country, but they do show how technological innovation in hardware and in electronics industries—particularly advanced chips, biomedical engineering, and chemical engineering—is the product of the joint work of development and production. This is one reason that the State of Israel succeeded in encouraging Intel to establish the chip factory in Kiryat Gat, close to the development centers, and it is also the rationale that when tech giants establish manufacturing plants in the United States and Europe, they prefer locations close to development and innovation centers. Intel's chip factory in Kiryat Gat could serve as a prototype for a model that combines the design and production of chips in the same geographical region, thus demonstrating the effectiveness of this model compared to the traditional structure of designing chips in the West and manufacturing them in Asia. From Israel's perspective, there is significant value in increasing the production footprint in Israel and bringing the country closer to the supply chain that is being rebuilt. In this respect, it should be mentioned that in June 2023, Intel announced the construction of another advanced chip factory in Israel, with an investment of about \$27 billion.⁶³

However, according to current trends, the enormous investments in research and development and in advancing local manufacturing industries could come at the expense of investments in Israel and could even push Israeli entrepreneurs and brains abroad. The current method of operation and the built-in bias in favor of the technological services sector is close to reaching its potential and could reverse the trend. A balanced mix between the services sector and the manufacturing sector is essential for maintaining technological innovation and Israel's standing as a start-up nation.

Back to Infrastructure: Government Investment in Research, Development, and Production for the Benefit of Technological Innovation

The election campaign of President Joe Biden used the slogan "build back better." President Biden identified the deep gap in the American economy, which had given up on its vital manufacturing plants. He called for rebuilding the productive infrastructure that would enable the country's future, understanding the importance of manufacturing plants in the balance of power and their contribution to innovation and the realization of national military and social interests. The timing was not coincidental, of course. As mentioned above, the struggle with China and its national plans constituted a decisive consideration in the decision, but the important lesson that the United States learned is also relevant to Israel's current challenges—the country is in need of infrastructure and a leap forward in research and development in order to keep up with the pace of technological change.

The various kinds of manufacturing industries and advanced infrastructure for the purpose of research and development are considered burdensome to establish and operate without government intervention. There is considerable historical evidence of the connection between public investment and production, and without public investment, production is neglected. The case of the United States and of some European countries illustrates this description. Alexander Hamilton, the first treasury secretary of the United States, published a document in 1791 that called for supporting the establishment of production plants in the United States and for funding their activity through duty relief and tax subsidies. European countries backed and supported the iron and agriculture industries and the production of vehicles and aircraft. Government investments aimed, first and foremost, to ensure supply for domestic demand but also expressed strength, in part, due to the ties between the defense manufacturing industries and military strength.

This approach of government investment in production among Western countries was maintained until after World War II, with the establishment of the global trade agreement and the migration of production systems to Asian countries as part of globalization. Starting in the middle of the 20th century, the Western world continued to invest in research and development, innovation, and sensitive industries in accordance with defense needs, but its portion of total global production decreased over time, to the point of losing its comparative advantage to Asian countries. The labor market changed to the degree that it is now impossible to compete with the employment of workers in countries like China, India, and Bangladesh. The result is the West's almost complete dependence on mass production in Asia.

According to the liberal approach customary in most Western countries, a free market economy—even at the cost of harming local factories—is preferable

to intervention that is seen as impeding growth and blocking competition and creativity. The services sector, to which the high-tech industry also belongs, assumed the place of manufacturing plants in the GDP of Western countries. Since the high-tech industry is capital-intensive, it has almost no need for government intervention, except in cases of risk.

In the early days of the young and developing industry in Israel, the government's investment in academia and research institutes enabled groundbreaking projects to develop. But in recent years, the decline in investment in higher education institutions has harmed the quality and level of research and development in a way that threatens Israel's comparative advantage compared to other universities in the world. Israeli and foreign companies have invested in academia in studies that serve their business needs, but this is not sufficient for ensuring Israel's national interests or the comparative advantage that it has enjoyed so far (see Figures 13 to 16). Furthermore, there has been a decline in academia in the human capital and brains that continue to engage in research and development. While this is a broad global trend, for a small country like Israel that relies on innovation and creativity, it is especially worrisome.⁶⁴

The collaborations between academic institutions in Europe and the tech industry create competition and difficulty for Israel. Despite the declarations by the tech giants to expand their research and development activity in Israel in the coming years, the state of the world market, the streamlining plans of the software giants, and concerns of a shortage of suitable workers could lead them to reevaluate their plans. Given the crisis, most companies are looking for innovation and growth channels; to guarantee continued investment in Israel, it is necessary to ensure the future of infrastructure and human capital in Israel. This trend could worsen given the increasing concerns about the consequences of the judicial legislation, and the decreasing motivation of academics to return to research positions in Israel.



Source: Israel Innovation Authority, "Annual Innovation Report – State of High-Tech, 2022."

FIGURE 14. NUMBER OF CITED PUBLISHED PEER-REVIEWED PAPERS



Source: Data from bibliometric databases, processed by the staff of the Neaman Institute

FIGURE 15. SPONSORED RESEARCH IN ACADEMIA 2012–2016 BY SECTORS



Source: Israel Innovation Authority, "Annual Innovation Report - State of High-Tech, 2022."

FIGURE 16. SPONSORED RESEARCH IN ACADEMIA 2012–2016 BY COMPANIES



Source: Israel Innovation Authority, "Annual Innovation Report – The State of High-Tech, 2022."

Advanced Chips and Production Technologies as the "National Resource" of the 21st Century

In 2023 it seems that countries have invested huge sums in the development and manufacturing of advanced chips. As already noted, like crude oil in the previous century, the developed countries perceive technology, and particularly the manufacturing plants that are responsible for the production of advanced chips and hardware, as a "national resource."

In Israel too it is evident that advanced technology is a necessary condition for the welfare of the country and its citizens, but notably absent is a national plan that will ensure Israel's access to its "cornerstones." The application of tools and systems based on big data, machine learning, and information security require processing and computation capabilities that advanced chips enable.⁶⁵ The development and production processes of these applied capabilities are dependent on and rely upon chip development and production processes, and therefore, from purely a technological standpoint, Israel should examine where it positions itself within the global techno-strategic events.

There are companies operating in Israel in the field of hardware or chips, the majority of which are under the American hardware giants and dependent upon production systems located outside of Israel. The significance of this is that it is impossible for Israel to benefit from the fruits of the investment, both economically and in other spheres, without relying on other countries.

The global competition over chips is primarily an economic matter of supply and demand, but in the current era it is also taking place on the desks of leaders and politicians. Trade in technology between countries is becoming increasingly based on shared values and interests, and just as crude oil dictates leaders to make decisions and create alliances, the standing of the chip and of advanced production technologies is also determined.

Investment in research and development in the field of technological production is an important component and a comparative advantage that Israel enjoys, but it only constitutes a partial solution to the problem. Israel needs a national plan that gives expression to all the aspects related to development, production, and trade of chips. Government direction is a condition for encouraging participation and competition, and it will make it easier for entrepreneurs in Israel and abroad to invest the initial investment in setting up billions of dollars of infrastructure. Infrastructure development, education, foreign policy, and a defense framework are all crucial for advanced and sustainable technology.

The Defense Consideration: Increased Dependence on Technology Produced Outside of Israel

Technology is a significant component of Israel's security concept. As a small country surrounded by enemies, Israel must have the most advanced capability to warn of a threat and to defeat its enemies quickly and efficiently while reducing losses and damage. The Israel Defense Forces depend on technological superiority for carrying out its missions, and it bases both its force and competence mainly on importing weapons and technology within the framework of the agreement of US military aid to Israel, which is adapted by the defense industries to Israel's unique needs. The Technology, Computer Service and Military Intelligence Directorates conduct independent research and development in cooperation with the defense industries. However, most of the armament is dependent on global supply chains. The scope of weapons production in Israel has decreased in recent years, and this trend is expected to continue as a result of the American decision to completely stop Israel's ability to convert US aid money for the benefit of local industries by 2028.⁶⁶

Advanced technology has become increasingly more central in the IDF's offensive and defensive capabilities. In recent years, the IDF has implemented digital technology and systems based on artificial intelligence that immeasurably improve intelligence gathering and processing capabilities, control of forces, and operational capabilities. People in the security establishment today describe the decisive contribution of data science and artificial intelligence

in combat,⁶⁷ and the working assumption is that advantages over enemies depend extensively on such capabilities. In practice, the dependence on advanced technology and on hardware in force buildup is increasing, and therefore the risks to supply sources could also endanger Israel in the long term.

The Israeli defense industries produced most of the needs of the IDF for weapons systems and military equipment in the early years of the state. Government support was the result of a strategic national motivation and sought to prevent dependence on the supply of military products from other countries. The weapons embargo that France imposed on Israel in 1967 served as a justification for this approach, and Israel, which was forced to develop advanced weapons of its own, invested large sums in research and development, as well as in production.

Until the 1980s, the industry had a direct and important impact on both Israel's economic development and the structure of the economy, but similar to other productive industries, as domestic consumption began to rely increasingly on imports from abroad and the pace of technological innovations in the civilian sector accelerated, its impact and standing declined. Accordingly, a large-scale privatization process began, and a considerable portion of the defense industries moved to the private sector, causing the weapons production in the industries to shrink. The record figures in defense industry exports in 2022 indicate a process similar to that of both the services sector and Israeli research and development in the field. In addition, these figures also indicate the industry's dependence and sensitivity to trends in the global market.

The IDF's procurement model, which focuses on development and is dependent on other countries and on the assumption that the supply chain is stable and resilient to various kinds of shocks, is a double-edged sword. On one hand, there is no reason to assume that the United States, Israel's main and longstanding partner, would take an unprecedented step that would endanger Israel's national security. Israel's technological cooperation with the United States and other countries is based on shared military interests and values. On the other hand, the current trends in technology indicate possible vulnerabilities and risks. Technology has become a currency and a tool for implementing policy. This means that given a dispute, a possible punitive tool is to reduce or restrict the supply of technology. Given the reality in which the military aid agreement with the United States will stop the possibility of converting aid dollars in a way that allows for local investment, restricting the use of technology could reduce Israel's degrees of freedom and endanger its national security.

In this context, we will note that in February 2023, a global summit convened in the Netherlands to discuss the responsible use of artificial intelligence for military and defense purposes. At the end of the summit, 57 countries, including all the permanent members of the Security Council except for Russia, agreed on a joint call for action in which they called for the responsible use of artificial intelligence on the battlefield. While Israel participated in the conference, it ultimately chose not to endorse this joint call. In the background of the decision was the use of advanced artificial intelligence capabilities in the war between Russia and Ukraine (facial recognition technologies that are connected to weapons systems, and semi-autonomic attack aircraft) and concerns about the possibility of connecting the use of advanced technology with weapons of mass destruction platforms. The joint call for action includes operating according to the rules of international law and humanitarian law and obligates its members to be transparent regarding design and development in order to prevent unintended biases. Although this is not the first time that Israel has chosen to remain ambiguous and has refrained from signing joint calls of this kind, Israel's lack of transparency could endanger its access to advanced technology. This issue has also been made clear in US declarations on the responsible military use of artificial intelligence and autonomic weapons.

In these circumstances, government intervention, whether through the coordination of positions and regulation or by examining alternatives in vital

cases, is a necessary step for ensuring independent production capability, at least in critical areas to be defined by the government. As a rule, Israel must examine its supply chains and the vital technological components to ensure unconditional continuity. Likewise, to maintain a technological advantage and added value, Israel must examine cases in which it should maintain a fully independent value chain. It is obvious that the Israeli economy, like in most countries, is not large enough to reach complete independence in every field, and therefore it must determine the vital areas where this is achievable, and in those areas where it is not, Israel must join the relevant alliances and coalitions in order to ensure the supply of critical technology infrastructure even at times of global crises.

Incidentally, it is crucial to emphasize the reciprocal relationship between the IDF, the tech industry, and the Israeli economy. Dan Senor and Saul Singer in their book *Start-up Nation* tell the story of the Israeli economic miracle and describe in detail how Israel has consistently outperformed developed countries and boasts the highest number of start-up companies per capita in the world.⁶⁸ A significant factor contributing to this success is the role of the military service, which fosters initiative and innovative thinking. The military is able to identify individuals with the highest potential and to provide them with training. Upon their release, they will be able to leverage their experience and their connections to advance both industry and economy. Consequently, it is vital to maintain the IDF as Israel's technological development incubator, as, in addition to its military capabilities, the IDF also contributes entrepreneurs and highly skilled workers to the economy.

"The Silicon Shield": Production Infrastructure as a Strategic Asset for National Security / A Case Study by Tzachi Shachar

A historical analysis of government interventions in manufacturing industries reveals cases in which a connection emerged between manufacturing infrastructure and other military considerations.⁶⁹ Taiwan is the clearest case of a country that succeeded in building and implementing a national security strategy based on domestic manufacturing infrastructure.

The development of the chip industry in Taiwan combined geopolitical necessities and elements of chance. After the establishment of relations between the People's Republic of China and the United States, the latter retracted its recognition of Taiwan, which was forced to forge a new economic and strategic path. Meanwhile, in the 1970s, the company RCA—a pioneer of radio devices for communication in Morse Code—moved its production systems to Asia, like many American manufacturing industries that enjoyed the advantages of globalization and the cheap labor in the East. An oil crisis occurred during those years in Taiwan, which led the government to seek production channels based on science and technology. In order to concentrate innovation and research efforts, the Industrial Technology Research Institute (ITRI) was established to serve as a technical leader of the entire Taiwanese industry, and it focused on applied technological research.

A Chinese-American director who had worked at RCA in the United States during this time suggested to the Minister of Economic Relations of Taiwan to develop integrated circuits.⁷⁰ In a success that would be considered one of the cornerstones of the Taiwanese chip industry, RCA was convinced to move its technology and production methods to ITRI and also to receive a delegation of 25 Taiwanese engineers for practical training. ITRI accelerated efforts to implement the knowledge and tools that it received in order to fulfill its purpose.

In 1987, Morris Chang, then the head of the ITRI, and one of the members of the delegation of engineers to the United States, joined forces with the Dutch

company Philips and established TSMC. TSMC was exposed to the world as the pioneer of the work model of solely producing chips (without development and without programming). Since the 1990s, demand for chips has soared. The growing world of the IoT has created tremendous demand and the advanced chips that TSMC produces are the cornerstones of AI technologies, quantum technologies, and, of course, advanced weapons systems. The fact that TSMC is a private company and its industrial maturity in the 1990s enabled it to become the main supplier of the drivers of technological progress and innovation led by the United States.

Today the chip industry in Taiwan is estimated to have a production value of \$146 billion, and it ranks first place in the global chip market. TSMC alone holds 54% of the global market share, and together with other producers in the country, Taiwan has cornered 63% of the global market share during the past three years.⁷¹ In addition to being the main chip supplier in the world, TSMC has positioned itself as the only producer in the world that is capable of producing advanced chips—5 nanometer chips.⁷² In the past three years, the three biggest chip producers in the world, TSMC, Samsung, and Intel, decided to build factories with this technology and to produce even more advanced 2 and 3 nanometer chips.

At the beginning of the 2000s, the chip industry in Taiwan became known as the "silicon shield," meaning it became a substantial factor in the island's security resilience.⁷³ At the core of the silicon shield doctrine is the main strength of the chip industry—the creation of dependence. The West and the East are dependent on Taiwan's production capacity as the main chip producer in an era when the chip is the cornerstone of every technology. The dependence is so deep that if China carried out its threat to invade the island, this would shock the economy of the United States and Europe. Analysts at the American Semiconductor Industry Association estimate that in such a scenario, the global electronics industry would face damages amounting to \$490 billion a year.⁷⁴ According to the doctrine formulated by Taiwan surrounding the chip industry, the world will stand with Taiwan when the time comes in order to ensure the stability of the supply chain.

The chip industry in Taiwan was branded as the fuel for the country's national growth, and it still is. Young people were called on to enlist in the effort and were seen as those leading the economy forward; social movements and government bodies directed populations toward working in the chip industry as much as possible. The result was a sense of mission on the part of workers and employers, production capacity that grew quickly, and skills that were built locally and on intensive experience over time.

In the name of the "silicon shield" doctrine, the government promotes an explicit policy of maintaining the industry for the sake of national security. The law in Taiwan requires government approval for workers in the chip industry to travel to China. The local publication of job offers from Chinese chip companies is prohibited by law. Punishments for industrial espionage or the use of trade secrets outside of the country's borders have been doubled. In the past year, the legal mechanisms for protecting the chip industry were incorporated into Taiwan's national security law.⁷⁵

Notably, there are increasing signs that Taiwan has identified the limitations of the silicon shield and no longer relies on this doctrine alone as ensuring the West's support. As a result, in the past year, TSMC started to build factories in the United States valued at \$40 billion, as well as announcing in July 2023 the construction of its first factory in Germany. It seems that Taiwan is distributing its assets around the world, which seemed unthinkable only two years ago.

Steps taken by Taiwan that could be relevant for Israel:

1. In summarizing the analysis of the case study of Taiwan, we can identify a series of primary policy measures led by the government, as well as the institutionalizing and integrating of national measures to support the country's chip industry. These measures could include the establishment of a body for applied research and examination of developing global industries.

- 2. Creating cooperation for importing engineering knowledge and practical training.
- 3. Identifying strategic needs in the United States and Europe that can be supported by a mature local production industry and building a stable global supply infrastructure.
- 4. Branding the industry as the engine of the national economy and incorporating social movements in efforts to recruit local labor.

Formally, Taiwan gave expression in legislation to the following measures to protect its industry, which essentially become a national asset. It is worth emphasizing that unlike ordinary economic and industrial laws, Taiwan introduced protective laws for the civilian industry under the set of national security laws and not only those in the civil-criminal sphere. These laws, together with other policy measures, may, in part, also be relevant for Israel:

- 1. Protecting the industry with laws to protect trade secrets.
- 2. Protecting the industry from industrial espionage as part of the national security law (increasing punishments and labeling the offenses as national security offenses in a way that enables the state to employ tools that are not usually used in the regular criminal sphere).
- 3. Monitoring and controlling the movement of human assets from advanced technological production industries to countries with a high risk of "brain theft" or the leakage of technological knowledge and skills.
- 4. Strengthening and maintaining local human capital—identifying and blocking attempts by foreign states to recruit local labor from advanced technological production industries.

Strengthening National Infrastructure, Databases for the Benefit of Citizens, and Privacy Protection

Like the defense system, national infrastructure and public institutions worldwide and especially in Israel rely on advanced hardware and communications components. Digital services that are based on the biometric identity of each citizen, the management of urban infrastructure, the supply of electricity and water, and medical solutions based on artificial alliance are all dependent on having continuous access to advanced technological components that are produced in chip factories abroad.

In February 2020, the chair of the Telem Forum (a forum for national infrastructure for research and development) appointed a committee to examine the need for government intervention for the purpose of accelerating Israel's involvement in the field of artificial intelligence and data science.⁷⁶ The committee's conclusions stated that the impact of artificial intelligence and data science on research and development in the fields of industry, infrastructure, defense, health, drugs, and materials and the expected expansion and acceleration of this impact have led many countries to define national plans involving the investment of hundreds of millions or billions of dollars. It also stated that while Israel is ranked high in research and development on the commercial side of artificial intelligence, it is ranked lower when it comes to the infrastructure required and government strategy. This gap, it was claimed, could significantly harm Israel in fields in which it has succeeded. Consequently, the committee recommended a national plan that would be a systemic solution, whereas one of the four aspects of this plan is the infrastructure, including the unique hardware required for fulfilling the potential.

With respect to infrastructure and hardware, the committee acknowledged a significant gap in access to high-level computing power at high availability and a reasonable price. Based on these considerations, in July 2021 Israel announced a project to establish the national supercomputer with a public investment of 290 million shekels, as part of the recommendations to improve the independent ability to consume and process data for the purpose of research and development in academia and industry and for a range of public needs, including defense capabilities and public services. The setup model, including the ongoing need for maintenance and consulting, would be implemented in cooperation with industry companies in Israel and abroad at an estimated cost of \$50 million each year. However, it is worth noting that at the present time, there is an argument in Israel over the continuation of the initiative.⁷⁷

The more Israel advances, stores information, and processes it for the purpose of improving research, development, and general welfare, the more it will be dependent on advanced hardware. A public database ("public cloud") containing classified and sensitive data on citizens would require a high-level security framework, while the pace of development in the field of information protection requires defense at the level of both software and hardware. Israel must have a full grip on cutting-edge technologies and the production of the advanced chips that are used for these critical databases in order to prevent parties with various vested interests from gaining access to this information.

To protect the data infrastructure, a conception regarding "hardware security" is developing in the world—protection of the base layer, the component itself, in a way that prevents access and the ability to influence. Currently being examined in the American defense establishment, this aspect is especially innovative and requires advanced levels of research and development. Investment in hardware security is a national interest, and thus Israel must consider a domestically produced solution.

The Moral Consideration: Democracy and Advanced Technology

Over the past few centuries, the connection between democratic, open, and liberal countries and societies with scientific and technological development

gradually became clear. In democratic countries, the education system encourages free thought, pluralism, and openness to diverse views and opinions that together enable creativity and innovation. Connecting these elements with sources of funding and international connections (including a relatively open immigration policy) was among the things that enabled the United States, for example, to become a global technology leader. In contrast, the authoritarian system of government in China—its controlling the education system, setting the scientific-technological agenda and priorities, alongside excessive involvement in the business and legal spheres as well as international connections that do not encourage internal migration—all these could constitute significant barriers to sought-after breakthroughs in science and technology, in particular. It seems, certainly in the short term, that these barriers are unlikely to change for the better; therefore, even given massive state investments, it is widely believed that China has a scientifictechnological "glass ceiling."⁷⁸

At the end of March 2023, the US Department of State hosted an international conference on the topic of democracy.⁷⁹ Although the conference focused on discussing the importance of coordination and cooperation between the democratic countries, in practice an alliance was established, based on shared values—promoting equal rights and protecting minorities. The conference's sessions discussed how best to maintain democracy for the welfare of citizens. This included the importance of enshrining in legislation principles of "economic democracy," which consists of fighting corruption, maintaining equal opportunities for women, and strengthening ethics and responsibility in domestic industries and in international trade as a necessary condition for growth and prosperous partnership between countries. The alliance also aims to serve the fight against negative forces, countries, and players that do not believe in democracy in its basic sense, such as Russia and China, whose conduct threatens the global economy and stability. Alongside the shared values and mutual enlistment, the alliance aims to ensure global

economic stability and to encourage cooperation between countries in the research, development, and trade of advanced technology and artificial intelligence "in the service of democracy."⁸⁰

The countries that participated in the international conference on democracy. Israel included, all are in need of cooperation, given the understanding that technology is a country's source of strength. In the technological struggle between the United States and China, which was also reflected in the conference, it is evident that blocking access of authoritarian countries to technology is a means of punishment that directly harms the country's growth and the well-being of its citizens. The foreign policy of the United States and other democracies is shaped by this issue, and it seems that a central component is the need for trust that is based on shared values (as opposed to only shared interests) as a necessary condition for cooperation. A country that is interested in maintaining its relations with the United States and its allies and in benefiting from research and development partnerships must ensure that it does not act against these values or serve the interests of other countries that do not share these values. In addition, a country has no choice but to express its values and worldview through policy and legislation in the spirit of these norms. This approach is true of the entirety of a country's defense, foreign, and economic policy, and all the more so regarding technology. Democratic values enshrined in legislation or a constitution will protect technology, and this will ensure the country's technological advancement and well-being.

Another perspective in the relations between advanced technology and democracy is that technological developments change the shape of democracy,⁸¹ as technology has changed the relationship between government institutions and the public. Thanks to advanced technology, holders of public positions come into unmediated contact with the public and can receive a situational assessment based on real data at a level of quality unheard of in the past. The ability to distribute high-quality information widely and quickly is powerful. At best, it provides a platform for exercising freedom of expression, and public

opinion can directly influence decision-makers in a way that expresses the rule of the people. At worst, it endangers stability when it serves as an echo chamber for extreme messages and for the publication of fake news that is difficult to disprove, thanks to advanced artificial intelligence, and can undermine public confidence in the truth and in government institutions. In the internal crisis in Israel surrounding the judicial legislation, one can clearly see the contribution of technology to exercising freedom of expression and freedom of demonstration, but also to deepening the polarization between the sides.

A state that aspires to being stable and to maintaining its character needs to recognize the power of technology and to encourage investments that will contribute to the welfare of its citizens, while it must also balance and restrain its strength. In an era when technology provides the government with unprecedented access to personal information about citizens, from precise location and daily routine to confidential medical information, it is important to ensure that this access exists for the sake of general welfare (for example, stopping the spread of the COVID-19 pandemic) but is limited to reasonable use in order to not violate privacy and human rights. The state has an important role in enshrining these limitations in legislation. On this matter, it is worth noting that Israel's legislation has gaps, and the changes being discussed as part of the judicial legislation could move Israel further away from technological partnerships, especially in Europe.⁸²

The global changes in the relations between democracy and technology and the internal crisis taking place in Israel serve as a warning sign for decisionmakers regarding the dependence and the sensitivity that exists between Israel's democratic character and its technological future. Despite the ideological and political disputes, among the great powers and among ourselves, the importance of access to advanced technology and its considerable contribution to the welfare of the state and its citizens are clear to all. Therefore, behind the need for government intervention in technology is also a moral consideration of maintaining the character of Israel as a democratic state that encourages its citizens to continue leading in research and development and breaking through the boundaries of the imagination, in a way that ensures its place, on the right side, in the economic alliances with its natural democratic partners.

The Social Consideration: Intervention for the Purpose of Diversifying Professions in the Economy and Integrating Populations with Low-Level Participation in the Economy

It is clear that technology and its engagement affect almost every aspect of life in Israel, from the macroeconomic level to the operational levels, and from the employment market to the level of education starting with early childhood. But despite the enormous influence of technology, when we examine the Israeli economy in broad terms, we see that only about 10% of the workforce is employed in the high-tech industry. These same 10% contribute between a guarter and a third of the state's income from employment taxes.⁸³ This is a dramatic figure that shows the economic potential inherent in this industry but also the structural weakness of a national mechanism that bases too much of its income on a single sector. Using the analogy of companies in the private sector, a business model that bases most of its revenues on a small number of customers could be sensitive to mishaps and unexpected incidents. To the same extent, a national economic model that is based on the participation of a relatively small segment of the population in the relevant labor market is also risky, or at least does not utilize all the potential resources in the labor market and increases the gaps between those who are employed in the tech sector and those engaged in other fields.

There does not seem to be any growth engine on the horizon that will replace the tech industry, and it will continue to lead the economy. If we accept this statement, then it is also clear that the industry will not be able to grow optimally without significantly increasing the citizens' participation in the workforce. In 2022 the government was presented with a vision of a million people employed in Israeli high-tech. Today there are neither a million jobs available in the industry nor a million candidates who could fill these jobs. According to figures of the Israel Innovation Authority for 2019, about 321,000 Israelis worked in the high-tech industry, constituting 9.2% of all employees in the economy. The industry has continued to grow and today it forms about 11% of the workforce. This is a large gap between the existing situation and the ambition of a million more jobs in the high-tech sector. It is worth mentioning that the high-tech sector is mainly homogeneous. According to figures from the Knesset's Economic Affairs Committee, in 2021 over 94% of people employed in high-tech were non-Haredi Jews.⁸⁴ Hence, it is clear that the country is not maximizing its human capital, and not fully utilizing the potential of the high-tech industry to include broad sectors and reduce the socioeconomic gaps. Instead, the productivity and success of the industry today are measured mainly in terms of exits for entrepreneurs and state revenues from tax on workers, and less through "soft" social measures of the industry's contribution to the overall advancement of the country's citizens, in part, by encouraging the entry of new populations into the workforce and in narrowing the gaps.

Two different frameworks are operating in the high-tech industry. The first is made up of a young and dynamic set of start-up companies in fashionable fields. They deal mainly with software-oriented fields that are characterized by minimal investment of time and money between the establishment stage and the exit stage. The idea behind this group is known in the industry as "surfing the waves"—the entrepreneur identifies a trend and tries to ride it on the path to success, and in the case of failure, he waits for the next one, and so forth. This is the opportunistic approach of a venture capital industry that aspires to fulfill dreams, under the clear assumption that over 90% of these ideas will fail. For the state, a successful industry provides high revenues derived from exits; but in the case of failure, the state has also profited from employment taxes, and therefore, the state is interested in the industry continuing to operate in its current format of "venture capital," in order to maximize the number of companies that reach the exit stage.

The second group is substantially different from the first. It is based on stable or "deep" technology, and less sensitive to trends. Most of the companies operating in this group are engaged in production in general and hardware in particular, and in the Israeli case, these are mainly the companies engaged in the development of semiconductors or chips. Israel's professional capability in these fields is thought to be at the level of global leadership. The chips developed in Israel are produced in various countries, the minority of them at the Intel factories in Kiryat Gat (and a longstanding private factory belonging to Tower Semiconductor Ltd., which is in the process of being acquired by Intel). In the past two decades, a significant number of multinational companies have chosen to open chip development centers in Israel. These companies include industry giants, such as Apple, Facebook, Amazon, Intel, Nvidia, Samsung, and many others.

In the social sphere, we can describe the first group of software companies as a dynamic group with frequent turnover of labor, and a relatively short lifespan. Most of the employees in them are people with academic degrees—some with advanced degrees—mainly in the fields of engineering and development. In contrast, the second group of hardware companies also includes complex production processes that require greater investment and longer fruition time. The amount of time needed for learning the profession and the work in these companies is longer, and the work in them is considered more stable. In these companies the workers tend to be educated, but they have more room for jobs that are filled by populations with a low participation level in Israel's economy.

The distinction between the software companies and the hardware companies in effect describes a reality of two economies—one a research and development economy that is based on a limited percentage of the population and the other a production and services economy that employs the lion's share of the workforce. The two economies are dependent on one another, and until the 1990s large companies even aspired to include and incorporate both components. But the idea of globalization restructured the commercial conception according to free-market principles and increasing profit in a way that enables separating the economies. As Thomas Friedman describes in his book *The World is Flat*, when the geopolitical system allows it, it will always be more efficient and profitable to trade with partners according to comparative advantage, regardless of the geographic distance between them.⁸⁵