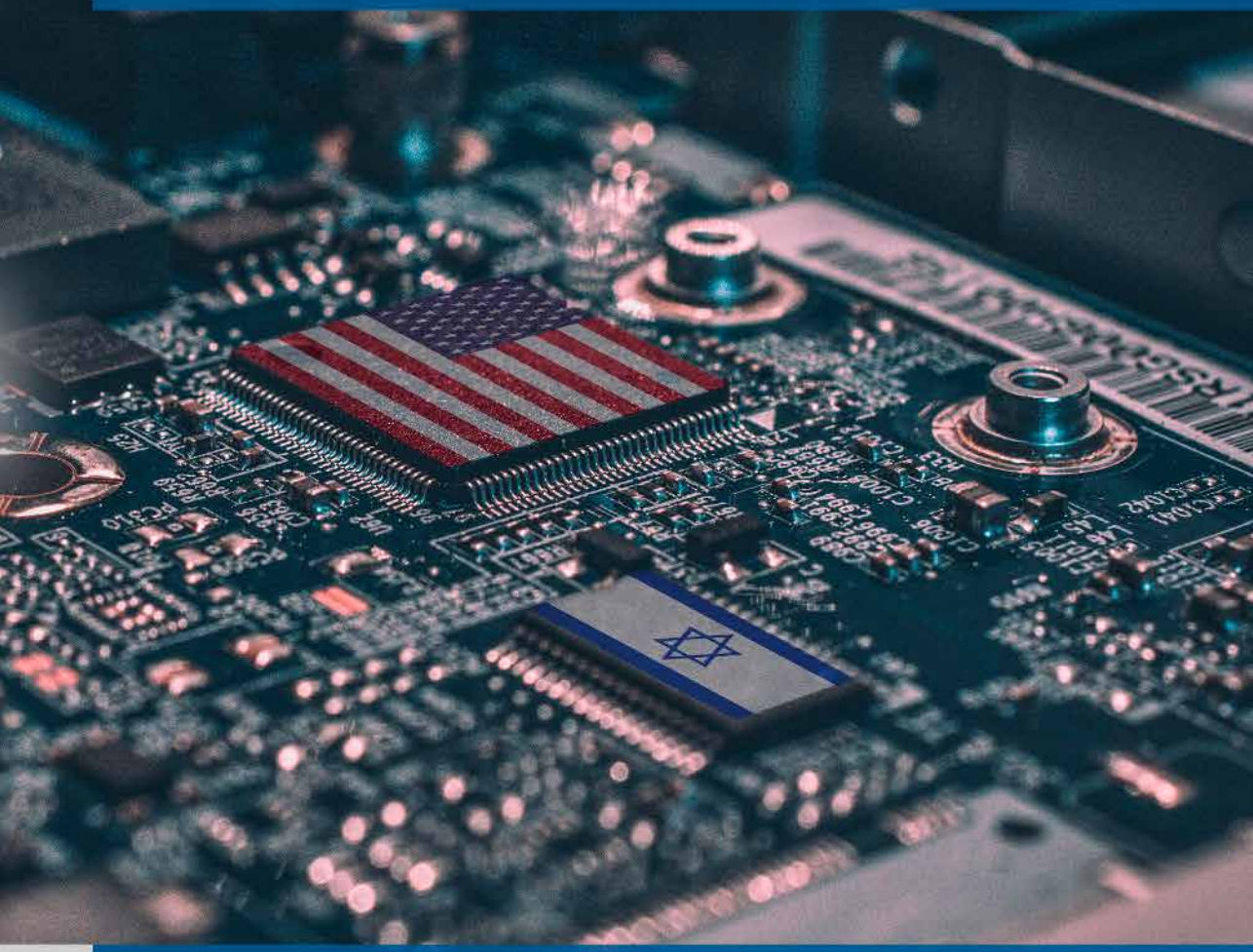
National Technology Plan in Israel

Ariel Sobelman and T.Z.



Memorandum 229

January 2024

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המכון למחקרי ביטחון לאומי
THE INSTITUTE FOR NATIONAL SECURITY STUDIES
אוניברסיטת תל אביב
TEL AVIV UNIVERSITY

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ARIEL SOBELMAN AND T.Z.

MEMORANDUM 229, JANUARY 2024

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תוכנית טכנולוגיה לאומית לישראל

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ISBN: 978-965-7840-02-3

January 2024

Series Editor: Dr Anat Kurz, Director of Research, INSS
Editor: Ela Greenberg
Managing Editor: Omer Weichselbaum
Translation: Hever Translations
Graphic design: Michal Semo Kovetz, TAU Graphic Design Studio
Infographics and visual aids: Nitsan Lear Graphic Design
Cover Design: Shay Librowski, INSS
Cover Photo: Alexandre Devieve via Unsplash

Printing: Digiprint Zahav Ltd., Tel Aviv

EXECUTIVE SUMMARY

Globalization is one of the most significant phenomena of history and has been an irrefutable axiom since World War II. Today it is difficult to imagine how either individuals or countries could survive without international partnership and movement of goods. However, since the outbreak of the COVID-19 pandemic and the supply chain crisis that followed cracks have become obvious in the principles of global trade, and one of its clearest manifestations is the Great Power technological competition between the United States and China.

During the past decade China has expressed its ambition to lead the most advanced technological production industry in the world. Its thirteenth Five-Year Plan, "Made in China 2025," publicized a national project aiming to reduce Chinese dependence on the United States by 2030. China seeks to exploit the principles of "free trade" and globalization to import the best brains and establish local industries producing advanced semiconductors or chips, which would strengthen research and development of artificial intelligence capabilities. At the same time, the global spread of the COVID-19 pandemic demonstrated to the West the risk of dependence on supply chains originating in Asia and the need to create a local alternative that will ensure independence and access to technology vital to national security.

President Joe Biden's election campaign emphasized that fortifying the US global standing and strengthening the economy is predicated on repatriating large swathes of global technological production to American control and on American soil. The United States intensified its efforts to deny China's access to advanced technologies. In October 2022, the United States passed the CHIPS and Science Act, which includes a budgetary investment of $278.2 billion over ten years for the acceleration of technological research and development, thus ensuring the US position as the strongest economic power in the world. Out of this total, $52 billion was allocated to subsidizing the establishment of

semiconductor manufacturing plants on US territory. In this step, the United States expressed a preference for security and political considerations over economic considerations and global free trade.

This legislation is creating a post-global reality, returning to alliances and coalition-based models. Each country (in effect, each company) must reexamine its partnerships and the partner companies in its supply chain in order to avoid American sanctions. Moreover, the United States has also turned to its partners in Asia and Europe and has attempted to convince them to join this effort to restrict China's ability to research, develop, and produce advanced chips. This could be a hard pill to swallow: These partners could face a high cost, not only economically, but also in other national aspects, given China's economic standing and its growing ties with Asia and Europe.

The US approach is controversial among liberal-democratic regimes. In capitalist countries, states generally prefer either to fund initial investment in research and development or to back the risk in order to encourage private entrepreneurs and investors to join these ventures; over the years these regimes have reduced their involvement and investments in most industries, choosing to offer stimulus in the form of tax and customs subsidies. The Israeli technology market and high-tech sector are a good illustration of the advantages of this approach. However, one reason for this success is that Israeli high-tech is primarily focused on a relatively limited variety of fields based on software, which does not require a high government investment in research and development. Not withstanding the value and importance of Israel's defense industries and of the lion's share of start-up companies, this model is not sustainable given the current pace of technological advances in hardware. It is this hardware that is now the basis for the entire industry. Furthermore, it is already apparent that Israel's standing as an innovative country, able to absorb future technologies, has already declined.

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 research

and development in an enormous range of fields, as well as a manufacturing sector (electronics, biotechnology) and industries associated with the services sector (computer programming, information security, artificial intelligence). In 1984, the Israeli Parliament passed the Law for the Encouragement of Industrial Research and Development, under whose aegis the Israel Innovation Authority was formed and has operated to this day. The funds established in those years are providing today's grant incentives for funding research and development in groundbreaking ventures. One of the main achievements of government intervention at that time was the establishment of a 100-million-dollar government investment fund named the Initiative Program. From the government's perspective, this fund was, in fact, the inspiration for additional private funds, established to encourage and enable Israeli companies to operate in the ever-increasingly high-risk technological environment. Israeli success stories in technological innovation attracted multi-national corporations to set up research and development centers in Israel that relied on and recruited top-notch engineers. A three-way relationship and interdependency evolved between scientists, entrepreneurs, and foreign investors that would become a prerequisite for advancing the economy.

In the early 2000s, the prohibition on expatriating intellectual property outside of the country was eased, thus reducing the de facto obligation to produce and manufacture in Israel. This change was the result of a struggle led by venture capital funds in Israel, who protested that the export restrictions deterred foreign investors and stifled the growth of start-up companies. Venture capital fund believed that a "free market" was a necessary condition for growth, and removing the intellectual property transfer restrictions would enable massive injection of foreign capital that would propel the economy's growth. However, this very change also entailed harm to the overall national interest, as it effectively weakened the government's ability to manage other critical national assets, including ones that were part of assuring Israel's social and demographic fabric. Manufacturers' unions warned of the potential

harm, and the original restrictions themselves ended up morphing into a system of fines and penalties to companies that chose to transfer ownership of their intellectual property. The system failed to deter entrepreneurs, who simply calculated the included fine in the gross cost of the sale or generated alternative financial mechanisms to circumvent the restrictions or to offset any penalties against other investments.

The expansion of foreign investment led to Israel's growing ever stronger and emerging as a technological powerhouse and a globally-admired international start-up incubator. Israeli human capital reached historic breakthroughs and propelled the industry to unprecedented achievements and financial yields. However, according to figures published by the Israel Innovation Authority in its 2022 report, it seems that we are in the middle of a concerning change in the trend. Despite the record highs attained in recent years for the State of Israel (including a record $27 billion of capital raised, 40 Israeli companies crossing the $1 billion value threshold, and 75 Israeli companies that have gone public), this is not sufficient for ensuring continued global leadership and the growth of the technology industry. We are witnessing that technology itself is generating and accelerating global changes. Keeping up with this accelerated pace of development requires enormous investments, and the global balance of power fluctuates in such a way that those countries that are able to keep up with the pace and cost of research and development increase their prominence and become influential global powers. Nations that are unable or fail to invest the necessary capital to promote innovation fall behind economically, socially, and militarily.

Investment in research and development in emerging production technologies is a crucial element and affords Israel a relative advantage, but it is only a partial solution to the problem. Israel needs a national plan that addresses industrial planning aspects across the full value chain of development, production, and trade of chips. Government guidance and leadership is of paramount importance for incentivizing participation and

competition. It may also motivate entrepreneurs in Israel and abroad to commit the initial investments of the billions of dollars, required for establishing a manufacturing infrastructure foundation. Advanced and sustainable technology is dependent on infrastructure development, education, foreign policy, and a defense framework.

The chip supply chain crisis marked the turning point that changed the world's attitude. Although the intensity of the crisis was felt in Israel too, it was not properly conceptualized, neither in the Israeli public and policy discourse nor in the unique context of the local high-tech industry. Israel clearly is an integral part of the global supply chain, and when this chain experiences disruption or failure in one of its links, it is the state's responsibility to identify and make economic or geopolitical adaptations needed to minimize the potential harm or to leverage emerging opportunities to advance the country's interests.

In this memorandum, we apply a methodological model developed by Dr. Zvi Lanir in his book *Fundamental Surprise: The National Intelligence Crisis*, which was published in 1983, to pinpoint the strategic displacement we believe Israel is currently in. While Israel views its trajectory as continuing to develop as a leading innovative and entrepreneurial nation in the high-tech industry on an international scale, in practice, the supply chain crisis and the escalating conflict between the United States and China have led to a reorganization of the technological arena in a way that challenges this strategic assumption. Nations striving to strengthen their technological industries are passing legislation, accompanied by unprecedented investments of public funds in production and hardware. To date, Israel has not yet formulated a comprehensive policy on the issue. This lack of strategy could lead to the deterioration of its qualitative advantage over time. The current disproportionate predominance of the technological services industry intensifies the polarization and deepens the gaps by effectively channeling young Israeli talent toward the software industry in a way that could, over time, erode Israel's human capital advantage.

If Israel elects to continue the current strategy, refraining from any direct industry intervention, while prioritizing focus on research and development, it risks reaching the limit and exhausting the effectiveness of its technological innovation strategy. This could happen for the simple reason that in light of the enormous government investments worldwide and a strong global trend of shifting to industrial policies of greater self-reliance, Israel may realize that its competitiveness has eroded. Unlike Israel, competing countries are currently advancing legislation and expanding available channels of investment to cope with an emerging reality of reduced trade in advanced hardware (a trend that is already being felt due to the struggle between the United States and China), through government subsidies to create a better balance between research and development and production capabilities, in a way that maintains their technological and economic stability.

This memorandum presents an alternative for Israel's technological policy and recommends that Israel align itself with the dominant trend among the most advanced countries, led by the technological powers. Government intervention, to a degree, is the only way forward to "breaking the linearity" of technological innovation. Consequently, it is imperative to formulate long-term goals and a "national plan." This strategy has been adopted by several countries, some the size of Israel and with similar economic characteristics, like the Netherlands and Ireland. In this alternative, the Innovation Authority, directed by the government, would focus on increasing production in Israel and would receive an increased budget and authority to fulfill these objectives, leveraging existing tools (tax breaks and incentives). The Authority would define a national policy for investment in start-up companies, so as to provide guidance and incentives to entrepreneurs to incorporate new companies in the prioritized and desired fields. This is unlike the present situation in which the investment arm of the Innovation Authority operates, in effect, as a venture capital fund, directing its investments based on return-on-investment projections. The role of the Innovation Authority is critical and

must be coupled with national investment in infrastructure and human capital, through the university education system and unique processes of placement in the relevant professions. Moreover, in this alternative, the Israeli government, through diplomatic initiatives, would pursue economic partnerships with the Gulf states and others to create a capital-engineering collaboration, thus increasing the production footprint in both Israel and the region and strengthening the ties between these countries.

This alternative challenges Israel to infuse a high initial investment and define objectives that could be perceived as an "industrial policy," imposing both a framework as well as limitations on the private sector, perhaps reminiscent of less liberal economic systems that could follow paths that are not as compatible with the current comparative advantage. To an extent, this alternative would force the Israeli tech industry into a process of maturing, from one based almost entirely on exploiting opportunities and trends—"riding the waves"— into following a more orderly definition of policy and objectives for developing the industry and economy of the chip value chain (packaging, assembly, and testing). The European Union allocates about €43 billion for the same purpose. It is obvious that the Israeli economy cannot earmark such sums; however, partnership between the government and private sector (in definition of both objectives and investments) is possible. In addition, partnerships with the Gulf countries would not only enable Israel both to retain its strengths and its appeal to investors in the software and services sectors but would also help finance and develop the local hardware industry. Given that Israel is competing with technological powers that invest enormous sums, it is unlikely that Israel could implement this alternative without the support of the United States, Europe, and other countries. Adopting a national plan aligned with American strategy could make such support possible.

This memorandum is a call to discuss a "national technology strategy" as soon as possible. To facilitate such a discussion, it is essential to undertake preparatory work to identify the critical technological infrastructure necessary

for the existence and growth of the Israeli high-tech industry, to assure it can continue driving the country's economy, even in cases of political, climate, or other crises such as the COVID-19 pandemic. For example, just as the state is obliged to provide energy and food security in the form of fuel and wheat, it must also define basic technological security for the country. Most high-tech fields, such as cyber and artificial intelligence, are actually applications that depend on the existence of technological hardware infrastructure. This infrastructure includes assuring either the supply of chips, or the ability to produce them.

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INTRODUCTION AND ACKNOWLEDGEMENTS

This memorandum is being submitted to readers in the middle of the Gaza War that broke out on October 7, 2023, as we were preparing for publication. Naturally, the war pushes aside academic engagement and long-term strategic issues as well. However, one of the main missions of the Institute for National Security Studies (INSS) at Tel Aviv University is precisely that, to ensure that the State of Israel prepares for the challenges it will face in all issues affecting its national security. This memorandum examines and studies what has come to be known as the "Chip War"—a titanic struggle between the United States and China for technological supremacy that has been raging for over three years around the globe and with tremendous impact on the State of Israel.

Chips—those tiny silicon microelectronic components found in every civilian or military electronic device—were mostly unknown to the general public until about three years ago. And if they were known, it was typically in some esoteric engineering context, certainly not as a geopolitical issue that was soon to become one with huge implications for national security in countries worldwide. And suddenly, like in a perfect storm, several factors came together—the internalizing in America of a major vulnerability to Chinese-made technology, the COVID-19 pandemic, Russia's invasion of Ukraine, the climate crisis—all contributing to an unprecedented global supply chain crisis, especially the supply of chips—for the first time raising public awareness to the issue and introducing it into the public, scholarly, and strategic discourse. The chip crisis affected governments, commercial entities, and individual end-user consumers, reaching all corners of the world, supressing and limiting the continuous supply of electronic devices, common home appliances, automobiles, infrastructure machinery, as well as critical components for smart weapon systems, thus rendering chips into the gold or crude oil of our time.

The chip crisis erupted during a unique period for me personally. My professional career began as a young researcher at the INSS (under its previous name, the Jaffee Center for Strategic Studies) at Tel Aviv University where I initiated and established a research program in an emerging, esoteric technological field that we called "information warfare." In time, a better name, "Cyber Warfare," replaced the cumbersome one that I had come up with for the program in 1997, and it became one of the most impactful fields of research and debate in military thought and practice. A desire to experience the tech industry in practice and not only to research it led me to seek opportunities in the high-tech market, where I ended up working for 20 years, both in Israel and abroad, almost exclusively in hardware and chip companies. I was privileged to work for companies that contributed greatly to the Israeli tech industry. Among them was the legendary M-Systems Ltd., under the leadership of the indefatigable entrepreneur Dov Moran, who was also kind enough to write a foreword for this paper. For the majority of my years in the industry, however, I worked for Valens, which grew to be the largest Israeli chip company and went public on the New York Stock Exchange two years ago.

Following Valens' public listing, my desire to return to research and writing grew and the emerging global chip crisis provided the opportunity. As part of my work in the industry, like many others, I easily recognized the signs of a brewing crisis and was startled by its potential impact on the global economy. My early training at the INSS, as well as my experience in strategic research, aroused my curiosity and caused me to hypothesize and speculate that the consequences of the emerging crisis could go well beyond the civilian-economic sphere, influence the great power competition between the United States and China, and usher in a new area of activity in the study of strategy and national security.

I shared my thoughts with industry and INSS friends and colleagues, and they agreed these global developments could indeed affect Israel and

warrant academic research. As was the case many times in the past, the INSS correctly recognized the research potential of this innovative field and the importance of engaging with it in producing policy-oriented research. It is a great privilege that Professor Manuel Trajtenberg and Brig. Gen. (res.) Assaf Orion offered me the opportunity to return to the INSS and lead this innovative research project. I was also fortunate to receive the support of my employer, Valens. When I shared with the company's CEO, Mr. Gideon Ben-Zvi, a highly experienced veteran and entrepreneur, my desire to return to academic research, Gideon immediately saw the potential for cross-fertilization between the industry and research institutes and academia and gave me a sabbatical year, which is unprecedented, as far as I know, in Israeli industry. I am deeply grateful for this unique opportunity, and this memorandum you are holding is the fruit of this research work.

It is my duty and pleasure to thank several people whose contribution to the process was enormous. First and foremost, I would like to thank my partner, Lt. Col. T. Z., a principled and meticulous IDF officer with whom I became acquainted during a research sabbatical that he took. T.Z.'s contribution to this study cannot be overstated. Work with Lt. Col. T.Z. was born out of a collaboration between the INSS and the IDF, a commendable initiative to carry out joint research studies between academic bodies such as the INSS and IDF officers. It should be emphasized that T.Z.'s contribution was only to the academic aspects of the study; I formulated the policy recommendations separately, and they are solely my responsibility. I hope that this paper will serve as a prototype for collaborations in other emerging fields of research.

I would like to thank the Executive Director of the INSS, Prof. Manuel Trajtenberg, for inviting me to the INSS and providing me with an outstanding organizational framework and a home for conducting this research. I am equally thankful to the Managing Director of the INSS, Major General (res.) Tamir Hayman, for the confidence, support, and advancement of my research. I owe an enormous debt to Brig. Gen. (res.) Assaf Orion, Director of the Glazer

Israel-China Policy Center at the INSS. Assaf and the group became my academic mainstay and a central part of my life. Assaf proved to be a tireless source of fuel, driving and pushing me to deepen the research, to verify, improve, correct, clarify, be precise, and to validate and verify every figure, statement, and conclusion. Research requires access to information sources, gathering, cataloging, and analyzing them. I would like to thank the INSS's information center under the leadership of Mr. Yoel Kozak, who manages a well-oiled machine for gathering and distributing raw data. To state the obvious, every academic study is based on the knowledge accumulated from previous research and generations. As Sir Isaac Newton famously said, if I have seen further, it is by standing upon the shoulders of giants—in my case, giants that spent decades researching Israel's security and the practice of developing its tech industry.

From the bottom of my heart, I wish to thank the wonderful staff of researchers of the Glazer Center—the late Ambassador Dr. Oded Eran who contributed greatly to this study and passed away after its completion, Deputy Director of the Glazer Center Ms. Galia Lavi, Lt. Col (Res) Shahar Eilam, Dr. Ori Sela, Dr. Doron Ella, Dr. Tomer Fadlon, Mr. Tuvia Gering, Adv. Ofer Granot, and Dr. Shira Efron—from whom I learned so much and who have all helped more than this space allows to describe. Further thanks to the researchers of the INSS who helped with characterization, guidance, analyses, reading, discussion, critique, and corrections. I would like to acknowledge and thank the INSS's Director of Research Dr. Anat Kurz, a colleague and dear friend for over 25 years, Dr. Gallia Lindenstrauss, Dr. Carmit Valensi, Col. (res.) Pnina Sharvit Baruch, MK Ofer Shelah, Ms. Inbar Noy-Freifeld, and Dr. Liran Antebi. I would like to mention the late Dr. Emily Landau who, even when seriously ill, brainstormed with me about the ways I could fulfill my research aspirations. Warm thanks go to Professor (Emeritus) Ashok Agrawala, whom I was privileged to have as a doctoral supervisor. I learned so much from him and am grateful for the lifelong friendship that endured for nearly three decades. I wish you

good health and longevity. Many thanks also to the former director of the Mossad, Mr. Tamir Pardo, for writing a foreword for this memorandum. It is impossible to conduct any study without research assistants, students, and interns. I had the privilege of working with a wonderful team of research assistants—Roy Ben Tzur, Ofir Dayan, and Ofir Munz—as well as intern Adv. Tzachi Shachar, who also contributed and wrote the case study that appears in this study. The INSS does not only research Israel's security, and its staff and researchers are not locked in the ivory tower of academia but are active partners in the burden and sometimes pay the heaviest price. Here I would also like to especially mention two staff members of the INSS, Dr. Mora Deitch, whose husband fell in battle in Gaza, as well as Lt. Gen. (ret.) Gadi Eisenkot, former IDF chief of staff and a former INSS researcher, who lost his son in Gaza.

I would also like to thank leading individuals in academia, defense, government, and industry who helped with the study, cooperated, and contributed their time, energy, and wisdom. In this context I would like to mention Prof. Major General (res.) Isaac Ben-Israel, Mr. Aharon Aharon, Mr. Dov Moran, Mr. Eyal Waldman, whose daughter Danielle and her partner were murdered at the Nova party on October 7th, Dr. Doron Meyersdorf, Mr. Mooly Eden, Ms. Yael Rosenberg, and Mr. Dudi Galanti.

A final thanks I send to my dearest and beloved family Karin, Yahel, Nadav, and Alma, for being infinitely accommodating.

The contribution of all of those mentioned above was great and significant. On behalf of myself and Lt. Col. T.Z., I thank all of you from the bottom of my heart and greatly appreciate your help and contribution. I apologize in advance for any name that I might have forgotten to mention. And a final point—any mistake or error that may have occurred is solely my responsibility.

Ariel Sobelman, December 2023

ABOUT THE MEMORANDUM

Since October 7, 2023, the State of Israel has been engaged in a war forced upon it by Hamas. This war is being waged not only in our own region, but also across the globe, in the western capitals, on campuses of prestigious universities, in the headquarters of the largest and most influential technology companies in the world; these entities have the power to directly and indirectly influence the narrative, the support for Israel, and the world's governments in a way that ultimately would affect Israel's room to maneuver in this war. In addition, it is impossible to disconnect the struggle from global contexts and from the competition of the superpowers. The INSS is committed to basic research on issues related to Israel's national security even in times of war, with the understanding that when the war ends, the strategic challenges facing Israel will necessitate a knowledge base that will be available to policymakers and decision makers. This work touches on one of the main factors shaping the world order and will return to occupy the State of Israel once the fighting ends.

The global economic situation is undergoing massive and profound changes. The global system that was formed after World War II and updated after the fall of the Soviet Union, created a flat world in which economic optimization dictates the location of production and the supply chain. The internet and improved transportation infrastructure have erased borders and accelerated communication and connection between different parts of the world. The global order changed in the early 2000s with the escalation of international terrorism, waves of migration, and a lack of trust between nations that led to a tightening of borders. The world suffered another blow with the arrival of the coronavirus pandemic, which utterly disrupted the supply chain and highlighted the security risks inherent in its fragility. And the most significant factor is the competition between the superpowers. The United States, in its efforts to maintain its global hegemony, is changing the rules of the game. The CHIPS and Science Act is merely a symptom of a broader phenomenon, in

which national security plays a key role in a nation's economic considerations—even though security considerations do not coincide with economic rationale. Morality, global interests, and rivalries with competitors are all significant disruptive factors.

The State of Israel must prepare itself for the global change. Israel's starting position is good, since the security component is not new to the country's economic considerations. Independence and an understanding that diplomatic isolation and boycotts are possible have been formative elements in Israel's national security policy for many years. However, the economic revolution of the high-tech industry, coupled with its huge advantages, has warped Israel's strategic thinking. The locomotive of high-tech was allowed to develop from the bottom up and without any political strategy. It was only after years of achievements that the Israeli establishment began to create the infrastructure that paved the way for the country's cyber industry to take off. This kind of strategic approach is not suited to a changing world and to the information-intensive industries of the future.

In an era when infrastructure is a precondition for the next technological revolution and microchips are a key raw material, Israel needs a different strategy—one that analyzes the global aspects of the competition between China and the United States and allows Israel to navigate wisely between the two superpowers, minimizing the risks and paving the way for infrastructure that ensures security independence. The physical limitations of the Israeli economy clearly must be taken into account. Israel will not, it seems, ever be a world leader in microchip manufacturing. But Israel can be a dominant player in the development of the next generations of microchips, and it can create infrastructure that will be integrated into the global production system for microchips and components that will be critical in the development of artificial intelligence and quantum computing.

The following memorandum analyzes the global technological system in a way that will allow Israel to formulate a technological strategy. It is not yet

too late to determine such a policy. Israel needs this kind of policy, and we cannot rely on the "muscle memory" of the previous revolution—the cyber revolution. We must adopt a policy that includes government involvement, wherein the balance between the government and market forces is different from that which served us during the cyber era.

Tamir Hayman, Managing director of the INSS

During my years in the security establishment, I had the privilege of seeing how technological power fortifies the national security of the State of Israel. Israel's technological superiority, intellectual capital, and spirit of entrepreneurship and innovation are an asset of paramount importance to its standing in the world, no less than Israel's moral compass as part of the democratic and liberal world. Since October 7, Israel has been engaged in a bitter war in Gaza, at the end of which it will have to test its basic assumptions about almost every issue on the national agenda, including the ways in which technology affects its national security and international relations, as part of the great power struggle and global technological competition.

In an era characterized by fast technological progress and a geopolitical struggle between the United States and China, the global landscape is changing. Artificial intelligence is creating greater technological audacity, and the conventional logic of mutual dependence is becoming obsolete. The United States and China, which are often seen as the standard-bearers of the new technological arms race, are pouring enormous resources into building technological production factories and cultivating local chip industries in a way that is reshaping the balance of power and the global supply chain. In practice, it appears that the COVID-19 pandemic and the Russian invasion of Ukraine have pushed other countries in the world toward self-reliance and proactiveness in shaping global trade. There is increasing engagement in the research, development, and production of powerful technologies (big data processing, robotics, autonomic weapons, and more), in a way that forces Israel, as a technological power, to reevaluate its course. The world is reorganizing into technological alliances based on military interests, and reliance on the currents of globalization in the present era could leave Israel vulnerable to external pressures. Sitting on the fence while attempting to simultaneously enjoy the fruits of the West and the East is a risk to military stability. The private sector alone in Israel cannot cope with the competition emerging in Europe and Asia.

Israel has the human capital and the potential to cultivate a robust innovation ecosystem; already today it has the ability to allow a certain level of technological independence and to ensure sustainable national security. This is an opportunity to bring together the public and private sectors and to determine our fate together. Israel must recognize the fact that the reality around it is changing, and it must strive not only to adapt itself to this change but also to excel in the global technological competition. Israel needs proactive technological leadership and a strategy that will empower the economy and develop diplomatic leverage in the global arena.

I welcome the decision of the INSS to analyze the global technological changes from a geopolitical standpoint and to offer a first-of-its-kind position paper in this field. The idea of a "technology strategy" that is introduced in this memorandum expresses simple reasoning—the state's role is not only to direct private investment and encourage entrepreneurs but also to produce a complete system that allows human capital to serve Israel's national needs. Such a system includes increasing investment in research and development, as well as strengthening academia, infrastructure, and strategic partnerships between the public and private sectors, which will be expressed in regulation and venture capital management. This investment also enables diversification of the labor market in Israel and creates an opportunity to expand participation in the tech industry.

Tamir Pardo, former head of the Mossad

During my long years as an entrepreneur, manager, and investor, I have been intimately connected to the Israeli technology industry and have worked tirelessly to advance Israel's technology, with the understanding and knowledge that the state's national security and economic strength are intertwined, and both are tied to our technological capabilities—military and civilian alike. For my many years of activity, whether as a naval officer or as an engineer and businessperson, the guiding principle of Israeli industry was, in fact, the absence of a guiding principle. In many ways, this is how the high-tech industry that we know has developed. The State of Israel has been blessed with a huge number of people with enterprising spirit who strive to push the industry forward, invent innovative and revolutionary developments, and contribute to the country. On the wings of globalization, these young entrepreneurs could realize their ideas through cross-continental collaborations.

Believing that political and national conflicts would diminish, it was possible to decentralize the inputs required to realize an idea and to bring in the necessary funding, components, knowledge, or resources. For generations, the world acted on the assumption that globalization would continue to enable optimal access to the necessary resources. But tectonic changes are increasingly reshaping our conceptions of the industry. Technology makes it possible to lower the cost of living around the world, but the cost of its development is rising, and the capital required to realize complex technological ideas will increase. And meanwhile, the world is undergoing significant shifts that affect the way we perceive globalization: the COVID-19 pandemic, climate change, the Russian invasion of Ukraine, as well as the dangers of political instability and regime changes around the world, including threats to the democratic form of government in many countries, such as Israel. These changes have fundamentally affected the global tech industry, including ours. Above all, the war that was forced upon Israel on October 7 adds a new dimension that obligates Israel to begin a process of national strategic planning in the field

of technology, to ensure that this unique locomotive will continue to pull the Israeli economy forward in the coming decades.

We are seeing the changing face of globalization, perhaps even its decline and the return of models based on greater national self-reliance and on technological collaborations based in part on moral, diplomatic, and strategic ties to the bloc of democratic country. Israel's responsibility, in part, is to ensure the ability of tech entrepreneurs to access both sources of funding around the world, as well as the most advanced technological infrastructure and equipment to realize their business ventures. In addition, it is the state's responsibility to identify emerging areas of technology that should be encouraged and promoted, first and foremost by ensuring that the education system is able to train and prepare future generations of Israeli engineers.

Moreover, the state should adapt the tools of encouragement and support given to young entrepreneurs by the Innovation Authority or new technology incubators and national labs, which need to be established in emerging fields. In order to provide the State of Israel, its policy-shapers, and its decision-makers with the necessary tools for understanding the changing reality and the data for shaping a national technology concept, research papers such as this one are important. To the best of my knowledge, this is the first attempt by a research body of national and international stature such as the INSS to investigate the need for a national technology plan and to conduct an initial characterization of its components.

I hope that by reading this memorandum, policy-shapers in Israel will understand the great importance of adapting the Israeli tech industry to the changing reality and challenges and of ensuring optimal conditions so that it will continue to thrive. I had the pleasure of being Ariel Sobelman's manager when he first started out in the high-tech industry, and I commend his efforts of contributing not only to "practicing" in the industry itself but also to conducting policy-oriented research on these issues. I also hope that additional researchers will continue to further develop the ideas of

this memorandum and will enrich the public discourse on this issue, as the success of the Israeli tech industry is the success of the country.

Dov Moran, entrepreneur and investor

SECTION ONE:

GLOBAL CHANGES IN THE WAKE OF THE TECHNOLOGICAL STRUGGLE BETWEEN THE UNITED STATES AND CHINA

Globalization has been an irrefutable axiom since World War II. It is one of the most significant phenomena that has occurred in history, and it is difficult to imagine today how individuals and countries could survive without international partnership and movement of goods. However, since the outbreak of the COVID-19 pandemic and the supply chain crisis following it, cracks have emerged in the principles of global trade. One expression of these cracks is the technological struggle taking place between the United States and China.

In October 2022, the United States publicized the CHIPS Act.[1] The law includes a budgetary investment of $278.2 billion over ten years to accelerate technological research and development, and to ensure that the United States remains the strongest economic power in the world. Out of this total, a direct investment of $52 billion is planned, by subsidizing the establishment of semiconductor manufacturing plants in US territory, a field in which China has been trying to achieve a global advantage for a decade.

Many in the world see this legislative process, which includes severe trade restriction regulations vis-à-vis China, as the beginning of a new era in global trade relations. It is considered unprecedented in scope and implications and is seen as a significant step up in the technological struggle between the United States and China,[2] because it entails breaking the principle of "free trade" that had been in place and allows room for government intervention and the entry of political considerations. In this section, we will attempt to explain the change taking place in the global system. To this end, we will present the history of economic relations between the United States and China and discuss the circumstances that have led the United States to change its approach and the global implications of this technological struggle.

The Beginning of 21st Century Globalization: How Was the Global Free Market Born?

The global trade with which we are familiar today first began in the peace talks following World War II. While World War II left most of the world's countries battered, including the pre-war European great powers, the United States finished the war as the big winner, militarily, economically, industrially, and technologically. If not for the United States, its advanced military capabilities, and its strong manufacturing industry, it is doubtful that some European countries would have succeeded in rehabilitating themselves and their economies in the decades after the war.

The United States had an ideological and economic interest to strengthen the European countries that fought against Nazi Germany, as well as Japan, South Korea, and other countries in Eastern Asia, and to ensure that this kind of war would not happen again.[3] Therefore, even before the war had finished, along with Britain, and in cooperation with the Soviet Union and China (then under the rule of the Kuomintang), it pushed for the establishment of the United Nations, which replaced the League of Nations. Alongside it came the International Monetary Fund, the World Bank, and the General Agreement on Tariffs and Trade (GATT), which served as the basis for the establishment of the World Trade Organization 50 years later. These institutions expressed the aspirations of the United States to manage a "global market of goods" and heralded the beginning of modern globalization and intercontinental free trade.[4] The world enjoyed the surplus production of the United States, and the scope of American exports in the food, military equipment, and industrial equipment industries grew significantly during these years. The United States won the confidence of other countries as the strongest and most stable economic hegemon in the world and also became the most important financial center, with the American dollar quickly becoming the strongest and most stable currency in the world. It provided the world with a dramatic improvement in production technologies, and most of the countries

that traded with the United States enjoyed economic growth and the fruits of the research and development that enabled technological progress.

In the years following World War II, like the European countries, China was a battered and bruised country. Not only World War II, but a span of over 100 years, beginning with the First Opium War, contributed to this complex scenario. Throughout this period, wars, rebellions, Japanese occupation, and overall instability placed China in challenging circumstances, while the internal struggles between the Kuomintang forces and the communist forces exacerbated the situation. These struggles reached their peak immediately after the war and culminated in 1949, when Mao Zedong, the leader of the Communist Party, succeeded in taking control of China with the help of the Soviet Union, while the Kuomintang, which the United States supported, retreated to the island of Taiwan. China under Mao was a communist country with an extremely centralized rule; starting in 1953, China instituted five-year economic plans, on the theme of growth and instilling society with culture and values according to the communist vision and worldview of Mao. Mao's actions accelerated China's progress and led to numerous scientific and military achievements. Despite this economic leap, China's economic situation still remained poor, partly because it did not maintain trade relations with the developed countries of the world, and due to the Cultural Revolution.

After Mao's death, Deng Xiaoping, Mao's deputy, ruled China and instituted a strategy that was called the "Four Modernizations," focusing on agriculture, industry, science and technology, and defense. This model was later recorded as China's fast industrial revolution, which amazed the world in the ability to separate between a communist approach to politics and a capitalist approach to the economy, and between authoritarian rule that encouraged initiatives and an economy that ostensibly advocated for the principles of the free market. Meanwhile, China also began a series of reforms, addressing issues such as legal and judicial issues to regulate new economic measures (for example, regarding private ownership) as well as increasing openness to the

world. The combination of the modernizations, the reforms, the openness, and the "state capitalism"/"socialism with Chinese characteristics" enabled China to import knowledge and capabilities from advanced countries and to overcome a decades-long scientific-technological (and also infrastructural) gap in order to try to match the level of the world's industrial leaders. But at this stage, at the beginning of the 1970s, China's portion of total global exports was less than one percent.[5]

In 1971, US President Richard Nixon announced the cancellation of the gold standard as the basis for the dollar. The decision was made as an effort to address inflation and the growth of the US trade deficit, which stemmed from the enormous expenses of the Vietnam War. Another reason for abandoning the gold standard was the desire to reduce the ability of foreign countries to burden the American financial system by trading dollars for American gold. This American act had far-reaching consequences that shaped the global economy and created a new foundation for global trade. The "Nixon shock," as it was called, was one of the steps that led to another shock—Secretary of State Kissinger opened a channel between the United States and China, and Nixon visited China in 1972, which ultimately led to the normalization of relations between the two countries in 1979. At that time, the United States experienced a sharp rise in investment in education, and as a result, the percentage of educated people grew and the supply of manufacturing workers in the United States declined. During this period, the United States continued to suffer from the economic consequences of the fighting in Vietnam, and the chair of the Federal Reserve raised the interest rate in a way that eroded exports and the profitability of investing in manufacturing plants in US territory. The American manufacturing industry was transformed—the vehicle and goods industries moved to Asia, but the technology, electronics, and computers sector continued to develop in US territory.

Starting in 1986, China held talks to join the General Agreement on Tariffs and Trade but did not receive the members' agreement. Western criticism of

China further increased following the events at Tiananmen Square in 1989, in which armed soldiers shot at protestors who sought to carry out democratic reforms in China. In 1991, the fall of the Soviet Union's Iron Curtain caused profound global change, which was also evidenced in the way the United States managed global trade. For China, this was an opportunity to strengthen its production systems and to improve its standing in global trade. By the year 2000, China had progressed and became the largest exporters of household consumption, particularly in the textile industry.

In April 1999, US President Clinton hosted Chinese Premier Zhu Rongji at the White House to discuss the future of economic and diplomatic relations and China's request to join the World Trade Organization (WTO). Clinton invited Zhu to dinner at the private residence wing to coordinate positions, with each having a clear interest in the partnership succeeding. Zhu wanted US support for acceptance in the WTO, while Clinton wanted to significantly increase the exposure of US goods to the Chinese market and to remove the difficulties that American exporters faced in trading with China. The understandings between the two led to the biggest bilateral trade agreement that the United States has ever signed.[6] President Clinton believed that the agreement would enable open and increased American exports to the country that made up a fifth of the world's population. Associates of the president voiced serious criticism of his willingness to advance China's accession to the WTO while China continued to violate basic human rights. Ultimately the economic consideration triumphed; Clinton believed that China was vital for global trade and willing to make concessions.[7]

After its acceptance into the WTO in November 2001, China committed to advancing reforms, including the removal of customs barriers, intellectual property regulations, transparency, and even changing laws that were incompatible with the rules of the free market. The WTO, for its part, was committed to allowing China to take part in joint initiatives, including in areas defined as sensitive, such as technologies and banking.[8] Even though

at this stage China engaged in limited trade with international technology companies, it continued to import production components and technologies that would serve the economy even more.

China's accession to the WTO heralded a new economic era in relations with the United States. The volume of goods that the United States imported from China increased from $100 billion in 2001 to $500 billion in 2021. A study conducted in 2019 showed that the purchasing power of the average American family increased by $1,500 per year between the years 2000 and 2007, thanks to imports from China, which lowered the costs of goods,[9] with China moving to third place in American export destinations, after Canada and Mexico. In the first few years after the agreement, exports to China provided two million jobs in the United States. Within less than a decade, China climbed to second place in the volume of global trade (after the United States) and took on a central role in the global supply chain—Chinese factories produced goods for the United States using equipment and components that were imported from it. President Clinton's dream was almost completely fulfilled.

Shattering the Illusion: China Plays the Whole Field and Strives for "Technological Superiority"

Since 2003, the United States has expressed doubts regarding the way that China has fulfilled its part of the trade agreements. The United States has levelled serious accusations against China regarding exploitation of workers and continued violation of human rights. In addition, it has accused China of violating intellectual property rights and the unfair use of government support, which undermines competition in the free market.[10]

The US administration attempted to settle the disputes with China via the WTO's mediation mechanism. President George Bush took minor steps, which included imposing tariffs on a variety of Chinese goods that were abnormally subsidized by the regime. Bush needed cooperation from China in the global war on terror, so he refrained from more stringent measures and

settled for a dialogue initiated in 2006, in which the United States expressed its concerns.

In 2009, President Barack Obama continued the discussions that President Bush had begun in the framework of the bilateral US–China Strategic and Economic Dialogue. During Obama's presidency, the United States took more stringent steps and waged an ongoing struggle via restrictions that were imposed by the WTO, and through a new oversight mechanism, the Committee on Foreign Investment in the United States (CFIUS). In 2011, China won in a hearing that took place at the WTO about the subsidies that it granted, which determined that it was not violating the free market regulations. Nevertheless, President Obama for the first time blocked two Chinese acquisition deals at the recommendation of CFIUS, based on national security considerations.[11] In 2015, the Trans-Pacific Partnership Agreement (TPP) was signed, through which the United States hoped to curb China's trade violations and to contain its fast pace of advancement. However, China's ambitions for global leadership were deeply embedded in its worldview, and thus it found ways to circumvent the restrictions and barriers that the United States imposed on it.

In March 2016, the Chinese government revealed the Communist Party's thirteenth five-year plan under the heading "Innovation-Oriented Nation." The 80-chapter plan aimed to recalibrate the Chinese republic—growth and prosperity via a modern, technological, and state-of-the-art manufacturing industry. There were concerns in China of economic stagnation that would threaten the desired growth targets (6.5% per year between 2016 and 2020 in order to double the GDP), in part because the heavy industries and cheap products would ultimately become a burden and drive away the educated population. China hoped to streamline industry and to provide employment to educated university students, partly so that it could compete with the United States for scientific and technological leadership in the 21st century.

The thirteenth five-year plan especially emphasized China's being fully open to the global technology market as a necessary condition for innovation.

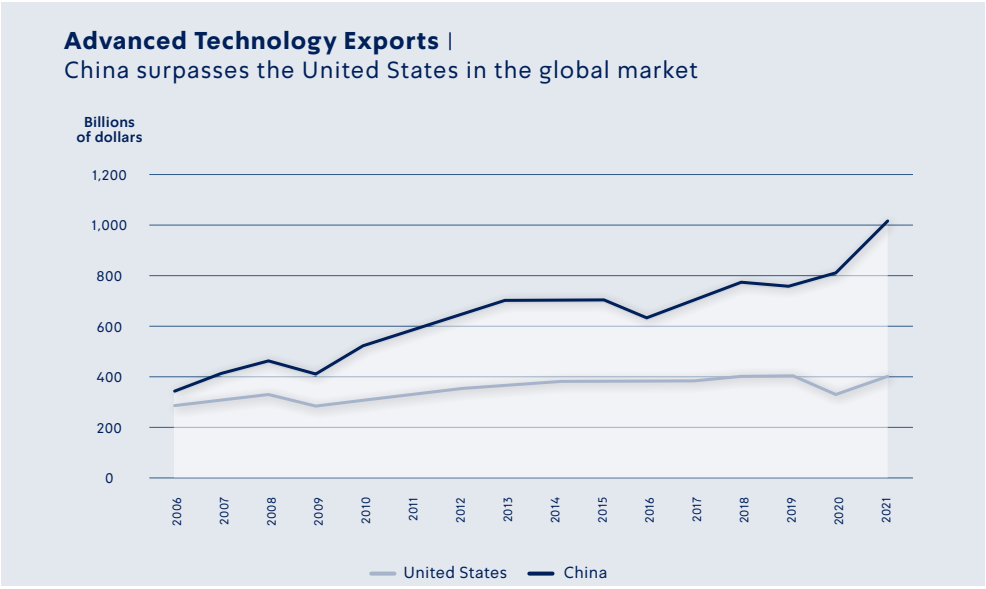
In order to encourage educated citizens to take part in the change, the plan continued the line of its predecessors and attributed supreme importance to resolving China's environmental crisis while directing dedicated resources to improving citizen welfare in this respect (10 out of the plan's 25 objectives were related to the environment). In addition, China continued the line in which it would remove restrictions on citizens, such as changing the *hukou* system in which citizens must work in the place where they are registered. The removal of barriers was supposed to increase citizens' motivation to fulfill their economic potential.

Similar to the five-year plans instituted by the Communist Party in the past, the State Council set measurable targets to meet between 2015 and 2020.[12] These included the aspiration to progress from 18th place to 15th place in the Global Innovation Index,[13] and to increase the investment in research and development within five years from 2.1% to 2.5% of the GDP (for comparison, in the United States in 2014, 2.8% of the GDP was allocated to research and development, which was $489 billion. China aspired to double these amounts).[14] In addition, China stated its intention to double the number of patents registered in its name and the workforce invested in research and development in all fields. In the plan, China set a GDP per capita target of $17,910 for 2020 (compared to $12,985 in 2015, the year the plan was published), and allocated subsidies and participation in tuition, in order to encourage residents to learn scientific disciplines related to math, physics, chemistry, and biology. Figure 1 shows that the volume of China's advanced technology exports, as defined by the OECD, is 2.5 times that of the United States.

Alongside the short-term targets, long-term targets in the field of innovation in technological production were also presented in the plan. According to the original timetable in the plan, China, as mentioned above, would be defined as an innovation-oriented nation in 2020. By 2030 it would be the world leader of technological production industries, and by 2050 it would be recognized

as the world leader in science and technology research and development. These competitive targets are incorporated in a plan known as "Made in China 2025." The plan's name hints at the clear intentions of the Communist Party, favoring openness to the global market that China ultimately will lead.

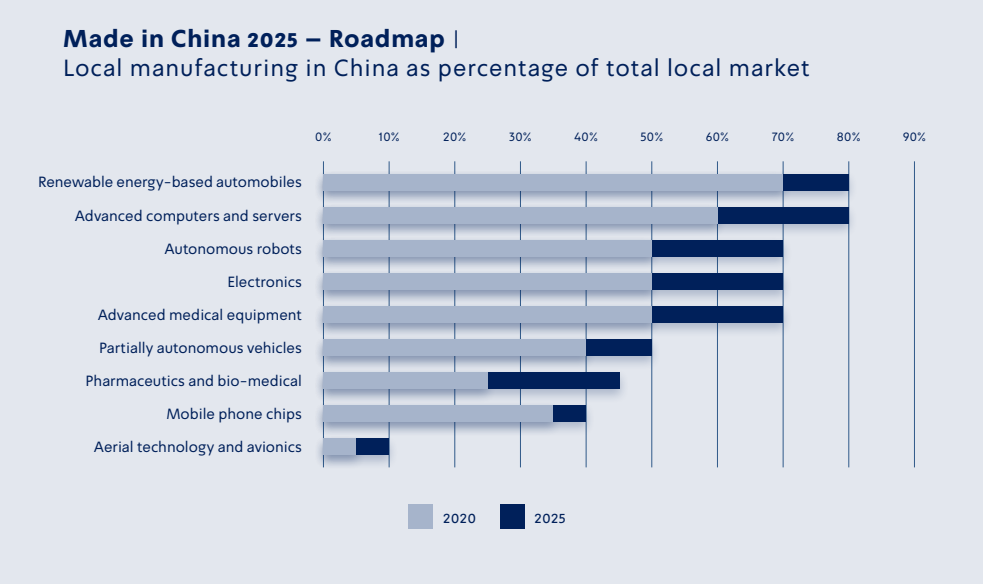
FIGURE 1. ADVANCED TECHNOLOGY EXPORTS



Source: Based on data of the OECD.

The Chinese Academy of Engineering detailed the goals of the plan, including the industries at the center of national attention. Figure 2 highlights the fact that the entire plan relies on advanced technology that China does not have, first and foremost advanced chips, thus increasing the need for imports from Taiwan and the West, especially the United States.

FIGURE 2. MADE IN CHINA 2025 – ROADMAP



Source: Institute for Security & Development Policy, "Made in China 2025."

To achieve the objectives, China needed to remove some of the political restrictions in a way that would encourage the private sector to increase investments with free market characteristics. The government approved an investment plan to encourage global tech giants to establish chip production plants in China at a total cost of around $80 billion.[15] According to the plan, the China Development Bank would invest over half the amount; a new national fund for investing in the chip industry would provide $20 billion, while innovation and production funds as well as taxes for the purpose of developing advanced robotics, particularly from the Beijing and Shenzhen districts, would cover the rest of the budget. In January 2023, China announced the establishment of a unified procurement platform for all chip companies in China to strengthen their bargaining power vis-à-vis the competition in the West.[16]

"Internet Plus," a plan parallel to "Made in China 2025," also appears in the thirteenth five-year plan. The project aimed to strengthen communications infrastructure and cloud computing to advance innovation, most of which operates on the Internet of Things (IoT). China wanted to encourage the exposure of local communications companies to the world, and the government decided that it would provide regulatory assistance and push for private companies in China to support global technology. For the internet infrastructure to support big data, China allocated $135.2 billion in the plan, in addition to $180 billion that would be allocated solely toward upgrading infrastructure.[17]

The Beginning of the "Trade War" and the Outbreak of the COVID-19 Pandemic

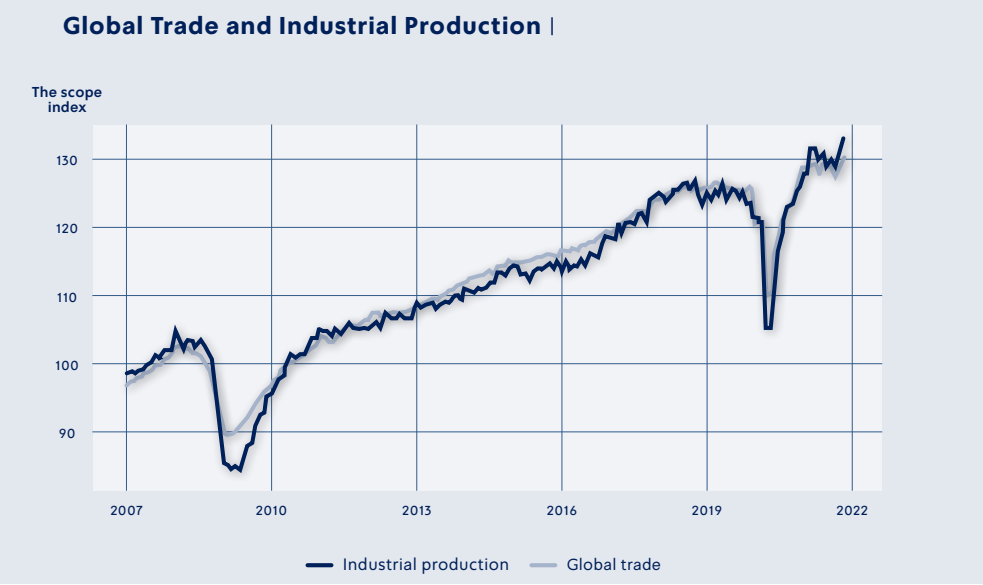
In the middle of the thirteenth five-year plan, Donald Trump was elected president of the United States and entered the White House in January 2017. Trump sharply criticized China's actions as part of his election campaign ("the rape of the American economy"),[18] and studies show that these messages received considerable American support. Trump accused the Chinese government of a customs policy, including subsidizing exports, which violated the rules of the free market and harmed the American economy. In the first few months of his presidency, the United States left the Trans-Pacific Partnership Agreement (against American interests), and imposed billions of dollars of tariffs on Chinese goods.[19] This was the opening shot of the "trade war" that continued throughout Trump's presidency.[20] In 2018, Trump announced government initiatives that aimed to strengthen the partnership with Asian countries other than China, in both the military sphere and the economic sphere. Trump attempted to advance negotiations in 2019 and signed an agreement ("Phase One") with China that aimed to address intellectual property violations, to "rebalance" trade between the countries, and to define fair rules for deals between American companies and China.

Another development that changed relations with China was the COVID-19 pandemic that spread throughout the world at the beginning of 2020. Global attitudes toward China worsened, as it was accused as having been the source of the coronavirus outbreak. To contain the severe health consequences of the disease, many countries imposed lockdowns, which significantly slowed the economy. For the first time in 70 years, the world was forced to cope with an almost complete stoppage of global trade and with considerable damage to supply chains.[21] The decline in the volume of goods in the first half of 2020 was similar in scope to that of the global economic crisis of 2008 and was indicative of China's centrality in the supply chain. The return to normalcy that characterized 2021 compensated for some of the losses that occurred. Nevertheless, great concern arose in the West given the risks of dependence on supply chains originating in Asia, particularly in China, which over the years had become a central supplier of vital goods and technologies. It is worth mentioning that these risks could also have materialized as a result of a stoppage of trade under other circumstances.

Figures 3 and 4 illustrate how the supply chain crisis that started during the COVID-19 pandemic has, in fact, continued until today, and despite the removal of restrictions, the global system is having difficulty addressing the increasing demand for goods in all sectors, particularly in the technology sector.

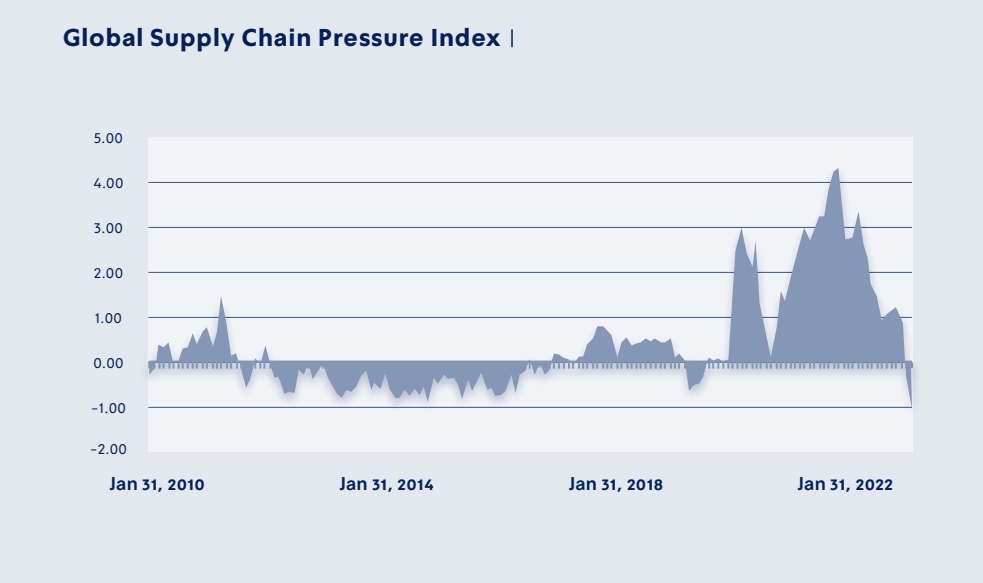
In 2022, most markets opened, but China maintained significant restrictions in its territory, and its markets did not return to full functioning. Even though the Communist Party continued to present optimistic growth and investment figures indicating progress according to the plan, the long lockdown that China imposed led to protests with tens of thousands of people participating, and in practice, like the rest of the world's countries, the pace of growth slowed.

FIGURE 3. GLOBAL TRADE AND INDUSTRIAL PRODUCTION



Source: OECD, "International Trade during the COVID-19 Pandemic: Big Shifts and Uncertainty," (March 10, 2022).

FIGURE 4. GLOBAL SUPPLY CHAIN PRESSURE INDEX



Source: "Global Supply Chain Pressure Index: May 2022 Update," *Liberty Street Economics.*

From Global Chip Crisis to the CHIPS Act: Industrial Policy for Preventing Chinese Superiority

The tech industry suffered serious harm from the supply chain crisis due to its being a global, decentralized industry that is distributed among countries according to comparative advantage. Research and development take place mainly in the West, while there are also smaller R&D centers in Asia. In contrast, most of the production of advanced technological components occurs in Asia, particularly in Taiwan and China. The decline in the activity of production plants and the export of these components was the last straw in the crisis that already occurred at the chip factories, which for a long time had been operating at maximum capacity. The demand for chips has increased throughout the past few years, but the process of producing them remains complex and expensive, and private investors are finding it difficult to bear the burden on their own. It has become clear that without hundreds of billions of dollars of government support, it is impossible to resolve the crisis. Furthermore, the COVID-19 pandemic, as mentioned above, exacerbated the chip crisis, making it difficult for the government and private entrepreneurs to give the issue the necessary attention and resources.

In China, a total investment (direct and indirect; governmental and private) of $150 billion led to only a limited achievement in the field of producing and assembling chips.[22] Even though China declared that by 2020 it would reduce its dependence on imports and provide 40% of demand via domestic factories, in practice in 2019 it succeeded in producing 16% of total domestic demand, and did not succeed in making the leap in the following years.[23] The main reason for this gap is that China still lacks production capabilities and a software environment that would allow it to make the desired advancement, and consequently it is dependent on the supply of equipment and components from the United States, Taiwan, and additional countries in Europe.

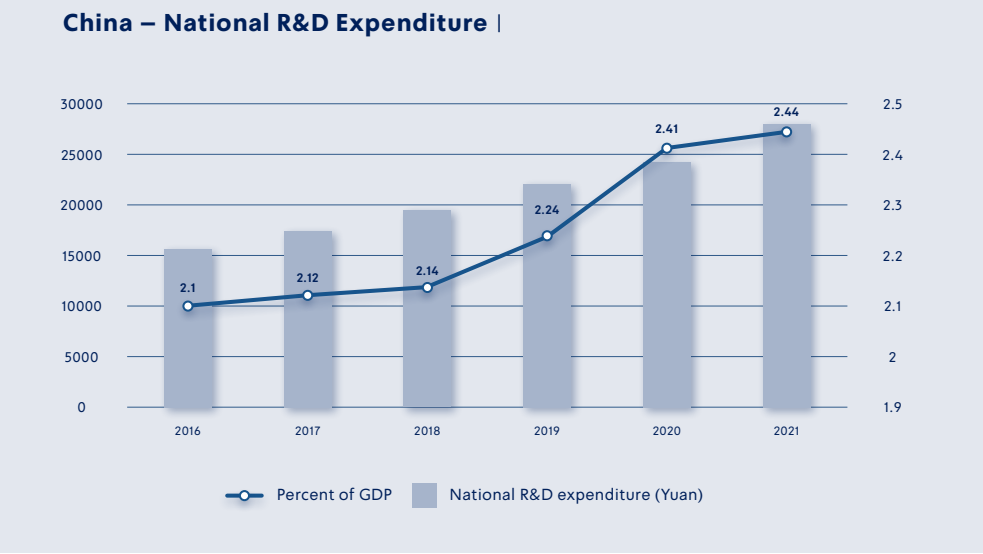
In 2021, the Chinese Communist Party's fourteenth five-year plan was published, under the slogan "Looking Forward to 2035." The plan continues

the approach of its predecessors in focusing on a modern society oriented toward technology and innovation but hints at a five-year delay on the path to global leadership, as a result of the consequences of the COVID-19 pandemic and the changes in trade policy vis-à-vis the United States. Because China did not meet its demand target (of producing 40% of total domestic demand for chips), the policy expressed in this plan still encourages continued investment in cutting-edge technologies in the field of producing chips for use in artificial intelligence,[24] as well as in research and development, totaling about half a trillion dollars.[25]

The supply chain crisis also demonstrated to the United States the risk posed to its national security when a sector in which its share of global production is only 12% is so vital to its stability.[26] In addition, the United States interpreted China's determination in the chips field as an arms' race whose winner would have the most advanced military capabilities. As a result, for the first time the US administration clearly saw the necessity of having a technology strategy that would improve American technological production capacity and exert significant pressure on China.[27]

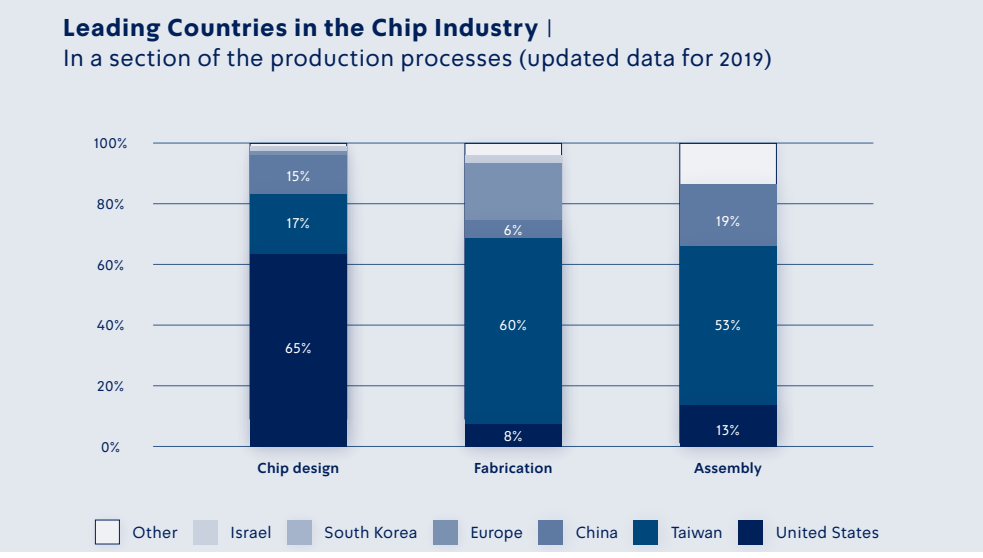
In November 2020, Joe Biden was elected US president, after having promised to bring the manufacturing industries back to the United States in response to the consequences of the COVID-19 pandemic and the disruption of supply chains. At the very beginning of his term, Biden advanced a technological legislative process that encouraged the establishment of production plants on American soil and imposed much more comprehensive export restrictions than his predecessors. The US administration's national security strategy, which was published in October 2022, highlighted the multidimensional competition with China and the need to prevent it from getting stronger and threatening global stability, particularly with respect to advanced technology and chips.[28]

FIGURE 5. CHINA – NATIONAL R&D EXPENDITURE



Source: National Bureau of Statistics of China, "China's R&D Expenditure Reached 2.79 Trillion Yuan in 2021," January 27, 2022.

FIGURE 6. LEADING COUNTRIES IN THE CHIP INDUSTRY



Source: Alicia García-Herrero and Pauline Weil, "Lessons for Europe from China's Quest for Semiconductor Self-Reliance," *Bruegel*, November 18, 2022.

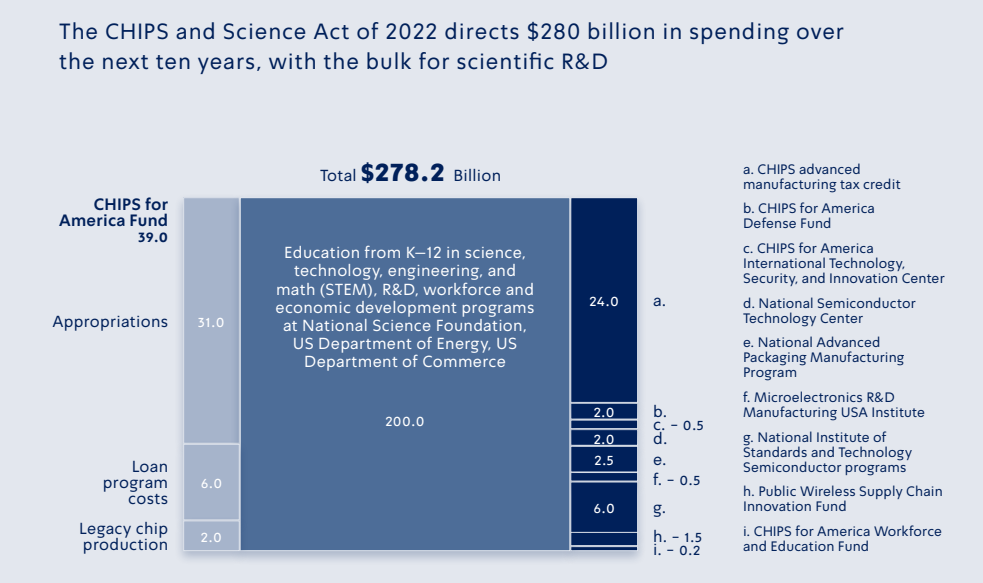
On August 9, 2022, President Biden signed the CHIPS and Science Act of 2022.[29] The law sets out industrial policy and a complete strategy regarding semiconductor industries,[30] and encompasses the logic, budget, and implementation of supervisory regulations on the export of artificial intelligence technologies. The law was passed in the House of Representatives and the Senate with broad support from both parties. Biden recruited a team of experts who set up a council that would guide the government's investments in the field of research and development. The message that the president has sought to convey to the American public is that the United States cannot maintain its standing without strengthening its manufacturing industry, first and foremost in the technology sector and in the field of semiconductors.

A document published by the White House stated that aside from the American aspiration to end the dependence on supply chains in Asia and to prevent the theft of intellectual property, the law would restore the prestige of the US manufacturing industry. It stated that in 2021 alone, the establishment of new production plants provided 642,000 new jobs. The administration indicated investment in education in this field as a central engine of growth for the entire American economy, which would increase the percentage of populations with low participation in this advanced market and reduce the social gaps.[31]

The total budget that the American government has allocated is estimated to be $278.2 billion over ten years (see Figure 7). This sum includes funding and regulatory support for all aspects necessary for achieving "technological superiority" in the field of chips and technological R&D. As part of the legislation, an investment fund of $39 billion was established for direct investment in companies that would develop and produce advanced chip technology; $2 billion was invested in production capabilities for older models of chips; $24 billion is to fund tax benefits up to a total of 25%. The remaining amount, about $200 billion, is invested in research and development, educational

institutions, and security and defense agencies that will ensure the future of the chip industry in the United States.[32]

FIGURE 7. FINANCING ACCORDING TO THE CHIPS AND SCIENCE ACT, 2022–2026



Source: Based on information from H.R. 4346, Chips and Science Act, 117th Congress.

In June 2023, the American Department of the Treasury announced the establishment of a team of experts that will choose the candidates for the Executive Committee of the National Semiconductor Technology Center. The Act gives the Executive Committee the authority to choose the companies and the projects that will receive government assistance. The team of experts is composed of key figures in the American high-tech industry, including Jason Matheny, president of the RAND Corporation; Donald J. Rosenberg, a policy and strategy research fellow at UCSD who previously served as general counsel for Qualcomm, IBM, and Apple; Brenda Darden Wilkerson, who serves as president of the organization for the integration of women and non-gendered or non-binary people in the technology industries; Janet Foutty, who served

as president and CEO of the strategy consulting company Deloitte; and John L. Hennessy, a professor of electrical engineering and computer science at Stanford University. The desire for the committee to express the diversity of voices in American society is intended to show the national and social purpose of the CHIPS Act as a strategic turning point for the manufacturing industries and the American labor market.[33]

Technology companies that express a desire to establish production plants on US soil and far away from China will receive generous government assistance. These companies will commit to not building advanced production plants in China, Iran, North Korea, or Russia nor exporting controlled technology to any of them. Companies that attempt to sell advanced chips intended for artificial intelligence and supercomputing to China will expose themselves to sanctions, requiring them to return the funding and to pay a fine. Since preventing deals may not be enough to curb China's advancement in the chip industry, the administration examined the ways China could achieve a comparative advantage in the field and proposed a comprehensive set of regulations that would block China's technological capabilities in both the short and long term.[34]

China is considered a leader in the use of artificial intelligence for the purpose of research, trade, and military technology. The Military-Civil Fusion (MCF) strategy ensures that every technology marketed in the business sector is available for military use in accordance with the needs of the party. As a result of the strong connection between the military and the business sector in China, chips and other components produced in the United States have been incorporated into Chinese military technologies. Although the United States attempted to prevent this use through sanctions, this policy failed in practice, and the Chinese military has continued to make use of the advanced technology for its purposes.[35] The current legislation is more comprehensive and does not allow China access to advanced chips for any purpose. Consequently, advanced chips that are used in artificial intelligence

technologies are completely prohibited for sale to any entity that operates in China, even if it is an American company whose activity in China is limited to the storage of information on servers.

In the United States, tech giants, AMD and Nvidia, account for the majority of exports of advanced chips for artificial intelligence to China. These companies received detailed explanatory letters that warned them of prohibited transactions according to the new legislation. In effect, the law expands the prohibition on chip deals according to the quality of the chip's performance and not according to the type of deal, the company selling it, or the customer. The sale of a chip whose performance is considered advanced, meaning its processing capability is higher than 300 terabytes per second and its data transfer rate is equal to or exceeds 600 gigabytes per second, is strictly prohibited. According to the administration, these chips could expose technological secrets and endanger national security; therefore, every deal will require reporting and federal approval. These conditions prevent the marketing of chips that were planned for large data servers or supercomputers that train artificial intelligence technologies; nonetheless, China is still permitted to continue to purchase chips intended for personal computers.

While the tech giants Nvidia and AMD are among the only companies in the world capable of designing the advanced chips described, several Chinese companies have made significant progress in adopting and independently applying this unique technology. The most significant comparative advantage of the American giants is the unique software environment marked by Nvidia, called CUDA. The company provides a complete product that makes it easier for the tech giants to carry out the complete process of developing the advanced chips, from the design stage to quality control processes in the production stage. For this reason, Nvidia currently controls 95% of advanced chip sales in China.[36] The prohibition on selling the software environment, in addition

to the chips themselves, ensures that the American company will maintain its comparative advantage and its profitability.

The trade restrictions will deny China access to the software environment for designing chips, such as CUDA, and to vital production components for advanced technology. The Department of Commerce has also designated the software environment known as EDA (Electronic Design Automation), which chip designers and developers use to turn the design into silicon on a chip, as a product that is prohibited from being exported to China, thus ensuring that this significant comparative advantage will remain at its disposal. Should a Chinese company try to use American software, whether by successfully stealing the product or by acquiring a license before the law came into effect, the company will not be able to send the design for production outside of China. This is a significant limitation, as China does not yet have advanced production systems necessary for assembling the advanced chips; therefore, it must export the design to factories abroad, and it is, in effect, dependent on them. Restricting China's access to the necessary software environment will inhibit its ability to design chips, while preventing the use of factories and production systems that rely on American technology will minimize the likelihood of China acquiring relevant production capability of advanced chips for the purposes of artificial intelligence.

Even without production systems, China could still gain access to the software environment and produce the chips using outdated equipment. The company Huawei has announced its intention to pursue this option via HilSilicon, its subsidiary for producing chips.[37] Nevertheless, the US administration believes that even the old equipment, which is based on American capabilities, will require support and maintenance that it does not intend to allow.[38] The legislation explicitly states that any company that supplies production components is prohibited from fulfilling contracts and providing service to Chinese manufacturing plants, while existing contracts with Chinese companies will be cancelled. Thus, even if China strives to

produce the chips on its own and needs American assistance, it is prohibited from receiving such support.

The administration is going as far as to not only deny China the ability to develop future technologies but also to erode its existing capabilities and to set China back a few steps. Similar to chip performance, production equipment is also classified by performance. It is customary to classify chips according to their geometric size, whereas the unit of measurement is the nanometer (billionth of a meter); one can understand that the most advanced chips are a size that is almost microscopic, and it is possible to squeeze an entire computer into a chip. The administration's efforts are currently focused on limiting China's ability to produce chips to a size of 16 nanometers, while the most advanced chips in the world are 3 nanometers and 2 nanometers are expected in the near future. The Chinese company SMIC currently is able to produce chips at a size of 14 nanometers, while the American actions could force it to produce larger chips. The company YMTC, which Apple is considering for producing chips for its devices, will also be limited to chips of 18 nanometers and could lose its business advantage. Even if these companies succeed in overcoming the difficulties, the lack of support from the United States will delay them by several years at least. Because China expected these restrictions, it has since completed large-scale purchases of chipmaking equipment in recent years, but it still lacks the comprehensive capabilities encompassed by the entire package described above.

The final layer of defense created by the United States in this context is preventing China from producing the essential equipment for making its own chips. The sale of American components used to produce the machines that manufacture the chips will also be prohibited. This equipment is considered especially advanced and complex to produce; therefore, exclusivity ensures that the United States has an advantage over all chip industries in the world. So far China has relied on the American technologies, and now it will be

prohibited from buying any component that serves the process of producing advanced chips.

At this stage it is still too early to assess China's readiness at coping with the significant restrictions that the United States has placed on it, but we can assume that China will remain determined, as reflected by the substantial investments in strengthening artificial intelligence that appear in the fourteenth five-year plan, especially the intention to develop an independent software environment. Regardless, China will continue to maintain a comparative advantage in older models of chips, components crucial for the proper functioning of household appliances (washing machines, computer or television screens), and it could make things difficult for countries that prevent its ambitions for global leadership in the field of artificial intelligence. While the current legislation also allocates funds for the production of the old chips, this is an issue that will require further examination as time goes on.

To ensure that China's access to advanced technology is limited, the United States will need to enlist its partners, particularly in Europe and Asia, who have their own advanced chip industries. For this exact reason, the legislation process was coordinated with the European Union and leading countries in the industry, and in the first few months after the legislation, the United States invested in publicity efforts and in enlisting partners to support the legislation and its consequences.

"Chip Coalitions": Interest-Based Alliances

The chip war is seen as a new kind of cold war.[39] In the period after the fall of the Soviet Union, globalization and the economic aspirations of countries sometimes acted as a deterrent to war, due to both the risks to trade and the costs of rehabilitation, which grew as countries developed. Most countries that take part in global trade have profited from mutual defense, although they have sometimes been forced to compromise on local interests. Countries that chose to isolate and to adhere to militant, anti-democratic agendas, such as

Iran and North Korea, have paid for this with the imposition of heavy sanctions. However, in recent years, given technological and cultural changes, and a certain erosion of values and interests, the question of the cost versus the benefit of dependence on others is being reconsidered. The Russia–Ukraine war undermined belief in the effectiveness of the mechanism of dependence on others, and in effect an increasing number of countries are concerned that this model exposes them to strategic risks that are not worth the economic benefit. History shows that conflicts between countries end with a balance between economic growth and national security interests. While there is no correct balance, the technological struggle between the United States and China and the decline in trade is putting globalization to the test.

The chip market is a global market that is not owned by any country. The supply chain is intercontinental and is sensitive to changes, from climate and demography to foreign relations and security. To succeed in producing a chip, many raw materials are needed, along with engineering capabilities and advanced production components. Raw materials for producing chips are found in China and other countries in Asia. While the United States has a substantial share in research and development, making it a focal point, the production of advanced equipment is done almost exclusively by the Dutch company ASML, and the chips themselves are manufactured and assembled in a variety of countries, led by companies in Taiwan (TSMC) and in Japan (KIOXA and others). Even though geopolitical challenges are pushing countries toward independence and exclusivity in the field of chips in the long run, global trade between countries with advanced chip factories or conditions conducive to the establishment of factories is necessary at this stage to fulfill the potential.

The legislation in the United States has created a reality in which each country (or, in fact, each company) is obliged to reexamine the partnerships in its supply chain in order to avoid American sanctions. Furthermore, the United States has turned to its partners in Asia and Europe and has attempted

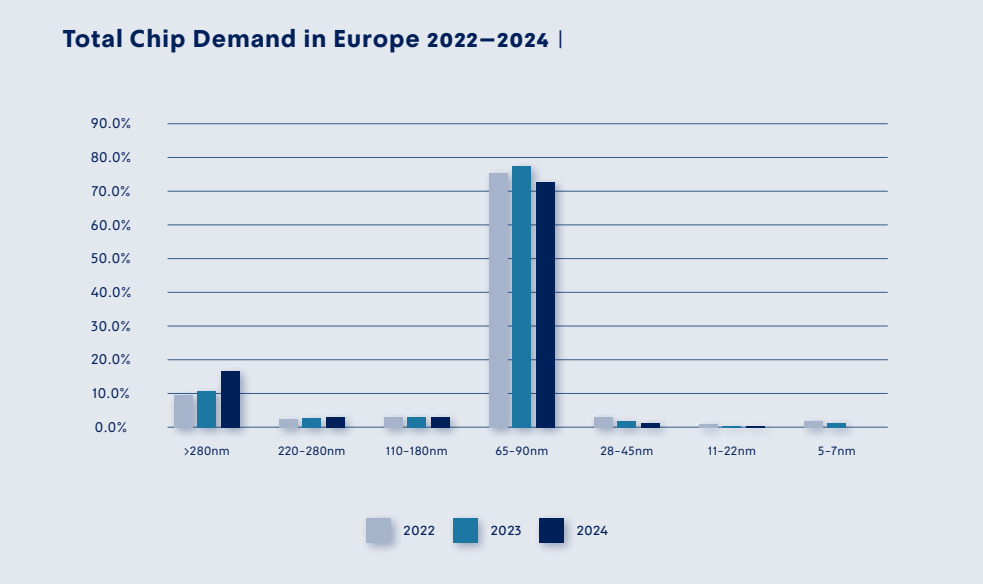
to convince them to join the struggle and adopt the policy restricting China's ability to research, develop, and produce advanced chips. This is a complicated demand given China's economic standing, its growing ties with the countries of Asia and Europe, and the high cost that these countries could pay not only economically but also in terms of national security.

In an era of post-globalization and a return to models based on alliances and coalitions, the United States has initiated several technology alliances. In the field of chips, the United States has invited the leading countries in the industry, Taiwan, Japan, and South Korea, to a four-way alliance of countries that produce the most advanced chips ("the Fab 4"), which is supposed to become one of the main axes in regulating and supervising the proliferation of chip technologies worldwide, especially with respect to China. Another alliance that has been proposed by the Atlantic Council will focus on the use of technology by democratic countries (Democratic Technology Alliance). These two alliances bring together two central motifs in the spirit of the lessons learned from the supply chain crisis and the struggle to prevent the proliferation of advanced technology, which could be used for destructive purposes in an uncontrolled manner. With the help of these alliances, the United States will strive to manage the global proliferation of the most advanced technologies, in part to prevent China from attaining the ability to independently produce the most advanced chips, as well as technologies that rely on these chips. In addition, an alliance of technologically advanced democratic countries would be able to define the accepted guidelines for the use and proliferation of all technologies. Without defining technologies as "good" or "bad," the broadest common denominator that defines the nature of their use is the regime that controls the technology. The basic assumption is that even if a democratic regime has countless weaknesses, it is more likely that it would use technology in a more responsible and moral manner than an undemocratic regime.

Taiwan, which relies on the United States for defense given the military threat from China, was the first to join the Fab 4 chip alliance. Soon after the publication of the law and the policy of restrictions against China, TSMC, the leading chip company in Taiwan, announced its intention to set up two advanced chip factories in Arizona with a total investment of $40 billion.[40] President Biden participated in the announcement ceremony that was held in Arizona together with the tech giants that are expected to acquire the advanced chips.[41] His speech demonstrated the seriousness of the administration's intentions and the expectation that other democratic partners join it. Since this announcement, the construction of the factories has advanced, and in August 2023 TSMC announced its intention to build another chip factory in Germany.[42]

In the past year, the European Union advanced its own efforts in the field of chips, and at the same time strengthened its coordination with the United States. A report by the European Commission on the EU's technology policy detailed the consequences of the global shortage of chips and the future demand for chips in the European Union.[43] The report showed that the demand for chips is expected to double between 2022 and 2030 and that in 2020 alone, a trillion chips were produced worldwide, and only 10% of them on European soil. The gap between the increasing demand in Europe and the supply and dependence on countries with which relations are unstable is not sustainable. The same report also published a survey of industry leaders in Europe, which revealed that the main consideration for choosing a location for a production plant is the availability of labor and supportive legislation. In addition, it stated that legislators need to invest in research, development, and production as well as in companies that would encourage new technological initiatives, since increasing demand for chips is no less important than increasing the supply, as both are crucial for encouraging economic growth and promoting the application of artificial intelligence for the benefit of citizens.

FIGURE 8. TOTAL CHIP DEMAND IN EUROPE (DIFFERENT SIZES) 2022–2024



Source: European Commission, European Chips Survey Report, July 2022.

The European Union's technological legislation was approved by the European Parliament in February 2023. As in the United States, the EU legislation aims to shorten supply chains and to promote the establishment of additional production plants in EU countries in a way that will double Europe's chip production to 20% of overall global production.[44] The European law does not contain severe trade restrictions against China, but it explicitly states that the European Union will be part of a supply chain that includes the United States, Japan, Korea, Singapore, and Taiwan. In the framework of the law, an additional €15 billion will initially be allocated to direct investment in companies that establish chip production plants on European soil. This investment joins technology and artificial intelligence development plans that were launched in 2021, which together amount to an overall investment of €43 billion in technology by 2030. Each country in the EU will publicly and

privately encourage additional investments in the chip industry, in accordance with its capabilities, as long as they serve the overall welfare of the EU's countries. The Netherlands and Germany, which are considered industry leaders in Europe, have both created an independent incentive policy that aims to ensure continued growth in the field.

In March 2022, Intel reported its intention to implement a plan to invest €80 billion in Europe in the coming decade.[45] The plan includes the establishment of two huge factories for producing chips (Mega-Fab) in Magdeburg, Germany, which will be responsible for producing the most advanced chips in the continent. Intel chose Germany after it was promised an incentive estimated at about 40% of the total setup costs (subject to the approval of the European Trade Council). Alongside the government benefits, Intel will benefit from advanced green energy infrastructure being installed in the region and water desalination infrastructure that is supposed to reduce the cost of the significant energy and water consumption of a chip factory of this kind.

As part of strengthening cooperation and trust with the United States, in December 2022, weeks after the publication of the American chip policy, a joint conference of the EU–US Trade and Technology Council (TTC) was held under the leadership of the foreign and trade ministers. In the closing announcement, the TTC stated that the increasing geopolitical challenges, in particular those originating from autocratic regimes that violate human rights, threaten both the shared values of the democratic countries and international trade.[46] The TTC emphasized that the Russian invasion of Ukraine alongside the COVID-19 pandemic and other factors that affected the global supply chains have led to the understanding that relying on areas of geopolitical tension as export centers expose the global economy to especially challenging risks. One of the prominent conclusions of the TTC is that there is no choice but to cooperate in the chip field, and to resolve the current crisis, alongside independent aspirations, a coordination mechanism based on transparency and trust is needed.

At the conclusion of the summit, it was decided that investment in technology would be based on shared democratic values, out of a desire to safeguard the citizens' future. The TTC emphasized the conflicting interests vis-à-vis China, which competes with the United States and Europe for technology and control of the global market. The TTC decided to establish a joint mechanism that would warn of supply chain disruptions and would fully reveal the amount of government support in the chip field in each country so that every country could independently assess future demand and the resulting risks. In addition, it was decided to establish ten work teams that will discuss, in part, economic growth, digital transformation, standardization, and international fair trade that will maintain regular supply. The work of these teams will create conditions and definitions for the safe and fair use of advanced technology, especially in the field of artificial intelligence, so that trade barriers will be removed, and global competition and innovation will be encouraged. Artificial intelligence and supercomputing were defined as necessary conditions for solving global problems, such as extreme climate change, agriculture, green energy, and coping with serious illnesses.

In January 2023, further progress was made, when the Netherlands and Japan signed a joint agreement with the United States in which they agreed to enforce the American restrictions on the export of chip technologies to China, which in practice would make it difficult for China to independently produce advanced chips.[47] The full details of the agreements between the countries have not yet been disclosed as of the date of this writing, but according to statements by figures involved in the negotiations, the restrictions that the governments of the Netherlands and Japan are preparing to impose on China apparently will be more limited than those of the United States and will not include restrictions on the employment of their citizens in Chinese companies and so on. Since the Netherlands and Japan are the world's leading countries for producing lithographic machines for manufacturing advanced chips, minimal export restrictions—meaning a prohibition on

the export of components developed in the United States or containing American technology—are sufficient for significantly impeding the Chinese companies and their commercial partners. For the companies in Japan and the Netherlands, this is a difficult decision that could harm their profitability, and therefore international cooperation and government intervention are a necessary condition for safeguarding the interests of these companies. According to economic forecasts, cooperation between the European Union and the United States will ensure incentives that will compensate for potential losses.[48] This is, in practice, a new economic framework that violates the principle of the free market that had been implemented until now in the chip industry.

India is also paving its way toward the American chip alliance. Under the auspices of the legislation, India and the United States have agreed on the establishment of a task force to examine India's potential in the global supply chain.[49] Today India is considered a leading country in research and development, and it is preparing to offer billions of dollars of incentives to companies that establish factories in its territory. From the perspective of the United States, India is an important ally in Asia, and it has a significant role in the struggle against China in the military sphere too.

The United Kingdom, which left the European Union, is also engaged in formulating government policy on chips, and like the European Union, it will probably align with the US policy. There were hints of this in the unusual government intervention in a deal to acquire the Newport Wafers chip production plan in southern Wales.[50] The government published an order that forced the factory to withdraw from the process of acquisition by the Chinese company Nexperia for £63 million, claiming that this was a transaction that could endanger British interests in the chips industry and as a result, could threaten national security. At the time of this writing, a legal battle is taking place between the Chinese company and the British government, and further developments could affect the future of the deal. We can assume that

the United Kingdom is closely coordinating and discussing the issue with its ally, the United States.[51]

In an effort to strengthen the local industry, the British government published an invitation to tender to encourage initiatives that will accelerate the UK chip industry.[52] It also appears that the United Kingdom will allocate £1 billion to invest in and subsidize companies engaged in semiconductors.[53] This is a tiny amount compared to the investment amounts of private British industrialists. The question at hand is to what extent the United Kingdom would agree to adopt as legislation the restrictions that the United States has imposed, and what incentives would it be able to provide to companies operating in its territory?

China is closely following the American actions and the emerging chip alliance. While it is not yet clear how it will respond, aside from the expected increased budgetary investment in the field, it seems that China is considering its next steps in the industry and trying to enlist partners that will enable it at least to maintain its current standing.[54] Because China is responsible for the production of the "old" chips that are located in most home appliances and are outside of the American sanctions, it is expected to maintain relations with the leading chip companies in the world in producing chips that are at least 28 nanometers in size.

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 high-tech 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 high-quality 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.

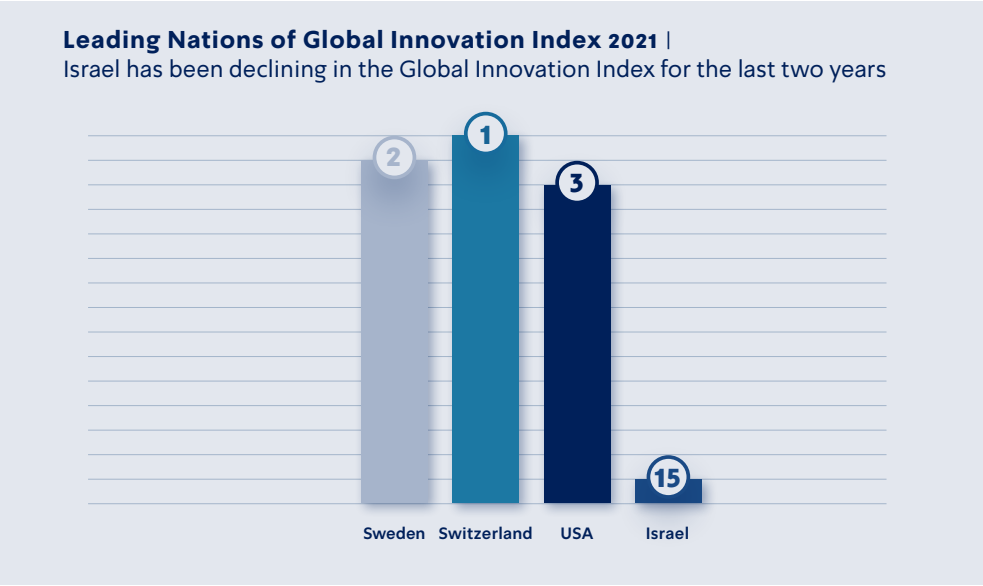
At the beginning of the 2000s, the prohibition on transferring intellectual property outside of the country's borders was reduced as was the obligation to produce inside Israel. This change was the result of a struggle led by the venture capital funds in Israel, who protested the fact that the export 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

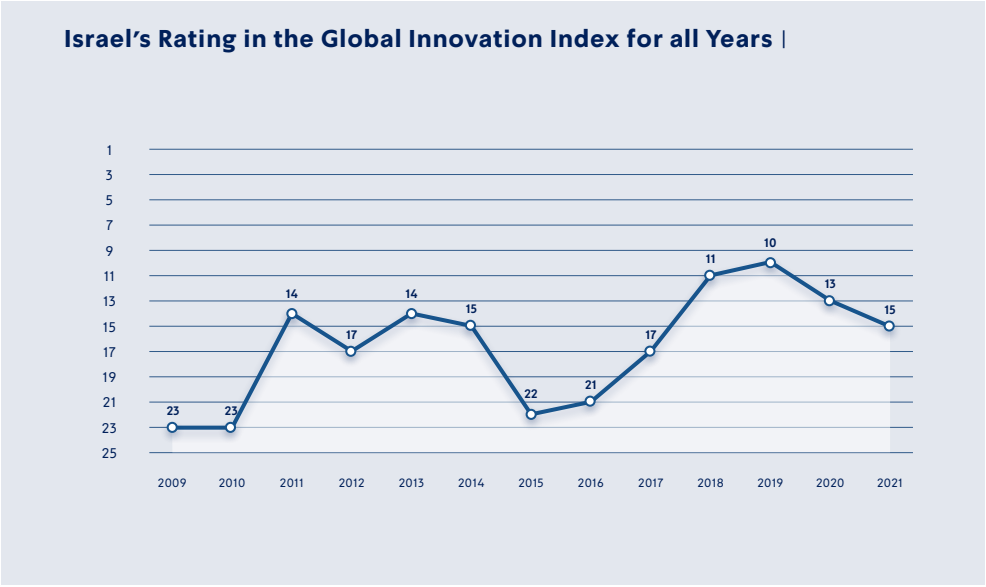


Source: Israel Innovation Authority, "Annual Innovation Report – State of High-Tech, 2022."

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

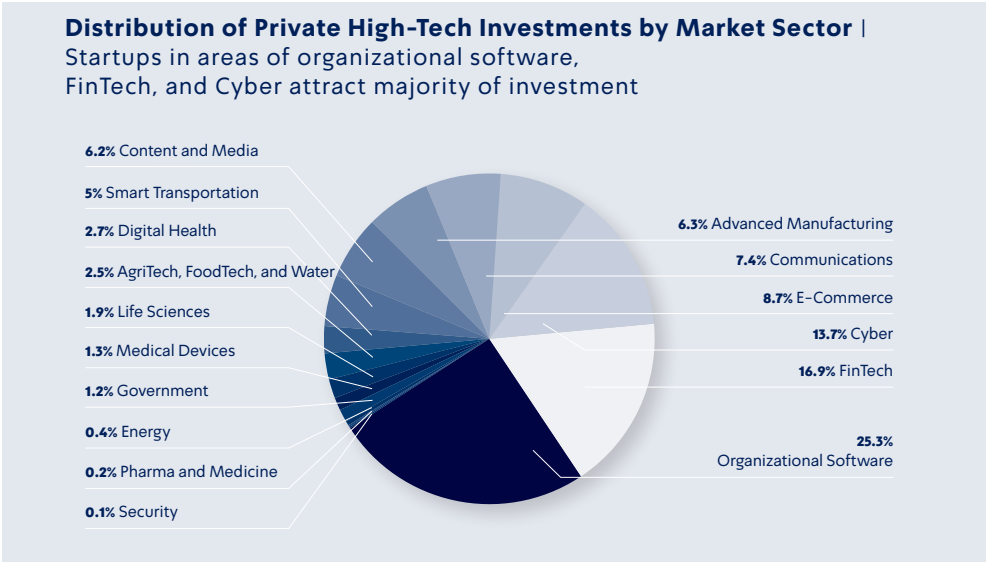
since then has improved Israel's situation. Another figure that intensifies the concern regarding the diversification and diffusion of risks in this context is the decline in the number of new start-up companies in Israel for the past several years. It seems that only 4% of the companies that raised 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)



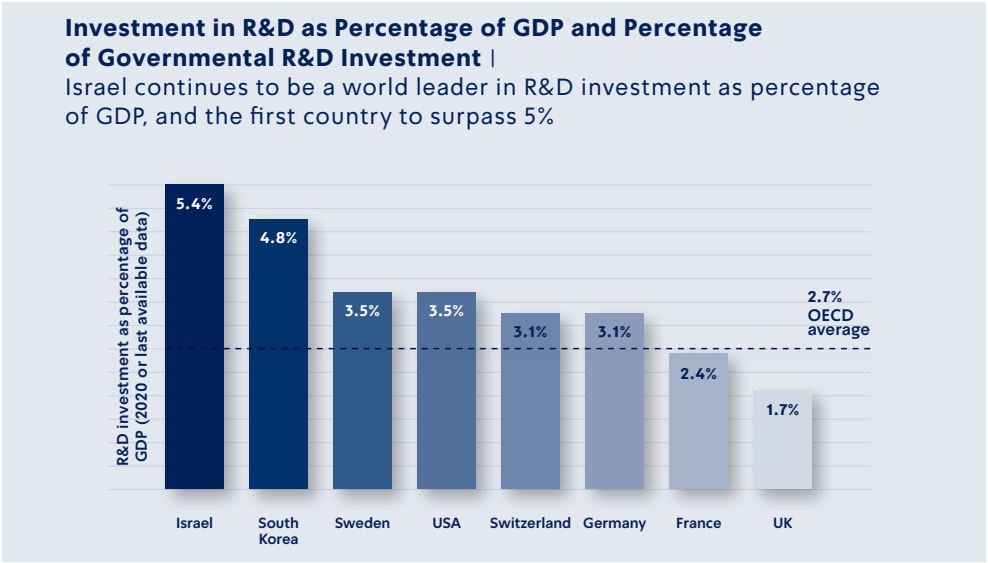
Source: Israel Innovation Authority, "Annual Innovation Report – State of High-Tech, 2022."

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.

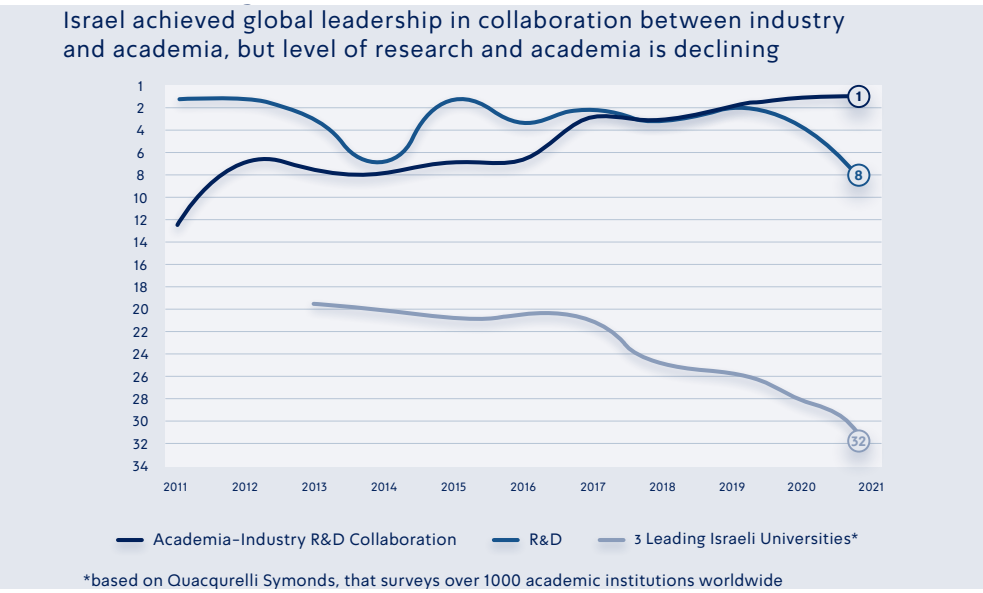
According to the liberal approach customary in most Western countries, a free market economy—even at the cost of harming local factories—is preferable

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]

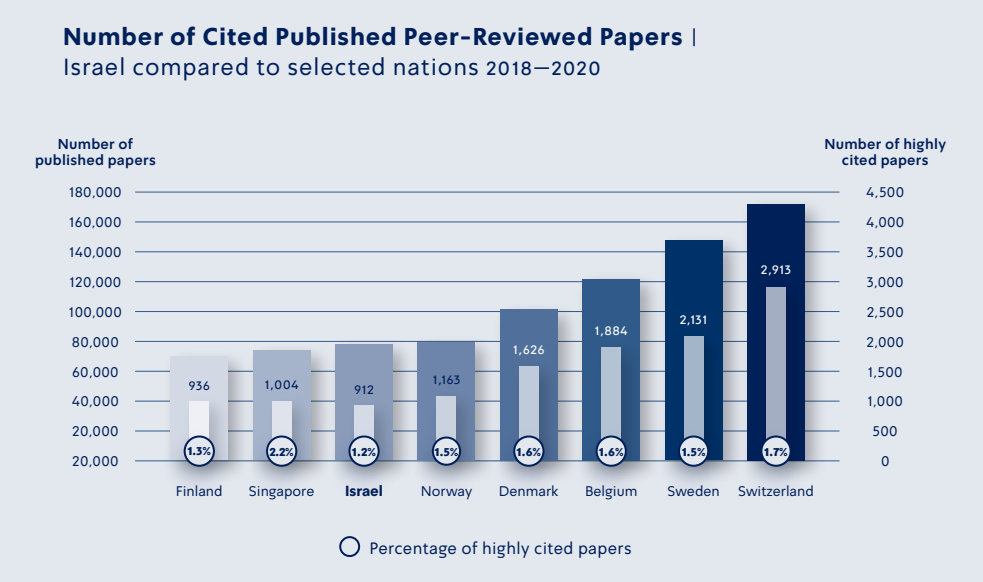
The collaborations between academic institutions in Europe and the tech industry create competition and difficulty for Israel. Despite the declarations by the tech giants to expand their research and development activity in Israel in the coming years, the state of the world market, the streamlining plans 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.

FIGURE 13. ISRAEL'S RANKING IN SELECTED GLOBAL INNOVATION INDICES



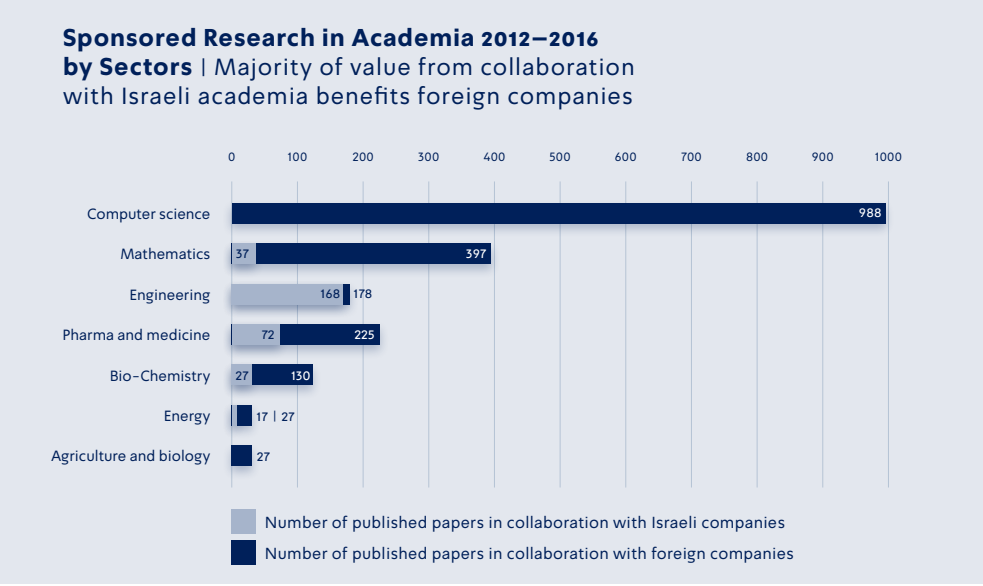
Source: Israel Innovation Authority , "Annual Innovation Report – State of High-Tech, 2022."

FIGURE 14. NUMBER OF CITED PUBLISHED PEER-REVIEWED PAPERS



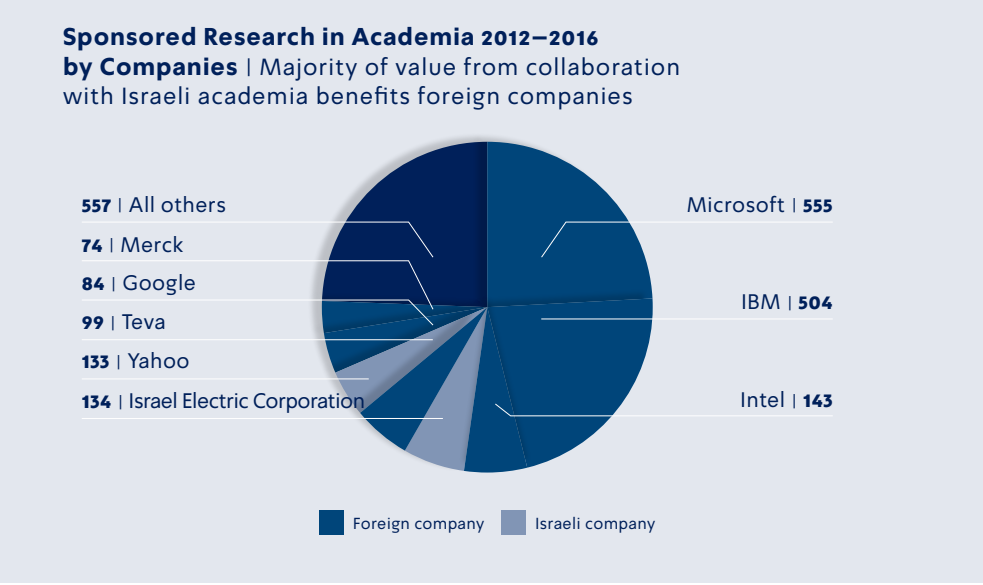
Source: Data from bibliometric databases, processed by the staff of the Neaman Institute

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 scientific-technological "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 decision-makers 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 quarter 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]

SECTION THREE:

ANALYZING ISRAEL'S POSSIBILITIES FOR ACTION

In the previous chapter, we discussed considerations that are meant to encourage decision-makers in Israel when planning a technology strategy and to examine investment in local technology production systems. In this section, we describe the current Israeli situation in the systemic context and the "displacement" that it is in. This section brings together the insights presented so far in a way that allows for discussing policy alternatives. The alternatives will be presented via the SWOT model, which helped us highlight the advantages and disadvantages of each alternative.[86]

As part of writing this section, we interviewed leading figures in the tech industry in Israel. We encountered consensus regarding the recommended technology policy from their perspective.[87] Their insights and their position with respect to policy will be presented as part of the systemic analysis and alternatives.

Is Israel Operating According to a Technology Strategy?

Before presenting the systemic analysis and the alternatives, we would like to argue that despite all of Israel's technological achievements presented in the previous section, Israel is not currently operating according to a sustainable technology strategy. This does not mean that the government is not investing in technology, but rather the current policy, which is expressed in minimal public investment (9.6% of the spending on R&D is governmental, last place among the OECD countries for 2019) and in encouraging the private sector via tax benefits and grants, does not ensure that the Israeli economy will continue to enjoy the fruits of the tech industry over time.

This policy of providing tax benefits and grants is enshrined in the Law for the Encouragement of Industrial Research and Development that was passed in 1984, and in the same framework, the Office of the Chief Scientist became

the Innovation Authority in 2015.[88] According to the wording of the law, the Innovation Authority is responsible for encouraging, advancing, supporting, and assisting technological innovation in industry, and for developing the infrastructure necessary for this, including by providing benefits, which are grants, loans, exemptions, discounts, tax breaks, guarantees, and other means of assistance, aside from the acquisition of stocks. The Innovation Authority is obligated to operate in accordance with government decisions in its regard, and according to the policy of the Minister of Innovation, Science, and Technology when lacking a government decision.

Unlike the state budget, which is anchored in legislation, the benefit tracks published by the Innovation Authority are subject to government decisions and are taken from the budget of the Innovation Authority or government ministries. Since their standing is different from that of a law legislated by the Knesset, these tracks can be changed and cancelled. Except for the law that grants the Innovation Authority its powers, there are no laws in Israel that enshrine public investments in the research, development, and production of technology or clear indices and monitoring for the purpose of maintaining Israel's advanced standing in the world. This method of operation of the Innovation Authority is intended to finance the risk of Israeli entrepreneurs who are interested in investing in channels that will ultimately be translated into economic growth; however, in recent years and all the more so since the intellectual property policy changed and the process of mergers and acquisitions by multinational companies became easier, the Israeli economy has not benefitted from the full potential of the tech sector. This is because the Innovation Authority's mode of operation incentivizes the aspiration for an "exit"—the purchase of the asset by a larger company, usually a foreign one. In most cases, the exit is done with meticulous tax planning that deprives the state of significant income from the acquisition itself. In many cases, the acquisition leads to the establishment of a development center in Israel that employs workers, while in other cases, sometimes in a long and gradual process, the acquiring

company disconnects from its Israeli roots and most of the workers and assets move abroad. One way or the other, the main compensation to the state is in the form of employment taxes by those employed in the company. If there were a policy that aspired to leverage Israeli intellectual property also for the purpose of state royalties for its investments in start-up companies, a business culture would presumably develop that would encourage companies to grow in Israel and become operational companies and not only aspire for an exit.

A report by the Innovation Authority for 2022 warned the government against "complacency and an expectation that without long-term investments, the economy's main export industry (high-tech) will continue to lead in the global arena," and provided the figures of the global innovation index and the strength of academia as warning signs regarding continuing the current approach. This determination by the Innovation Authority is also true of the entire tech industry in Israel, and not only of the high-tech software and services sector, which comprises the majority of current investments. Furthermore, given the global changes detailed at length, it is evident that the competition Israel faces in the technology market has become increasingly tough, in a way that does not enable the private sector to compete without public support and a stable long-term policy.

Systemic Analysis: The Context in which Israel Operates

For the purpose of this discussion, the global context in which Israel operates is a complex system of civil, economic, social, technological, and military interrelations. From this context, we reached four conclusions that focus on the technological context of the global order as it is currently being shaped. Each conclusion has challenges and opportunities for Israel:

1. **The "blue camp" versus the "red camp"**—When it comes to technology, the "blue camp" led by the United States is expanding and slowly taking form as a "democratic technological alliance." The shape in which the alliance is emerging is not yet clear, but its strategic purpose is to maintain

the position of the United States as the strongest power and to place pressure on the "red camp" led by China. The "red camp" represents the camp opposed to the alliance of democracies. Israel is closer to the "blue camp" in the technological context, but it is not yet considered a full partner in the "chip alliance," whether due to its intentionally refraining from making declarations on the issue, or because an in-depth discussion has not yet taken place on the consequences, nor in other initiatives led by the United States whose goal is management and control of global technology resources. Should Israel seek to officially join the "chip alliance," it will need to clearly declare its positions regarding the "red camp" and to comply with restrictions as they are expressed in legislation (for example, it is possible that Intel will choose not to export chips produced in Israel to China). In this sense, Israel will become an active partner in the technological arms race that the United States is leading against China, but it will be able to join international initiatives in the fields of regulating artificial intelligence and protecting privacy and human rights, and to benefit from the economic opportunities that will open up for Israeli industry. Although the use of the image of the blue camp is not suitable for describing all the relations in the world, it is worth noting that there are many gray areas in relations between the great powers, and it appears that the dichotomy is easier to identify and characterize in the technological field. Considering the huge scope of investment and the means of monitoring and supervising the proliferation and leakage of technology, here we can actually see a clear division into camps, with very few gray areas.

2. **The chip alliance's branch in Asia is a growing and expanding market**—Taiwan, Japan, and India have officially declared that they are joining the chip alliance. Japan, already perceived as a technological development and production power, declared its intention to stop its trade of advanced technology with China and is expected to benefit from the fruits of American investment. China signed a memorandum of understanding with the United

States and is going to invest a fortune in subsidizing and establishing chip factories in its territory. Taiwan relies on its relations with the United States for defense against the threat of Chinese invasion, but it is evident that it has not yet formulated a strategy that will allow it to transfer part of its technological production capabilities to the United States without undermining its stability. Israel, as a research and development power, faces a strategic opportunity to examine a strategy similar to that of Japan and India, albeit at a smaller scale given resource limitations. The way that Israel is encouraging Intel to establish an additional chip factory in Kiryat Gat is a right step in this direction, but it is not enough. Israel must examine how it can encourage other chip companies to establish factories (TSMC, for example) and ensure that its export policy matches the interests of the entire supply chain. It is important to note that the chip industry is not built only on the silicon factories alone, but also on packaging, assembly, testing, and quality control companies. The costs of the factories that complement a chip factory are immeasurably lower, and the State of Israel should incentivize companies in the field to come to Israel. In this context, Israel should strengthen its partnership with India and Japan, both of which are significant players in the field, and examine the supply chains of critical technology.

3. **The Middle East as an arena of struggle between the great powers and the important role of Israel with respect to the United States**—The current US strategy expresses the American focus on domestic affairs, whereas the CHIPS Act and the "chip alliance" aim, first and foremost, to serve the needs of the United States. The United States does not at present maintain technological partnerships in the region, and China is exploiting the current American focus as an opportunity to strengthen its relations with Saudi Arabia and the Gulf countries, including intervening in resolving internal conflicts in the region, in particular the conflict between Saudi Arabia and Iran. Israel has an important role in maintaining American

interests in the region, and it can be a "blue camp" bridge to the region when it comes to advanced technology, under American patronage. Israel can host a "chip alliance" of Middle Eastern countries, contribute from the considerable knowledge that it has accumulated on chip research and development, and support the establishment of chip factories in the Gulf, out of considerations of redundancy and creating strategic alliances of supply chains that are not dependent on China. From a strategic perspective, combining the tremendous financial strength of the Gulf countries with Israel's groundbreaking technological innovation generates unprecedented opportunities to jointly invest in chip technologies that were beyond Israel's economic capability and beyond the engineering resources of the Gulf countries.

4. **Technology as a tool for resolving the internal tension and security challenges of Israel**—Israel's internal struggle, including the comprehensive judicial reform being advanced by the government and the ongoing decline of national investment in academia, affect the ability to lead innovation. In addition, Israel is still subject to security threats that demand attention and resources. A national technology plan could simultaneously be a solution to these two challenges. In the external environment, a national technological plan would ensure Israel's position as a technological power and maintain its military partnerships in the world, while in the internal environment, it could enable the narrowing of gaps, increase participation, and strengthen cohesion in a way that would allow for the restoring investments in security needs over time.

Describing Israel's Displacement

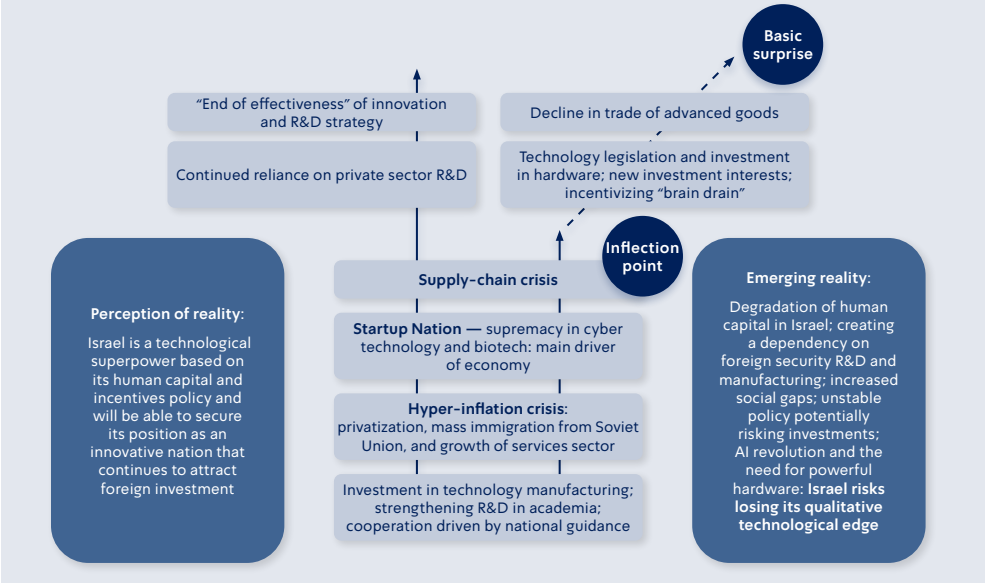
Addressing the conclusions of the systemic analysis provided below, we would like to apply a model developed by Dr. Zvi Lanir in his book *Fundamental Surprise*, published in 1983, and to point out that Israel has been displaced.[89] While Israel sees itself continuing to develop as a leading innovative and

entrepreneurial country in high-tech on an international level, in practice, the supply chain crisis and the worsening conflict between the United States and China have led to a reorganization of the technological arena that challenges the current strategy. While countries that aspire to strengthen their technological industries are advancing legislation and investing a fortune in the field of production and hardware, Israel has not yet formulated a comprehensive strategy on the matter, which could lead to a decline in its comparative advantage over time. The current focus on the services economy is exacerbating the polarization and deepening the gaps in a way that erodes human capital.

The turning point that changed the world's approach is the supply chain crisis. In Israel too, the intensity of the crisis was felt, but the crisis was not conceptualized in the Israeli discourse and in its unique contexts for the local high-tech industry. Israel is part of the global supply chain and when there is a disruption or failure at a certain point in the chain, it is the state's responsibility to implement changes or adjustments at the economic or geopolitical level in order to minimize the damage or to exploit opportunities to advance the country's interests. Still, an institutional discussion has not yet taken place on the challenges and opportunities created by the crisis, and the steps needed for strengthening the economy have not yet been taken. If Israel chooses to continue the current strategy, refrain from direct intervention in the industry, and focus on research and development, it could find itself reaching the limits of its innovation strategy. This is for the simple reason that in the face of the enormous government investments around the world and the investment in an industrial policy of greater self-reliance, Israel could find that its competitive ability has eroded. Unlike Israel, its competitors in the world are now working to advance legislation and to expand investment channels in a way that will enable them to cope with a reality of reduced trade in advanced hardware (a trend that is already being felt given the struggle between the United States and China), through government subsidies to create a better balance

between research and development and production capabilities, in a way that will maintain their technological and economic stability.

FIGURE 17. BASIC SURPRISE IN THE SUPPLY CHAIN CRISIS



Alternatives for Policy and Strategy in Technology

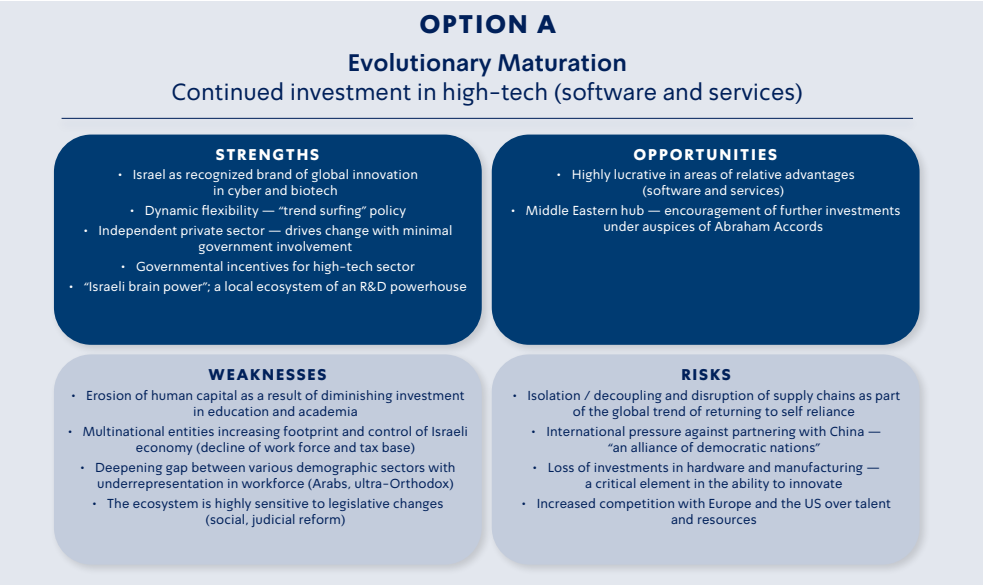
Option A: Evolutionary Development—Continued Investment in Innovation-Oriented "High-Tech" (software and services)

The first option is one in which the state is not expected to invest further resources in technology beyond its current investments and, in effect, continues the current situation. In addition, there is no declared or practical national intention to participate in the "chip alliance." In this scenario, the focus will be directed at maintaining Israel's appeal: Human capital that encourages multinational companies to establish R&D centers in Israel, alongside tax benefits that alleviate operational costs.

Implementing this option, while ignoring the emerging trends in the global technology market, would increase the risk of brain drain from Israel, given the increasing competition with the United States and Europe and the incentives that they are expected to offer in return for moving R&D centers close to production plants in their territory. In-depth interviews with heads and leaders of the tech industry in Israel also revealed that given both the crisis taking place among the tech giants in the world and the forecasts that this crisis will continue in the coming years, the volume of foreign investment in Israel, which propels the local industry, is expected to decline. In addition, if the pressure increases on Israel to adopt a stance on the global technological struggle, it is possible that Israel will not be able to implement this option without endangering foreign investment or risking its place in the global supply chain.

In his book *Strategy: The Logic of War and Peace,* Professor Edward Luttwak describes the paradoxical nature of every strategy and warns of a situation in which continued implementation of an existing strategy will reach its limits, which could become a barrier to achieving national objectives.[90] This is the main weakness of this option. While it expresses the strengths of the Israeli economy as presented in Figure 18, it does not allow for coping with the weaknesses, which could cause the Israeli tech sector to deteriorate in the long term.

FIGURE 18. POLICY ALTERNATIVE – OPTION A



Option B: Maintaining the Existing Model—But Changing the Focus—Investment Adapted to Trends in the International Arena

The second option (see Figure 19) is similar to the first in the sense that the state is not expected to invest further resources in technology, or to declare an official intention to take part in the "chip alliance." However, in this option, the state would focus and direct the private sector toward opportunities in the global market, particularly new investment channels in the field of technological production, to encourage multinational companies to set up factories and establish themselves in Israel.

At first glance, it might appear that the difference between this alternative and the first is semantic, but this alternative incorporates Israel's strengths while it maintains a liberal environment for an independent private sector that leads the economy. In return for the incentives and tax benefits that are in place today, Israeli entrepreneurs would be able to establish R&D centers

that would attract the production giants to Israel. This alternative could also encourage the development of business opportunities with hardware companies abroad to consider establishing factories in Israel, given an explicit statement by the Israeli government that this is its aspiration, and it would support and incentivize such initiatives. At the same time, this option does not necessarily address the weaknesses of the Israeli economy, particularly regarding academia and the scope of participation among Arabs and ultra-Orthodox in this technological workforce. This option could be difficult to implement if the State of Israel does not carry out the necessary investments in technological education from a young age to ensure the training of a suitable labor force. Similar to the cyber industry, the human reserve in this industry develops from a young age by providing after-school activities for youth and cyber studies in high schools, offering the initial knowledge foundation that young people have when they enlist in the army, where their knowledge develops in an efficient and focused manner.

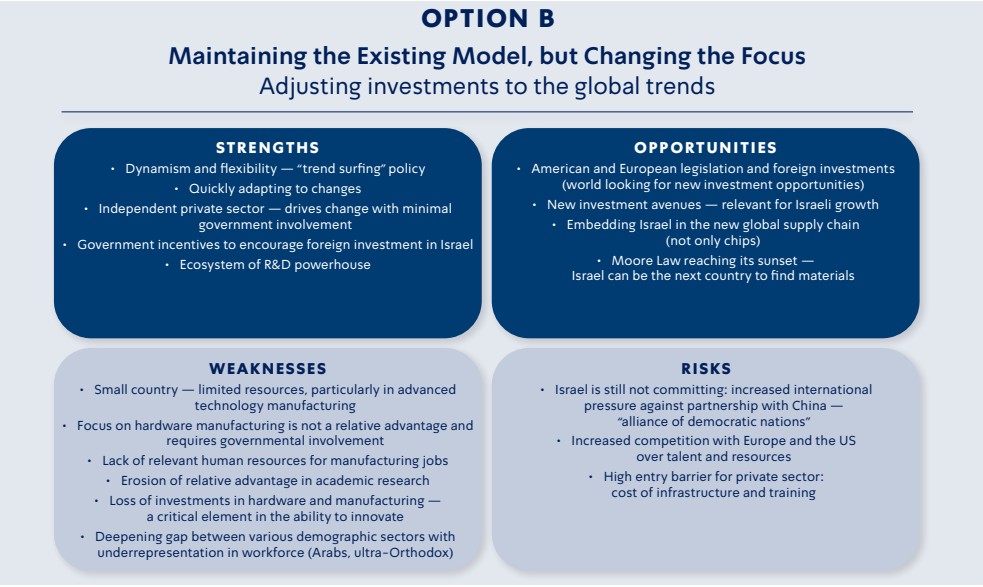
The majority of interviewees, all leaders in the Israeli tech industry, expressed support for this option because it preserves the Israeli ecosystem—the young minds who lead the research and development in a way that attracts investors throughout the world. In addition, Israeli entrepreneurs assume that given resource limitations, Israel will choose not to invest in setting up production plants, and therefore, there is no point in government intervention, except for the incentives currently offered. In this sense, the interviewees indicated this possibility as the most realistic option to implement.

The main difficulty in implementing this option is that investment in the technological production industry involves high initial costs, investment in infrastructure, education, academia, and training of a workforce. This is a project that is difficult to pursue without government intervention, and, in effect, this is also the main reason that there are no private initiatives in Israel in the field of technological production. Furthermore, the United States poses an external challenge in implementing this option , as it is expected to

create difficulties in providing incentives and benefits as part of the CHIPS Act without the provision of a commitment on a national scale (transparency regarding relations with China, for example, would be a basic condition in any negotiations).

In practice, choosing this option without government intervention beyond what exists today would ultimately mean that this option would not be implemented due to the limitations of the market as they are expressed today.

FIGURE 19. POLICY ALTERNATIVE – OPTION B



Option C: Enshrining in Legislation Government Investment in Technology and Establishing a Public Investment Fund

The third option (see Figure 20) aims to address the limitations of the second option and to propose government intervention to facilitate new investment channels to enter the technology market, particularly in the production of advanced technology. In this option, Israel aligns with the dominant trend of

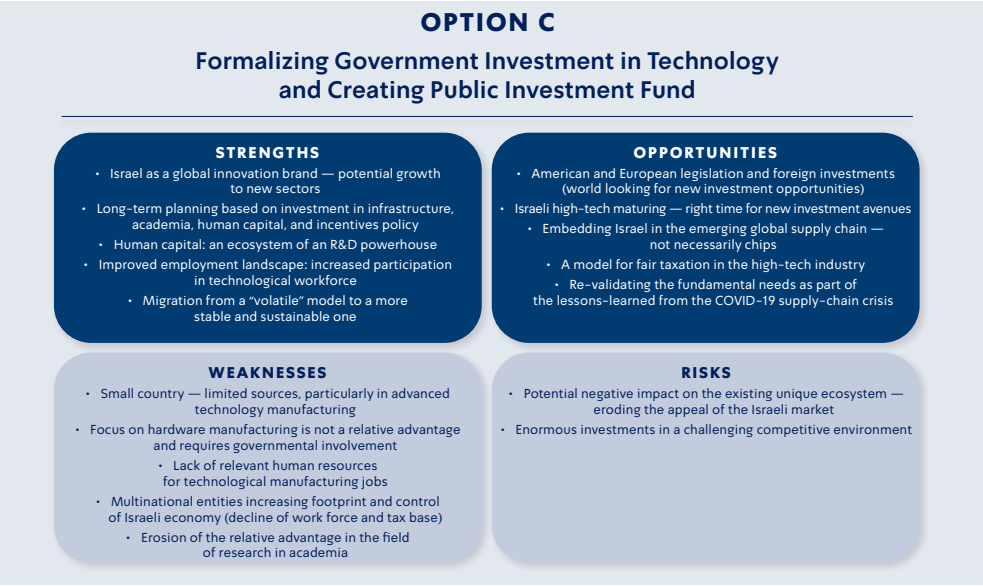
the most advanced countries in leading the tech powers and understands that the only way "to break the linearity" of technological innovation is through government intervention, and consequently it must formulate a national plan and long-term objectives. This trend has been adopted by a wide variety of countries, some of them the size of Israel, and that have similar economic characteristics, such as the Netherlands and Ireland. In this option, the Israel Innovation Authority, under the direction of the government, would focus on fulfilling the objective of increasing production in Israel. The Israel Innovation Authority would receive an increased budget and powers to fulfill these objectives, via existing tools (tax breaks and incentives), in addition to defining a national policy for investment in start-up companies in order to direct and encourage entrepreneurs to establish companies in specific fields. This is in contrast with the current situation, in which the investment arm of the Innovation Authority operates like a venture capital fund and directs its investments based on return-on-investment forecasts. The role of the Innovation Authority is critical and would be in addition to national investment in infrastructure and in human capital via the university education system and special placement processes for the relevant professions. Furthermore, through diplomatic initiatives, the Israeli government could promote a capital-engineering partnership with the Gulf countries and others, which would increase the production footprint in both Israel and the region, and thus contribute to strengthening the partnership between the countries.

This option challenges Israel with a high initial investment, and in defining objectives that could be perceived as an "industrial policy" that imposes a framework and limitations on the private sector in ways that are incompatible with the current comparative advantage. In certain ways, this option forces the Israeli tech industry to undergo a process of maturation, beginning with the stage of almost entirely exploiting opportunities—"riding the waves"—to more orderly defining of policy and objectives for the development of the industry and economy. To understand the scale of the inputs needed, in the

United States, the CHIPS Act allocates about $270 billion, whereas about 53 billion are intended for direct subsidies for the construction of chip factories or factories related to the value chain of chips (packaging, assembly, and testing). The European Union has allocated about €43 billion toward the same goal. Of course, the Israeli economy cannot allocate such sums, but a gradual definition of objectives, fully embracing the private sector (both in defining objectives and in investments), and possibly also partnerships with the Gulf countries would enable Israel to maintain its strengths and its appeal among investors and also to develop the local hardware industry. Since Israel competes in this field with great powers that invest enormous sums of money, it is likely that Israel would not be able to implement this option without the support of the United States, backing from Europe, and investment from additional countries. Declaring a national plan that aligns with the American strategy is likely to enable this support.

In the past year, despite serious shocks in both international markets and in Israel's business and corporate climate, Israel's comparative advantages in chip engineering continue to appeal to multinational companies in the field. Intel announced the expansion and upgrading of its factories in Israel, along with Nvidia, which is developing its production infrastructure based on the acquisition of Mellanox Technologies. In this option, with the right investment by the Israeli government, it is possible to incentivize companies throughout the hardware value chain to establish a presence in Israel. Because Israel is interested in solidifying and improving its standing in the global supply chain, and because chip production plants are not necessarily the most lucrative investment channel, other investment directions can be examined in the field of technological production, such as incentivizing support industries to set up factories in Israel, such as for chip packaging factories or chip testing equipment.

FIGURE 20. POLICY ALTERNATIVE – OPTION C



Option D (risky): A Process of Anti-Globalization and Complete Self-Reliance
The fourth option (see Figure 21) is presented for the purpose of mthodological reasons in using the SWOT model. While this alternative is not feasible, it is presented mainly to illustrate the enormous difficulties of an anti-coalition policy that relies on complete autonomous production capability. Underlying this option is the assumption that Israel is forced to invest resources in order to build independent technological production capabilities for national security purposes. Several countries in the world are coping with almost complete self-reliance due to geopolitical circumstances or intentional isolation. Technological isolation could develop over time as a result of losing Israel's place and standing among the technologically advanced democratic countries.

FIGURE 21. POLICY ALTERNATIVE – OPTION D

SECTION FOUR:

CONCLUSION AND RECOMMENDATIONS FOR ISRAEL

This memorandum has presented the emerging world order, at the center of which is the global technological competition between the great powers, in the context of the retreat from globalization and a return to models based on self-reliance, alliances, and coalitions. The supply-chain crisis demonstrated to the world the risk of relying on factories in countries with which cooperation is strategically sensitive, given the potential for instability in relations. Most technologically advanced countries have internalized the depth of the geostrategic changes and in the past year have examined the implications, each country according to its size, strength, geographic location, economy, and unique characteristics.

The United States and the European Union have shaped a dual strategy of bringing the core technological production back from Asia and imposing supervision and monitoring regimes to prevent the leakage of Western technology. Smaller countries have begun characterizing their basic technological needs in a way that enables them to maintain computing and hardware infrastructure to support knowledge-intensive industries and their continuous functioning in regular times and in times of crisis.

Unlike most technologically advanced countries, the State of Israel has not yet held an orderly discussion to analyze the implications of the technological competition between the great powers and the retreat of globalization, and it has not yet formulated a strategy or national plan in response to the recent technological developments. Basic academic discussions as well as policy-oriented research are meant to help policy-shapers and authorized bodies. We hope this memorandum will contribute to understanding the geostrategic reality and will present several initial recommendations to decision-makers.

Israel, like the United States and Europe, needs to examine its supply chains to ensure the regular supply of technology that is critical to its security needs

and to advance local production and partnerships with dependable allies. The rivalry between the United States and China has also highlighted the issue of the use of technology to violate human rights (espionage, for example), and this is a source of criticism, even if it only affects private companies in Israel. The global discourse on technology is conducted as a battle of values between clashing worldviews. The United States has indicated a clear policy line according to which the condition for partnership is based on interests as well as shared values (democracy first and foremost). This historic change requires Israel to create clarity with respect to its character and intentions. An ambiguous policy is interpreted as support for the wrong side of the global map and could jeopardize Israel's place in the global supply chain.

As part of the technological discussion announced in 2021 and officially launched in September 2022,[91] the government should advance the issue of hardware and chips in particular. Meanwhile, in terms of the European Union, Israel should strive for collaboration initiatives under the Horizon plan that address hardware and chips. In this context, Israel needs to highlight its comparative advantage in research and development, especially in artificial intelligence fields, in which Israel has an ecosystem that combines industry, academia, and defense bodies. They drive the field forward through cooperation, knowledge, and human resources at levels higher than many other countries.

Furthermore, Israel needs to understand that the United States is willing to change the structure of global trade for the sake of protecting its national security and democratic values. The chip alliance seems to be the most ambitious global architecture to attempt to regiment access to technology sources and to harness them in favor of American geostrategic ambitions. The current administration is willing to target American companies, let alone foreign companies, which violate the requirements. The place of values in global trade is changing, as technology has become a tool in the struggle between democracies and other forms of government. We can learn from

the case of the Israeli company NSO, which has been tied to the murder of exiled Saudi journalist Jamal Khashoggi. The case demonstrates the changing value system of technology, and other Israeli companies may be knowingly or innocently violating US demands. The government has a responsibility toward entrepreneurs and high-tech companies in maintaining a clear and transparent policy about the safe and legitimate spheres for economic cooperation with undemocratic countries. In the geostrategic environment of the rivalry between China and the United States, the latter is demanding transparency and clarity from its allies and advanced technology partners with respect to their conduct vis-à-vis autocracies, especially China. Israel must refrain from ambiguity when it comes to China and formulate a policy that includes restrictions on trade with China, as a trust-building measure vis-à-vis the United States and its partners in the "chip alliance."

In concluding this memorandum, we would like to reiterate that the State of Israel is in a state of displacement when it comes to planning its technology strategy, compared to other similar countries, and it needs to act quickly to narrow the gaps in addressing the emerging reality if it wants to maintain its leading position in the world. It is quite possible that the basic model of Israeli high-tech that was built on minimizing government intervention is already past its prime. In the face of the enormous investments abroad and the return to models of self-production, self-reliance, and technology coalitions, the Israeli strategy will reach its limit. We contend that just as the Israeli government decided to reshape the economy as part of the economic stabilization plan of 1985 and to align with the global trend, and despite having significant consequences for many sectors and imposing occupational change on masses of citizens and entire communities, Israel must now hold a similar discussion in the context of the tectonic change worldwide and the retreat from globalization to self-reliance and alliances.[92]

Israel needs a policy that will maintain its standing as an innovative nation and a center for high-tech entrepreneurship. The international changes in

technology indicate an accelerated pace of development that directly affects the balance of powers and leads every developed country to examine how it can maintain or improve its standing.

This memorandum is a call for a discussion on Israel's "national technology strategy" that should be held as soon as possible. For the purpose of this discussion, preparatory work is required that would define the technological infrastructure as necessary for the existence and success of the Israeli high-tech industry, enabling it to continue to drive the country's economy, despite political, climate, or other crises such as the COVID-19 pandemic. Just as the state is committed to providing energy and food security, it must also define the meaning of basic technological security for the country. Most high-tech fields, such as cyber and artificial intelligence, are applications that depend on the existence of technological hardware infrastructure, including supplying or producing chips.

The world has experienced a revolution whose essence is the understanding among the technologically advanced countries—the United States, the European Union, Japan, and South Korea—that the key to economic success is a combination of R&D capabilities and production capabilities. These countries are now working to increase their independent production capabilities. Consequently, the State of Israel must strive to increase its production footprint and to examine how to adapt the structure of the economy to these changes, in part, by using new tools to incentivize multinational companies that are interested in expanding their technological manufacturing plants. Intel alone is not enough. In the chip industry there are other players, including production companies or companies in the technological supply chain of chip production, including chip assembly, packaging, and testing companies. By encouraging activity in Israel, it is possible to develop a technological ecosystem that is more suitable for the current reality. Aside from its contribution to the entire tech industry, this could provide a stable, long-term employment solution for diverse populations in Israel.

Given the international sensitivity and the potential upheaval, Israel must ensure that it maintains a comparative advantage in the technological production process as a "strategic card" for cooperation. Israel's strategic card today is its technological advantage in R&D, which has encouraged multinational companies to continue to invest in Israel. But many countries in Europe (the Netherlands, Germany, Ireland) are closing the gap with Israel by strengthening academia and encouraging investment in research, development, and production.

The more Israel has independent production capability inside its territory, the more it will be able to reexamine industrial policy and to characterize the areas in which it is preferable to maintain a certain level of self-reliance. This is of great value when it comes to Israel's defense development and production, especially in an era when the connection between technological assets and national security is increasing. In this context, the state will need to support industries that produce critical capabilities that are vital to its security and stability.

In our view, investment in technological production must be expressed as part of a comprehensive plan of investment in education at all levels, technological training, enrichment programs at a young age in the geographical and social periphery, as well as in academia and infrastructure. Only then will it be possible to ensure the participation of different segments of the population in the prosperous high-tech industry and to help narrow gaps between populations that have had low-level participation in Israel's economy.

Israel can offer the "chip alliance" a regional advantage and serve as a gateway to the Middle East. The Abraham Accords are an opportunity for Israel to encourage technological investment in its territory and to help the United States create a clear buffer vis-à-vis the competing interests of China and Russia, which are probing and aspiring to deepen their partnerships in the region. This channel connects Israel's need for large investments to support the model proposed in this memorandum with the Gulf countries that seek

cooperation and economic benefits from the enormous opportunities that Israel's high-tech provides.

In this context, it is recommended that the state establish a national policy and define clear criteria regarding the legitimate, responsible use of Israeli technology that is acceptable to Israel and its allies, as well as the uses and customers that are incompatible with democratic values. Thus far, the state has chosen to engage in defining military technology that requires special approvals for export or dual-use technology. In the current era, completely civilian technologies could fall into the hands of those whose values contradict those of the State of Israel and could make use of Israeli technology in a way that would damage Israel's standing and reputation.

While the key to the success of the technology economy in Israel was and still is the free market that gives entrepreneurs the freedom to fulfill their potential with as few barriers as possible, we believe that the lack of a government strategy and continued reliance on the investments and successes of the private sector could undermine Israel's national security. The level of government intervention in technology throughout the world has increased, particularly as it is understood that the risks have grown. Therefore, in light of the tremendous inputs of Western countries in advancing their technological strength vis-à-vis China, huge financial investments, as well as legal frameworks of export controls, trade alliances, and coalitions of countries that define the accepted values for the use of technology in a democratic country, it is recommended that Israel adopt an unequivocal strategic stance with respect to its position on these burning issues.

EPILOGUE

In this memorandum, we attempted to study several global phenomena that are occurring simultaneously and are still in the process of developing. One of the biggest dilemmas in writing a comprehensive study of this kind is how best to refine all of the processes into a significant statement, in the hope that it will reverberate with the readers and enrich the discourse and thinking, while also providing a practical contribution to those engaged in formulating policy recommendations and decision-makers whose are responsible for directing the long-term processes that will affect the State of Israel in the coming decades so that it can optimally fulfill its aspirations for the benefit of its citizens.

For us, the best way to summarize this study is by simplifying and comparing Israeli ways of thinking to an equilateral triangle. The first side of the triangle is the deeply rooted traditional conception that the Jewish people during their 2,000 years of exile developed an exceptional ability to utilize Jewish intellect and mental capacity to survive exile and persecution, and even in some cases to thrive in exile. For a short period in Jewish history, the people of Israel, in the spirit of Herzl's vision, aspired to be a productive nation. Worldwide globalization processes affected Israel too and enabled Israelis to return to the pattern of living off of brainpower; in modern terms, we can call it an "R&D country." Our hope is that this study has shown that the world today is undergoing a process of greater fusion between research, development, and production, while separating them does not necessarily enable the State of Israel to fully realize its tremendous potential.

The second side of the triangle relates to the de facto model of the Israeli high-tech economy. Although many describe the Israeli tech industry as "surfing," the entire system is oriented toward the global trends and trying to meet the changing needs of the market. We hope that this memorandum has shown that this opportunistic model might be reaching the limits of its

ability to serve the needs of Israel's economy. The "surfing" model is suitable for a developing economy and enabled the phenomenal growth of the Israeli tech industry. But it seems that in the country's 76th year, "surfing" is no longer practical. The geostrategic processes in the world are forcing all economies to adapt themselves to changing circumstances, and it is vital that Israel also examine the basic economic model of its tech industry so that it can continue to be competitive in the emerging world order, which ties technological leadership to a system of alliances and shared values.

The third and final side of the triangle is the vision that this study is attempting to lay before its readers. Throughout the memorandum, we described how worldwide, changing geostrategic circumstances have led many countries to reexamine their technological policy. We surveyed huge investments of countries that neglected their production capabilities during the past 40 years and are now making tremendous efforts to rebuild them. In offering this theoretical foundation of a national technology plan, our hope is that readers will be provided with a window into the future image of the country. This window, if it is utilized to build a national policy and strategy, will contribute to a situation where the high-tech locomotive will continue to drive forward for decades and take Israel's economy to new heights, while creating sources of productive, advanced employment for the benefit of new and diverse populations, with the hope of enabling the largest possible number of the country's citizens to receive an equal opportunity to be part of the Israeli dream.

APPENDIX

LIST OF INTERVIEWEES (LISTED ALPHABETICALLY)

1. **Shmuel (Mooly) Eden**—served as senior VP at Intel global, CEO of the Perceptual Computing group, and president of Intel Israel. Today he is an innovation consultant for start-up companies.
2. **Aharon Aharon**—engineer, former director-general of the Innovation Authority. He was the first CEO of Apple Israel and vice-president of hardware technologies at Apple Global. Today he is CEO of the consulting company C-Perto.
3. **Major General (res.) Isaac Ben-Israel**—professor emeritus at Tel Aviv University. In the IDF he served in the air force and retired at the rank of major general after having been head of the Administration for the Development of Weapons and Technological Infrastructure. He served as chairperson of both the National Council for Research and Development and of the Israel Space Agency.
4. **Eyal Waldman**—Israeli electrical engineer, entrepreneur, and businessperson. He founded Mellanox Technologies, which was sold to the tech giant Nvidia, and today serves as the chairperson of Waldo Holdings, a private investment company.
5. **Dov Moran**—Entrepreneur and businessperson, one of the leaders of Israeli high-tech. He founded M-Systems Ltd., which invented the flash drive, and he served as chairperson at Tower Semiconductor Ltd., which develops and produces semiconductors for the electronics industry. Today he heads the venture capital fund Grove Ventures.

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86 The SWOT model—an acronym for Strengths, Weaknesses, Opportunities, Threats—is one of the most common models for planning and managing strategy and examining an organization's ability to generate a competitive advantage in the environment it is operating in (market/industry). The method analyzes the organization's internal and external environment, and based on the analyses, estimates the organization's chances of succeeding.

87 See the list of interviewees in the appendix.

88 Government of Israel, Law for the Encouragement of Industrial Research and Development, 1984, https://main.knesset.gov.il:443/Activity/Legislation/Laws/Pages/LawPrimary.aspx?t=lawlaws&st=lawlaws&lawitemid=2000783 [Hebrew].

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91 White House, "Fact Sheet: U.S.–Israel Strategic High-Level Dialogue on Technology," September 30, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/30/fact-sheet-u-s-israel-strategic-high-level-dialogue-on-technology.

92 Government of Israel, "Society and Economy, the Stabilization Plan of 1985," [Hebrew]; Meirav Arlosoroff, "The Day When Israeli Capitalism Was Born," *TheMarker*, July 1, 2015, https://www.themarker.com/news/2015-07-01/ty-article-magazine-ext/0000017f-e22f-d75c-a7ff-feaf4ba90000 [Hebrew]; Dan Giladi, "The Israeli Economy: Shock Treatment–Stabilization and its Success: 1985–1989," (Ministry of Education, 1998), https://lib.cet.ac.il/pages/item.asp?item=4129 [Hebrew]; Tom Navon and Tal Elmaliach, "The Stabilization Plan, the Kibbutzim Arrangement, and the Cognitive Failure of the Nirim Kibbutz," *Society* no. 50 (December 2011), http://hevramag.net/wp-content/uploads/2017/11/50-11.pdf [Hebrew].

In recent years the technological struggle between the United States and China has intensified. Washington has increased its efforts to deny Beijing access to advanced technologies and has announced huge investments to accelerate technological research and development, in order to secure its status as the world's strongest economic power. At the same, time, the United States is demanding that its partners join the fight and adopt a policy of restricting China's research, development, and manufacturing capabilities in the field of advanced chips. Investment in technological research, development, and manufacture is a vital component and a relative advantage that Israel enjoys, but this is only a partial solution to the problem. Israel needs a national plan to cover all aspects of the development, manufacturing, and trade in chips. This memorandum presents alternative technological policies for Israel and calls for a discussion, as soon as possible, on national technological strategy.

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