Promoting the Growth of the Semiconductor Ecosystem in the Philippines

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BETTER POLICIES FOR BETTER LIVES

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Foreword

The economic geography of the semiconductor industry is shifting, with economies worldwide increasingly striving to strengthen their presence in this critical sector. *Promoting the Growth of the Semiconductor Ecosystem in the Philippines* is part of a new series of OECD reports that analyses challenges and explores opportunities in the domestic semiconductor ecosystems in selected economies, with a particular focus on assembly, testing and packaging activities.

OECD semiconductor ecosystem studies, developed in close collaboration with key interlocutors in selected economies, offer policy recommendations to support the development or expansion of the semiconductor ecosystem. This report examines the Philippine local market and economy, identifying strengths and areas of improvement, and highlights trends, key policy priorities, and the institutional landscape relevant for semiconductor firms and the broader ecosystem.

The methodological approach builds on both quantitative analysis of economic data on the existing medium- and high-technology manufacturing industries in the economy, with a focus on the semiconductor and electronics industries and their workforce, as well as insights gathered from policy analysis and engagement with government and non-government stakeholders.

The project began in October 2023 and benefits from an on-the-ground fact-finding mission which took place in January 2024. This work was undertaken in the context of the United States-Philippines partnership under the International Technology Security and Innovation (ITSI) Fund, appropriated under the Creating Helpful Incentives to Produce Semiconductors (CHIPS) Act of 2022, and is made possible with the financial support of the United States Department of State.

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Table of contents

FIGURES

TABLES

Abbreviations and acronyms

ATP	Assembly, testing and packaging
ADMATEL	Advanced Device and Materials Testing Laboratory
ARTA	Anti-Red Tape Authority
ASEAN	Association of Southeast Asian Nations
ASPBI	Annual Survey of Philippine Business and Industry
BOI	Board of Investments
CPBI	Census of Philippine Business and Industry
DOST	Department of Science and Technology
DTI	Department of Trade and Industry
E-TRACC	Electronic Tracking of Containerized Cargo
FDI	Foreign Direct Investment
ISLE	Integrated Survey on Labor and Employment
MISSI	Monthly Integrated Survey of Selected Industries
OSAT	Outsourced Assembly and Testing Company
PATHS	Product and Technology Holistic Strategy
PSA	Philippine Statistics Authority
PCIEERD	Philippine Council for Industry, Energy, and Emerging Technology Research and Development
VAT	Value-added tax

Executive summary

The semiconductor industry, the backbone of modern digital and electronic technologies, is witnessing significant shifts in its global landscape as economies seek to strengthen their role in this strategically important sector. This report analyses the semiconductor ecosystem in the Philippines and identifies policy recommendations to help its development, with a focus on assembly, testing and packaging.

The report unpacks both quantitative and qualitative evidence. Quantitative analysis focuses on the existing semiconductor and electronics industry in the Philippines, examining its evolution and performance using both aggregate and micro-economic data, and analysing key enabling factors including infrastructure, human capital and integration into global value chains. The report also provides a mapping of the institutional and policy landscape affecting the semiconductor ecosystem of the Philippines, with deep dives into the policies affecting human capital and technology, research and development (R&D) and innovation impacting the domestic semiconductor ecosystem.

The Philippines has a vibrant ecosystem of firms active in the electronics and semiconductors manufacturing industry, which is the country's single largest export industry. This reflects the Philippines' role as a key player in assembly, testing and packaging services, ranking ninth globally by exports of chips. Locally owned and operated firms have an established presence in the sector's core niches in assembly, testing and packaging, and to a lesser extent in integrated circuit design, where they compete against international firms. Nevertheless, the OECD analysis suggests that there is room to improve labour productivity and address infrastructural and regulatory bottlenecks for the Philippine semiconductor industry. The limited role played by young firms and few recent greenfield investments from foreign firms suggest untapped potential in the Philippines.

To unlock this development, this report offers policy recommendations structured in four main areas:

- **Improve the business environment for Philippine semiconductor firms**, including by designing a long-term vision and national strategy for semiconductor industrial development, and facilitating investment by addressing regulatory bottlenecks in chemicals and business permitting. Ensuring a stable policy environment, including with respect to taxation, is essential for unlocking semiconductor investment.
- **Address the operational requirements for the semiconductor industry in the Philippines.** The semiconductor industry relies on sustainable and affordable access to key enablers, like electricity, good quality freight and logistics and infrastructure to transport goods within the Philippines and internationally. This entails encouraging more renewable energy investment, fostering competition in the logistics sector and investment in key infrastructures, including roads and airports.
- **Support the Philippine semiconductor innovation landscape**, including by continuing to facilitate access to key technological infrastructures that support the semiconductor ecosystem in the Philippines; and ensuring any new government-funded facilities are sustainably financed and respond to demand from the ecosystem. Encouraging both public and private R&D investments, including through R&D grants, is also essential.

- **Focus on demand-driven, evidence-based policies for human capital development in the Philippines**, including by ensuring education and training systems are responsive to changing needs, and building mechanisms to institutionalise already extensive and long-standing collaborations between industry and academia. Looking abroad to the Filipino diaspora and international partnerships can also help to meet ambitious goals for the development of the Philippine semiconductor workforce.

1. Assessment and recommendations

This chapter presents the overall assessment and recommendations of the OECD semiconductor ecosystem study of the Philippines. It highlights the Philippines' key strengths in the global semiconductor landscape and identifies areas of potential improvement, focusing on the business and operational environment; the technology and innovation ecosystem; and human capital.

Policy recommendations

Business and operational environment

- Design a single long-term vision and national strategy for developing the Philippine semiconductor ecosystem, with clearly defined policies, funding and goals.
- Reduce the time required for key administrative processes, including obtaining business permits and chemical licenses.
- Increase the ease of doing business, including reducing red tape and regulatory burden, also with respect to tax administration — value added tax (VAT) exemptions and refunds.
- Address burdensome administrative requirements for the semiconductor industry by easing data sharing and collaboration across government.
- Invest in renewable energy capacities through policy initiatives that have emerged as international best practices.
- Continue to invest in key infrastructures to address logistical bottlenecks for the semiconductor ecosystem, including at Ninoy Aquino International Airport in Manila.
- Encourage greater competition and address regulatory barriers to reduce the cost of freight and logistic services.

Technology, research and development (R&D), innovation and business support

- Prioritise public R&D funding from the government, higher education institutions and firms, particularly by expanding the use of R&D grants.
- Protect and possibly expand effective programmes that enable semiconductor firms, such as the national testing facility ADMATEL, to access technology.
- Assess the presence of a sustainable business model, including demand and key skills, prior to the development of a local laboratory-scale wafer fabrication facility.

Human capital

- Map the relevant skills required for the Philippine semiconductor industry and their forecasted demand.
- Provide a concrete work plan and timeline to reach the goal of 128 thousand semiconductor engineers and technicians by 2028.
- Review the governance of institutions involved in skills development for the semiconductor industry to ensure that skills programmes are sufficiently responsive to industry needs.
- Develop mechanisms to encourage more partnerships between universities and semiconductor companies and use lessons from these partnerships to update curricula and develop more demand-driven systems.
- Utilise international partnerships to help train instructors and professors of semiconductor-related programmes and technologies.
- Deploy further efforts to incentivise the repatriation of the Filipino diaspora with semiconductor-related skills, including through the expansion of programmes like the Balik Scientist Program.

The Philippines has a vibrant ecosystem of firms active in the electronics and semiconductor manufacturing industry. Electronics and electrical products are the single largest Philippine export industry, accounting for almost 60% of total Philippine merchandise exports. Most of these exports are finished semiconductor products that are subsequently incorporated into electronic devices, reflecting the Philippines' role as a key player in assembly, testing and packaging services. Locally owned and operated firms have an established presence in the sector's core niches and to a lesser extent in integrated circuit design, where they compete against international firms. However, the OECD economic analysis (see Chapter 2) indicates room for improved labour productivity and reduced costs within the Philippine semiconductor industry; relatively few young firms and limited recent greenfield investments from foreign firms suggest untapped potential.

This chapter provides tailored policy recommendations to help the Philippines build on its existing strengths in assembly, testing and packaging and unleash growth in the local semiconductor ecosystem. Governments must carefully assess all spending decisions in a constrained fiscal environment to retain budget neutrality and identify crucial investment areas that support the development of the semiconductor ecosystem. The following sections provide recommendations on prioritising expenditures in key areas for such development in the Philippines.

The business and operational environment for Philippine semiconductor firms

The Philippines has a vibrant and diverse semiconductor industry, a young English-speaking workforce and strong links between the industry and academia. With these advantages, the Philippines should be well positioned to benefit from investments in the semiconductor industry deployed in the near future. Nevertheless, several business and operational environment improvements are necessary for the Philippines to fully seize current opportunities. These policy recommendations address the business and operational environment, with a particular focus on changes that can be implemented swiftly. They could reduce costs and increase performance for firms in the industry.

Design a coherent long-term vision and national strategy for developing the Philippine semiconductor ecosystem

The Philippines boasts key advantages for investments in the semiconductor industry and a number of existing, successful programmes and policies are in place to support local firms. Moreover, the Philippines government and leading policy makers have publicly announced their commitment to encouraging the development of the local semiconductor ecosystem.

To better communicate these plans, ambitions and policies, the Philippines could establish and publish a single medium- to long-term strategy for the industry, co-developed by all relevant public agencies and stakeholders (industry, research community, civil society and trade unions). This approach would provide a single reference point to understand the landscape of policies and incentives relevant to the ecosystem. Furthermore, developing a strategy would help all parts of government streamline their policy-making efforts. Clear benchmarks and policy plans would communicate the Philippines' vision for the semiconductor industry and further demonstrate a long-term commitment to policy and programme continuity.

The Philippines has already progressed towards developing a coherent long-term vision and national strategy for the semiconductor ecosystem. First, several relevant policy documents already exist, including a technology-focused roadmap from the Department of Science and Technology (DOST) (DOST, 2023[1]) and a previous electronics industry development plan from the Board of Investments (BOI) (BOI, 2013[2]). These and other documents could serve as a foundation for a single, coherent semiconductor strategy.

The Philippines is already home to a high degree of collaboration among government and non-governmental stakeholders in the ecosystem, which could help ensure a collaborative and well-developed strategy that meets the needs of all stakeholders. For example, an existing electronics sectoral working group composed of representatives from relevant government agencies and the industry could be expanded to encompass other non-governmental stakeholders, to include different perspectives from the technical and research community, civil society and trade union representatives.

Such a strategy could also help address several interrelated challenges noted by stakeholders. The first relates to a lack of awareness or clarity about government policy initiatives available to the semiconductor industry. For example, understanding the utility of key technology initiatives could foster a virtuous cycle of technological development. A second issue relates to inter-agency co-ordination of these initiatives: stakeholders note that similar initiatives are led by different government branches, suggesting streamlining opportunities. For example, regional innovation hubs and regional inclusive innovation centres in the Philippines are administered by two different departments.

The third challenge relates to the continuity of policies and programmes. Some stakeholders benefitting from highly successful government programmes that encourage and support technological adoption note a lack of confidence in their long-term funding. Some firms have noticed that recent taxation reforms have affected investment incentives and confidence in the stability of the wider investment environment. Finally, although the government has made publicly announced goals for the semiconductor industry, it could establish a more concrete roadmap to achieve these aims (see section below on human capital development and Chapter 3).

To best address these challenges, a public, government-led strategy would have clear advantages over internal, unpublicised roadmaps or industry-led strategies. A government-led and authored strategy disseminated publicly would demonstrate a political commitment to the semiconductor industry in the Philippines and abroad. While the government has funded private sector-led strategies, like the Product and Technology Holistic Strategy (PATHS) roadmap, such a strategy is likely to risk incoherence with other strategic public goals. Moreover, a government-led strategy developed in conjunction with relevant non-governmental stakeholders has positive collaborative spillovers for the broader ecosystem.

Such a strategy should highlight the key goals for developing the semiconductor industry in the Philippines. Given the existing landscape of Philippine assembly, testing and packaging firms, one such goal could include encouraging these firms to move up the value chain by enhancing the technology intensity and value added to their operations through increased investments in innovation and human capital. The strategy should also include clear commitments to medium- to long-term government programmes in the semiconductor ecosystem. For example, long-term continuity or expansion of funding for key initiatives (like the Advanced Device and Materials Testing Laboratory, ADMATEL) or an expansion of grants available to innovating firms could signal a strong commitment to the development of the Philippine ecosystem (see section below on technology and Chapter 3). Similarly, a key focus could include concrete plans to meet human capital requirements in the semiconductor industry (see section below on human capital development).

Facilitate investment by continuing to address regulatory bottlenecks for the semiconductor industry

The importance of coherent, fair, clear and predictable regulation for investment is well recognised by the Philippine government, which has a long-standing focus on improving the business climate. Successive development plans have identified regulatory streamlining as a key priority to encourage international investment. Some of these efforts have been very successful: for example, the Philippine Economic Zone Authority (PEZA) has a strong reputation for its investment facilitation and promotion services. The passage of the Ease of Doing Business and Efficient Government Service Delivery Act in 2018, with its focus on regulatory streamlining, has helped simplify procedures, reduce red tape and expedite transactions. New efforts in regulatory impact assessment under the Anti-Red Tape Act and through the Anti-Red Tape Authority (ARTA) are also positive signals to prospective international investors.

Still, some concerns about the regulatory climate remain, affecting investor confidence. For instance, firms highlight delays in receiving necessary permits — e.g. business permits administered by local government units. For issuing business permits, the government has partnered with local government units to help standardise and digitalise the process (ARTA, 2024[3]), while ARTA has provided guidelines to local government units (2021[4]). Still, stakeholders note continued concerns about the process of receiving these permits. Bottlenecks at the local level can spread because business permits typically act as prerequisites for other licenses from other public agencies, such as the Bureau of Customs (BSP, 2023[5]).

Similarly, lengthy processes linked to necessary inputs can represent bottlenecks for just-in-time semiconductor manufacturing processes. For example, the regulatory process for acquiring controlled chemicals used in semiconductor manufacturing, which also have applications in other regulated or controlled activities, has been reported as slow, with issues stemming from unclear regulatory requirements and poor or insufficient co-ordination. The Philippine government is aware of the issues in chemical permit delivery and making progress through regulatory impact assessment, close stakeholder engagement and the implementation of the Philippine Chemical Industry Roadmap, though challenges persist.

Finally, duplicative regulations and reforms can raise costs for the semiconductor industry. For example, the implementation of the Electronic Tracking of Containerized Cargo (E-TRACC) system by the Bureau of Customs duplicated existing systems in economic zones, increasing administrative burden and highlighting co-ordination issues within the Philippine government.

Beyond existing efforts, administrative simplification represents an important means of improving the regulatory environment and of helping the semiconductor industry and the broader business environment. Success stories from PEZA or local government units in addressing administrative challenges should be disseminated and implemented further. Greater resources for burdened public agencies to reduce administrative delays could also have a tangible impact on the local industry. Government agencies should be incentivised to co-ordinate, ensure consistent, streamlined regulatory application and minimise burdens on relevant firms. Better digitalisation of government processes and data-sharing agreements, such as those already in place between the Bureau of Customs and PEZA, could be expanded or adapted to address co-ordination issues across government agencies.

Finally, the developing one-stop-shop system under the Green Lanes mechanism, established by Executive Order No. 18 in 2023, could also provide lessons for the regulatory streamlining of priority projects in the semiconductor industry. Green Lanes has supported billions of pesos of investment in renewable energy in the Philippines; although the electronics industry is a key target for the initiative, no semiconductor investments have made use of this initiative to date. A key factor of the programme's success to date appears to relate to BOI officers' dedicated time and expertise in identifying and addressing bottlenecks across several levels of government. The government could consider proactively extending dedicated support to the semiconductor industry to help address regulatory bottlenecks through the Green Lanes or other investment promotion programmes.

Continue efforts to address taxation issues experienced by firms

In 2023, the CREATE Act was enacted to make the Philippines competitive in the region by lowering corporate income tax rates and rationalising fiscal incentives, including VAT exemptions, granted to registered business enterprises. However, the administration of zero-VAT rating for suppliers as part of the CREATE Act reforms has been noted as lengthy, with delays in the VAT exemption application process for suppliers of registered export enterprises and in receiving the relevant refunds.

In collaboration with the Department of Finance, the BOI continues to work towards a simpler and more efficient VAT regime through the CREATE MORE Bill, which is currently under consideration in the Philippine parliament. Aside from proposing amendments for a simplified tax refund system for registered business enterprises and implementing a risk-based classification of claims and audit framework in collaboration with the Commission on Audit, the bill also clarifies the VAT regime for registered business enterprises and effectively seeks to restore the VAT zero-rating of suppliers of registered export enterprises. Fully addressing these issues would build investor confidence and increase competitiveness for electronics and semiconductor exporters in the Philippines.

Learn lessons from abroad when incentivising investments in renewable energy

Sustainable and reliable electricity at competitive prices is necessary to operate semiconductor manufacturing facilities, including in the assembly, testing and packaging stage of the value chain. However, the provision of this utility service in the Philippines remains challenging. Firms report that energy costs in the Philippines are among the highest in Southeast Asia and electricity outages are common (Francisco, 2022[6]).

Stakeholders highlight that the forecasted demand for energy exceeds the available supply, particularly as the Philippines transitions to renewable energy sources under the Philippine Energy Plan, which seeks to increase the share of renewable energy in power generation to 50% by 2040. In addition to contributing to the Philippines' own climate goals, renewable energy is increasingly a consideration for semiconductor companies as part of their global environmental, social and governance goals. Enhancing efforts towards renewable energy while reducing the cost of electricity would increase the Philippines' attractiveness as a destination for semiconductor investment.

While the causes of high prices in the Philippines are multi-faceted, public commitment to diversifying energy sources and modernising energy infrastructure in the Philippine Development Plan are encouraging. Similarly, extending fiscal incentives to firms that invest in energy efficiency projects under the Renewable Energy Act of 2009 and the CREATE Act is also an important step in the right direction, as are concurrent efforts enabling foreign investment in the sector. The BOI issued Memorandum Circular 2023-006 to allow tax incentives and duty exemption on imports of capital equipment, raw materials, spare parts or accessories for self-financed energy efficiency projects. This policy is the government's response to electronics companies' need to green their supply chains in order to remain competitive in the export market.

However, the Philippines could learn from lessons abroad when considering instruments designed to encourage investment in renewable energy. For example, production grants are a common mechanism to support the renewable energy ecosystem. Contracts for difference, a long-term agreement where the government or a public entity guarantees a fixed price (strike price) for electricity generated from renewable energy sources, can help to stabilise prices and producer revenues (see also Box 3.3). Both kinds of policies can reduce the cost of capital and incentivise investment in energy production assets with high fixed (and often sunk) costs. A mix of such incentives could help encourage firms to invest in renewable energy, boost energy supply and address high power costs.

Improve competition in the freight and logistics sector

Freight and logistics services are required to receive the inputs necessary for semiconductor firms to operate within globally or regionally integrated production networks, facilitate reliable, just-in-time delivery of inputs and ship finished products to the end user. However, the domestic semiconductor industry considers the cost of freight and logistics services in the Philippines to be high compared to other economies in the region. Analysis in Chapter 2 highlights that transportation could be improved to strengthen the performance of the electronic component manufacturing industry in the Philippines. More generally, better logistics are key to increasing a country's economic development by facilitating international trade and improving competitiveness.

As an archipelagic country, maritime freight is particularly important for the Philippines. Maritime freight is used for imports of key semiconductor inputs, including those stable and less sensitive to light and heat. The OECD has identified key barriers to competition in the sector, which affect its competitiveness (OECD, 2021[7]). Chief amongst these is a perceived or real conflict of interest for relevant regulatory authorities, and barriers to foreign investment stemming from the legislative designation of seaports as a public utility. A complex regulatory structure involving overlapping agencies, governing authorities, licenses and regulatory permits can further limit competition (PCC, 2021[8]).

Encouraging greater competition in freight and logistics could help encourage carriers to serve other airports and seaports in the Philippines, including those closer to semiconductor firms outside metropolitan Manila. The Philippines should, therefore, seek to foster competition in the sector, notably by encouraging regulatory independence and separating the functions of relevant authorities (OECD, 2021[7]).

Continue to invest in infrastructure to encourage better movement of goods within the Philippines and internationally

Similarly, transport infrastructure in the Philippines is noted as a challenge for the semiconductor and other exporting industries. While air transport represents a small share of overall freight, most semiconductors and other electronic products are shipped by air to allow for just-in-time production processes in globally integrated production networks. In the case of the Philippines, almost all semiconductor products are exported through Ninoy Aquino International Airport in Metro Manila. Road infrastructure, which is required for the internal transport of inputs in the Philippines, is less developed than other Southeast Asian neighbours.

The Philippine government is increasing investment in infrastructure, with several projects and initiatives now being implemented to address concerns related to the movement of goods within and outside the Philippines. The Department of Transportation is working on fully utilising Clark International Airport, approximately two hours north of Metro Manila and located near some semiconductor firms. Through the Build Better More infrastructure programme, the government is also building the New Manila International Airport in Bulacan and developing key road infrastructure projects to improve the access between industry and key ports.

More investments in these key infrastructures could help diversify options, reduce costs and alleviate potential bottlenecks in the local semiconductor industry. Investing in Ninoy Aquino International Airport and diversifying the options for airborne freight could help reduce this potential bottleneck for the semiconductor and other industries that rely on air freight.

Technology, R&D, innovation and business support

The analysis of the Philippine electronic component manufacturing industry in Chapter 2 highlights important improvements that could be made to enhance firms' productivity and overall performance. This section provides recommendations on prioritising expenditures on technology and innovation policies to further the goals related to the semiconductor ecosystem.

Focus on increasing government and business expenditure on R&D

The Philippines faces a significant challenge in its low gross expenditure on R&D as a percentage of gross domestic product, which stems from inadequate government and business investment. Additionally, Chapter 2 highlights the need to boost productivity in the electronic component manufacturing industry, as well as address the low share of researchers per capita, where the Philippines trails its counterparts in Southeast Asia by a wide margin. Prioritising investment in R&D is crucial, as it enhances absorptive capacity, fosters innovation and drives the development of new technologies and the refinement of existing products and processes. These advancements can lead to wider economic benefits, such as increased productivity and improved living standards. Moreover, increased R&D investment could strengthen absorptive capacity and help develop a more efficient local supply chain that meets the requirements of back-end manufacturing exporters.

To further catalyse the semiconductor ecosystem and increase its productivity and innovative capacity, the Philippines should increase its investments in R&D and innovation by both the public and private sectors. For public R&D, a key focus could include greater funding in areas supporting the ecosystem, including material sciences and electronic engineering. Strong commitments to continued support for pivotal programmes, like ADMATEL and the Centre for Integrated Circuit Design and Device Research (CIDR), are key for the sector. This would also demonstrate a public commitment to developing the semiconductor industry (see the section on semiconductor firms' business and operational environment).

Among the most efficient means to encourage firms to invest in R&D, targeted R&D grants can complement existing efforts in the CREATE Act to offer R&D tax incentives. Through the DOST Philippine Council for Industry, Energy and Emerging Technology Research and Development, the Philippine government provides R&D grants to research projects led by government research and academic institutions and the private sector in key priority areas. While electronics is a priority industry, few ongoing or completed projects have been related to the semiconductor industry or core semiconductor technologies, suggesting potential scope for improvement (DOST-PCIEERD, 2022[9]).

Effective efforts to facilitate access to technology for semiconductor firms are laudable and should continue

Publicly funded shared innovation and technology facilities can enable access to technology for the local semiconductor ecosystem. Typically, well-designed programmes target specific needs, reduce prohibitive fixed costs that otherwise stifle innovation or production, and encourage positive spillovers between industry and the technical community.

The Philippines already boasts several successful programmes that meet these criteria and support the competitiveness of the local semiconductor industry. The government-funded national testing facility ADMATEL is chief amongst these, enabling access to advanced failure analysis and laboratory testing capabilities. This facility provides the local ecosystem access to state-of-the-art services, helping local assembly, testing and packaging firms provide competitive services. In addition, ADMATEL also facilitates increased research on additive and material sciences, which could help firms increase the technology intensity of their production and, therefore, move up the value chain. ADMATEL and other similarly effective programmes should be protected and potentially expanded, including closer to hubs for assembly, testing and packaging in Calabarzon and Luzon.

The Philippines should ensure that all expenditures on publicly funded infrastructure are targeted, sustainable and undergo an impact assessment before and during implementation. Typically, proposals for publicly funded infrastructure are administered by DOST, where the technical and financial viability of the project is assessed. Following this process, a governing council composed of several government agencies and private sector representatives assesses the proposal before it is finally approved by the DOST executive committee led by the DOST secretary.

In contrast to ADMATEL, efforts to develop a local laboratory-scale wafer fabrication facility to encourage faster testing of semiconductor designs could be premature. Before committing to the considerable expense of such a facility, the government should first identify a sustainable business model. This includes investigating whether sufficient demand from industry or academic stakeholders exists and whether other core foundational requirements for the facility, like adequately trained workers or relevant infrastructure, are met. In the case of this facility, beyond the extensive DOST-led process outlined above, additional consultation may be warranted to identify whether other options or facilities, such as support for multi-project wafer services, could adequately address the needs of local stakeholders. The Philippine government has initiated a feasibility study on establishing the wafer fabrication facility to be completed in the coming months.

Human capital development for Philippine semiconductor firms

Skills and workforce development are key factors in attracting semiconductor investments and encouraging the long-term sustainability and performance of the existing ecosystem. The analysis of the Philippine electronic component manufacturing industry in Chapter 2 highlights important scope to improve labour productivity in the semiconductor ecosystem in the Philippines, and challenges associated with shortages and retention of key skills. The following section provides recommendations for building skills in the Philippines.

Skills policies, policy making, and governance should remain demand-driven and evidence-based

Human capital is a key input for Philippine semiconductor firms and workforce development remains a major policy priority for semiconductor ecosystem development worldwide. Employers cite a shortage of skilled engineers to meet the needs of the established assembly, testing and packaging sector and the developing integrated circuit design industry in the Philippines. Chapter 2 of this report also underscores that vacancies for highly skilled workers are hard to fill in the Philippine electronic components industry.

In response, the BOI recently announced a target of training 128 thousand additional engineers and technicians by 2028, although a timeline or work plan to achieve this goal has not yet been made public. The Philippine government should also announce the specific actions to be undertaken to reach this goal to demonstrate a tangible commitment to the semiconductor industry (see section on firms' business and operational environment). The Philippine government, through the BOI, is drafting a plan to realise this goal, which would include efforts to target electronics industry jobs at students. This plan and relevant policies should be included in a holistic and public strategy for the Philippine government's vision for the semiconductor ecosystem (see section on firms' business and operational environment).

This public statement of intent in building the workforce for the Philippine semiconductor ecosystem is encouraging for international investors and the local industry. However, this goal must reflect the projected demand for engineers in the sector. Assessing this demand requires strengthening labour market information systems. Mapping the skills required by the national semiconductor industry would help provide more details about public commitment: this effort could contribute to the Department of Trade and Industry's Philippine Skills Framework, which currently does not feature the industry (see section above on firms' business and operational environment). Similarly, technical and vocational education and training (TVET) is a key means of training graduates and encouraging labour force mobility; however, the existing national TVET plans do not prioritise the semiconductor industry.

Beyond the number of graduates, it is paramount that curricula meet the needs of industry. Chapter 2 highlights that firms in the electronic components industry carry out extensive on-the-job training, much more than the rest of the manufacturing sector and for even the most junior of staff. This indicates that current graduates are not fully meeting the skills required by the industry. The governance of higher education should be reviewed to ensure that curricula design is responsive to technological development and skills needs in the semiconductor industry. The Commission on Higher Education (CHED), as the sole organisation responsible for the formulation of policies, standards and guidelines in all higher education institutions, holds a particular responsibility in ensuring that science, technology, engineering and mathematics curricula, and in particular engineering, remain consistent with international best practice and the needs of the local industry. Moreover, care should be taken to ensure that the primary and secondary education systems can adequately equip learners with the foundational skills required to thrive in future technical careers. Greater horizontal co-ordination (e.g. with other government agencies like the Technical Education and Skills Development Authority, TESDA, and the Department of Education) and vertical co-operation (including with trade unions and civil society groups) can help ensure that skills frameworks remain responsive.

In the context of human resource development, a new programme from the Philippine government on "Academe-Industry Matching" aims to improve the alignment between academic education and industry needs, targeting basic education, higher education and technical and vocational education. In this context, the BOI is understood to have signed memoranda of understanding with CHED and with the Department of Education which would explore options for increasing the responsiveness of educational pathways to skills demand, including updating curricula, developing courses and training instructors. Similarly, the BOI is collaborating with TESDA to consider the industry's needs in technical training regulations. These laudable policy efforts should be developed in collaboration with all key stakeholders in the semiconductor ecosystem and incorporated into the longer-term vision and strategy for the ecosystem (see section on firms' business and operational environment).

Bilateral and ad hoc industry-academia linkages in skills development should be institutionalised

The Philippine semiconductor ecosystem features a strong degree of collaboration between government agencies, industry and academia, leading to mutually beneficial collaborations and successful government programmes. However, even if collaboration between universities and the semiconductor industry is deep and well established in skills development, it is not institutionalised. Typically, individual companies sign memoranda of agreement or understanding with individual universities, which can be used to endow faculty positions or fund scholarships and enable easier provision of training to students or teachers. These arrangements also help ensure a steady pipeline of human capital to semiconductor firms.

These bilateral relationships are a clear local strength for the Philippine semiconductor ecosystem, which the government should support. For example, this could include the development of template agreements or a one-stop shop within a relevant government agency to better enable universities and firms to enter into agreements.

The CIDR, a network of government-funded facilities, was established to serve as a research platform between industry and academia to ensure medium- and long-term technological competitiveness. It specifically acts to share resources among universities and enable human capital development. It could also act as a means of enabling more institutional collaboration, particularly for workplace-based learning, between the semiconductor industry and academia. However, the CIDR currently only focuses on developing the integrated circuit design landscape in the Philippines. In contrast, most of the existing ecosystem and workforce is in back-end semiconductor manufacturing, notably assembly, testing and packaging. Expanding the scope of the CIDR or developing separate resources to encourage more systematic training relationships between industry and the education and training system could help encourage more skilled workforce participation in the Philippine assembly, testing and packaging industry, thereby boosting labour productivity in the electronic component manufacturing industry.

Further, the benefits of these collaborations should be leveraged to ensure that their benefits can reach more universities and students. For example, input from individual firms on training programmes at specific universities could be used to update national curricula and train instructors in other universities. This could also enable a broader range of semiconductor-relevant skillsets, which would help achieve the government's ambitious target of training 128 thousand engineers and technicians by 2028 (see also above).

Harness international ties to meet domestic priorities for human capital in the semiconductor industry

The international semiconductor industry is a key source of knowledge and skills that can help to strengthen the existing Philippine semiconductor ecosystem. The Philippines should deepen relationships with other economies and the institutions, companies and universities within them to help achieve its ambitious semiconductor human capital goals. In particular, international ties could be strengthened by leveraging relationships with universities abroad, such as forging partnerships with international universities to train instructors in new semiconductor-related technologies or develop specialised or dual courses. The AIM! Programme is understood to also include a focus on supporting internationalisation initiatives and enabling collaboration across borders in higher education.

Similarly, the Filipino diaspora remains a key source of potential talent for the local semiconductor industry. Stakeholders note that Filipino workers already work abroad in the semiconductor industry in other regional economies, such as Malaysia, Chinese Taipei or Thailand. The Philippines could learn from efforts in other jurisdictions to attract the skilled diaspora through fiscal incentives and other benefits related to housing and employment. Existing initiatives, like the Balik Scientist Program, could be expanded to target the semiconductor ecosystem and provide useful lessons.

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2. Examining the domestic Philippine semiconductor ecosystem, with a focus on assembly, testing and packaging

The chapter provides a quantitative analysis of the semiconductor ecosystem in the Philippines, examining its industrial composition and evolution in terms of employment, revenues, expenditures, value added, and labour productivity. The analysis presents a mixed picture: while semiconductors remain a key export and strength for the Philippines, the industry has struggled to achieve sustained growth in recent years. The chapter highlights that foreign direct investment, which has historically fostered the ecosystem, has not increased in recent years. Critical cost factors such as electricity and logistics are relatively expensive, and the Philippines, despite remaining a crucial actor in the global semiconductor landscape, is not strengthening its foothold in global value chains. To address these challenges and improve its position in the semiconductor value chain, the Philippines can continue investing in its human capital and foster technological innovation, where promising signs emerge.

The semiconductor industry has had a presence in the Philippines since the 1970s, when foreign semiconductor companies Fairchild, Intel and Texas Instruments opened back-end manufacturing plants, spurring a local landscape of both domestic and foreign semiconductor assembly, testing and packaging (ATP) firms. While the electronic component manufacturing sector is the highest export sector of the Philippines, its performance has been challenged over the past decade, without sustained increase in labour productivity and expenses outstripping income for many firms. For statistical purposes, most semiconductor activities are captured under the manufacturing of electronic components. However, this category may not fully capture the activities of a nascent local industry in semiconductor design. To better understand these different stages of the semiconductor value chain, please refer to Annex A.

The following section provides an overall assessment of the Philippine semiconductor industry, focusing on downstream ATP segments where possible. The chapter's first section will present evidence regarding the industry's performance using macroeconomic, sectoral and firm-level data. Later sections will examine common elements of the expense structure for firms, like electricity and logistics, and specifically focus on the skills in the industry and the broader economy, the integration of the domestic ecosystem into global value chains and the state of semiconductor innovation and technology in the Philippines.

Market structure

Key players in the Philippine semiconductor industry

Semiconductors represent an important portion of the Philippine economy within the broader electronics sector. In December 2023, electronics exports alone accounted for 58.4% of Philippine merchandise exports (PSA, 2023[1]; 2024[2]). Of this share, approximately 70% can be directly attributed to semiconductors: in 2021, out of more than USD 42 billion in Philippine exports of electronic products, approximately USD 31 billion was due to semiconductors (PSA, 2022[3]).

The history of the electronics industry in the Philippines dates back to the 1970s, when the country began to attract foreign investments in manufacturing, particularly in semiconductor assembly and testing. By the 1970s, multinational corporations such as Intel and Texas Instruments had established operations in the Philippines, making the country one of the early hubs for electronics manufacturing in Asia. The availability of a skilled, English-speaking workforce and competitive labour costs further bolstered the industry's growth, positioning the Philippines as a key player in the global electronics supply chain.

The Philippine semiconductor ecosystem is diverse, featuring local and international firms of varying sizes and business models. An overview of the companies active in the semiconductor ecosystem in the Philippines is presented in Table 2.1. The table highlights the ecosystem's main strength: downstream activities (i.e. ATP), as illustrated by the presence of outsourced assembly and testing companies like Amkor Technology, Automated Technology (ATEC) Philippines, Cirtek Electronics Corporation, Fastech and Integrated Micro-Electronics (IMI) as well as ATP facilities from international integrated device manufacturers like Analog Devices, OnSemi and Texas Instruments. This segment of the value chain also accounts for the most employees.

While no semiconductor fabrication facilities (front-end manufacturing) have been set up in the Philippines to date, there is a nascent integrated circuit design industry, with domestic players like ESi Labs and Xinyx Design Consultancy and Services Inc. (hereinafter referred as Xinyx) and the presence of design centres from international firms like Analog Devices. Their planned investment in a research and development (R&D) centre located in Cavite highlights the Philippines' growing presence in this part of the value chain.

Unlike other economies in the region, several of the key players active in the Philippine semiconductor ecosystem are domestic firms, including the aforementioned ATEC Philippines, Cirtek, ESi Labs, Fastech, IMI and Xinyx. Many key semiconductor firms highlighted in Table 2.1 are active members of the

Semiconductor and Electronics Industries in the Philippines Foundation (SEIPI) (see Chapter 3), which, together with the other leading Philippine electronics business association, the Electronics Industries Association of the Philippines (EIAPI), collaborates with the government in developing public policies for the semiconductor ecosystem.

Table 2.1. Key players in the Philippine semiconductor ecosystem

Company name	Activities in the Philippines	Locations	Start of operation in the Philippines	Number of establishments	Number of employees (2022)	Domestic ownership
P. IMES Corps.	Equipment manufacturer	Rosario (Cavite/Calabarzon)	1993	1	1 473	No
Teradyne	Equipment manufacturer	Lapu-Lapu (Cebu/Central Visayas)	1996	1	1 000-5 000 2 800	No
ESi Labs	Design	Muntinlupa (Metro Manila)	2020	N/A	50	Yes
Xinyx	Design	Muntinlupa (Metro Manila)	2009	N/A	250	Yes
Allegro MicroSystems	ATP	Parañaque City (Metro Manila)	1975	1	3 000	No
Amkor Technology	ATP	Muntinlupa (Metro Manila); Biñan (Laguna/Calabarzon)	2000	2	n/a	No
Analog Devices	ATP and design	General Trias (Cavite/Calabarzon)	1982	1	n/a	No
ATEC Philippines	ATP	Cabuyao (Laguna/Calabarzon)	1987	1	800+	Yes
Cirtek Electronics Corporation	ATP	Biñan (Laguna/Calabarzon)	1984	1	430	Yes
Fastech	ATP	Cabuyao (Laguna/Calabarzon)	1983	1	400	Yes
Ibiden	ATP	Santo Tomas (Batangas/Calabarzon)	2000	1	2 300	
Integrated Micro-Electronics Inc.	ATP	Biñan (Laguna/Calabarzon)	1980	3	14 076	Yes
Lattice Semiconductor	ATP	Muntinlupa (Metro Manila)	Unknown	1	n/a	No
Microchip Technology	ATP	Calamba (Laguna/Calabarzon); Muntinlupa (Metro Manila); Cabuyao (Laguna/Calabarzon)	2004	3	n/a	No
Murata Manufacturing	ATP	Tanauan (Batangas/Calabarzon)	1998	1	3 600	No
Nexperia	ATP	Cabuyao (Laguna/Calabarzon)	1981	1	2 000	No
OnSemi	ATP	Carmona (Cavite/Calabarzon); Tarlac City (Tarlac/Central Luzon); Lapu-Lapu (Cebu/Central Visayas)	1999	3	4 547 in Carmona	No
ROHM	ATP	Carmona (Cavite/Calabarzon)	1989	1	4 906	No

Company name	Activities in the Philippines	Locations	Start of operation in the Philippines	Number of establishments	Number of employees (2022)	Domestic ownership
Samsung	ATP	Calamba (Laguna/Calabarzon)	1997	1	7 103	No
STMicroelectronics	ATP	Calamba (Laguna/Calabarzon)	2008	1	2 000	No
Telford	ATP	General Trias (Cavite/Calabarzon)	2000	1	1 300	No
Texas Instruments	ATP	Clark (Pampanga/Central Luzon); Baguio (Benguet/Cordillera Administrative Region)	1979	2	n/a	No

Note: The 22 companies included in this table were selected based on a consultation with Filipino stakeholders, following in-depth desk research aimed at identifying the key players in Philippine semiconductor ecosystem.

Understanding the evolution of the Philippine electronic component manufacturing industry: Insights from sectoral data

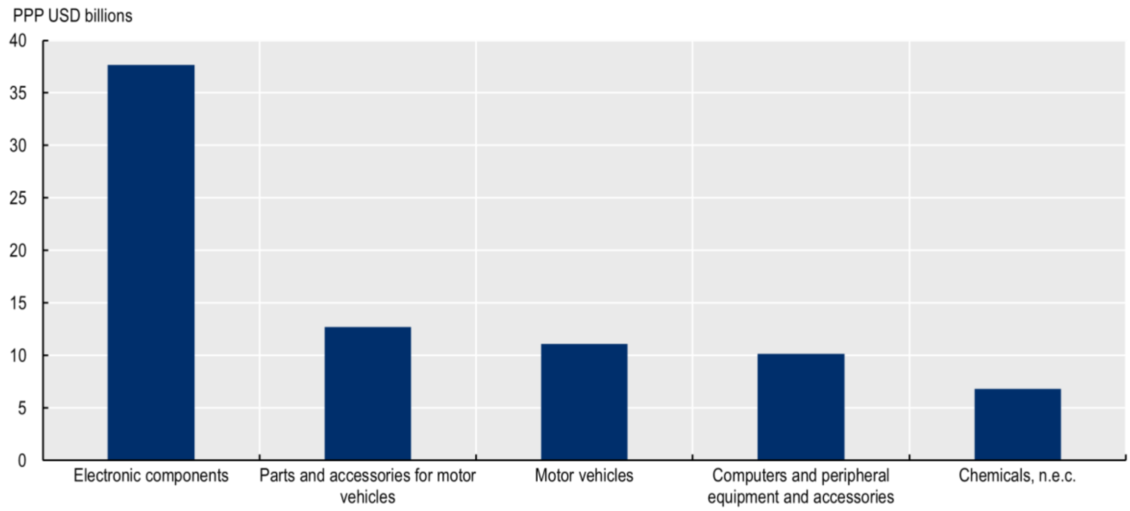
Sectoral data help highlight the evolution of the market structure and firm dynamics and differences in performance between the electronic component manufacturing industry and the manufacturing sector in the Philippines. For statistical purposes, the sector "Manufacture of electronic components" (also shown as Sector C261) encompasses firms engaged in back-end manufacturing, including ATP, but may not fully capture the nascent Philippine semiconductor design industry.[1] Semiconductors represent over 70% of electronic component exports, highlighting its sizeable role within the industry (PSA, 2024[2]). This sectoral analysis is complemented by an analysis of firm-level data in the following section.

While manufacturing electronic components, particularly semiconductors, remains a key industry for the Philippines, the sector has not experienced sustained growth over the last decade. Revenues and value added have largely plateaued and foreign investments have not increased. While exports of chips, the Philippines' main electronics export, have increased overall, the share of global exports attributable to the Philippines in this critical area has slightly decreased.

Electronic component manufacturing, which encompasses semiconductor back-end manufacturing activities, was the largest medium and high-tech manufacturing industry by revenue in the Philippine economy in the last available period, generating over PHP 719 billion (USD 38 billion)[2] (Figure 2.1) (for more information on medium and high-tech manufacturing industries – a subsector of the manufacturing sector – see Horvat and Webb (2020[4]).[3] The automotive industry, a key source of demand for semiconductors, is another significant area of economic activity in the Philippine economy: the manufacture of vehicles and their parts constitute the second and third-largest industries by revenue in the Philippines in 2021. Computer manufacturing was the fourth-largest manufacturing industry by revenue, highlighting the importance of electronics for the Philippine economy.

Over the past decade, the electronic component manufacturing industry (C261) has experienced volatile revenue performance. Between 2013 and 2014, revenues plummeted, to then recovered until the period 2018-19, which they started growing again (Figure 2.2). This contrasts with the performance of the broader manufacturing sector, which experienced steady growth from 2013 until the onset of the COVID-19 pandemic in 2020.

Figure 2.1. Revenues from Philippine industries in the medium and high-tech manufacturing sector, 2021

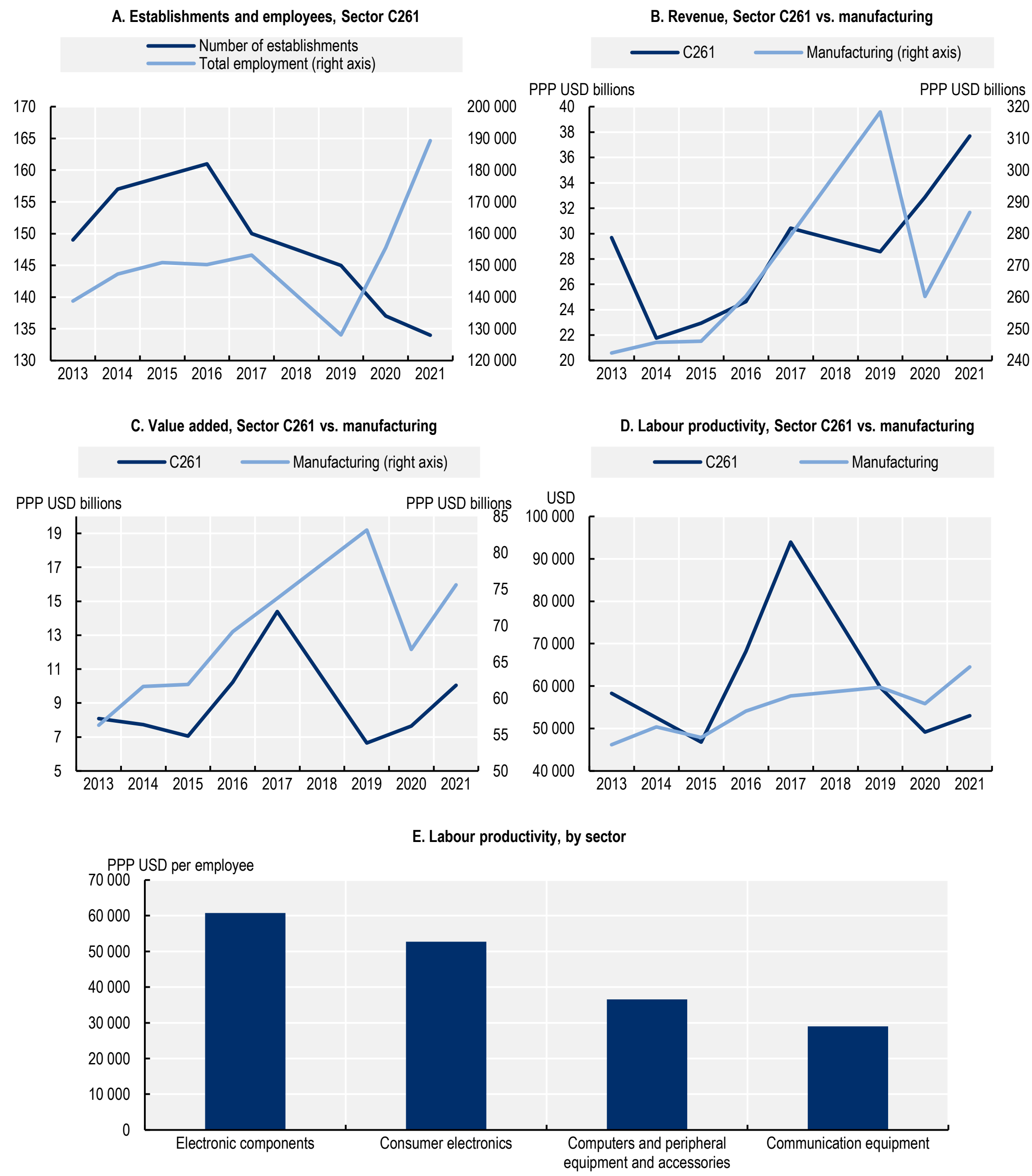


Note: The top five medium and high-tech manufacturing industries by revenues (in 2021) are represented. The industries are defined based on the 2009 Philippine Standard Industrial Classification (PSIC). The "Manufacture of electronic components" (Sector C261) is the main sector under consideration. Revenues are measured in purchasing power parity (PPP) USD billions. The main headings under this class include: "Manufacture of electronic valves and tubes" and "Manufacture of semiconductor devices and other electronic components".
Source: OECD calculations based on the Philippine Statistics Authority, Annual Survey of Philippine Business and Industry, https://psa.gov.ph/statistics/survey/business-and-industry/index (accessed May 2024).

Similarly, volatility can be observed in value added for the electronic component manufacturing industry, with an initial decrease from 2013 to 2015 followed by a period of growth from 2015 to 2017 and later another decline. While a brief recovery occurred from 2019 to 2021, the industry's value added has not shown consistent growth. As indicated in Figure 2.2, the number of establishments in the electronic component manufacturing industry has decreased over the 2013-21 period, while the number of employees in the sector reached a new maximum in 2021, indicating growing consolidation in the market.

The labour productivity of the electronic component manufacturing industry shows cause for concern, with no evidence of a sustained increase over time, although the volatility of this variable, and possibly its underlying data, makes interpretation challenging (Figure 2.2). The industry experienced a downturn from 2013 to 2015, followed by growth until 2017, and later a decrease until 2020, followed by an increase in 2021. In 2021, the labour productivity of the industry trailed the performance in the broader manufacturing sector, in particular behind the most productive industries in Philippine medium and high-tech manufacturing, including motor vehicles and battery manufacturing. Nevertheless, over the period 2013-21, the electronic component manufacturing industry outperforms related electronics industries in labour productivity (Figure 2.2), like computer manufacturing (e.g. computers and laptops), consumer electronics manufacturing (e.g. televisions, headphones and video game consoles) and communication equipment manufacturing (e.g. routers, modems, telephones and antennas).

Figure 2.2. Evolution of the main economic variables, electronic components and total manufacturing

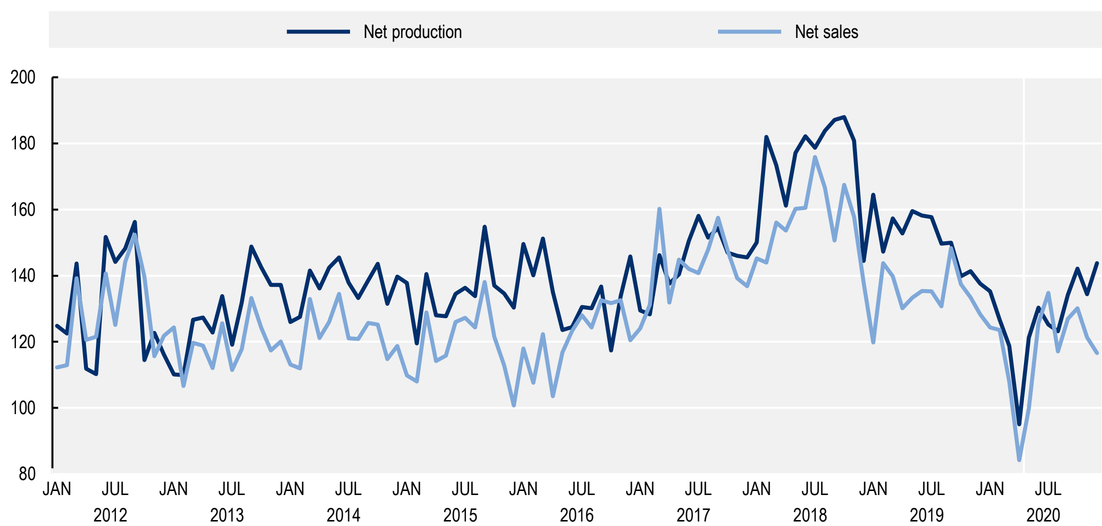


Note: Industry definitions are based on the PSIC 2009. The “Manufacture of electronic components” (Sector C261) is the main sector under consideration. The main headings under this class include: “Manufacture of electronic valves and tubes” and “Manufacture of semiconductor devices and other electronic components”. The panel report aggregate data were provided by the Philippines’ BOI and accessed by the OECD in October 2023. They cover the periods 2012-17 and 2019-20. Data from 2012 and 2018 originate from the CPBI rather than the ASPBI. To ensure consistency and continuity, data for 2012 were discarded, and data for 2018 were computed by averaging 2017 and 2019 ASPBI values. Data were extended in May 2024 with data from 2021. Labour productivity is computed as value added over total employment year on year. In the fifth panel, this value is averaged over 2013-21.
Source: OECD calculations based on the Philippine Statistics Authority, Annual Survey of Philippine Business and Industry, https://psa.gov.ph/statistics/survey/business-and-industry/index (accessed May 2024).

The Monthly Integrated Survey of Selected Industries (MISSI) provides further insight into the above data. It is used to calculate the Value of Production Index (VaPI), Volume of Production Index (VoPI), Value of Net Sales Index (VaNSI), Volume of Net Sales Index (VoNSI) and the average capacity utilisation rate for manufacturing industries, including the electronic component manufacturing industry. While only covering a selected number of industries, this dataset allows for more granularity than the APSBI in industry (five-digit level, at least over 2012-20) and temporal (observations are monthly) terms.[4] When focusing on the 2012-20 time series, the following figure (Figure 2.3) shows the value of the production and net sales indexes for the "Manufacture of semiconductor devices and other electronic components" (Sector C26120, according to the PSIC 2009), a subsector of the previously described electronic component manufacturing industry. Both indices have increased overall, with the production value being particularly notable. Both indices experienced sharp declines between the end of 2018 and spring 2020, then recovered in the last recorded months. Despite their recovery, their values remain well below the peak levels reached in 2018.

Figure 2.3. Value of production and net sales indexes for the manufacture of semiconductor devices and other electronic components (C26120)

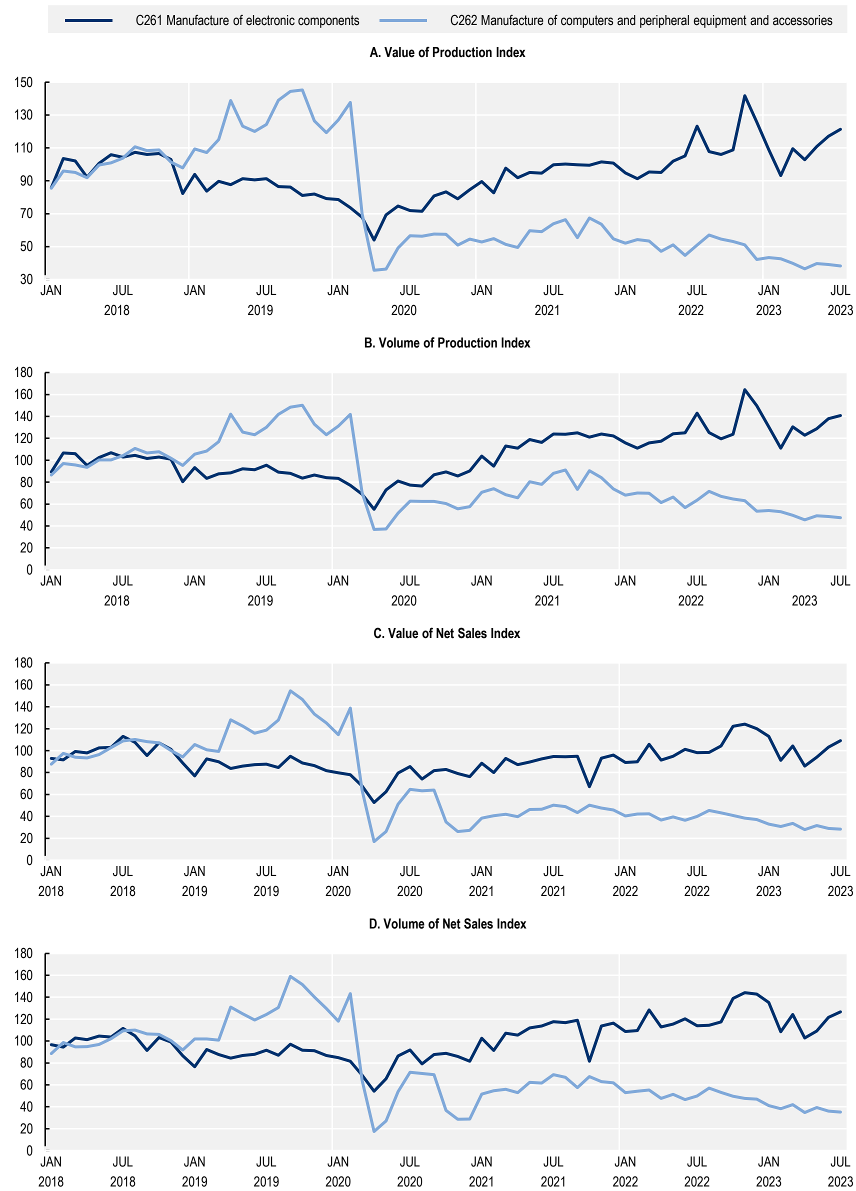
100=year 2000



Note: According to the Philippine Statistics Authority, the Value of Production Index (VaPI) – net production in the figure – measures the monthly production values of manufacturing relative to reference period and base year. Value of Net Sales Index (VaNSI) – net sales in the figure – measures the net sales value of goods sold by the manufacturing sector relative to reference period and base year (PSA, https://psa.gov.ph/statistics/manufacturing/missi/technical-notes).
Source: OECD calculations based on the Philippine Statistics Authority, Monthly Integrated Survey of Selected Industries, https://psa.gov.ph/statistics/missi/index (accessed February 2024).

Figure 2.4 shows that the electronic component manufacturing sector (more recent MISSI data are not as granular as for the period 2012-20) experienced a downturn until early 2020, followed by a recovery until 2023, ultimately exceeding 2018 levels. In contrast, Sector C262 ("Manufacture of computers and peripheral equipment and accessories"), which had outperformed the electronic component manufacturing industry before the COVID-19 pandemic, experienced a sharper decline between late 2019 and early 2020. This industry then entered a period of stagnation, irrespective of the variable under consideration.

Figure 2.4. Value of Production Index, Volume of Production Index, Value of Net Sales Index and Volume of Net Sales Index for the electronic component manufacturing industry, 2018-23



Note: According to the Philippine Statistics Authority, the Value of Production Index (VaPI) measures the monthly production values of manufacturing relative to reference period and base year. Volume of Production Index (VoPI) measures the monthly production volume of manufacturing relative to reference period and base year. Value of Net Sales Index (VaNSI) measures the net sales value of goods sold by the manufacturing sector relative to reference period and base year. Volume of Net Sales Index (VoNSI) measures the net sales output of manufacturing sector relative to a reference period and base year (PSA, https://psa.gov.ph/statistics/manufacturing/missi/technical-notes).
Source: OECD calculations based on the Philippine Statistics Authority, Monthly Integrated Survey of Selected Industries, https://psa.gov.ph/statistics/missi/index (accessed February 2024).

Better understanding the performance of the Philippine electronic component manufacturing industry: Insights from firm-level data

The PSA conducts the ASPBI every year to collect and generate information on the levels, structure, performance and trends of the country's formal sector economic activities. However, for the years the PSA conducts the CPBI, the latter replaces ASPBI proceedings. This report examines data from 2012 to 2021: 2012 and 2018 are results from the CPBI and the rest are from the ASPBI.[5]

Given the focus of this report, the subsequent analyses are based on the "Manufacture of electronic components" (International Standard Industrial Classification of All Economic Activities [ISIC] Rev. 4 Division C261) industry, which includes the semiconductor industry. As noted above, over 70% of exports from this industry are semiconductor products. Results of the C261 industry are benchmarked against the wider manufacturing sector whenever relevant.[6]

Large and old firms play a dominant role in the Philippine electronic component manufacturing industry

Larger and older firms (defined as being over ten years old) are responsible for the biggest share of the total income, expenses, tangible fixed assets and employment in the electronic component manufacturing industry in the Philippines (Figures 2.5 and 2.6). In the survey, firm age is defined as the number of years the establishment has been operating in the Philippines. Given that a significant share of firms in the industry are foreign-owned (i.e. multinational enterprises), older firms' role may be underestimated in subsequent analyses.

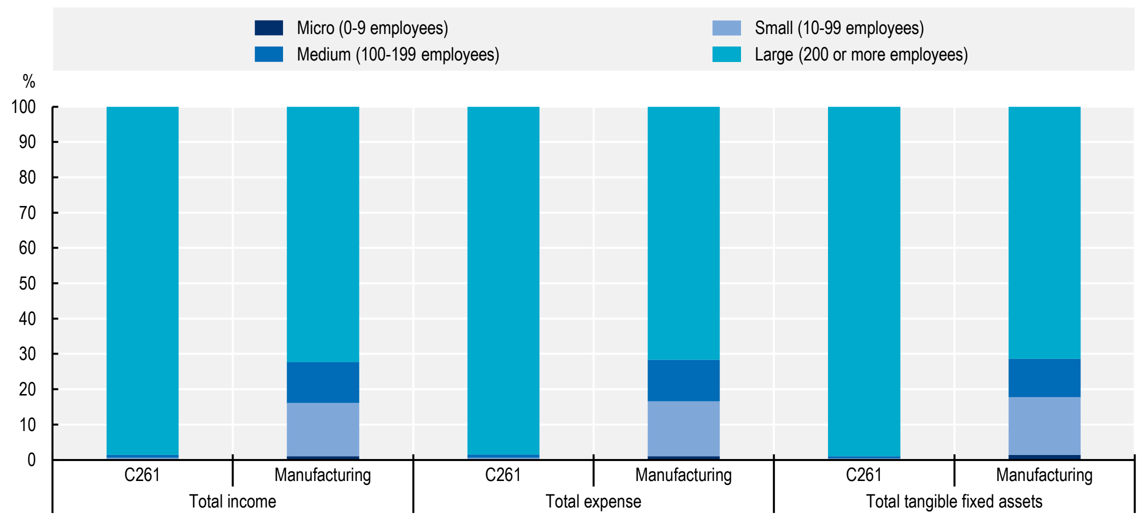
From 2012 to 2021, the electronic component manufacturing industry accounted for an average total income of PHP 583.2 billion, accounting for 11.5% of the wider manufacturing sector. Large firms alone generated 98.6% of the income in the industry, substantially higher than the 72.3% in manufacturing (Figure 2.5). This difference highlights that large firms are more likely to play a prevailing role in the Philippine semiconductor industry than in the manufacturing sector.

Large firms in the industry earn more, spend more and invest more in tangible fixed assets. They accounted for more than 98% of the average total expenses and average total tangible fixed assets in the electronic component manufacturing industry from 2012 to 2021. In comparison, large firms represent over 70% of total income, total expense, and total tangible fixed assets in the broader Philippine manufacturing sector (Figure 2.5). Older firms (more than ten years of age) account for more than 80% of total income, total expense and total tangible fixed assets for both the electronic component manufacturing industry and the broader manufacturing sector (Figure 2.6).

Employment is heavily concentrated among large firms in the electronic component manufacturing industry. Larger companies employ approximately 147 400 workers (as compared to 772 845 workers in the manufacturing sector as a whole), which represent 97.1% of total employment in the industry (62.5% in the manufacturing sector). Smaller firms in the industry play a trivial role in employing workers. In comparison, almost a quarter of workers are employed in small firms in the broader Philippine manufacturing sector.

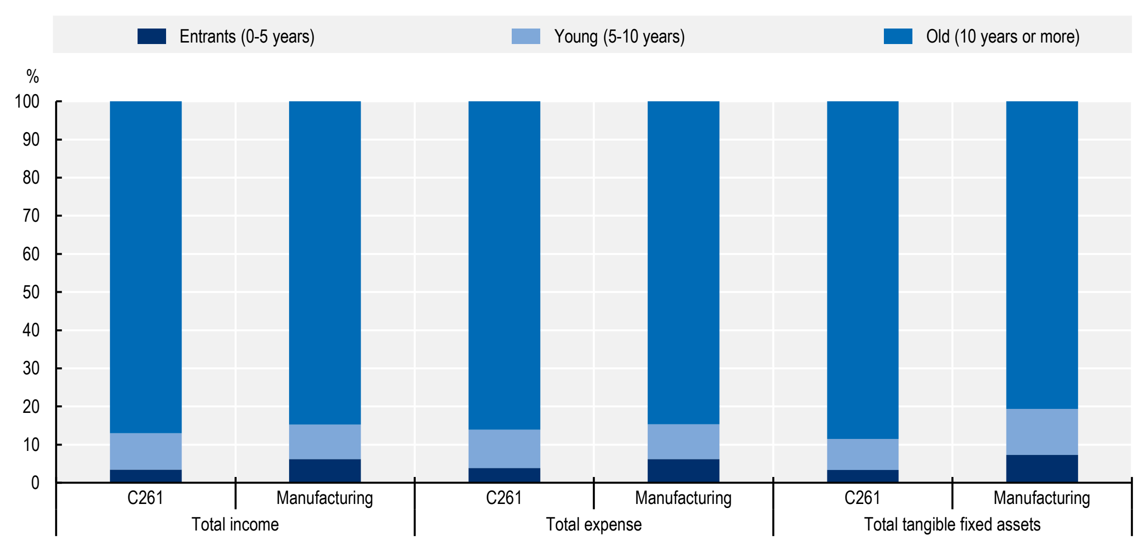
Similarly, older firms employ more workers than younger companies. In the electronic component manufacturing industry, old firms employ 131 922 workers (as compared to 928 221 workers in the manufacturing sector), which represents 88.0% of total employment in the industry (75.6% in manufacturing sector). Younger firms contribute less to total employment, with their relevance being even less pronounced for the electronic component manufacturing industry.

Figure 2.5. Total income, expenses and tangible fixed assets in the Philippine electronic component manufacturing industry and its manufacturing sector, by firm size group, 2012-21



Note: The figure shows total income, total expense and total tangible fixed assets by firm size group, where values are the average of 2012 to 2021. Data for 2019 have been interpolated due to data irregularities. The new value for 2019 is computed by the average of 2017 and 2018. The book value defines the total tangible fixed assets as of the end of the concerned year, corresponding to the initial or acquisition cost of tangible fixed assets minus accumulated depreciation charges. The population was retrieved using sample weights.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

Figure 2.6. Total income, expenses and tangible fixed assets in the Philippine electronic component manufacturing industry and the manufacturing sector, by age of firm, 2012-21

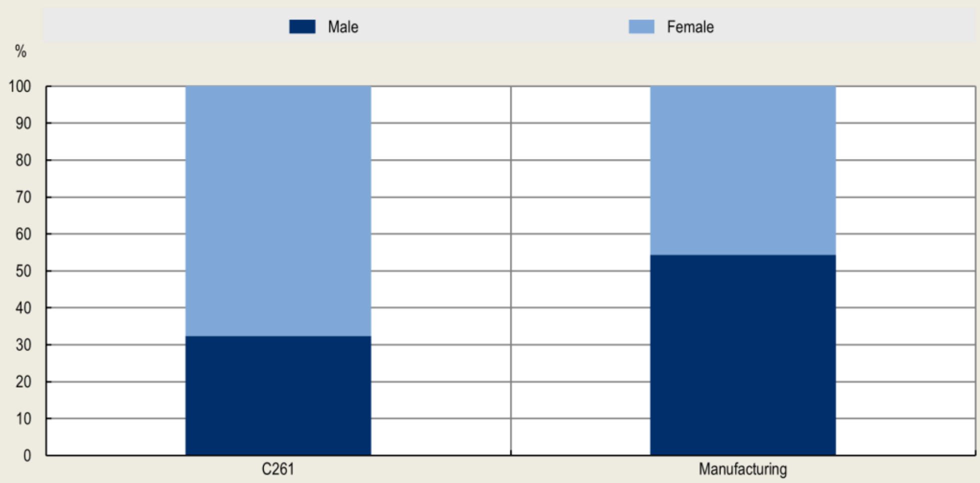


Note: The figure shows total income, total expense and total tangible fixed assets by size group, where the values are the average of 2012 to 2021. Data for 2019 have been interpolated due to data irregularities. The new value for 2019 is computed by the average of 2017 and 2018. The book value defines total tangible fixed assets as of the end of the concerned year, which corresponds to the initial or acquisition cost of tangible fixed assets minus accumulated depreciation charges. The population was retrieved using sample weights.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

Box 2.1. Composition of employment by gender in the Philippine electronic component manufacturing industry and the manufacturing sector

Examining employment from a gender perspective presents interesting results. The semiconductor industry employs more women than men, contrary to the manufacturing sector, where the opposite is true (Figure 2.7). In the semiconductor industry, in the last ten years (i.e. 2012 to 2021), the average share of male and female employment was 32.4% (49 231 workers) and 67.6% (102 571 workers), respectively. Contrastingly, the manufacturing sector registered an average share of male and female employment of 54.4% (673 040 workers) and 45.6% (564 470 workers), respectively. This indicates that the semiconductor industry in the Philippines has been seeing a more active participation of women relative to the rest of industries within the manufacturing sector.

Figure 2.7. Employment by gender



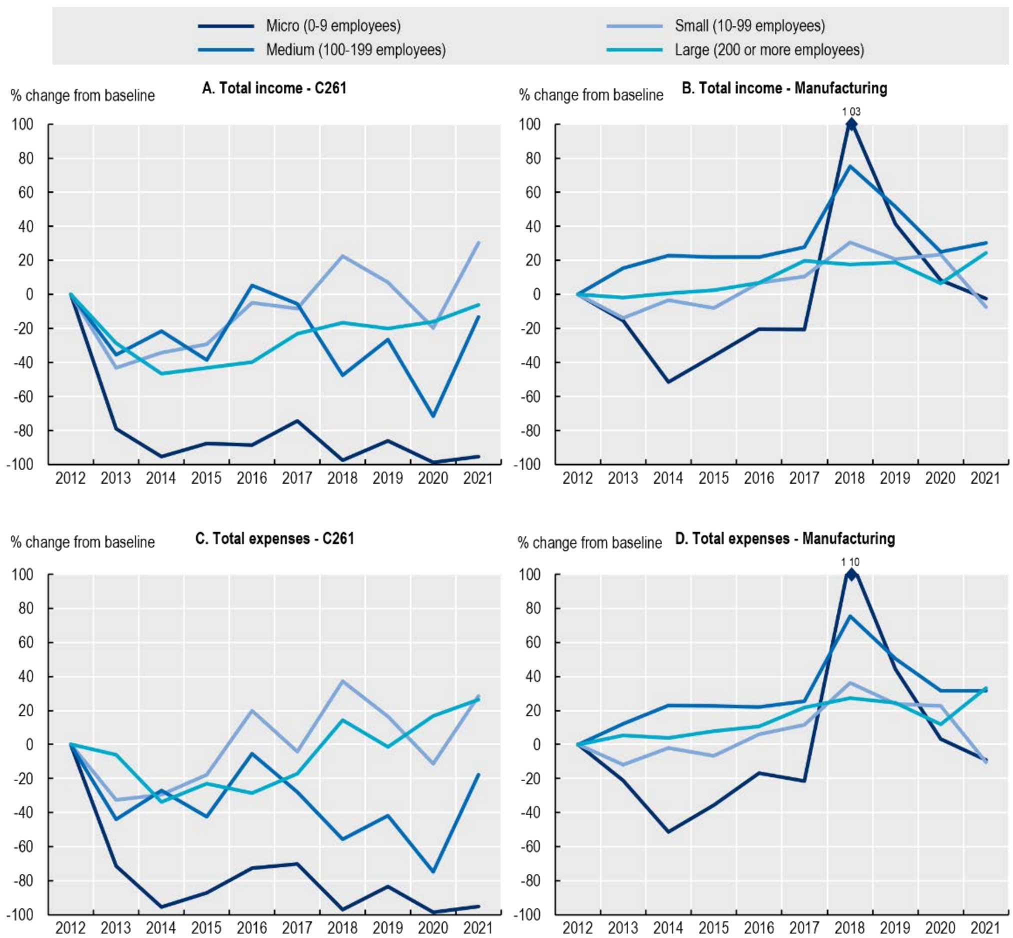
Note: The figure shows the share of employment by gender, where the values are the average from 2012 to 2021. Data for 2019 have been interpolated due to data irregularities. The new value for 2019 is computed by the average of 2017 and 2018. The population was retrieved using sample weights.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

The Philippine electronic component manufacturing industry has seen limited growth in recent years

From 2012 to 2021, the Philippine electronic component manufacturing industry displayed lacklustre performance. Figure 2.8 shows that large firms, the size class that mainly drives the overall industry performance, were not able to achieve any positive growth in income throughout the period, using 2012 as the baseline year. Nevertheless, following a drop from 2012 to 2014, income started picking up gradually. Meanwhile, expenses grew by 26.5% in 2021 with respect to 2012.

In contrast, large firms from the wider manufacturing sector have been on a general upward projection since 2012. Growth slowed in 2020 to 6.4%, most likely due to the COVID-19 crisis, but the value quickly bounced back to 24.5% in 2021 (Figure 2.8). However, expenses grew faster than income: in 2021, total expenses increased by 33.2% relative to 2012. Hence, the overall profitability performance of manufacturing did not experience a favourable evolution over this period.

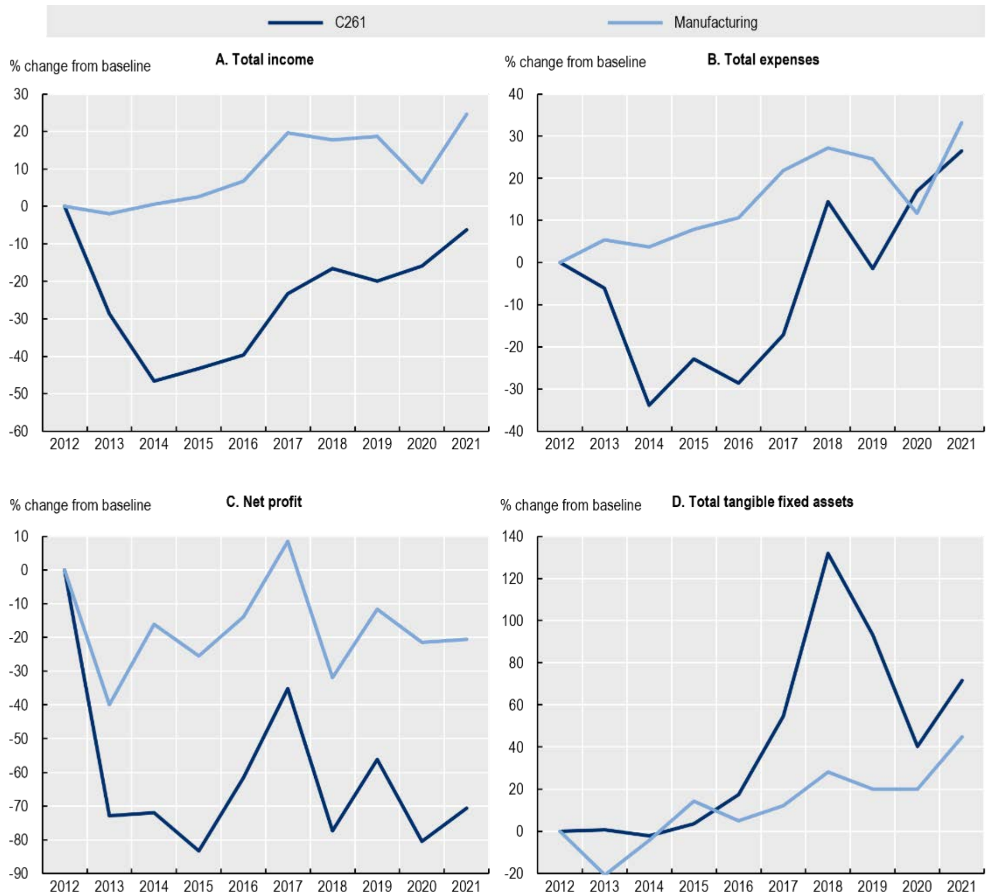
Figure 2.8. Indicators by size category



Note: The figure shows the trend in the growth of total income (panels A and B) and total expenses (panels C and D), with 2012 as the baseline year. Results show similar trends when the baseline year changed to 2013. Data for 2019 have been interpolated due to data irregularities. The new value for 2019 is computed by the average of 2017 and 2018. The population was retrieved using sample weights.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

Among the four size classes within the semiconductor industry, only small firms grew from 2012 to 2021. However, it is important to note that they only constitute approximately 0.6% of total income in the electronic component manufacturing industry. While this increasing trend (see small firms in Figure 2.8) may suggest growth potential within this size class, it is insufficient to affect the overall industry's growth. On the contrary, large firms, which constitute most of the income generated in the electronic component manufacturing industry, experienced a decline in income during the period 2012-14, resulting in a downturn in products (Figure 2.9). Since 2014, they have experienced both increasing revenues and expenses, which combined caused profits to stagnate overall in the period 2014-21, while large firms in the wider manufacturing sector have experienced an upward trend in profits.

Figure 2.9. Indicators of large firms

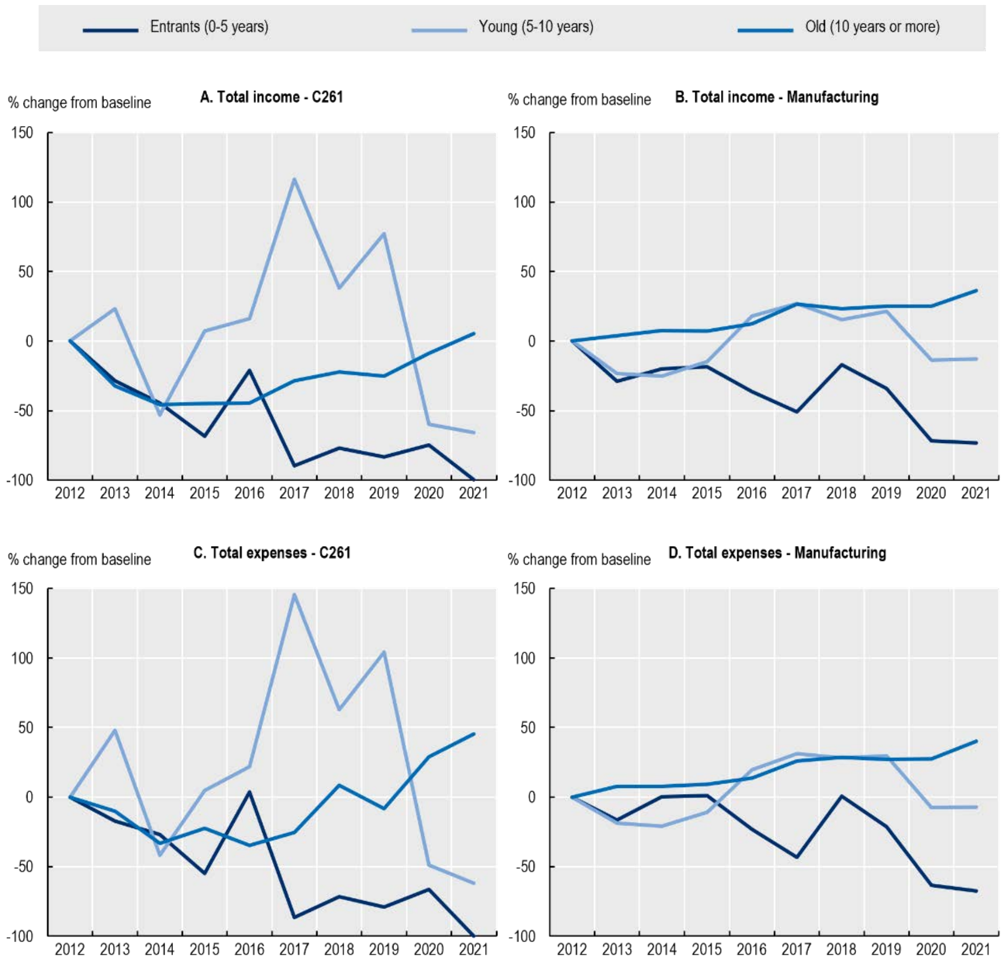


Note: The figure shows the growth of total income, total expense, net profit (total income minus total expense), and total tangible fixed assets for large firms, with 2012 as the baseline year. Results show similar trends when the baseline year is changed to 2013, except for net profit. The book value defines total tangible fixed assets as of the end of the year, corresponding to the initial or acquisition cost of tangible fixed assets less accumulated depreciation charges. Data for 2019 has been interpolated due to data irregularities. The new value for 2019 is computed by the average of 2017 and 2018. The population was retrieved using sample weights. Large firms are defined as firms with more than 200 employees.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

When categorised by age, indicator growth trends hint at potential for further improvement in the electronic component manufacturing industry, where expenses grew faster than income for old firms (Figure 2.10) and expenses have grown much faster. In 2021 alone, for example, total expenses for these firms increased by 45.2%, which may reflect the supply chain disruptions affecting inputs to this industry during this period.

On the contrary, the manufacturing sector saw a steady income increase and a manageable expense rise. In 2021, old manufacturing firms increased total income and total expense by 36.2% and 40.0%, respectively (Figure 2.10). The struggles of older firms within the electronic component manufacturing industry are emphasised in Figure 2.11, which highlights the steep growth of expenses compared to the broader manufacturing sector.

Figure 2.10. Indicators by age category



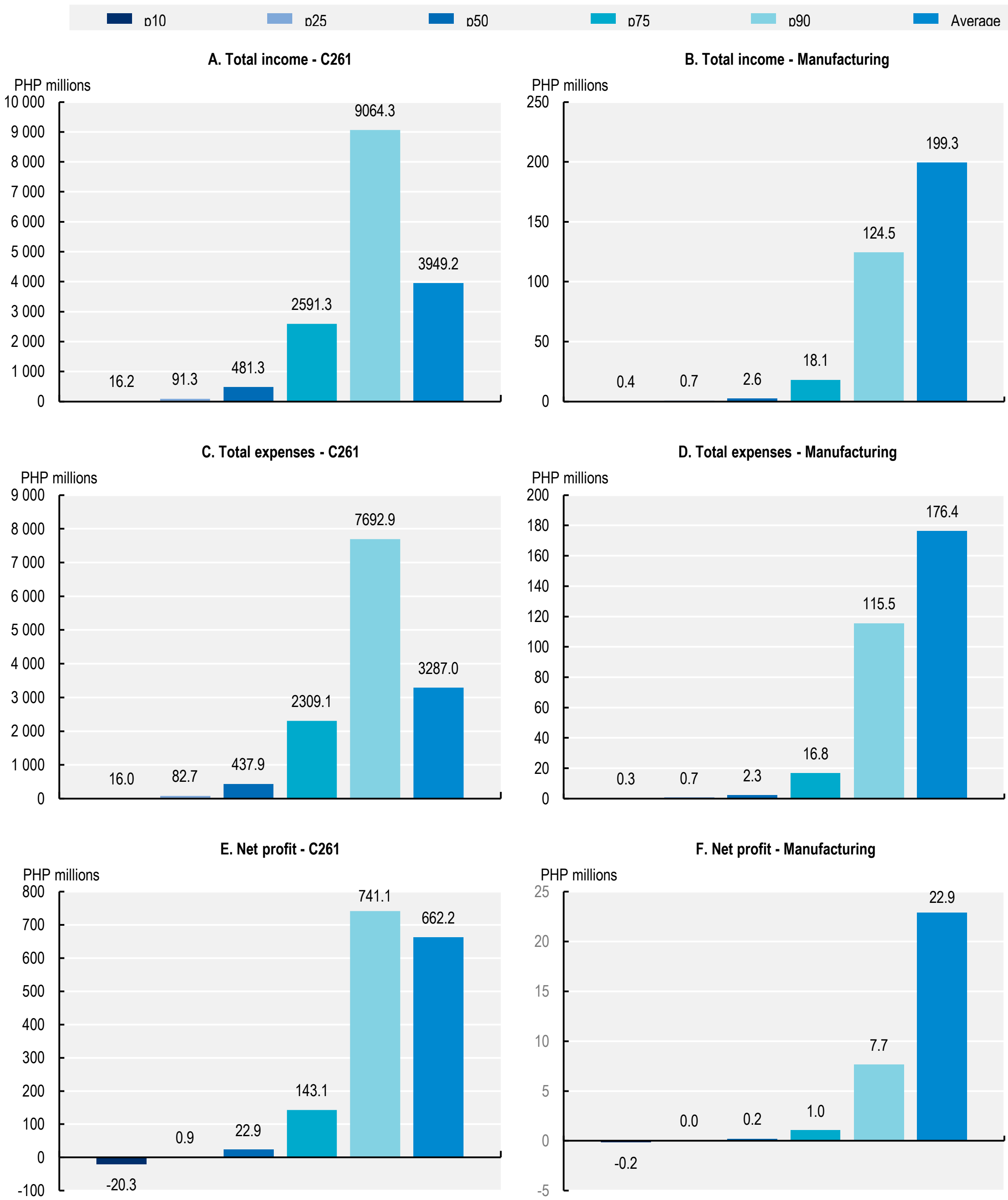
Note: The figure shows the trend in the growth of total income (panels A and B) and total expenses (panels C and D), with 2012 as the baseline year. Results show similar trends when the baseline year changed to 2013. Data for 2019 have been interpolated due to data irregularities. The new value for 2019 is computed by the average of 2017 and 2018. The population was retrieved using sample weights.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

Figure 2.11. Indicators of old firms

Note: The figure shows the growth of total income, total expense, net profit (total income minus total expense), and total tangible fixed assets for old firms, with 2012 as the baseline year. Results show similar trends when the baseline year changed to 2013, except for net profit. The book value defines the value of total tangible fixed assets as of the end of the year, corresponding to the initial or acquisition cost of tangible fixed assets less accumulated depreciation charges. Data for 2019 have been interpolated due to data irregularities. The new value for 2019 is computed by the average of 2017 and 2018. The population was retrieved using sample weights. Old firms are defined as firms that are more than ten years old.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

Apart from the nontrivial role of large firms in the electronics manufacturing industry, there seems to be an even more restricted set of few firms "at the top" of the distribution that shape the overall industry performance in the Philippines. This is true for the electronic component manufacturing industry and even more so for manufacturing.

Figure 2.12. Distribution of total income and expenses in the Philippine electronic component manufacturing industry and the manufacturing sector, 2012-21



Note: The figure shows the distribution of incomes, expenses and net profit in the electronic component manufacturing industry (C261) and the manufacturing sector. It shows the average values from 2012 to 2021 in PHP millions. The difference between total income and total expenses gives net profit. Data for 2019 have been interpolated due to data irregularities. The new value for 2019 is computed by the average of 2017 and 2018. p: percentile.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

Figure 2.12 shows that the average income and expenses for firms in the electronic component manufacturing industry are higher than firms at the 75th percentile but lower than those at the 90th percentile. This suggests that a small percentage of firms are significantly raising the average values of the entire sample. This trend is even more pronounced in the manufacturing sector, where the average income and expenses exceed those of firms at the 90th percentile by a greater extent. The predominant role played by a relatively small set of larger, older firms is crucial to keep in mind when looking at the following graphs.

Profitability in the electronic component manufacturing industry is likewise driven by firms at the upper tail of the distribution (Figure 2.12). Consequently, it is vital to understand firms' cost structure to ensure that the expenses are sustainable. Subsequent sections provide further analysis on some of these cost drivers.

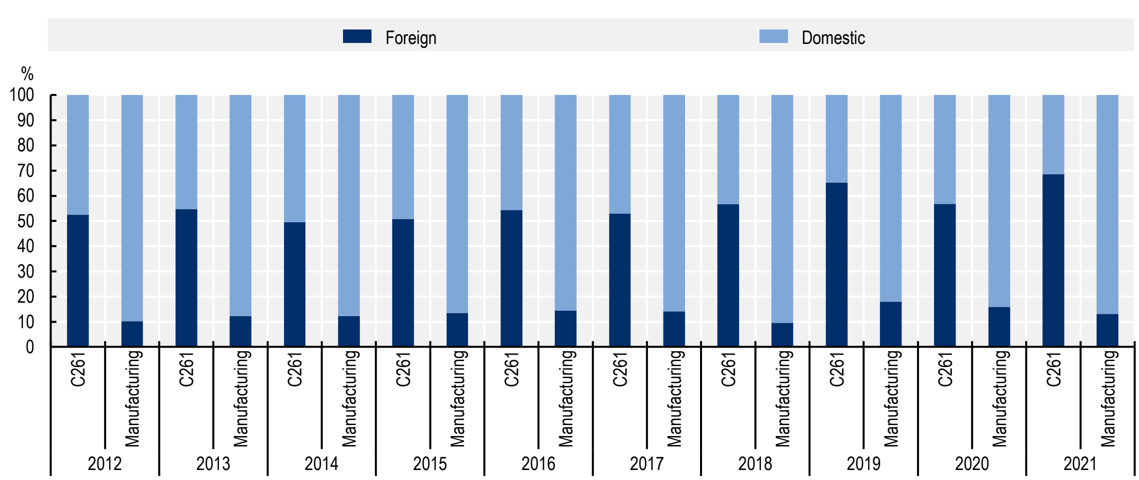
Foreign direct investment in the Philippine semiconductor ecosystem

Since the 1970s, foreign direct investment (FDI) has been crucial in developing the Philippine semiconductor ecosystem. Today, foreign semiconductor companies continue to play an important role in the Philippines by establishing new operations in the country (plants, regional headquarters, research centres, etc.) and acquiring local companies. This sub-section uses insights from the ASPBI and CPBI, as well as the database fDi Markets to broadly characterise foreign investments in the Philippine semiconductor ecosystem.

Foreign capital participation in the electronic component industry has been growing

The contributions of foreign investors to firms in the electronic component industry in the Philippines have been growing in recent years, according to the ASPBI and CPBI. While respondents in the manufacturing sector reported a marginal uptick (from 10.2% in 2012 to 13.1% in 2021) in the average foreign capital participation, establishments in the semiconductor industry experienced a more sizeable growth (from 52.5% in 2012 to 68.5% in 2021) (Figure 2.13). Consequently, foreign investors have a significantly larger stake in the electronic component manufacturing industry in the Philippines relative to the manufacturing sector.

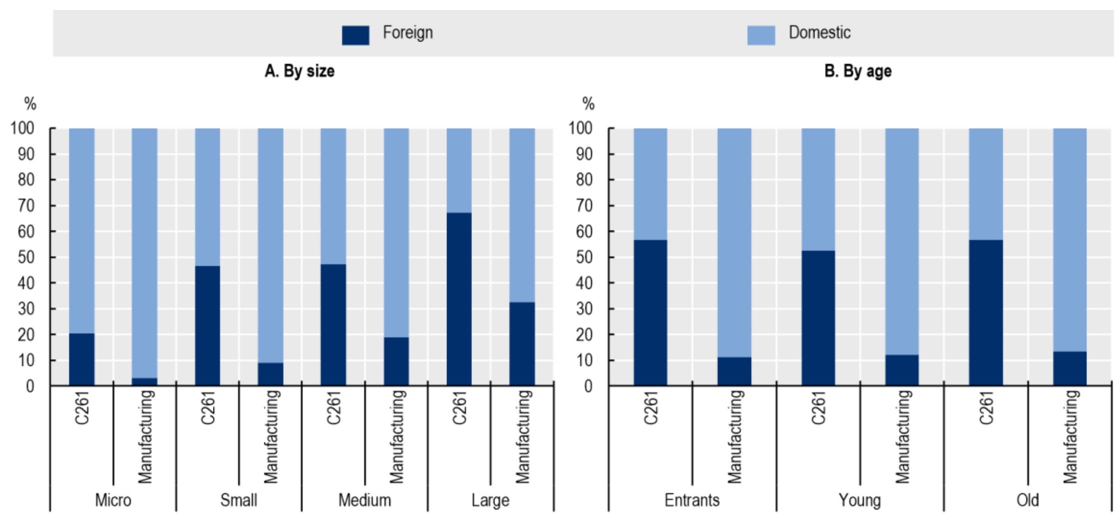
Figure 2.13. Average domestic and foreign capital participation, by year



Note: Capital participation refers to the claims of foreign and/or domestic investors against capital/equity. The figure is based on establishment ASPBI/CPBI responses. The average domestic and foreign capital participation information is based on 52 676 observations for manufacturing and 1 377 for C261.
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

Moreover, a firm's size is positively correlated with foreign contribution, where larger firms have higher foreign capital participation than their smaller counterparts. The positive relationship holds for both the manufacturing sector and the semiconductor industry but is more prevalent for the latter. Based on ASPBI's respondents, only one-fifth of capital contribution in the semiconductor industry comes from foreign investors for micro firms (0 to 9 employees) and the value increases to almost half for small and medium firms (10 to 99 and 100 to 199 employees, respectively). In comparison, foreign investors own almost 70% of the total capital of large firms in the semiconductor industry (Figure 2.14). The structure of foreign capital participation does not significantly change across age groups, remaining close to 70% for establishments in the semiconductor industry and 10% for those in the manufacturing sector.

Figure 2.14. Average domestic and foreign capital participation, by size and age

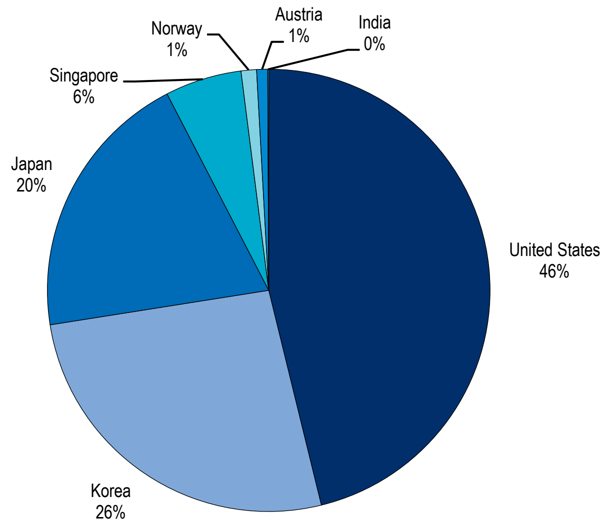


Note: Capital participation refers to the claims of foreign and/or domestic investors against capital/equity. The figure is based on establishments' ASPBI/CPBI responses. Information on average domestic and foreign capital participation from 2012 to 2021 is based on 52 676 observations for manufacturing and 1 377 for C261. Size categories are defined as follows: Micro (0-9 employees), Small (10-99), Medium (100-199) and Large (200+). Age categories are defined as follows: Entrants (0-5 years), Young (6-10) and Old (10+).
Source: OECD calculations based on the Philippine Statistics Authority Annual Survey of Philippine Business and Industry and Census of Philippine Business and Industry, confidential data (accessed March 2024).

Understanding greenfield investment in the Philippine semiconductor ecosystem

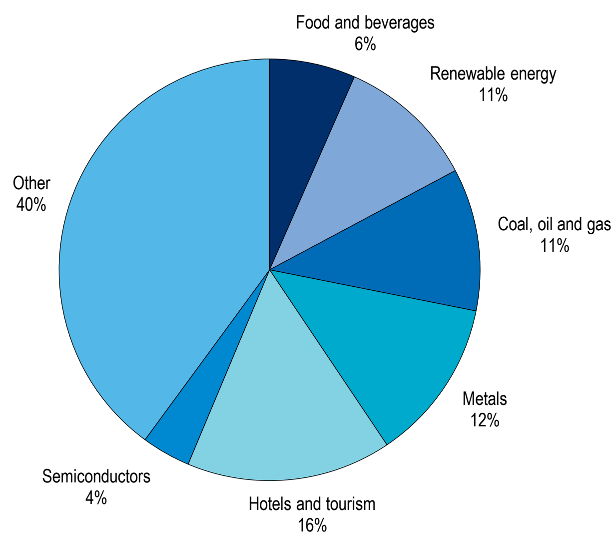
According to the fDi Markets database, international firms invested over USD 5.5 billion in the Philippine semiconductor ecosystem through 24 investments between 2003 and 2023. Figure 2.15 highlights that investments in the Philippine ecosystem stem largely from 3 economies: the United States (over USD 2.5 billion), Korea (over USD 1.4 billion) and Japan (over USD 1 billion). Jointly considered, these investments are primarily due to three companies: Texas Instruments (United States), Samsung (Korea) and Murata Manufacturing (Japan). Texas Instruments, in particular, emerges as a key investor, accounting for 3 of the 24 transactions and almost a quarter of total greenfield investment in the Philippine semiconductor industry for 2003-23. However, most FDI in the Philippines goes to industries other than semiconductors. Just 4% of invested capital flows to the semiconductor industry (Figure 2.16), suggesting unrealised potential.[7]

Figure 2.15. Greenfield investment in the Philippine semiconductor industry, by country, 2003-23



Note: Data cover 2003-23 but the first recorded investment in the Philippine semiconductor industry occurred in March 2004. There are no missing values on the capital invested or the jobs created for each investment. The data include announced deals. Capital investment is measured in current USD millions.
Source: OECD calculations based on fDi Markets, https://www.fdimarkets.com/ (accessed July 2023).

Figure 2.16. Greenfield investment in the Philippines, by sector, 2003-23

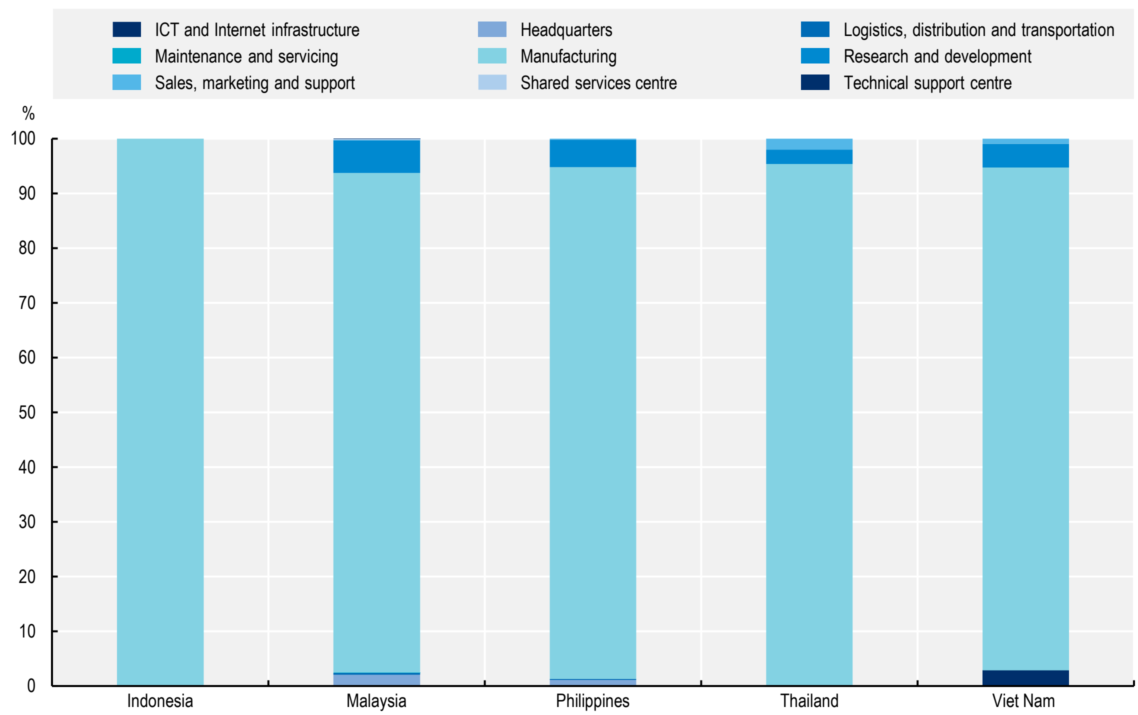


Note: The top five sectors by capital invested (2003-23), plus “Semiconductors”, are explicitly included. The residual category “Other” includes all the remaining sectors in the database which are not explicitly portrayed for interpretability. Data cover 2003-23 but the first recorded investment in the Philippine semiconductor industry occurred in March 2004. There are no missing values on the capital invested or the jobs created for each investment. The data include announced deals. Capital investment is measured in current USD millions.
Source: OECD calculations based on fDi Markets, https://www.fdimarkets.com/ (accessed July 2023).

“Manufacturing” activities in the Philippines attracted the most FDI (Figure 2.17), followed by “Research and development”. Similarly, foreign investments in Indonesia, Malaysia, Thailand and Viet Nam – Association of Southeast Asian Nations (ASEAN) countries comparable in size and gross domestic product (GDP) per capita – largely target manufacturing.

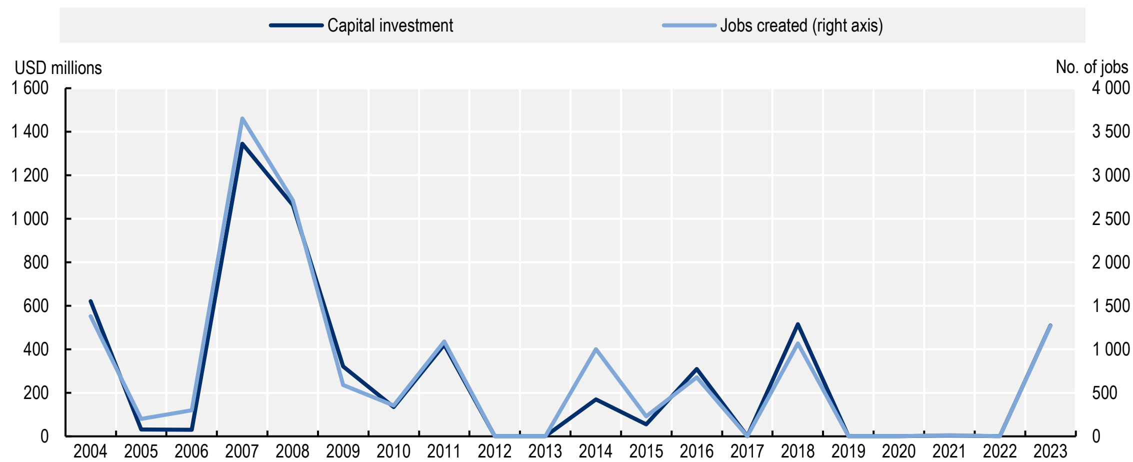
Figure 2.18 portrays the trend of capital invested and jobs created through FDI. The largest investments occurred early in the sample period, confirming the importance of older firms in the Philippine electronic component manufacturing industry. Between 2004 and 2007, United States (US) companies invested nearly USD 2 billion and, in 2008, Korean companies invested USD 1 billion. Japanese investments were more dispersed in 2009, 2011 and 2018. The notable spike in 2007-08 is due to significant investments: Texas Instruments invested USD 1 billion in the Philippine semiconductor industry in 2007 and Samsung invested the same amount in 2008. Another spike occurred in 2023, driven mainly by Singaporean and US companies.

Figure 2.17. Greenfield investment in semiconductor, by activity and country, 2003-23



Note: Capital investment is measured in current USD millions. Data cover 2003-23. The data include announced deals. fDi Markets reports only two investments in the semiconductor industry in Indonesia.
Source: OECD calculations based on fDi Markets, https://www.fdimarkets.com/ (accessed July 2023).

Figure 2.18. Greenfield investment in the Philippine semiconductor industry, capital invested and jobs created, 2004-23



Note: Capital investment is measured in current USD millions. The data include announced deals.
Source: OECD calculations based on fDi Markets, https://www.fdimarkets.com/ (accessed July 2023).

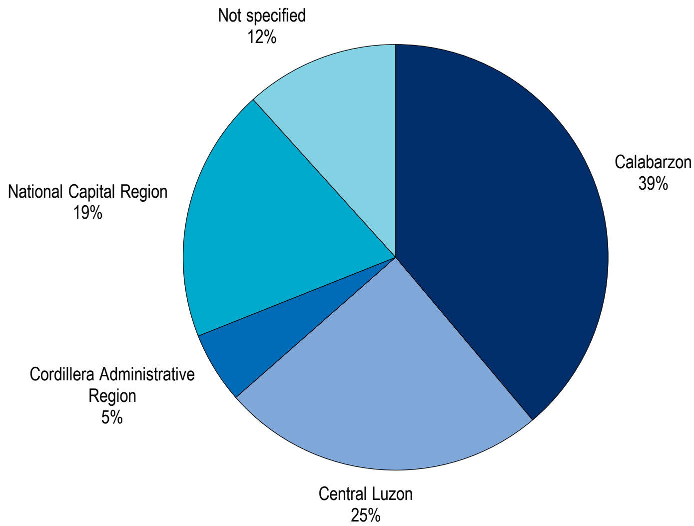
Almost two-thirds of FDI in the Philippine semiconductor industry is directed to just two regions in the Philippines: Calabarzon and Central Luzon (Figure 2.19). Calabarzon, for instance, has been the recipient of two considerable investments made by Murata Manufacturing and one by Analog Devices, among others.

The geographical distribution of semiconductor companies in the Philippines is linked to the presence of special economic zones which, over the 2007-19 period, have accounted for the majority of Philippine exports (67% on average) (PEZA, 2021[5]). Most of the semiconductor firms introduced in Table 2.1 are based in special economic zones in three provinces (Batangas, Cavite and Laguna) in the Calabarzon region, generating the highest volumes of direct employment and exports (Figure 2.20). Semiconductors and electronics companies have been responsible for more than a third (35%) of investment in the 415 special economic zones present in the Philippines in the period 1995-2020 (PEZA, 2021[5]).

International firms can also invest in a domestic industry by acquiring or merging with local firms. However, there has been very little merger and acquisition activity in the Philippine electronic component manufacturing industry (of which the semiconductor industry is a subset): just 22 deals, initiated by non-Philippine companies and targeting electronics firms, took place in 1998-2022, representing just 0.47% of the foreign-led merger and acquisition market in the Philippines.

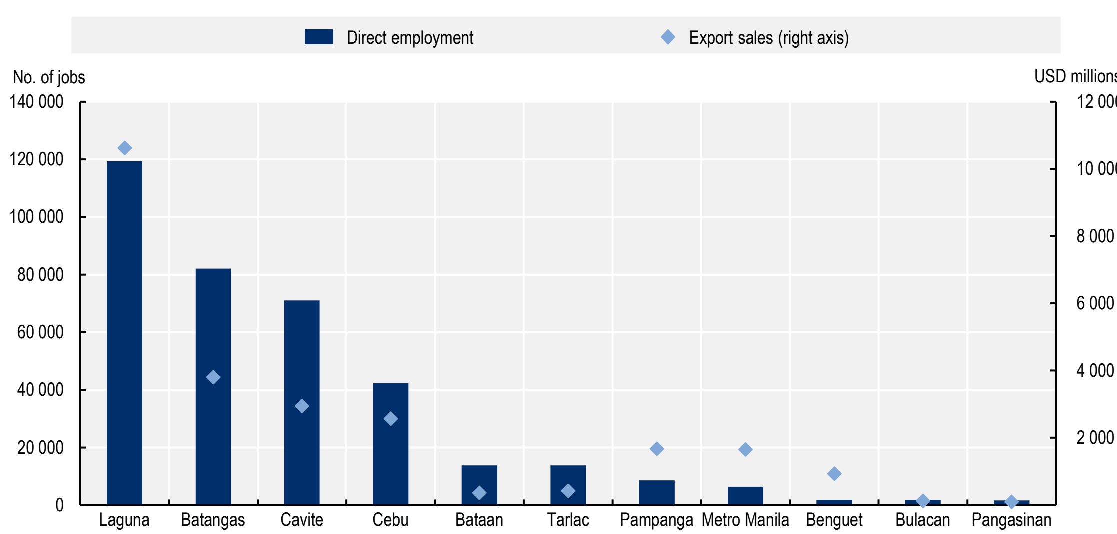
The industry that is most represented among acquirers is other manufacturers of electronic components, although financial intermediaries led the most valuable deals. These deals were concluded by 19 different companies, originating from 13 economies: 4 from Japan, 3 from Chinese Taipei and 2 from Singapore. On average, acquired firms had larger revenues than other firms in the electronics industry in the Philippines (Figure 2.21).

Figure 2.19. Greenfield investment in Philippine semiconductors, by region, 2003-23



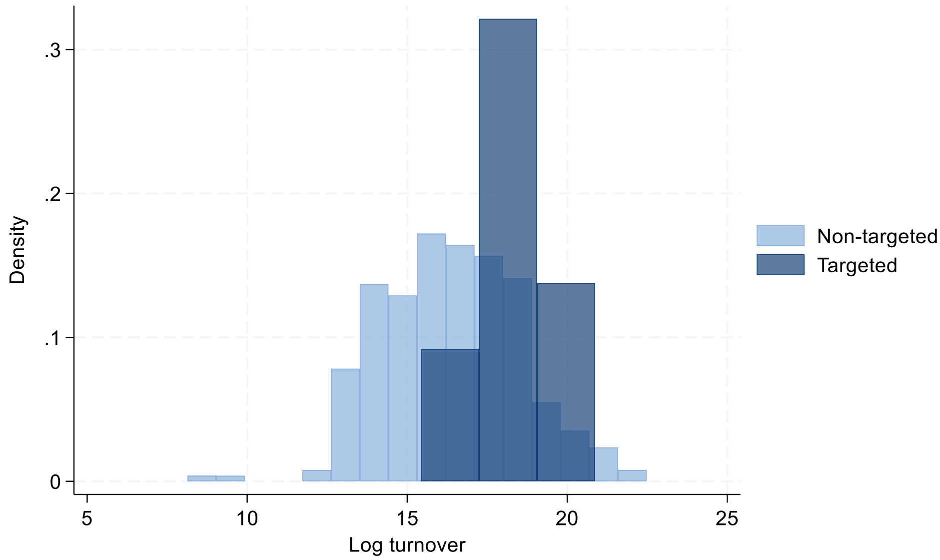
Note: Data cover 2003-23 but the first recorded investment in the Philippine semiconductor industry occurred in March 2004. There are no missing values on the capital invested or the jobs created for each investment. The data include announced deals. Capital investment is measured in current USD millions. The dataset does not include information on the specific region that attracted the investment for three observations.
Source: OECD calculations based on fDi Markets, https://www.fdimarkets.com/ (accessed July 2023).

Figure 2.20. Distribution of electronics and semiconductor company exports and employment in special economic zones, by provinces



Note: Export data cover the period January-November 2023. Data on employment have been updated as of November 2023.
Source: OECD calculations based on the Philippine Economic Zone Authority (PEZA), confidential data (accessed February 2024).

Figure 2.21. Merger and acquisition activity in the Philippines, 1990-2021



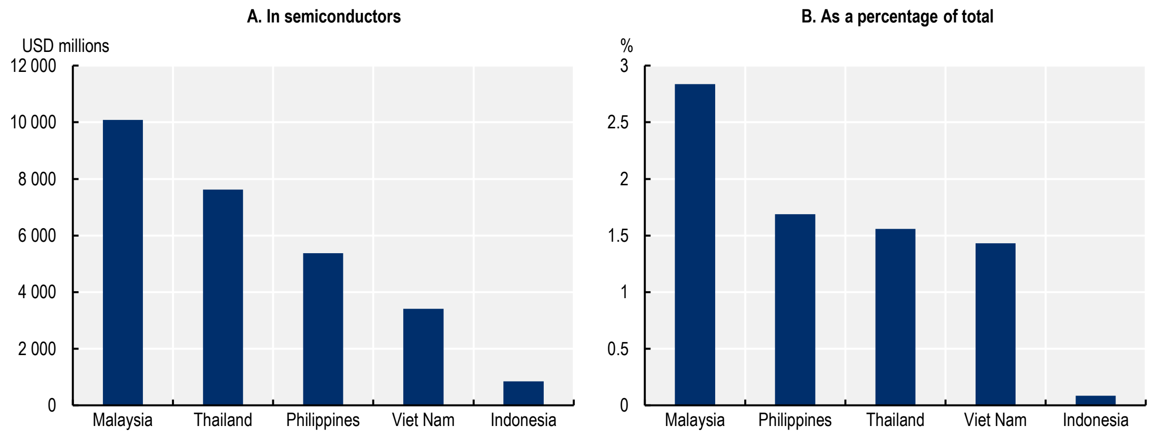
Note: The turnover is reported in PPP (constant 2005 EUR). The turnover is averaged for all years Orbis provides information about each company. The values are taken in logarithms to facilitate the figure interpretation. According to Orbis, there are 299 companies in Philippine Sector 261 (European Nomenclature of Economic Activities, NACE). Notably, there are discrepancies in terms of the sector between Orbis and Zephyr, as sometimes target companies reported as belonging to the semiconductor industry in Zephyr are not reported as belonging to the semiconductor industry (i.e. NACE 261) in Orbis.
Source: OECD calculations based on Bureau van Dijk, Orbis, https://login.bvdinfo.com/R0/Orbis and Bureau van Dijk, Zephyr, https://login.bvdinfo.com/R1/ZephyrNeo (accessed December 2023).

Understanding the value added by the Philippine semiconductor industry

Inter-Country Input-Output (ICIO) data identify intermediate inputs and final demand flows by industry and country and provide a complete picture of the value added at each stage of production and distribution provided by an economy to a given product. Figure 2.22 portrays the value added by the Philippines to the semiconductor industry in comparison to other economies in the region. In this respect, the Philippines performs well, ranking behind the leaders in the group (Malaysia and Thailand) but better than Indonesia and Viet Nam. However, the Philippines has a larger share of overall value added generated by the semiconductor industry than Thailand, while Malaysia retains an even clearer advantage over the other benchmark countries (Panel B, Figure 2.22).

ICIO data also enable further analysis of the flows of intermediate inputs and how they affect – or are affected by – the Philippine semiconductor industry. Reflecting the complexity of global semiconductor value chains, where intermediate products can cross borders hundreds of times during the production process, Philippine semiconductors are both a key input for and rely on intermediate inputs from the semiconductor industries in the People’s Republic of China (hereafter “China”). In addition, in 2018, the Chinese computer sector used significant inputs from the Philippine semiconductor industry and the Philippine semiconductor industry relied to a large extent on Korean semiconductors. In 2018, the Philippine semiconductor industry also relied on domestic intermediate inputs from the “Wholesale and retail trade, repair of motor vehicles”, “Chemical and chemical products” and “Basic metals” industries. More analysis of dependencies using trade data is provided in the section on integration in semiconductor global value chains.

Figure 2.22. Value added in semiconductors and as percentage of total, by country, 2018



Note: The NACE sector is divided into 261S (Semiconductors) and 26X (Computer, electronic and optical equipment). Panel A reports the overall value added generated in Sector 261S, while panel B considers the proportion of this value over the total value added generated in the country.
Source: OECD calculations based on OECD semiconductor-augmented ICIO tables (2018), https://www.oecd.org/en/data/datasets/inter-country-input-output-tables.html (accessed December 2023), and based on the methodology and database established by the OECD in Haramboure, A., et al. (2023), "Vulnerabilities in the semiconductor supply chain", *OECD Science, Technology and Industry Working Papers*, No. 2023/05, OECD Publishing, Paris, https://doi.org/10.1787/6bed616f-en.

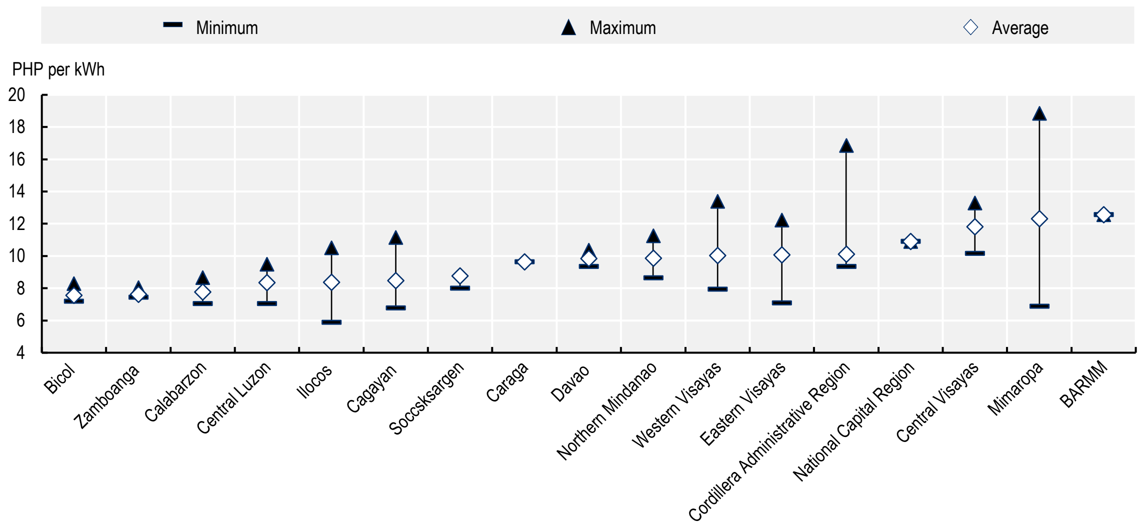
Electricity and logistics can constrain the attractiveness of the Philippines for investment

The analysis in the section above highlights the importance of the expense structure for the performance of the Philippine electronic component manufacturing ecosystem. Stakeholders mention two areas in particular, electricity and logistics, where costs in the Philippines exceed those in the region. This section examines these two areas.

Electricity costs in the Philippines are high

Stakeholders have highlighted the high cost of electricity as detrimental to the Philippine semiconductor industry's attractiveness for investment. A recent World Bank survey of Philippine enterprises (World Bank, 2024[6]) found that over 22% of surveyed firms cite electricity as a major or severe business constraint compared with 8% on average for firms in the East Asia and Pacific region. In the Philippines, electricity was cited as the most important constraint on business, more often than informality, access to finance or transportation (World Bank, 2024[6]). Some sources indicate that the provision of electricity is costlier in the Philippines compared to other Southeast Asian countries, where one kilowatt-hour (kWh) of electricity in the Philippines can cost approximately double that in Viet Nam (Global Petrol Prices, 2024[7]). This is likely a consequential difference, as stakeholders emphasise the importance of electricity cost for their investment choices. Figure 2.23 suggests that prices tend to change considerably in different regions of the country, with the ones where most semiconductor activities are concentrated (Calabarzon and Central Luzon) being among those with the lowest prices.

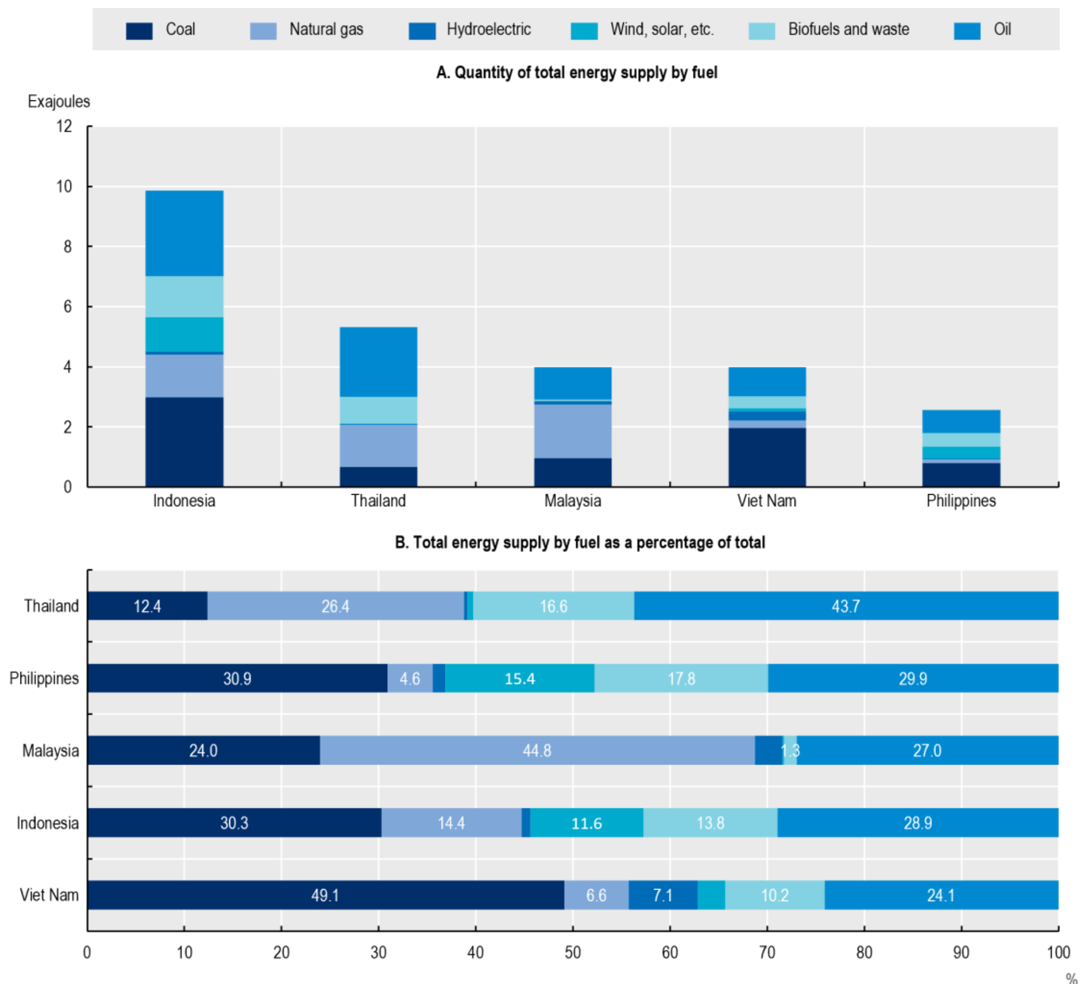
Figure 2.23. Price of electricity in the Philippines, 2023



Note: The figure reports the minimum, average and maximum prices for electricity reported across different energy providers active in different Philippine regions.
BARMM: Bangsamoro Autonomous Region in Muslim Mindanao.
Source: OECD calculation based on Philippine Board of Investments (2024[8]), *2024 Cost of Doing Business*.

Apart from the cost of energy, the proportion of electricity provided by renewable resources constitutes a crucial issue that stakeholders emphasise to reach their sustainability goals. Currently, the Philippines relies more on renewable resources (close to 17% of its total energy supply) than comparable countries, ahead of Indonesia and Viet Nam (Figure 2.24). Most of this is attributable to wind and solar power, with hydroelectric power playing a comparatively less important role. The Philippine Energy Plan 2023-2050 provides further information and guidelines on how the government aims to reach its goals in terms of renewable energy capacity by 2030 (35%), 2040 (50%) and 2050 (more than 50%).

Figure 2.24. Total energy supply by fuel, by country in Southeast Asia, 2021

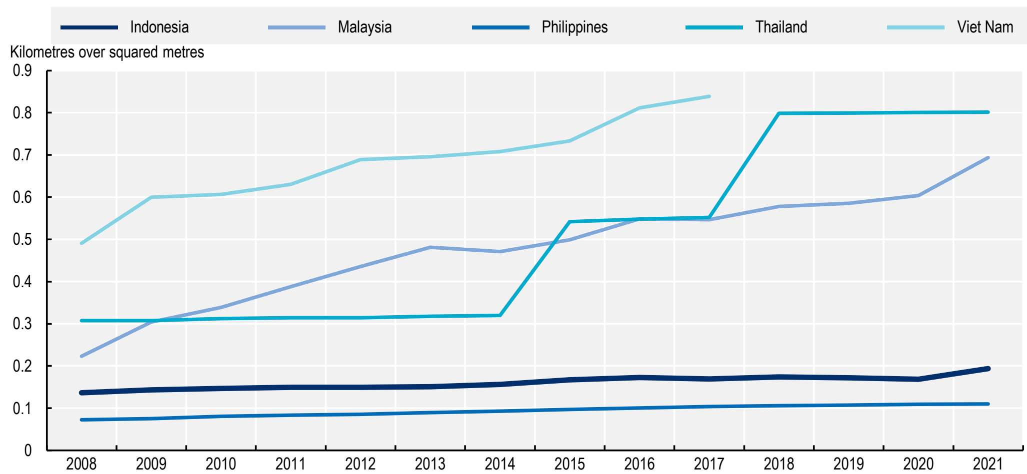


Note: This figure portrays the total energy supply, which includes all of the energy produced in or imported to a country minus that which is exported or stored. In panel A, the data are reported in exajoules. In panel B, quantities below 3% (i.e. 0.03) are not reported.
Source: OECD calculations based on IEA, https://www.iea.org/countries/Philippines (accessed February 2024).

Logistics and related infrastructure can also constrain investment

Logistics is a second area of improvement mentioned by stakeholders when discussing the attractiveness of investment in the Philippine semiconductor industry. When considering the country size, the Philippines has the least widespread road network within the benchmark sample (Figure 2.25). For example, in terms of kilometres of paved road per square kilometre, the Philippine road network is approximately one-eighth the size of the Vietnamese network. This may be due to the country’s archipelagic nature.

Figure 2.25. Road network extension (kilometres) over country size (square kilometres), in Southeast Asian economies

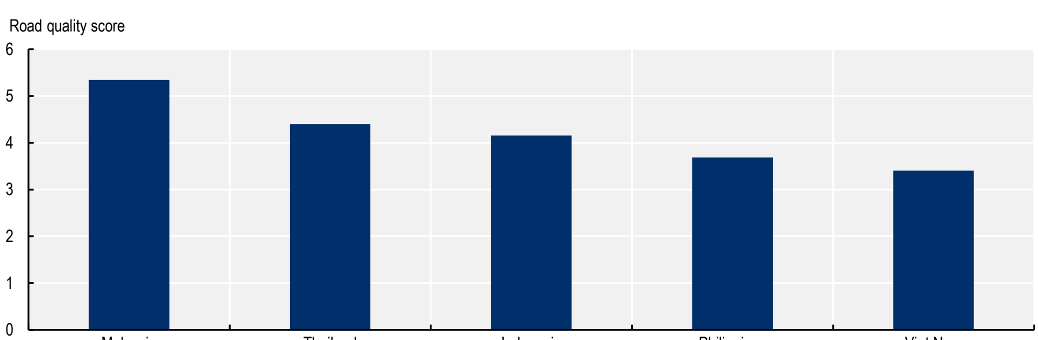


Note: The last available data for Viet Nam cover 2017. A paved road is defined as a road that has been covered with a hard surface, such as stones, bricks, tiles, concrete or asphalt.
Source: ASEANstats (n.d.[9]), Length of Paved Road (in kilometre), https://data.aseanstats.org/indicator/ASE.TRP.ROD.A.002; World Bank (n.d.[10]), Land Area (sq. km), https://data.worldbank.org/indicator/AG.LND.TOTL.K2?most_recent_value_desc=false (accessed February 2024).

The state of a road network is also critical for its effectiveness. In the context of semiconductors, machinery needed for the assembly, testing and packaging (ATP) of semiconductor is typically transported by road. Stakeholders noted that this equipment, used for high-precision tasks, requires roads in good condition to avoid losing calibration during transport. From this point of view, Figure 2.26 suggests that the Philippines has room for improvement, as the country lags behind other benchmark countries (aside from Viet Nam) in terms of road quality, with Malaysia achieving the best performance.

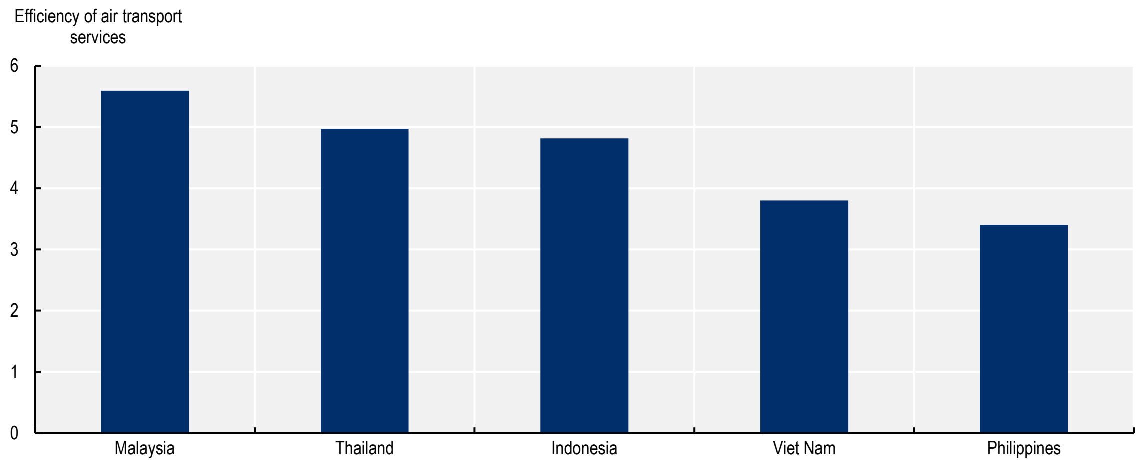
Stakeholders' consultations also emphasised the importance of another critical infrastructure for the shipment of semiconductors (due to their high value and low weight): air transportation. Figure 2.27 delineates a picture similar to the one presented in the previous paragraph, suggesting that the Philippines has room for improvement.

Figure 2.26. Road quality in Southeast Asian economies, 2019



Note: This figure portrays the quality of roads based on answers to the World Economic Forum (WEF) Executive Opinion Survey. The scale ranges from 1 ("underdeveloped") to 7 ("extensive and efficient by international standards").
Source: OECD calculations based on WEF (n.d.[11]), *Global Competitiveness Index 2019*, World Economic Forum.

Figure 2.27. Air transport service quality in Southeast Asian economies, 2019



Note: This figure portrays air transport infrastructure quality based on answers to the WEF Executive Opinion Survey. The scale goes from 1 ("underdeveloped") to 7 ("extensive and efficient by international standards").
Source: OECD calculations based on WEF (n.d.[11]), *Global Competitiveness Index 2019*, World Economic Forum.

Skills

The analysis in the section on market structure highlights the role of human capital in the performance of the Philippine semiconductor ecosystem. This section more closely examines the vacancies and training in the Philippine electronic component manufacturing industry, followed by an analysis of the demand and supply of skills, which is complementary to the subsequent analysis in Chapter 3.

Understanding job vacancies and training in the Philippine electronic component manufacturing industry

The PSA conducts the bi-annual Integrated Survey on Labor and Employment (ISLE) to examine different aspects of employment and establishment practices.[8] The survey provides an extensive overview of the demand and supply of skills in the Philippines by collecting data on occupational shortages and surpluses, as well as job-related training of workers. In this report, analyses are drawn from the survey results of ISLE 2019/20.[9]

Given the data limitation, the subsequent analyses will be based on the "Manufacturing of computer, electronic and optical products" (ISIC Rev.4 Division C26) industry.[10] Results of the semiconductor-related industry (i.e. C26) will be benchmarked against the manufacturing sector whenever relevant.

In 2019-20, the manufacturing sector and the semiconductor-related industry generally had a similar distribution of job vacancy positions (Figure 2.28). Among the responses, more than half of available managerial positions were at the senior level, while vacant jobs for professionals, technical and associate professionals as well as plant and machine operators and assemblers were mostly entry-level or junior. Employers mostly sought entry-level workers for plant and machine operator and assembler positions, where the openings were relatively easy to fill.

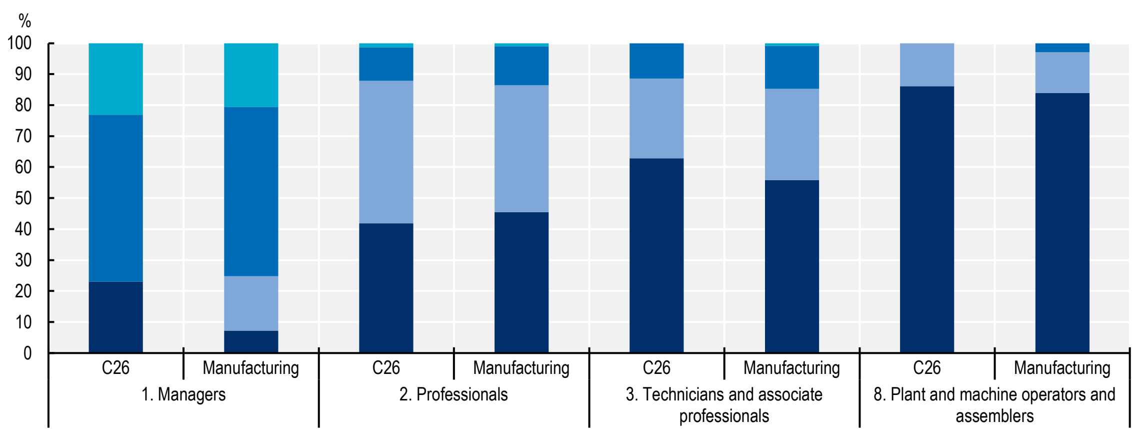
Vacancies requiring higher skill levels were relatively harder to fill for manufacturing and semiconductor industries (Figure 2.29). Consequently, most respondents indicated that managers and professionals were difficult to recruit. In fact, 92.3% of managerial positions in the semiconductor-related industry were hard to fill due to no/few applicants and, if there were any, they lacked either skills or experience (Figure 2.30).

Filipino stakeholders have also observed that experienced, skilled employees face high turnover due to better opportunities with, for instance, other domestic companies or international options.

This is coherent with a more general observation: lack of experience is a more prevalent reason for hard-to-fill vacancies for managers and professionals in the Philippine electronic component manufacturing industry than the manufacturing sector as a whole. Some Philippine employers note that employees leave after a few years (i.e. two to three years) of working in the semiconductor industry, whether due to poaching or seeking more competitive offers.

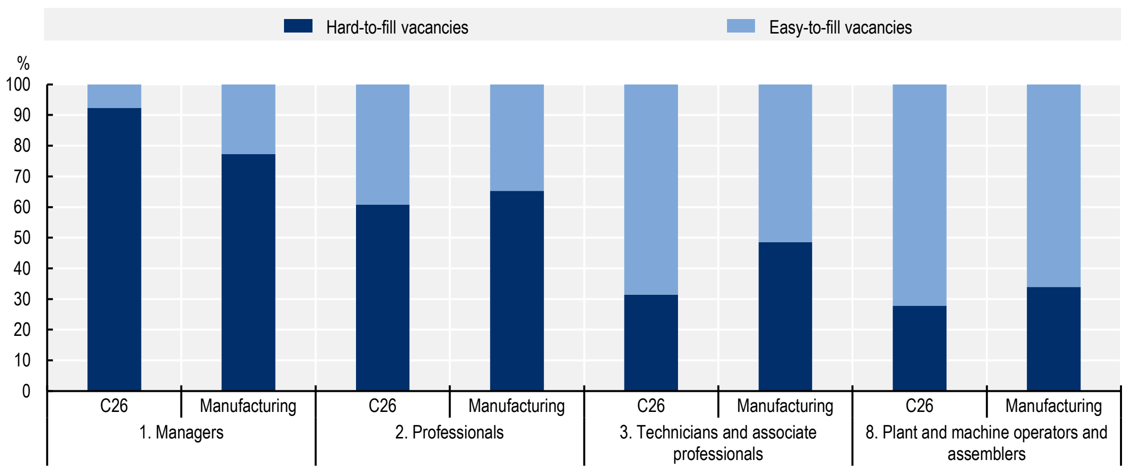
Finally, recurring factors, such as a lack of applicants and necessary skills, explain why establishments struggle to recruit for hard-to-fill vacancies across various occupation classifications (Figure 2.30). As presented in Figure 2.29, low-skilled vacancies (i.e. plant and machine positions, in this case) are comparatively easy to fill. However, where such vacancies cannot be filled in the electronic component manufacturing industry, this is typically due to a lack of applicants, possibly indicating that demand for these skills continues to outstrip supply.

Figure 2.28. Job vacancy position by 1-digit Philippine Standard Occupational Classification (PSOC), Sector C26 vs. Manufacturing, 2019-20



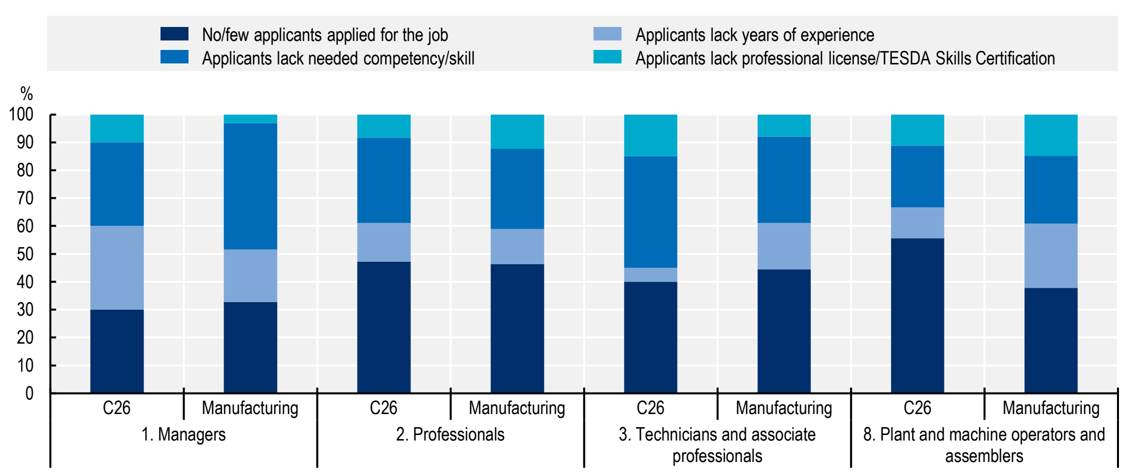
Note: This figure shows the share of job vacancies for each type of position during the reference period. Job vacancies refer to unfilled job openings that are immediately available for placement and for which active recruitment steps are undertaken anytime during the reference period. The information pertains to the most recent vacancy for the position if the position became vacant several times during the reference period. Entry-level positions refer to starting positions that require little or no experience. The occupational classification follows the 2012 PSOC. For the context of this report, only the following major groups are further analysed: 1 Managers; 2 Professionals; 3 Technicians and associate professionals; and 8 Plant and machine operators and assemblers. For more information on the 2012 PSOC, see https://psa.gov.ph/classification/psoc/technical-notes.
Source: OECD calculations based on the Philippine Statistics Authority Integrated Survey on Labor and Employment 2019/2020 PART IV: Occupational shortages and surpluses, confidential data (accessed March 2024).

Figure 2.29. Job vacancy, hard vs. easy to fill by 1-digit PSOC, Sector C26 vs. Manufacturing, 2019-20



Note: Job vacancies refer to unfilled job openings immediately available for placement and for which active recruitment steps are undertaken anytime during the reference period. Information pertains to the most recent vacancy for the position in case the position became vacant several times during the reference period. The occupational classification follows the 2012 PSOC. For more information on the 2012 PSOC, see https://psa.gov.ph/classification/psoc/technical-notes.
Source: OECD calculations based on the Philippine Statistics Authority Integrated Survey on Labor and Employment 2019/2020 PART IV: Occupational shortages and surpluses, confidential data (accessed March 2024).

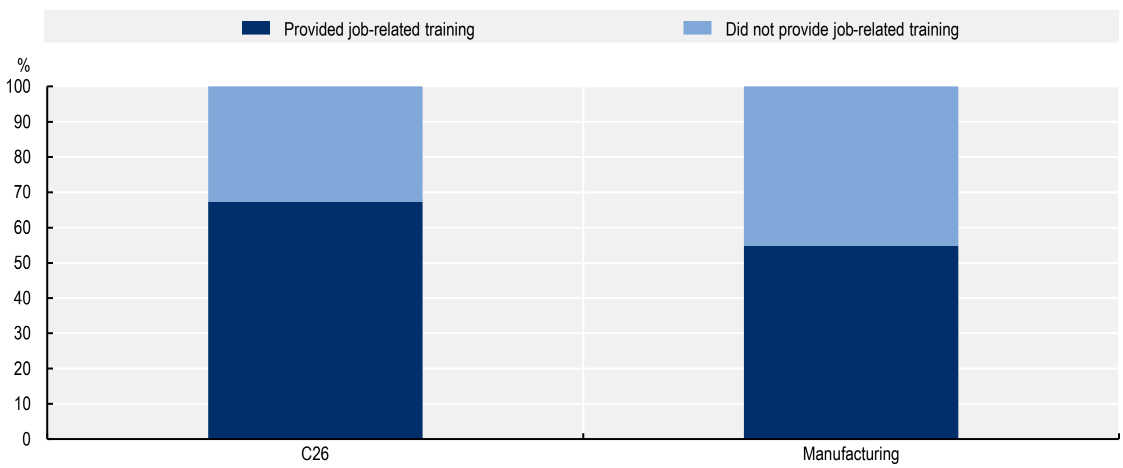
Figure 2.30. Reason for hard-to-fill vacancies by 1-digit PSOC, Sector C26 vs. Manufacturing, 2019-20



Note: This bar graph represents the dark blue portion in Figure 2.29. Observations with out-of-range responses were dropped: C26 and Manufacturing represent 14.6% and 12.2% of the hard-to-fill vacancies, respectively. The occupational classification follows the 2012 PSOC. For more information on the 2012 PSOC, see https://psa.gov.ph/classification/psoc/technical-notes.
Source: Philippine Statistics Authority Integrated Survey on Labor and Employment 2019/2020 PART IV: Occupational shortages and surpluses, confidential data (accessed March 2024).

Figure 2.31 shows that a higher percentage of establishments in the semiconductor-related industry provided job-related training relative to firms in the broader manufacturing sector. This might be due to the abovementioned difficulties in finding skilled applicants within the semiconductor industry, especially for technical and associated professions. For the semiconductor-related industry, 67.3% of the responding establishments (out of 113) provided job-related training to their employees. Meanwhile, for the manufacturing sector, 54.7% of the 1 383 establishments that responded provided job-related training to their employees.

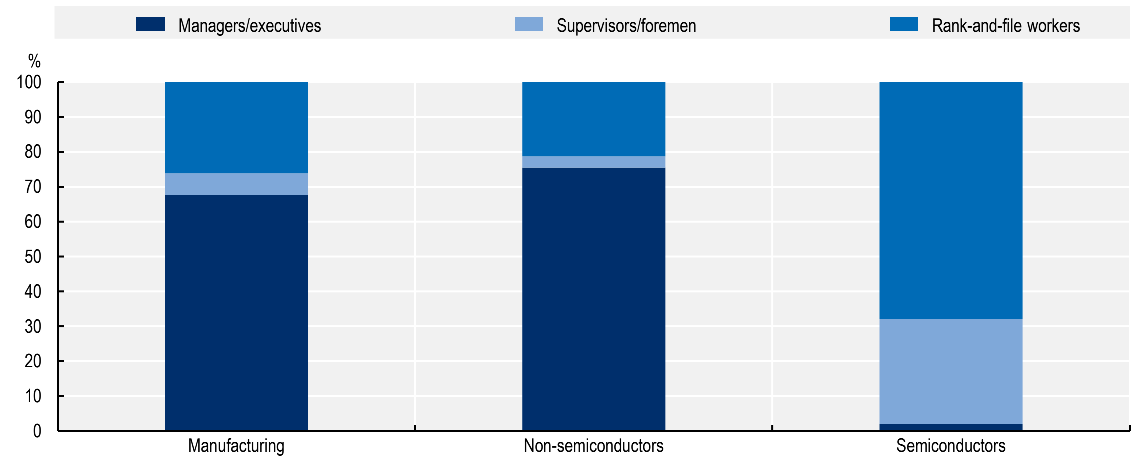
Figure 2.31. Share of establishments that provided job-related training, Sector C26 vs. Manufacturing, 2019-20



Note: Job-related training refers to employees receiving training to acquire knowledge or new skills for a current or future job conducted by the establishment and other institutions, where general orientation, team building and similar activities are excluded.
Source: OECD calculations based on the Philippine Statistics Authority Integrated Survey on Labor and Employment 2019/2020 PART V: Job-related training of workers, confidential data (accessed March 2024).

In 2019, 10.6% of the workers who received job-related training in the manufacturing sector (90 644 of 856 203) were employed in the electronic component manufacturing industry. Establishments in the semiconductor-related industries prioritised training rank-and-file workers relative to supervisors or managers, a notably different pattern from the rest of manufacturing (Figure 2.32). Almost 70% of employees trained in the semiconductor-related industry are rank-and-file workers compared to only 21.3% in the rest of the manufacturing sector. This figure highlights the mismatch in the skills required by the electronic component manufacturing industry and those already available in the labour force. This aligns with stakeholders' views: employers in semiconductor-related industries consistently train their junior staff to ensure they attain the specialised skills and technical expertise required in the highly complex semiconductor industry.

Figure 2.32. Share of workers who received job-related training, by category of employees, 2019-20



Note: This figure represents the population, with values retrieved from the sample using weights. Job-related training refers to employees receiving training to acquire knowledge or new skills for a current or future job conducted by the establishment and other institutions, where general orientation, team building and similar activities are excluded. Semiconductors refer to C26. Non-semiconductors refer to industries in the manufacturing sector, excluding C26.
Source: OECD calculations based on the Philippine Statistics Authority Integrated Survey on Labor and Employment 2019/2020 PART V: Job-related training of workers, confidential data (accessed March 2024).

Demand for skills

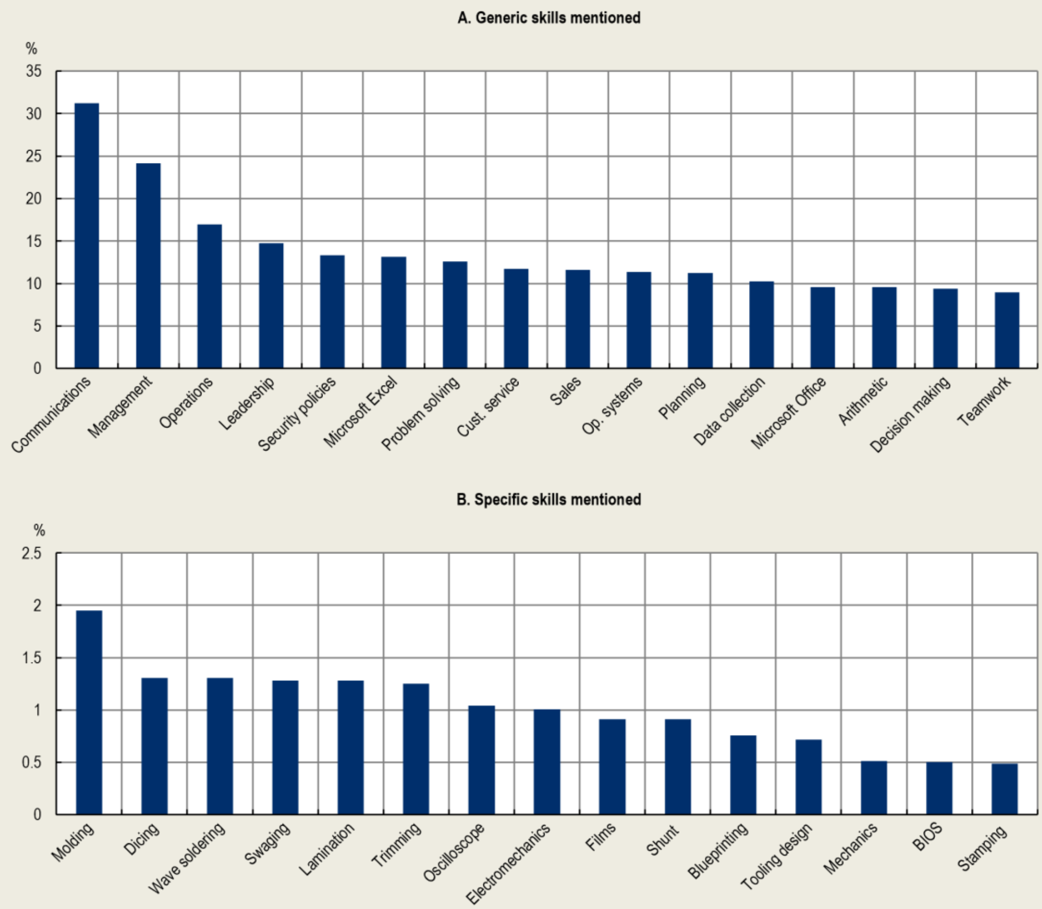
The semiconductor industry in the Philippines hires a variety of different occupations, roles and skill profiles. Consultation with employers indicates the important role of academic institutions in providing the required technical foundations, especially for engineering tasks that require complex skills (e.g. integrated circuit design). Employers note the role of vocational courses in equipping workers with relevant technical skills for less specialised tasks. More specific and technical skills, often related to manufacturing processes (such as moulding, dicing, wave soldering and swaging), complement more socio-emotional and functional skills like communications and management. Box 2.2 highlights the diversity of skills mentioned in job vacancies for the downstream semiconductor industry relative to other manufacturing industries in selected countries.

Box 2.2. Which skills are needed for the downstream semiconductor industry? Insights from job vacancies

The semiconductor industry is diverse and hires a variety of occupations, roles and skill profiles. Job vacancy data can help underscore which skills are in demand, particularly in the semiconductor value chain's assembly testing and packaging segment and whether technical, socio-emotional and functional skills are relatively more important.

Figure 2.33 portrays the most cited skills in online job postings for the downstream semiconductor industry, particularly ATP, in Indonesia, Mexico and Viet Nam, grouped into skills specific to the semiconductor industry and generic across occupations. The most important generic skill "Communications" was mentioned in over 30% of the posts considered. Despite not figuring prominently in online job postings among the most crucial skills for the semiconductor sector, speaking English can represent an advantage due to the global linkages characterising this industry and the dominant role played by multinational companies. Filipino workers may have an advantage in the semiconductor market, given that most of the workforce is English-speaking.

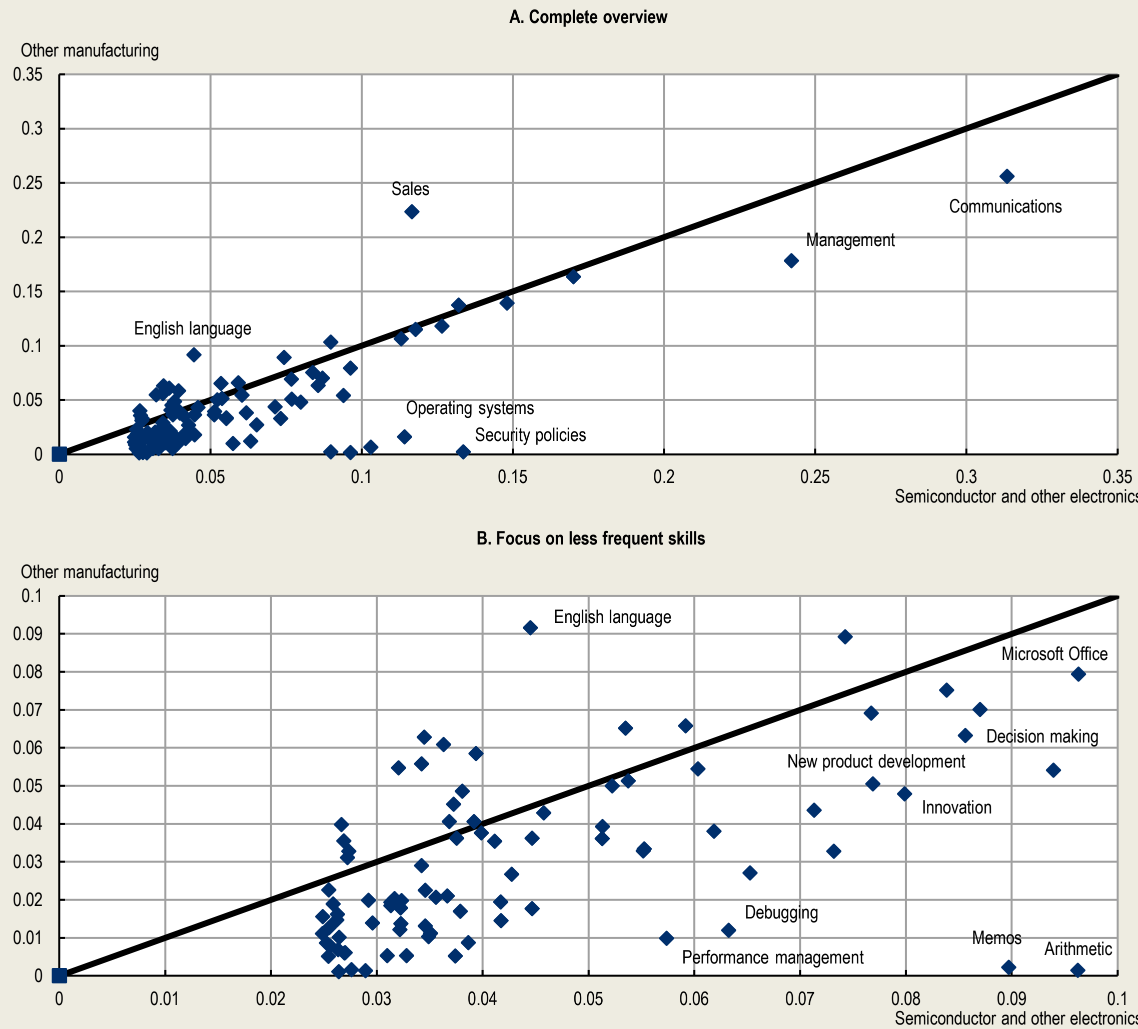
Figure 2.33. Understanding semiconductor job postings and relevant skills



Note: The Y-axis corresponds to the percentage of online job postings where the skills were tagged over the total number of posts. Not all job postings include skills tags. Lightcast platform job postings are from the semiconductor industry with Code 3344 in the NAICS system. The job postings analysed are from Indonesia, Mexico and Viet Nam.
Source: OECD calculations based on Lightcast, https://lightcast.io/products/data/overview (accessed October 2023).

Comparing the most sought-after skills in the semiconductor and other electronics sector to those in other manufacturing activities (Figure 2.34) highlights which skills are particularly important to the semiconductor-related employers. For instance, the skill "Communications" is mentioned in 31% of job postings within the semiconductor and electronics industry but only in 25% of postings for other manufacturing industries. In addition, semiconductor job postings are more likely to include "Security policies" (13-percentage-point difference in semiconductor job postings relative to other manufacturing vacancies), followed by "Operating systems" (10-point difference), "Data collection" (10-point difference), "Arithmetic" (10-point difference), and "Memos" (9-point difference). Conversely, skills such as "Sales" and "English language" are relatively less sought after in the semiconductor and electronics sector compared to the broader manufacturing sector.

Figure 2.34. Relevant skills in semiconductor vs. manufacturing, percentage of postings



Note: The Y-axis corresponds to the percentage of online job postings where the skills were tagged over the total number of posts. Not all job postings include skills tags. Lightcast job postings are from the semiconductor industry with Code 3344 in the NAICS system. The job postings analysed are from Indonesia, Mexico and Viet Nam.
Source: OECD calculations based on Lightcast, https://lightcast.io/products/data/overview (accessed October 2023).

Industry stakeholders also emphasise the different skill sets engineers are required to have compared to technicians and operators. With respect to the former, industry stakeholders noted that most hiring companies seek engineers graduating from specialised university degree programmes in science, technology, engineering and mathematics (STEM) fields, especially as the complexity of engineering tasks increases as firms upgrade their operations to more complex parts of the value chain. Having a specialised background (e.g. in microelectronics) can considerably reduce the time dedicated to on-the-job training, with noticeable benefits for companies that otherwise may need up to two years of training for newly hired employees to reach complete autonomy.

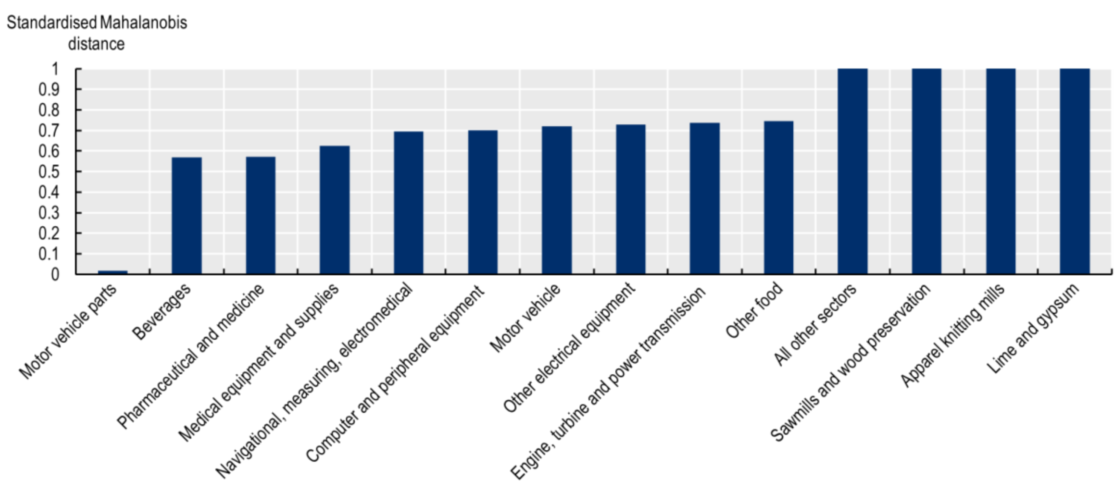
Academic requirements are less stringent for technicians and operators, with courses lasting weeks or months often sufficient to train for most tasks. In this respect, vocational training is crucial. Once minimum requirements are met (which tend to vary from one company to another and between different occupations), employers are mostly open to providing further training to their workers to develop their skills but also to facilitate talent retention.

Efforts made in developing the talent required for semiconductor production can benefit from overlaps and spillovers with other industries that require a similar mix of skills. Figure 2.35 shows the sectors more closely aligned with the semiconductor industry based on the skills mentioned in their online job postings. In light of this similarity, these sectors may represent important pools for employers aiming to expand their workforce in a phase where talent for semiconductors is in high demand. Establishing collaborations across sectors to develop a more versatile workforce may be equally beneficial for both employers and employees.

Manufacturing motor vehicle parts is by far the closest sector to semiconductors in terms of skills required by employers. This sector produces vital components for automotive assembly, requiring precision engineering and adherence to stringent safety regulations, similar to the semiconductor industry. Other sectors share similarities with semiconductors: the manufacture of beverages and of pharmaceutical and medicine require clean room manufacturing (McKinsey, 2024[12]), ingredient sourcing, production processes, packaging and cutting-edge R&D. In addition, medical equipment and supplies manufacturing, as well as the navigational, measuring and electromedical manufacturing sectors require proficiency in software, precision machinery and electronics assembly.

Consistent with Figure 2.35, human capital from the motor vehicle and computer and peripheral equipment manufacturing – which already represent important industries for the Philippines – appears best suited for reallocation to the semiconductor industry.

Figure 2.35. Closest manufacturing sectors to semiconductors in terms of demanded skills



Note: Lightcast online job postings are from the semiconductor industry with Code 3344 in the NAICS system. The job postings analysed are from Indonesia, Mexico and Viet Nam. The Mahalanobis distance is a metric for evaluating the similarity between economic sectors. It provides a distance between industries in the skills space, weighting the different skills by the number of job postings in which they appear. The last three sectors of the graph correspond to the furthest from semiconductors. Distances were standardised, meaning that the maximum distance (between semiconductors and lime and gypsum sectors) was assigned as 1 and all of the remaining distances were assigned values between 0 and 1 relative to the furthest distance.
Source: OECD calculations based on Lightcast, https://lightcast.io/products/data/overview (accessed October 2023).

While technical skills are paramount in the semiconductor field, they must be complemented with appropriate socio-emotional and functional skills. However, the latter, such as the ability to effectively communicate, manage, lead and work in teams, solve complex problems, think critically and adapt, are transferrable and highly demanded in other industries.

The results of the ISLE highlight that, in the case of the Philippines, four general skills stand out in semiconductor-related industries, irrespective of the specific occupation: effective communication, flexibility, adaptability and problem solving. Other skills, such as organisational skills, management skills and critical thinking, despite their importance, figured less prominently in the results of the survey. This underscores the homogeneity in the demand for socio-emotional and functional skills when working in an establishment beyond technical skills.

Supply of skills

Three interrelated labour market issues impact the semiconductor ecosystem in the Philippines. First, employers highlight a lack of engineers as a bottleneck to the semiconductor industry's growth. Stakeholders identified a range of possible causes for this shortage, including a possible lack of early exposure to STEM, inadequately targeted education and a shortage of STEM educators to teach interested students. The lack of qualified teachers is a recurring issue, especially for more advanced courses and degree programmes.

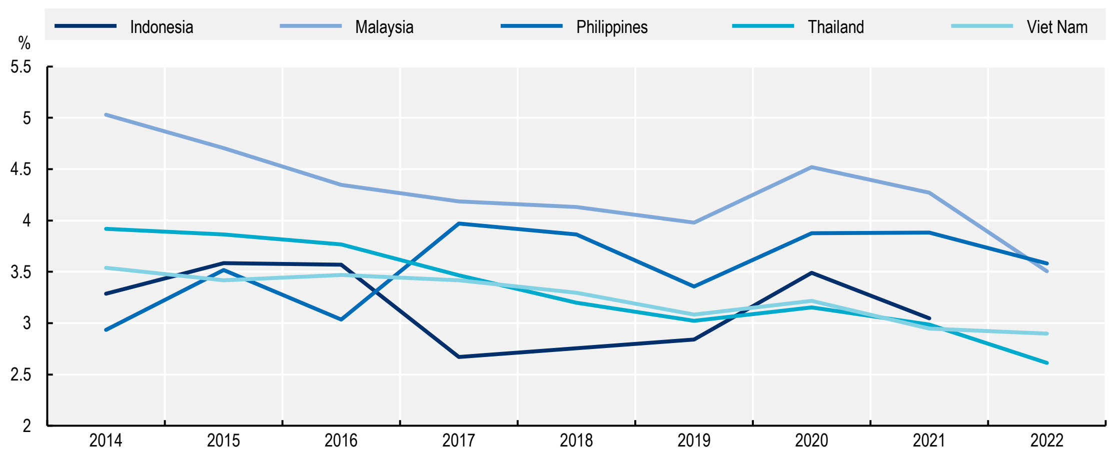
Second, because some semiconductor occupations are technically complex and highly specialised, skills mismatch can be a concern. Some key stakeholders have recognised underemployment as a bigger problem than unemployment in the Philippines. In fact, the latest figures recorded underemployment at 12.3% and unemployment at 4.3% (PSA, 2024[13]).[11] To mitigate this challenge, employers provide training and invest in their engineers and technicians so they can productively contribute to their respective fields. For instance, companies noted that an average of 2-3 years of training after hiring is needed until engineers can productively integrate into the firm's activities. However, this comes at the cost of increasing the likelihood that employees will be sought after by both domestic and international employers.

This leads to a "brain drain" phenomenon (Box 2.3), the third main bottleneck experienced by the Philippine semiconductor ecosystem regarding the labour market. In fact, stakeholders have noted that the highly mobile Philippine workforce is likely to leave its employers after having developed valuable specialised skills, attracted by international employers paying more competitive wages.

The following paragraphs are dedicated to quantifying and providing evidence explaining why the persistent cycle of limited supply and reduced demand for skilled workers continues in the Philippines. Numerous factors define whether a country has the right set of skills for semiconductors. Education plays a vital role in preparing future employees for some of the most critical positions within this industry.

The percentage of GDP allocated to education is a useful metric to gauge the availability of the resources needed to develop human capital capable of producing semiconductors, especially when comparing the Philippines to the usual set of benchmark countries: Indonesia, Malaysia, Thailand and Viet Nam.[12] In this respect, Figure 2.36 highlights the increasing share of Philippine GDP allocated to education, contrasting with the trend in the selected benchmark countries, where the allocation has decreased over the last decade. Compared with this set of countries, the Philippines is performing well in terms of GDP expenditure on education, having recently (2022) overtaken Malaysia to become the biggest spender (in percentage terms).

Figure 2.36. Total government expenditure on education, share of GDP

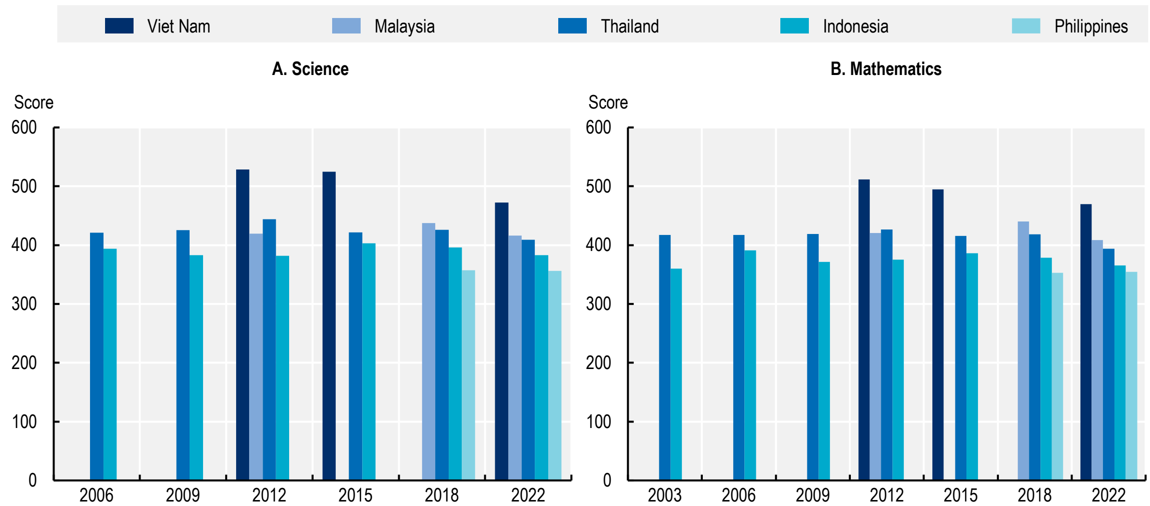


Note: Data provided cover the period 1970-2022. 2014 was selected as the starting year for growth because it is the first year with complete information for the Philippines. Data for 2022 for Indonesia are missing.
Source: OECD calculations based on World Bank (n.d.[10]), Government Expenditure on Education, Total (% of GDP), https://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS (accessed December 2023), original data from the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics (UIS).

Technical aptitude is particularly relevant to engineering profiles required for the semiconductor industry. One measure of this aptitude includes results from the OECD Programme for International Student Assessment (PISA), which tests 15-year-old students across countries on a set of selected topics. In the crucial subjects of mathematics and science, the Philippines appears to be lagging behind comparable economies in both subjects, with Viet Nam being the best performer in both areas. Unlike other economies, where there has been a general decline in performance in both science and mathematics over the last two periods, the results have remained constant for the Philippines since their inclusion in PISA in 2018 (Figure 2.37).

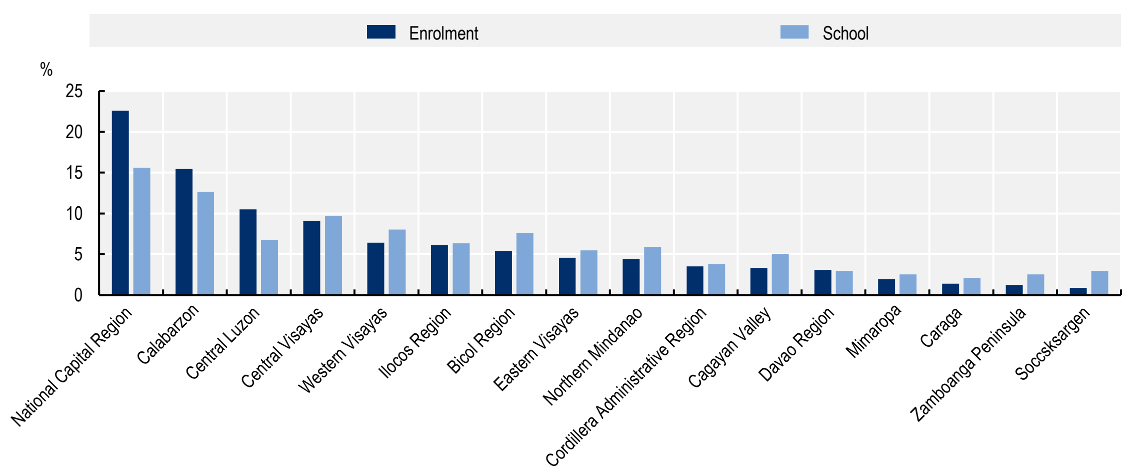
While secondary education is an important foundation, industry stakeholders highlight the importance of tertiary education in preparing future engineering and STEM-related students. Commission on Higher Education (CHED) data identified electronic, electrical, chemical and mechanical engineering as the most popular semiconducting engineering disciplines. Among regions in the Philippines, the National Capital Region did not only have the greatest number of institutions offering related engineering programmes but also had the greatest number of students. In fact, 22.6% of enrolees and 15.6% of the schools that offer engineering disciplines related to semiconductors are in the National Capital Region (Figure 2.38). This is followed by the Calabarzon region, where numerous semiconductor-related companies are located (see also Table 2.1).

Figure 2.37. PISA results in Southeast Asian economies



Note: While data cover PISA batches 2000, 2003, 2006, 2009, 2012, 2015, 2018 and 2022, the Philippines joined the PISA programme only for the last two vintages.
Source: OECD calculations based on OECD, PISA, https://www.oecd.org/en/about/programmes/pisa.html (accessed December 2023).

Figure 2.38. Share of baccalaureate-level enrolment and schools, engineering disciplines related to semiconductor by region, academic year 2022/23

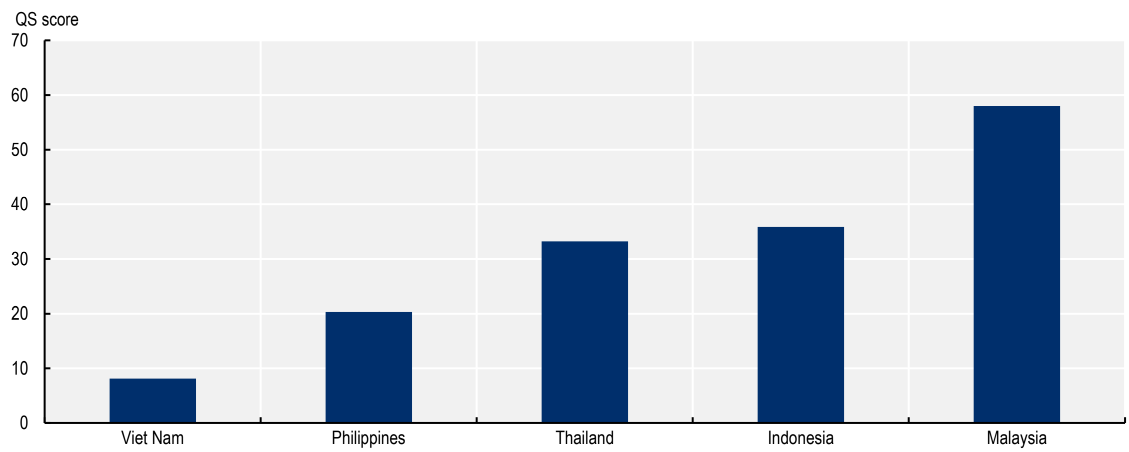


Note: Data based on the submission of higher education institutions as consolidated by the Office of Planning, Research and Knowledge Management Knowledge Management Division as of 19 February 2024.
Source: OECD calculations based on Commission on Higher Education, confidential data (accessed February 2024).

An approximate evaluation of the Philippines universities' performance is offered by the Quacquarelli Symonds (QS) ranking of countries' university education, based on the QS score of the three best universities within each country. While this metric is far from providing a comprehensive view of Philippine universities, it suggests that the Philippines could improve compared to the usual set of benchmark countries: Figure 2.39 highlights how universities in Malaysia, and to a lesser extent Indonesia and Thailand, are performing considerably better.

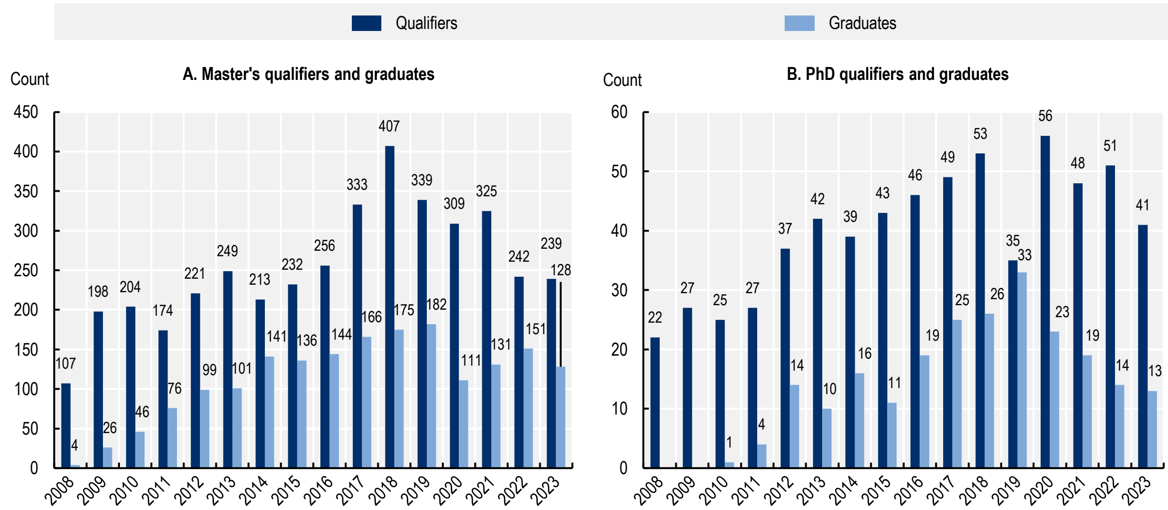
However, the QS World University Rankings covers a very limited set of universities, which may not encompass those providing the most relevant skills needed for semiconductors. Data provided by the Research Organization Registry (ROR) can be employed to assess this more carefully and in a more nuanced way. More specifically, ROR data show that 126 of 213 Philippine universities, or 59% of the sample, have curricula relevant to the field of semiconductors, typically electrical or electronic engineering. Among these most relevant universities, the University of the Philippines Diliman and Mindanao State University – Iligan Institute of Technology have well-known programmes and expertise in microelectronics, while others, like Ateneo de Manila University, Batangas State University, Caraga State University, FAITH Colleges, the Technological University of the Philippines – Manila, the University of San Carlos, the University of Santo Tomas and the University of Science and Technology of Southern Philippines participate in key programmes like the Center for Integrated Circuit and Device Research and also produce graduates in semiconductor-related fields. These universities tend to be particularly clustered in the National Capital Region but some are outside Metropolitan Manila, including on the islands of Cebu and Mindanao.

Figure 2.39. Quacquarelli Symonds (QS) top three university ranking, 2021



Note: This figure shows the average score of the top three universities per country. The QS score is a weighted average of several indicators: academic reputation, employer reputation, faculty-student ratio, citations per faculty, international faculty ratio, international student ratio, international research network, employment outcomes and sustainability. The sum of the scores of the listed universities is divided by 3 if fewer than three universities are listed in the QS ranking of the global top 1 000 universities. This implies a score of zero for non-listed universities.
Source: OECD calculations based on Quacquarelli Symonds (2022[14]), *QS World University Rankings 2022*, https://www.topuniversities.com/university-rankings/world-university-rankings/2022, in WIPO (2022[15]), *Global Innovation Index*, World Intellectual Property Organization.

Figure 2.40. Engineering Research and Development for Technology (ERDT) qualifiers and graduates



Source: Philippine Engineering Research and Development for Technology consortium, confidential data (accessed February 2024).

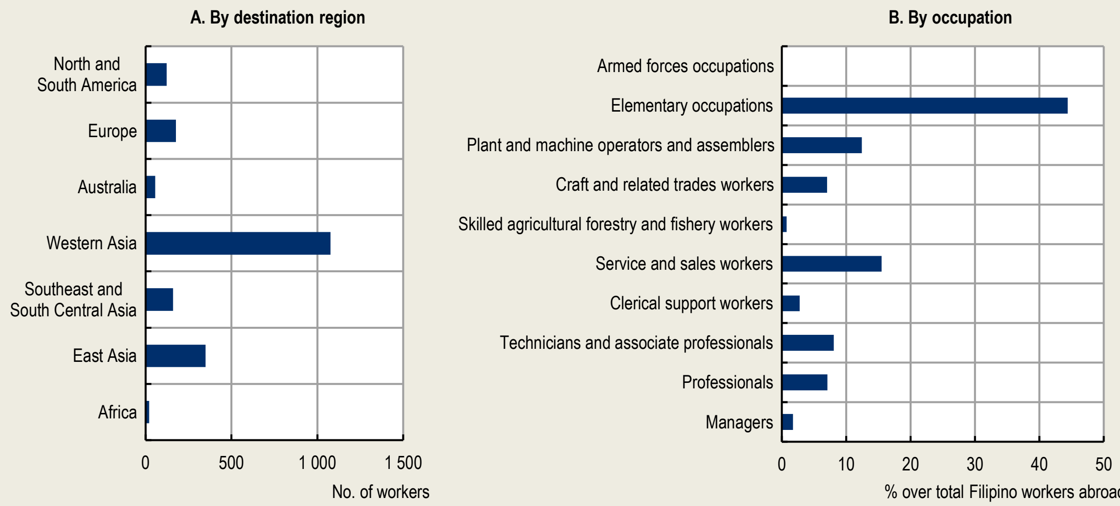
The Engineering Research and Development for Technology (ERDT) consortium consists of eight technical universities in the Philippines: Ateneo de Manila University, Central Luzon State University, De La Salle University, Mapúa University, Mindanao State University – Iligan Institute of Technology, the University of the Philippines (UP) Diliman, UP Los Baños and University of San Carlos. These universities offer master's and doctoral degrees in various engineering fields. Figure 2.40 shows an increase in the numbers of qualifiers and graduates for master's and PhD programmes in these universities until 2018, followed by a fall until 2023. Industry stakeholders anecdotally confirmed this development and noted skills shortages persist in engineering fields. Apart from the effect of the COVID-19 pandemic, speculative explanations raised by industrial stakeholders include a more general lack of awareness and other more lucrative career paths for STEM-inclined students, including software development.

Box 2.3. Beyond skills development: Skills retention in the Philippines

The analysis has mainly focused on developing the skills needed for semiconductor production. However, retaining skilled workers is equally important. Skills retention (and concerns related to "brain drain") have emerged as a key policy issue in the Philippines.

The PSA (2022[16]) highlights that the Philippines is experiencing a noticeable outflow of human resources. Overall, almost 2 million Filipino workers currently reside abroad (from a population of almost 114 million) largely in Western Asia (Saudi Arabia in particular), East and Southeast Asia, and Europe. Notably, "Plan and machine operators and assemblers" is the third-most represented occupation among Philippine workers abroad, which can be especially relevant for the local semiconductor industry, particularly firms active in ATP. Data provided by the Science Education Institute of the Department of Science and Technology emphasise how a large share of Filipino engineers, up until 2015 (the last year for which there are available data), work abroad: this percentage is never below 35% in all periods under consideration in the report (with vintages in 1990, 2000, 2010 and 2015).

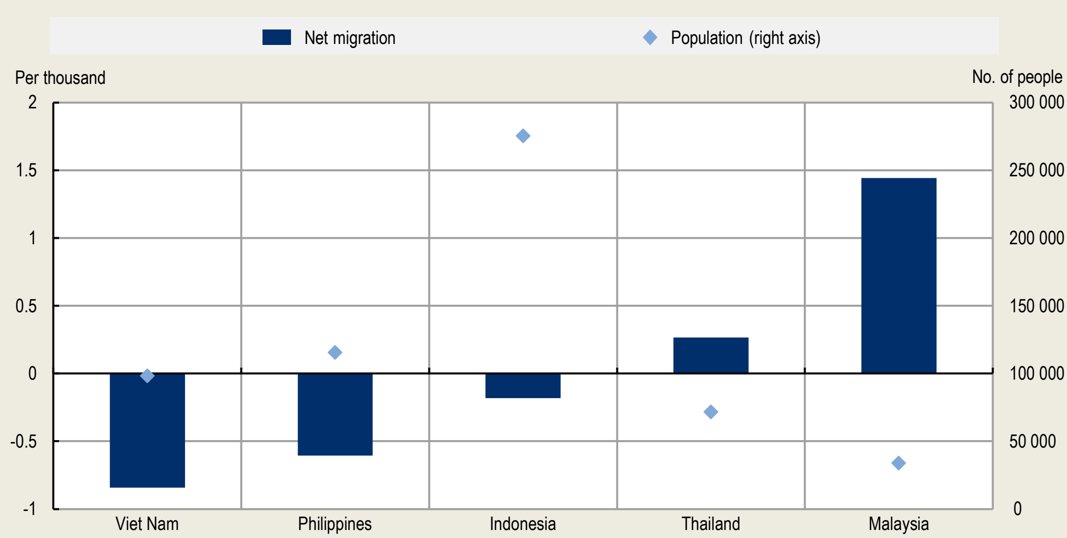
Figure 2.41. Overseas workers, by destination region and occupation, 2022



Note: Data refer to overseas Philippine workers whose departure occurred in 2017-22 and who have worked from April to September 2022. The geographical areas and occupations are the same as those reported in the publicly available data.
Source: OECD calculations based on the Philippine Statistics Authority, Survey on Overseas Filipinos, (2022), https://psa.gov.ph/statistics/survey/labor-and-employment/survey-overseas-filipinos (accessed February 2024).

The Philippines experienced a net loss of 0.5 persons per 1 thousand inhabitants in 2022, accounting for both immigration to and emigration from the country (Figure 2.42). Viet Nam is the only other country experiencing a similar outflow of human resources within the sample under consideration. Conversely, Malaysia and Thailand experienced positive inflows of migrants in 2022.

Figure 2.42. Net migration in Southeast Asian economies, 2022



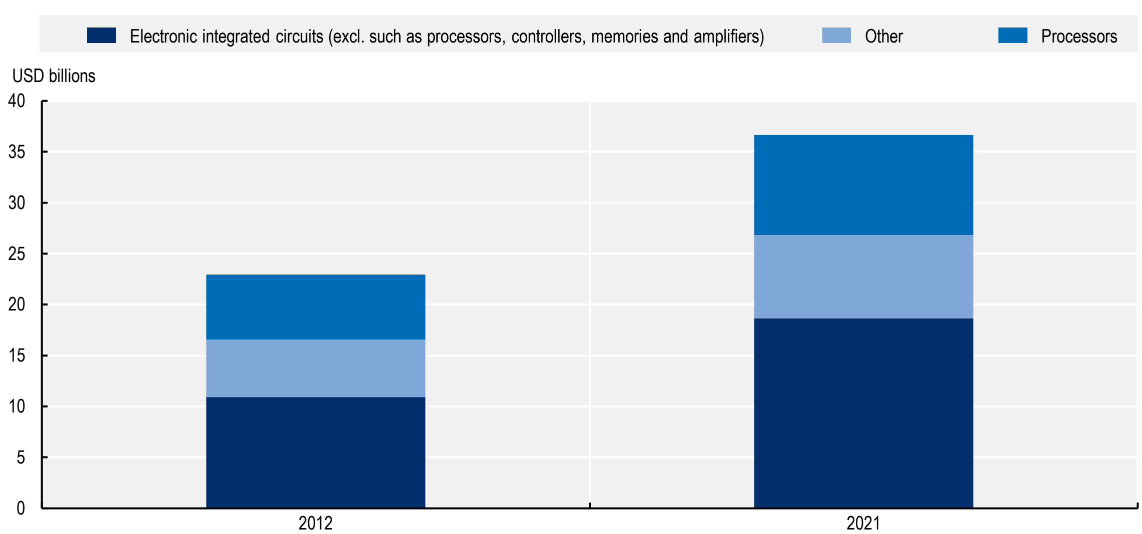
Source: OECD calculations based on World Bank (n.d.[17]), *Net Migration*, https://data.worldbank.org/indicator/SM.POP.NETM (accessed April 2024), but original data from World Population Prospects.

Issues with skills retention may be related to key characteristics of the Filipino workforce. English is one of the two official languages of the Philippines and most basic education is taught in English. While this facilitates easier interaction with foreign workers, for example, in a multinational enterprise context, it also enables workers to move abroad easily. Other factors, like compensation and career progression, are also likely to play a role in skills retention in the Philippines.

Integration in semiconductor global value chains

The Philippines exported almost USD 38 billion worth of chips in 2021 (Figure 2.43). These products are typically processors and controllers, and other types of electronic integrated circuits (excluding processors, controllers, memories and amplifiers). Coherently with the predominant role played by ATP manufacturers in the market structure described in Table 2.1, exports of semiconductor manufacturing equipment, foundry inputs and raw materials from the Philippines are marginal and, in the case of inputs and raw materials, have been decreasing since 2013.[13]

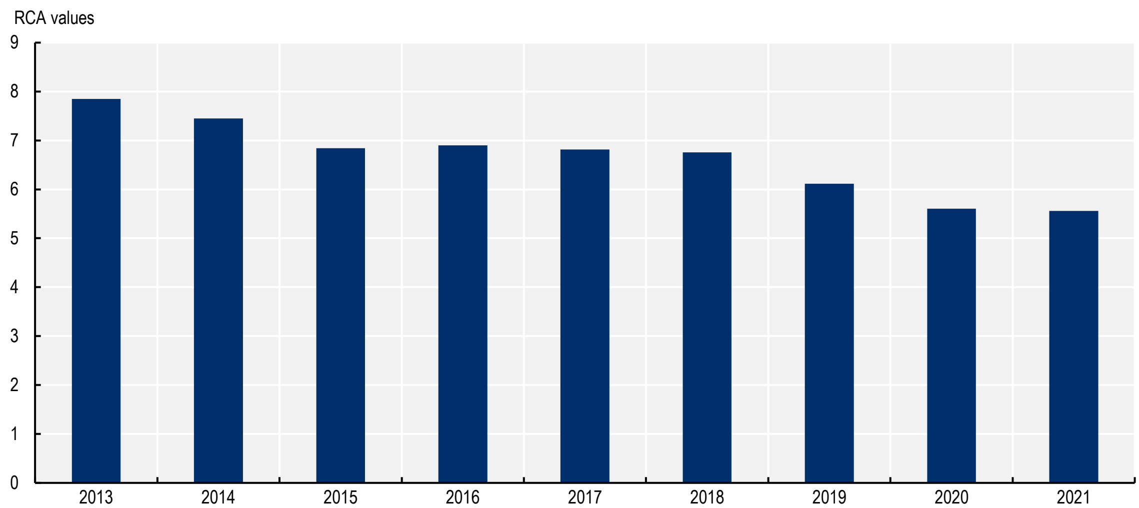
Figure 2.43. Exports of chips from the Philippines



Note: Data cover the period 2012-21 but only the first and final years are shown. Semiconductor goods are defined based on a list of 54 Harmonized System (HS) codes discussed in Annex B. The annex also includes an explanation concerning the four distinct subcategories ("chips", "manufacturing equipment", "foundry inputs" and "raw materials"): this figure takes into account chips only. This figure explicitly portrays the two main products of Philippine export and includes any other products considered under the "Other" category.
Source: OECD calculations based on the United Nations Commodity Trade Statistics Database, https://comtradeplus.un.org/ (accessed December 2023).

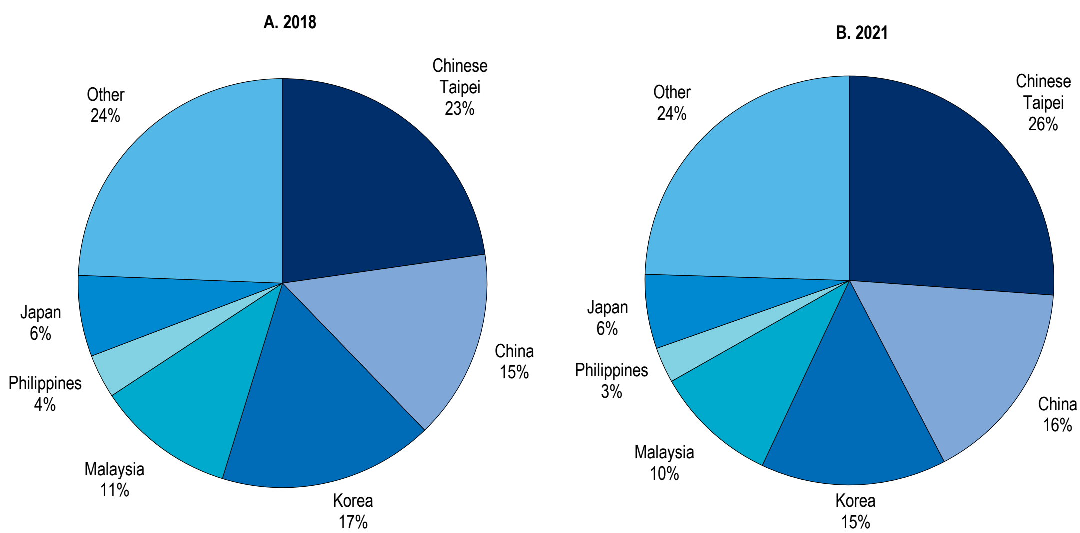
A country has a revealed comparative advantage (RCA) in a given product when the ratio of its exports of that product to total exports of all products exceeds the same ratio for the world as a whole. Figure 2.44 highlights that the Philippines still has a significant RCA in chips, although this advantage has fallen between 2012 and 2021. Considering the evidence shown in the previous paragraphs, namely increasing production and sales rates in the Philippines, the decreasing RCA potentially points to the emergence of other competitive countries in the field of semiconductors or to a decreasing focus on semiconductors within the Philippines.[14] The Philippines' share of global exports of finished semiconductor products has decreased from 3.47% in 2018 to 2.82% in 2021 (Figure 2.45). It nevertheless remains the ninth-largest exporter of chips over this period.

Figure 2.44. The Philippines RCA for chips, 2013-21



Note: Semiconductor goods are defined based on a list of 54 HS codes discussed in Annex B. The annex also includes an explanation concerning the four distinct subcategories ("chips", "manufacturing equipment", "foundry inputs" and "raw materials"): this figure only takes chips into account, namely the most important Philippine export in the semiconductor field.
Source: OECD calculations based on the United Nations Commodity Trade Statistics Database, https://comtradeplus.un.org/ (accessed December 2023).

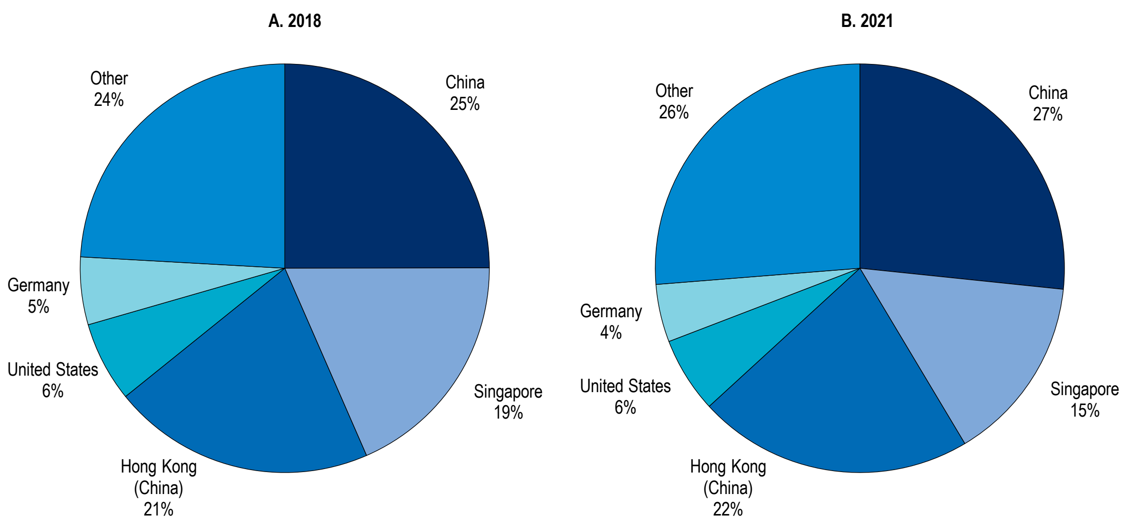
Figure 2.45. Share of exports of chips, by economy



Note: Data cover the period 2012-21. However, panel A portrays 2018 and panel B 2021. Semiconductor-related products are defined based on a list of 54 HS codes discussed in Annex B: this figure only considers chips. The top five countries by exports of semiconductor-related products, plus the Philippines, are explicitly portrayed.
Source: OECD calculations based on the United Nations Commodity Trade Statistics Database, https://comtradeplus.un.org/ (accessed December 2023).

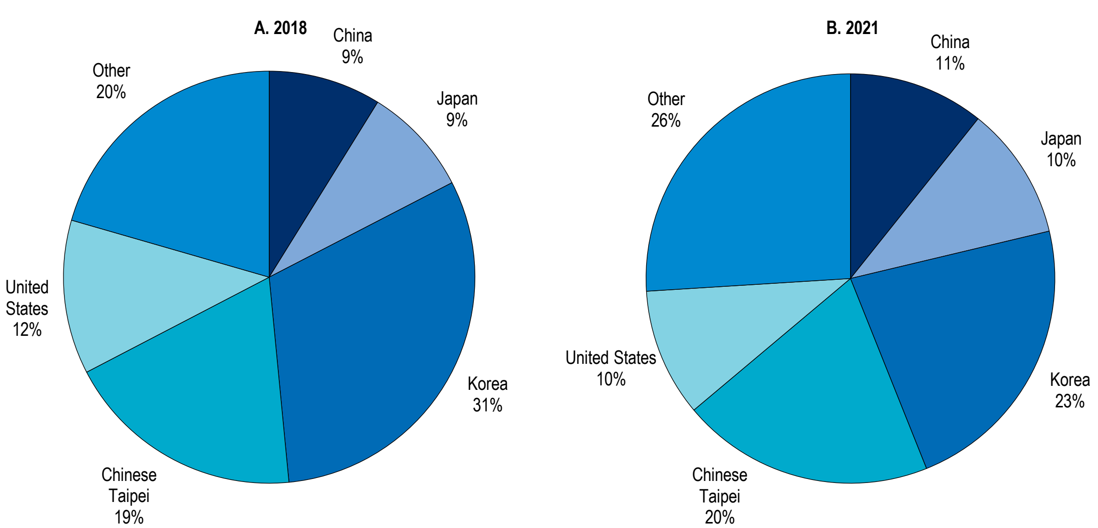
Figure 2.46 also highlights that the Philippines' exports of chips are highly concentrated, with 3 economies (China, Hong Kong [China] and Singapore) accounting for approximately 64% of the Philippines' exports of chips in 2018 and 63% in 2021. When focusing on imports (Figure 2.47), one noticeable shift in the lead exporter to the Philippines occurred from 2018 to 2021, with Korea declining from 31% to 23%, while China, Chinese Taipei and Japan gained importance. Economies like the United States have retained their considerable shares.

Figure 2.46. Share of Philippine exports of chips, by economy



Note: Semiconductor-related products are defined based on a list of 54 HS codes discussed in Annex B: this figure considers chips only. The top five economies receiving exports of chips from the Philippines (in 2021) are explicitly portrayed.
Source: OECD calculations based on Comtrade, https://comtradeplus.un.org/ (accessed December 2023).

Figure 2.47. Share of Philippine imports of chips, by economy



Note: Semiconductor-related products are defined based on a list of 54 HS codes discussed in Annex B: this figure considers chips only. It explicitly portrays the top five economies exporting chips to the Philippines (in 2021).
Source: OECD calculations based on the United Nations Commodity Trade Statistics Database, https://comtradeplus.un.org/ (accessed December 2023).

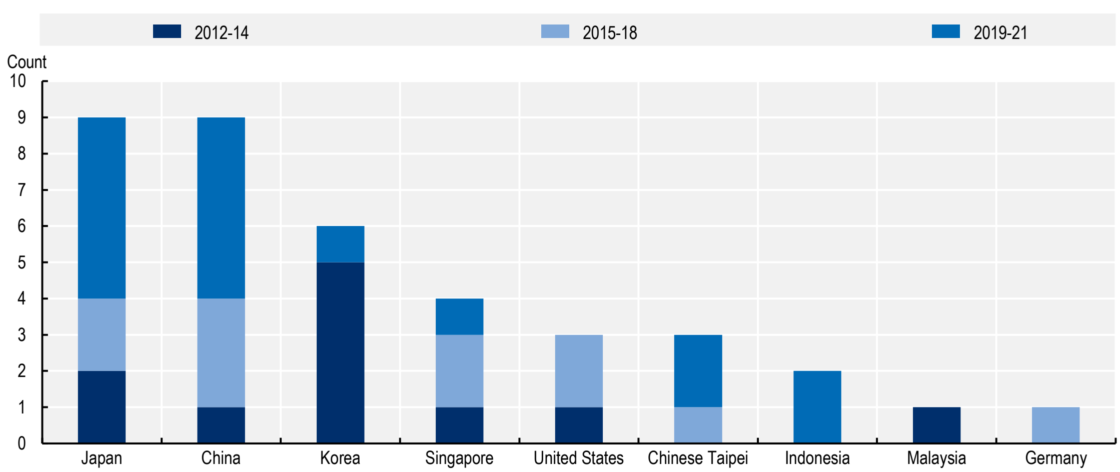
Examining bilateral trade dependencies can also help understand the strength and depth of economic ties between economies and where potential bottlenecks could occur. In general, the semiconductor industry is characterised by several dependencies and "bottlenecks", as some products that are vital for the entire semiconductor value chain are produced by a very limited number of countries (Kleinhans and Baisakova, 2020[18]).

Nevertheless, dependencies might still exist for specific products and resources. In the following analysis, the Philippines is considered to be dependent on another economy for a particular semiconductor-related product if a high share of imports for a given semiconductor-related product originates from a given economy and limited diversification options exist (meaning that the Philippines imports that product from relatively few other economies). Additionally, the value of the imported goods must be non-negligible and the ratio of imports to exports must be considerable.

Figure 2.48 highlights the number of Philippine bilateral trade dependencies for semiconductor-related products (see Annex B for the full list of identified products) from 2012 to 2021. China and Japan stand out as two countries on which the Philippines is increasingly reliant: in the most recent period (2019-21), the Philippines is dependent on China and Japan for ten products, more than on all other countries combined. On the contrary, Korea used to be an economy on which the Philippines was highly dependent but, in recent periods, this has been less so. This decreased dependency on Korea echoes the decreased imports from the country highlighted in Figure 2.47.

The Philippines has been consistently (in all three periods) dependent on China in terms of imports of argon, a raw material relevant to semiconductor production. In the last two periods, the Philippines has also been dependent on China for “Sheets and plates of polarizing material/sheets of semiconductor” and “Photographic plates and film in the flat, sensitised, unexposed, with any side > 255 mm”. The Philippines seeks to reduce external dependencies and diversify its value chain, especially by implementing a localisation policy to favour import substitution (see also Chapter 3).

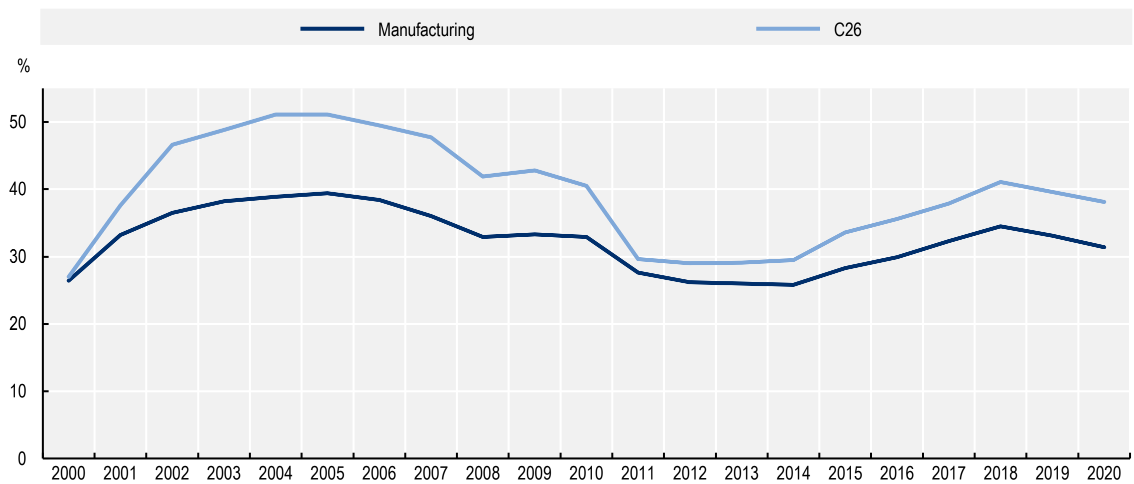
Figure 2.48. Number of Philippine dependencies for semiconductor-related products, by economy and period



Note: To define a “trade dependency”, the following criteria are taken into account: country j is said to be dependent on another country i, for a specific product k, when the gross imports of product k by country j are concentrated (HHI>0.4) and country i accounts for more than 10% of the focal country imports for product k. Additionally, only products whose imports to a country are non-negligible (above USD 1 million) and whose imports to a country are considerable with regard to the exports from a given country (at least worth 90%) are taken into consideration.
Source: OECD calculations based on the United Nations Commodity Trade Statistics Database, https://comtradeplus.un.org/ (accessed December 2023).

Moreover, the computer, electronic and optical products industry (i.e. C26) shows higher backward linkages than the broader manufacturing sector (Figure 2.49). Almost 40% of gross exports come from foreign value-added in the computer, electronic and optical products industry, compared to 31.4% in manufacturing. The increasing share over time reflects that the industry has become more dependent on foreign inputs to meet foreign demands, potentially affecting the cost structure for the firms operating in this industry.

Figure 2.49. Foreign value-added share of gross exports, 2000-20



Note: This figure shows the foreign value added as a percentage of gross exports in the Philippines for manufacturing and C26 (manufacture of computer, electronic and optical products). A foreign value-added intensity measure is often considered a measure of 'backward linkages' in analyses of global value chains.
Source: OECD Trade in Value Added (TiVA) 2023 ed, https://www.oecd.org/en/topics/sub-issues/trade-in-value-added.html (accessed July 2024).

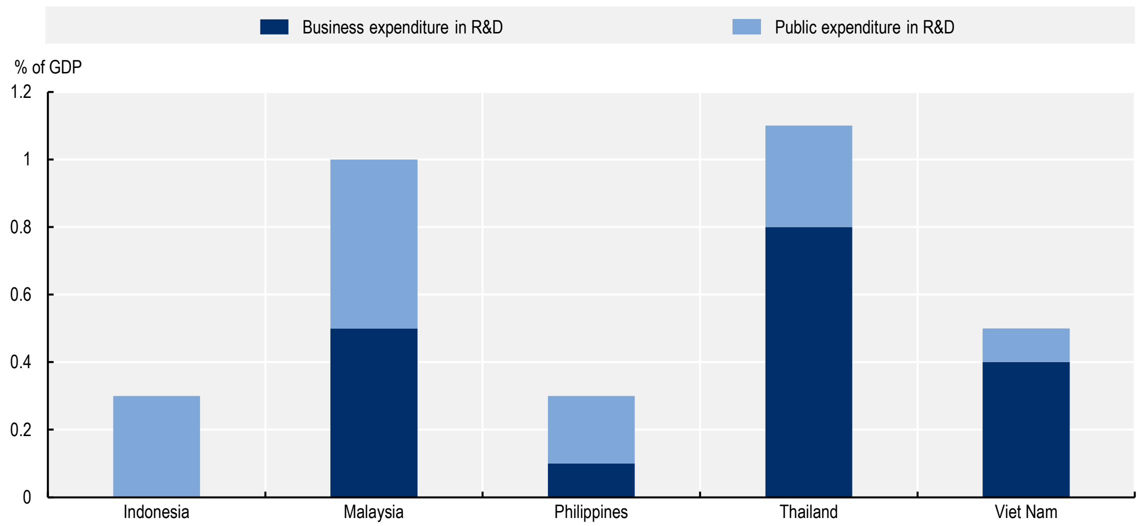
Technology

This section aims to highlight the current state of the innovation landscape in the Philippine semiconductor ecosystem. It does so by examining both inputs to innovation, such as R&D expenditure, and outputs, focusing in particular on patenting activities.

Innovation inputs

As an activity defined by the pursuit of new knowledge, R&D expenditures are an often-used input measure of innovation readiness. Figure 2.50 shows that the Philippines spends just 0.3% of GDP on R&D. It also shows that Malaysia, Thailand and Viet Nam are outspending the Philippines regarding R&D expenditures as a percentage of GDP. This difference appears to relate to business R&D expenditures. More specifically, Thailand is considerably outspending the Philippines in this area (0.8% of Thailand's GDP vs. 0.1% for the Philippines), with only Indonesia having a weaker performance than the Philippines.

Figure 2.50. Gross expenditure on R&D, 2020



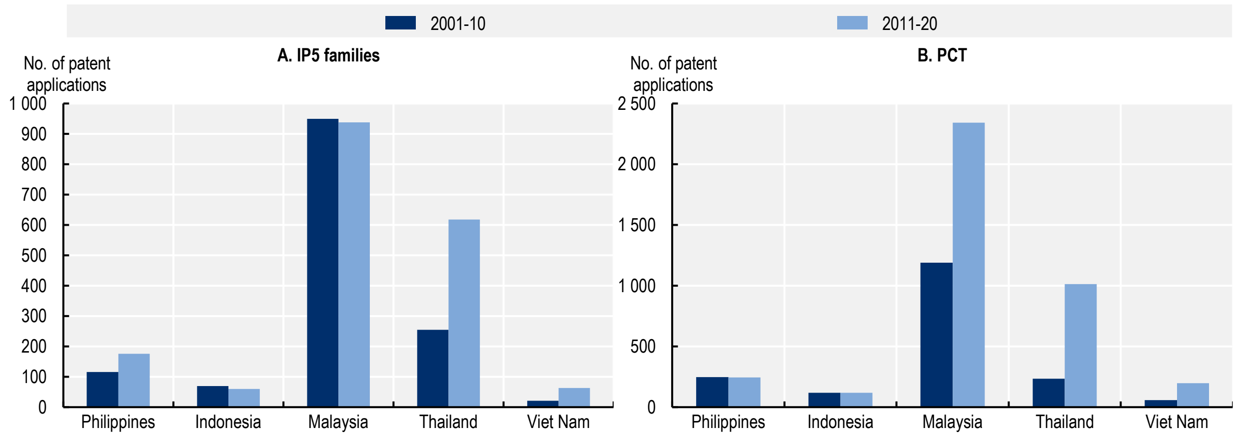
Note: The sources directly provide business expenditure as well as total expenditure, while public expenditure is inferred as the difference between the two.
Source: OECD calculations based on UIS (n.d.[19]), *Welcome to UIS.Stat*, http://data.uis.unesco.org (accessed December 2023); Eurostat (n.d.[20]), *Database*, https://ec.europa.eu/eurostat/data/database (accessed December 2023); OECD (n.d.[21]), *Main Science and Technology Indicators Database*, https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB (accessed December 2023); RICYT (n.d.[22]), *Ibero-American and Inter-American Network of Science and Technology Indicators (RICYT)*, http://www.ricyt.org/en/ (accessed December 2023) in WIPO (2022[15]), *Global Innovation Index*, World Intellectual Property Organization.

Innovation outputs

Patents protect technological inventions. Patent statistics provide insightful information on the general state of the art in the concerned technology area and can help to identify the maturity of certain technologies or identify technological trends (EPO, n.d.[23]; WIPO, 2023[24]). While patent data may not paint the entire picture of the innovative nature of an industry in a certain country, they are often used as a proxy for measuring innovation. In evaluating technological progress, this information may be complemented with other indicators ranging from, but not limited to, number of innovative startups and adoption of digital technologies.

Among selected ASEAN countries, Malaysian entities file for patents the most. Figure 2.51 exhibits that under IP5 families[15], the Philippines recorded around one-fifth of the patent applications filed in Malaysia from 2011 to 2020. The gap is wider for patent applications filed under the Patent Co-operation Treaty (PCT), where the Philippines has only one-tenth of Malaysia's applications.

Figure 2.51. Total patents



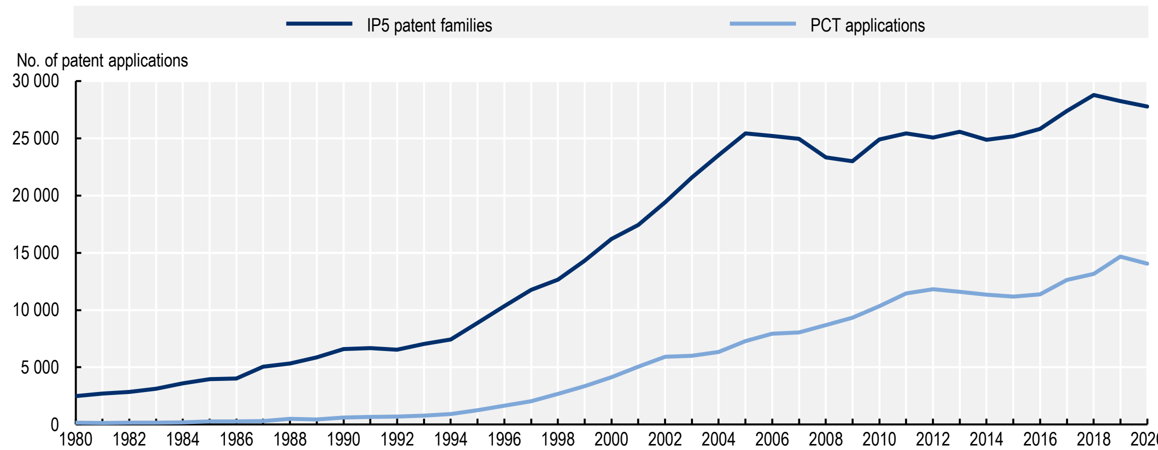
Note: Data refer to patent applications filed under IP5 patent families and the PCT by earliest filing date. Patent application follows fractional counting. Please see Annex C for the definition of IP5 patent families, as well as the keywords used to identify trends in patents related to semiconductors
Source: OECD (n.d.[25]), STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats.

Focusing on semiconductors, over the past four decades, semiconductor patents (see Annex C for how semiconductor patents are defined) have been steadily increasing worldwide, both in absolute numbers and as a share of all patents, gaining traction in the early 2000s (Figure 2.52). In 2020, approximately 5% of PCT applications were related to semiconductors and more than 10% to IP5 patent families (Figure 2.53). As semiconductors increase in computing power and end-market applications grow, semiconductor-related patents are expected to further increase.

More patents are filed in the Philippines for semiconductor-related patents than in any other benchmark country, except Malaysia, which is the clear frontrunner among the five Southeast Asian countries under consideration. Looking at patents filed under IP5 families, the Philippines has increased its patenting output in the semiconductor industry, from 22.82 patent applications from 2001 to 2010 to 42.84 from 2011 to 2020 (Figure 2.54). Other countries, particularly Indonesia and Viet Nam, have not been applying for patents under the IP5 families from 2011 to 2020. Meanwhile, the Philippines has filed fewer applications under the PCT in the more recent period (i.e. 2011-20).

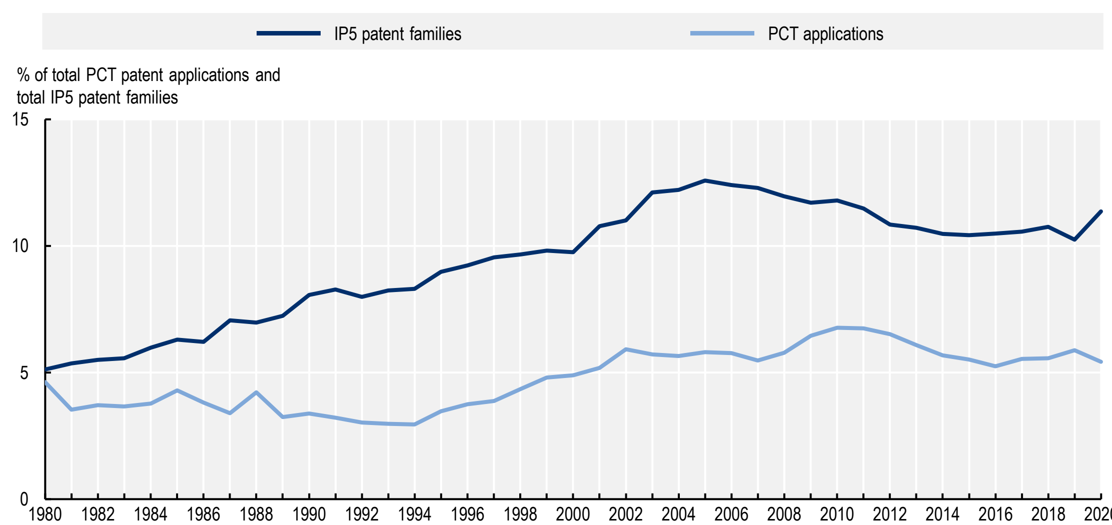
The Philippines appears to have innovated more in the semiconductor industry than in other industries. A quarter of the IP5 patents filed in the Philippines in the period 2011-20 are innovations related to semiconductors, which is significantly higher than Malaysia's 11.4% and Thailand's 1.4% (Figure 2.55), while Indonesia and Viet Nam have not applied for any semiconductor-related patents in 2011-20. However, the absolute number of total patents remains very low, implying that these numbers should be cautiously interpreted.

Figure 2.52. Trends in patents related to semiconductors, 1980-2020



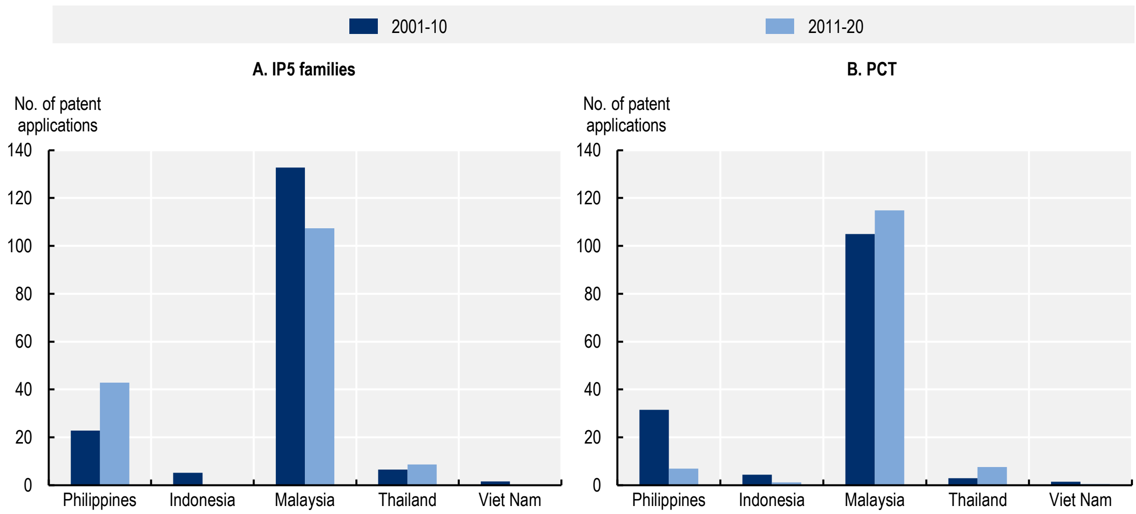
Note: Data refer to patent applications filed under IP5 patent families and the PCT by earliest filing date for technologies related to semiconductors. Semiconductor patents are identified as those allocated to International Patent Classification (IPC) codes H01N or H10, and complemented with patents featuring semiconductor-related keywords in their abstract that are not classified in the aforementioned IPC codes. Please see Annex C for the definition of IP5 patent families, as well as the keywords used to identify trends in patents related to semiconductors.
Source: OECD (n.d.[26]), *STI Micro-data Lab: Intellectual Property Database*, http://oe.cd/ipstats.

Figure 2.53. Trends in patents related to semiconductors, 1980-2020



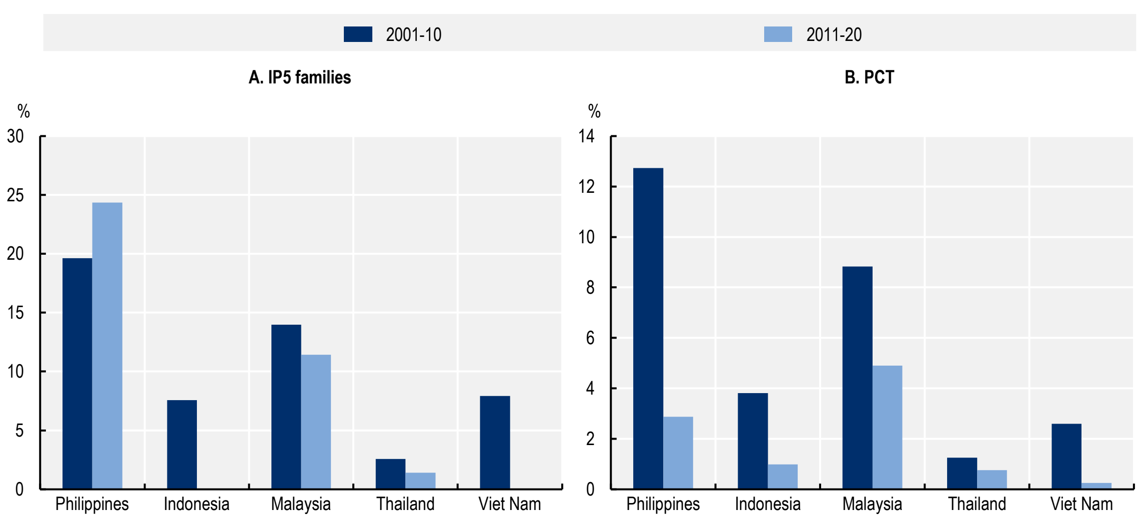
Note: Data refer to patent applications filed under IP5 patent families and the PCT by earliest filing date for technologies related to semiconductors. Semiconductor patents are identified as those allocated to IPC codes H01N or H10, and complemented with patents featuring keywords related to semiconductors in their abstract that are not classified in the aforementioned IPC codes. Please see Annex C for the definition of IP5 patent families, as well as the keywords used to identify trends in patents related to semiconductors.
Source: OECD (n.d.[26]), *STI Micro-data Lab: Intellectual Property Database*, http://oe.cd/ipstats.

Figure 2.54. Patent count of semiconductors, by country



Note: Data refer to patent applications filed under IP5 patent families and the PCT by earliest filing date for semiconductor-related technologies. Semiconductor patents are identified as those allocated to IPC codes H01N or H10 and complemented with patents featuring keywords related to semiconductors in their abstract that are not classified in the aforementioned IPC codes. Patent application follows fractional counting. Please see Annex C for the definition of IP5 patent families, as well as the keywords used to identify trends in patents related to semiconductors.
Source: OECD (n.d.[26]), *STI Micro-data Lab: Intellectual Property Database*, http://oe.cd/ipstats.

Figure 2.55. Patent share of semiconductors, by country

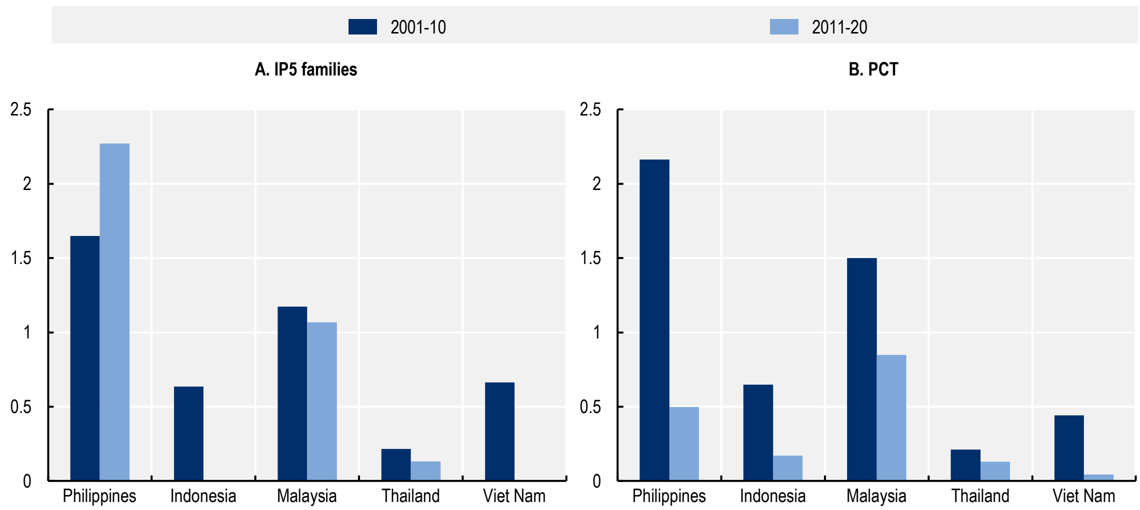


Note: Data refer to patent applications filed under IP5 patent families and the PCT by earliest filing date for semiconductor-related technologies. Semiconductor patents are identified as those allocated to IPC codes H01N or H10 and complemented with patents featuring keywords related to semiconductors in their abstract that are not classified in the aforementioned IPC codes. Please see Annex C for the definition of IP5 patent families, as well as the keywords used to identify trends in patents related to semiconductors.
Source: OECD (n.d.[26]), *STI Micro-data Lab: Intellectual Property Database*, http://oe.cd/ipstats.

Similarly, the computation of revealed technology advantage (RTA)[16] is heavily influenced by the shares of semiconductor patents to total patents and, given the low numbers of patents in many of the benchmark countries, must be interpreted with great care. Based on available information, Figure 2.56 shows that the Philippines has a technological advantage in the semiconductor industry, reflected by an RTA value above

1. This implies that the Philippines exhibits relative specialisation in this technology compared to its neighbouring countries.

Figure 2.56. Revealed technology advantage (RTA) in semiconductors, by country



Note: Data refer to patent applications filed under IP5 patent families and the PCT by earliest filing date for semiconductor-related technologies. Semiconductor patents are identified as those allocated to IPC codes H01N or H10 and complemented with patents featuring the keywords related to semiconductors in their abstract that are not classified in the aforementioned IPC codes.
Source: OECD (n.d.[26]), *STI Micro-data Lab: Intellectual Property Database*, http://oe.cd/ipstats.

There are many possible explanations for the low share of business expenditure in R&D and the small number of patent applications made in the Philippines for semiconductor technologies. In general terms, the value of patents as a measure of innovativeness has long been questioned (Acs and Audretsch, 1989[27]) as their quality is heterogenous (Squiccarini, Dernis and Criscuolo, 2013[28]) and there are many alternative approaches (like trade secrets or copyrights) available to firms that wish to protect the returns of their innovative activities (Hall et al., 2014[29]). In the specific Philippine context, the prevalence of firms in the ATP segment, which is less R&D-intensive than earlier stages of the value chain (Varas et al., 2021[30]), may play an important role. In addition, multinational enterprises active in the country (see Table 2.1) may prefer locating their R&D and, therefore their inventors, outside the Philippines, potentially where their headquarters are located (Karkinsky and Riedel, 2012[31]; Gaessler, Hall and Harhoff, 2021[32]).

When digging deeper into the production of the companies included in Table 2.1, Philippine semiconductor firms do not focus on the most advanced packaging technologies available. For example, there is no evidence of either 2.5-D or 3-D chip packaging being produced in the Philippines.

However, a forthcoming investment from Analog Devices in a centre of excellence will focus on 300 mm wafers (PCO, 2023[33]), the current frontier as well as the new standard in terms of wafer size (CRS, 2023[34]). This may herald the adoption of more advanced semiconductor technologies in the Philippines. Public initiatives like ADMATEL – which counts most of the companies included in Table 2.1 among its clients – have helped to reinforce and upgrade the failure analysis and materials testing facilities of the Philippine semiconductor industry and help to ensure a high technological standard (see Chapter 3).

Technology plays a crucial role in the semiconductor industry. While the Philippines may underspend in R&D relative to its neighbouring countries and has not yet experienced a considerable amount of patent filings, indicators such as the share of patents devoted to semiconductors over total applications, the country's RTA in semiconductors, its active investments and the local uptake of existing technologies suggest that the Philippines is open to advancing its semiconductor industry.

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Notes

[1] Note that throughout the report, the terms "industry" and "sector" are used interchangeably.

[2] Publicly available data from the ASPBI and MISSI are provided by the PSA. While ASPBI data are not granular enough to disentangle specific types of semiconductors, they cover more sectors and provide a wider range of variables when compared to MISSI. In terms of sectoral comparison, the "Manufacture of electronic components" industry – Sector C261 according to the 2009 PSIC – is a key sector for the Philippines and encompasses most semiconductor firms.

[3] The industry included in the medium and high tech manufacturing sectors as shared by PSA are the following: Manufacture of basic chemicals (code C201), Manufacture of other chemical products, n.e.c. (code C202), Manufacture of man-made fibres (code C203), Manufacture of pharmaceuticals, medicinal chemical and botanical products (code C210), Manufacture of electronic components (code C261), Manufacture of computers and peripheral equipment and accessories (code C262), Manufacture of communication equipment (code C263), Manufacture of consumer electronics (code C264), Manufacture of measuring, testing, navigating and control equipment; watches and clocks (code C265), Manufacture of irradiation, electromedical and electrotherapeutic equipment (code C266), Manufacture of optical instruments and photographic equipment (code C267), Manufacture of magnetic and optical media (code C268), Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus (code C271), Manufacture of batteries and accumulators (code C272), Manufacture of wiring and wiring devices (code C273), Manufacture of electric lighting equipment (code C274), Manufacture of domestic appliances (code C275), Manufacture of other electrical equipment (code C279), Manufacture of general purpose machinery (code C281), Manufacturing of special purpose machinery (code 282), Manufacture of motor vehicles (code C291), Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers (code C292), Manufacture of parts and accessories for motor vehicles (code C293), Building of ships and boats (code C301), Manufacture of air and spacecraft and related machinery (code C303), Manufacture of transport equipment, n.e.c. (code C309).

[4] The downside is that MISSI data include only a limited set of variables compared to APSBI data. More specifically, they include the Value of Production Index (VaPI), the Volume of Production Index (VoPI), Value of Net Sales Index (VaNSI), Volume of Net Sales Index (VoNSI) and finally the “average capacity utilisation rate”. Notably, MISSI data are split into two time series: while data were originally provided having 2000 as a base year, in 2020 the PSA introduced 2018 as the new base year. Consequently, data are currently available over the period 2012-20 with the former base year (2000) and for the period 2018-23 with the new base year (2018). Another difference between the two time series is that the former uses the 1994 PSIC, while the latter adopts the 2009 PSIC.

[5] Both the ASPBI and CPBI use a stratified systematic sampling design, with three-digit or five-digit PSIC serving as the first stratification variable and employment size as the second. Weighing adjustments are applied, making it possible to obtain the population from the sample. For more information on the ASPBI, please refer to https://psada.psa.gov.ph/catalog/251/related-materials. For more information on the CPBI, refer to https://www.psa.gov.ph/content/2018-census-philippine-business-and-industry-manufacturing for the 2018 data collection and https://www.psa.gov.ph/content/2012-census-philippine-business-and-industry-manufacturing-sector-all-establishments-final for the 2012 data collection.

[6] The industry classification of ASPBI and CPBI (i.e. 3-digit ISIC Rev.4 Division C261) is more narrowly defined compared to the ISLE (i.e. 2-digit ISIC Rev.4 Division C26), making it possible to draw a more precise snapshot of the semiconductor industry in terms of the indicators under examination.

[7] By including “electronic components” in this sector, the size increases up to nearly 5% of total greenfield investments.

[8] The main objective of the ISLE 2019/20 was to generate an integrated dataset on employment of specific groups of workers, unionism and collective bargaining, occupational shortages and surpluses, job-related training of workers, occupational safety and health practices, occupational injuries and diseases, labour cost of employees, and productivity improvement programmes and gainsharing practices (PSA, 2023[39]). The reference period for the 2019/20 survey is July 2019 to June 2020. The data collection period for the 2019/20 survey is October 2020 to March 2021. The ISLE uses a stratified sampling design, where respondents are post-stratified in industry and employment size classifications. Weighing adjustments are applied, making obtaining the population from the sample possible. Consequently, survey results may be prone to potential unwarranted biases, given that the current sampling method does not pool the entire population (for instance, via a business registry). Nevertheless, they still provide substantial quantitative and qualitative insights. For more information on the ISLE, please refer to https://psada.psa.gov.ph/catalog/232/study-description#metadata-scope.

[9] For “Part IV: Occupational shortages and surpluses”, the manufacturing sector had a sample size of 2 194, where 235 were from C26. For “Part V: Job-related trainings of workers”, the manufacturing sector had a sample size of 1 383, where 113 were from C26.

[10] The industry classification ISLE (i.e. 2-digit ISIC Rev.4 Division C26) is more broadly defined compared to the ASPBI and CPBI (i.e. 3-digit ISIC Rev.4 Division C261), limiting an in-depth analysis of the indicators under examination.

[11] Underemployment is defined as employed persons who expressed the desire to have additional hours of work in their present job, or to have additional jobs, or to have a new job with longer working hours during the reference week (PSA, n.d.[40]).

12 The insufficient number of scientists in the Philippines is attributed to the shortage of science, technology, engineering, agri-fisheries, and mathematics graduates. The Philippines only has 189 scientists per million, which is significantly lower compared to UNESCO's recommendation of 380 scientists per million (Anito Jr. and Morales, 2019[41]). The registered value lags behind its ASEAN neighbours: Viet Nam at 674, Thailand at 974, and Malaysia at 2 100 per million (Anito Jr. and Morales, 2019[41]; Jalea, 2018[42]).

13 Another interesting product to highlight is HS code 854121 ("Electrical apparatus; transistors, (other than photosensitive), with a dissipation rate of less than 1W"), which has an important role among the exported products by the Philippines: four countries, including Madagascar, the Federated States of Micronesia (hereafter Micronesia), Moldova and the Republic of Türkiye (hereafter "Türkiye"), have had a trade dependency from the Philippines regarding this product. While Micronesia and Palau are the countries that have had the most trade dependencies from the Philippines, Viet Nam constitute an interesting case because it has had a dependency in both the last two periods, in "Photographic flashlight apparatus", and before in "Lenses, prisms, mirrors and other optical elements, mounted".

14 It is important to note that the RCA figure considers as chips a list of products reported in Annex B, which may not necessarily be fully aligned with the products considered under "Manufacture of electronic products" in the previous figures.

15 IP5 patent families are defined as sets of patent applications protecting the same invention filed in at least two IP offices – with at least one application filed in one of the five largest IP offices worldwide (IP5): the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (CNIPA) or the United States Patent and Trademark Office (USPTO).

16 The RTA index provides an indication of the relative specialisation of a given country in selected technological domains. The RTA index in a technology field t and economy c is compiled as the share of patents in the technology filed by applicants in economy c divided by the share of patents filed by the same economy in all technologies. It can be expressed as follows: $RTA_{ct} = \frac{P_{ct}}{\sum_c P_{ct}} \Big/ \frac{P_c}{\sum_c P_c}$ where P_{ct} represents the number of patents filed by economy c in the technology t, and P_c represents the total number of patents filed by economy c. The index is equal to zero when the country holds no patent in a given sector; is equal to 1 when the country's share in the sector equals its share in all fields (no specialisation); and above 1 when a positive specialisation is observed.

3. Understanding the policy and regulatory landscape in the Philippines

This chapter analyses the institutional, policy and operational landscape shaping the Philippine semiconductor industry. It begins with an examination of the strategic framework, key government agencies and policies affecting the semiconductor ecosystem, and key policy bottlenecks, including in energy, permitting and logistics. Policy issues related to research and development (R&D), technology and innovation, as well as human capital and workforce development are examined in greater detail.

Following the analysis of the semiconductor ecosystem in the Philippines, this section focuses on the institutional, policy and operational landscape shaping the Philippine semiconductor industry. It begins with a broad examination of the institutional and operational framework followed by an examination of those particularly relevant to the downstream segment of the semiconductor ecosystem. This section focuses on research and development (R&D), technology and innovation, human capital and workforce development. Together with the analysis in Chapter 2, these sections form the analytical basis of the policy recommendations introduced in Chapter 1.

The institutional, policy and operational landscape of the domestic semiconductor ecosystem

Semiconductors and the electronics industry in national policies and strategies

The Philippine Development Plan (NEDA, 2023[1]) outlines the medium-term development strategy for the country, with the latest version covering the period of 2023 to 2028. This plan focuses on industrial modernisation, where the semiconductor and electronics industries are described as ripe for adopting more advanced packaging technologies and further integration with global value chains.

The plan further identifies the importance of promoting R&D to enhance technological capabilities and improve infrastructure to support industrial growth, including logistics and utilities, which are critical for the Philippine semiconductor ecosystem. The role of foreign direct investment and workforce development are also highlighted as relevant to industrial modernisation.

Similarly, the Philippine Export Development Plan 2023-2028 emphasises the significance of the electronics and semiconductor industry in the Philippines, highlighting its substantial contribution to the country’s export economy. The document notes that the semiconductor segment, which traditionally focused on less technology-intensive assembly, testing and packaging (ATP), is evolving towards higher value activities, for example using more advanced technologies within ATP firms already active in the electronic component manufacturing industry. This document shows the shift as crucial for maintaining a competitive edge and achieving a compounded annual growth rate of 15% or more in electronics exports, contingent on strong government support and foreign investment.

The plan outlines several strategic actions to bolster the electronics and semiconductor industry. These include offering compensatory incentives to offset cost disadvantages, implementing joint government and private sector programmes for skills development and increasing local value addition. Creating a favourable business environment through stable policies and efficient infrastructure is also important. Furthermore, the collaboration between the BOI and the Commission on Higher Education (CHED) is mentioned to strengthen industry-academia linkages. However, this arrangement has not been made public to date.

The Department of Science and Technology (DOST) also published a technology-focused roadmap (2023[2]) for the Philippine semiconductor and electronics industry, which outlines key technology development programmes designed to support the semiconductor industry. Similarly, a Board of Investment (BOI) plan outlines policy support for developing the Philippine electronics industry (DTI, 2013[3]).

Institutional framework

In the Philippines, semiconductor policy development, implementation and enforcement are managed through a co-ordinated approach among various government entities. The Department of Trade and Industry (DTI), along with its attached agencies, leads key industrial development strategies and finances a variety of initiatives related to the semiconductor industry. In contrast, DOST and its attached agencies oversee the administration of several technology and research-related projects. Meanwhile, a constellation of government agencies is involved in workforce development, including the semiconductor industry.

The DTI creates conditions conducive to economic development, fostering innovation and inclusivity in business. It incentivises private sector advancement and drives economic growth via a comprehensive industrial strategy. Additionally, the DTI develops policies to promote trade liberalisation, deregulation and diversification. Attached agencies like the Board of Investment (BOI) and the Philippine Economic Zone Authority (PEZA) are integral to its functioning and act within the scope of the DTI's overarching economic mission, as established by agency-specific legislation.

The Philippine BOI is the central government agency driving investment. It actively promotes domestic and foreign investment opportunities in key economic sectors. The BOI and other investment promotion agencies approve and authorise incentives for ventures with investments of up to PHP 15 billion, while the interagency Fiscal Incentives Review Board (FIRB) manages approvals for larger projects exceeding this threshold. The FIRB was incorporated into the approval process by the Corporate Recovery and Tax Incentives for Enterprises (CREATE) Act. Prior to CREATE, all approvals were carried out by investment promotion agencies.

The BOI publishes the Strategic Investment Priority Plan (SIPP), which specifies industry segments eligible for governmental incentives, including the semiconductor industry. Relevant government bodies are urged to align their policies and programme executions with the directives of the priority plan. The SIPP is reviewed every three years, and the next set of priorities for investment is envisaged in 2025.

PEZA is also attached to the DTI and tasked with registration oversight, support provision and investor incentives for export-oriented special economic zones (ecozones) established by presidential decree. While PEZA oversees 415 ecozones across manufacturing, information technology, tourism and logistics, semiconductor products constitute the largest product by investment amount within special economic zones (PEZA, 2023[4]). PEZA is responsible for administering fiscal incentives and non-fiscal incentives, including assisting with administration and paperwork. The Special Economic Zone Act of 1995 facilitates economic development by establishing special economic zones. This legislation provides the structural and operational framework for integrating, co-ordinating, planning and monitoring various economic zones, including special economic zones, industrial estates/parks and export processing zones (PEZA, 2023[4]).

DOST directs the Philippine government's efforts in science and technology, driving policy development and spearheading programmes aimed at fostering national technological growth. One of its planning councils, the Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD), focuses on creating strategic programs that support innovation across various industries, including semiconductors and electronics. Two attached agencies under DOST – the DOST's Advanced Science and Technology Institute (DOST-ASTI) and the Industrial Technology Development Institute (ITDI) – are actively involved in implementing semiconductor-related initiatives. DOST also supports the Center for Integrated Circuit and Device Research (CIDR), a programme led by the University of the Philippines – Diliman, which operates mirror laboratories nationwide to enhance semiconductor research capabilities.

The education system in the Philippines is governed by three entities: the Department of Education (DepEd), responsible for formal and informal basic education; the Technical Education and Skills Development Authority (TESDA), responsible for post-secondary technical and vocational education and training (TVET); and CHED, responsible for higher education.

DepEd formulates, implements and co-ordinates basic education policies, plans, programmes and projects. It supervises all elementary and secondary education institutions, including alternative learning systems, both public and private. It provides for the establishment and maintenance of a complete, adequate and integrated basic education system relevant to national development goals. It is responsible for formulating national policies and plans, setting educational standards, monitoring learning outcomes, conducting research, improving the status and competency of educational personnel and enhancing learner development through programmes and projects.

CHED governs both public and private institutions of higher education as well as degree-granting programmes in all post-secondary educational institutions, public and private (Republic of the Philippines, 1994[5]). It is attached to the Office of the President. CHED is vested with a broad range of powers and functions, focused on overseeing, developing and improving higher education and research. It is tasked with creating and recommending development plans, policies and programmes, setting and enforcing minimum standards for educational programmes and institutions based on expert insights and public feedback. It oversees the monitoring and evaluation of higher education institutions to ensure quality and compliance, offering incentives or imposing sanctions as necessary. The commission also identifies and fosters centres of excellence and rationalises educational programmes to meet national and regional needs. Furthermore, it is responsible for allocating resources like grants and scholarships, directing research to support national development, developing resources and managing relevant funds (Republic of the Philippines, 1994[5]).

TESDA manages the TVET system and the educational network encompassing both the school system and non-formal classes, as outlined in the TESDA Act of 1994 (Republic of the Philippines, 1994[6]). The TESDA Central Office manages standards, certification and the National Institute for Technical Education and Skills Development, regional and provincial field offices provide policy development and 178 TESDA Technology Institutions provide direct training services through 5 special training centres, 16 regional training centres, 46 provincial training centres and 57 TESDA-administered schools (ADB, 2021[7]). TESDA also offers the TESDA Online Program, a free, open-source programme designed to provide upskilling and reskilling to address skills mismatch in the Philippines (ADB, 2021[7]).

Key policies and incentives for investment in the Philippines

The Strategic Investment Priority Plan (SIPP) 2022 extends the framework established by the 2020 Investment Priorities Plan (IPP), which provided incentives for sectors identified as critical investment areas. The SIPP offers incentives, including income tax holidays, enhanced deductions and a preferential 5% special corporate income tax rate.

This menu of tax incentives was enacted as part of the CREATE Act in 2021, which also reduced the corporate income tax rate from 30% to 20% for domestic micro, small and medium-sized enterprises and lowered the tax rate to 25% for all other corporations in 2022 (FIRB, 2023[8]).

The CREATE Act also rationalises incentive schemes across the Philippines, replacing a system that previously depended on different investment regimes under different laws and administered by a variety of bodies, including PEZA, the BOI and local special economic zones. Enterprises can only avail of the CREATE incentives if registered with an investment promotion agency. The CREATE Act includes a transition period for companies availing of incentives prior to the law's passage. Some semiconductor firms note that, in its current state, the CREATE Act reduces the incentives previously provided to them in special economic zones, reducing the certainty of the policy environment for relevant firms (see Chapter 1).

The current Philippine tax scheme under the SIPP and CREATE Act provides a tiered approach to the incentives available for relevant firms, depending on the type of strategic activity undertaken by the firm ("tier"), whether the activity is export-oriented and the location of the investment. Eligible firms benefit from 4-7 years of income tax holiday before transitioning to 5-10 years of enhanced deductions of up to 150% for certain eligible expenses (depreciation, R&D, training and power among them) or a special corporate income tax of 5% (the usual corporate minimum tax is 20-25%).

The Strategic Investment Priorities Priority Plan (SIPP) 2022, the first Plan under the CREATE Act, adopted the 2020 Investment Priorities Plan as Tier 1 activities. Further activities comprising Tiers 2 and 3 were identified under the Act. As noted in Chapter 2, most semiconductor activity in the Philippines is export-oriented. Activities related to integrated circuit design fall into Tier 1 of incentives, while activities that address "industrial value-chain gaps" fall into Tier 2. Finally, Tier 3 reflects activities strategically important for the economy's transformation, including R&D, highly technical manufacturing and innovation support facilities. Were wafers being fabricated in the Philippines, the relevant firm would be eligible for either Tier 2 or Tier 3 incentives, depending on the scale of fabrication. Table 3.1 outlines the key incentive schemes applicable to exporting semiconductor firms that fall into these tiers.

Table 3.1. Incentive scheme for firms in the Philippines

Region	Tier 1	Tier 2	Tier 3
For exporter activities			
National Capital Region	4 years of ITH + 10 years of ED/SCIT	5 years of ITH + 10 years' ED/SCIT	6 years of ITH + 10 ED/SCIT
Metropolitan areas or areas contiguous and adjacent to the National Capital Region	5 years of ITH + 10 years of ED/SCIT	6 years of ITH + 10 years of ED/SCIT	7 years of ITH + 10 years of ED/SCIT
All other regions	6 years of ITH + 10 years of ED/SCIT	7 years of ITH + 10 years of ED/SCIT	7 years of ITH + 10 years of ED/SCIT
For domestic market activities			
National Capital Region	4 years of ITH + 5 years of ED	5 years of ITH + 5 years ED	6 years of ITH + 5 years of ED
Metropolitan areas or areas contiguous and adjacent to the National Capital Region	5 years of ITH + 5 years of ED	6 years of ITH + 5 years of ED	7 years of ITH + 5 years of ED
All other regions	6 years of ITH + 5 years of ED	7 years of ITH + 5 years of ED	7 years of ITH + 5 years of ED

Note: ED: enhanced deduction; ITH: income tax holiday; SCIT: special corporate income tax rate.
Source: FIRB (2023[8]), *What Incentives Are Available?*, https://firb.gov.ph/incentives-available/.

In addition, investments larger than PHP 50 billion (approximately USD 1 billion) or an investment that generates more than 10 000 local jobs could be eligible for additional incentives upon approval of the President based on the recommendation of the Fiscal Incentives Review Board. The CREATE Act specifies that any additional incentives provided for large investments must not include an income tax holiday of more than 8 years and that the total period of incentives should not exceed 40 years (FIRB, 2023[8]).

Non-fiscal incentives for those economic activities identified in the SIPP include support for employment of foreign nationals, simplified customs procedures, duty exemption on imported capital equipment and spare parts, import of consigned equipment and operation of a bonded manufacturing warehouse.

Another consequence of the CREATE Act includes the rationalisation of value-added tax (VAT), whereby the "zero-rating" (non-imposition) of this tax on local purchases only applies to goods and services directly and exclusively used in the registered project or activity by a registered business enterprise. Exporting firms must now seek approval for the refund of VAT on goods and services used in an exporting enterprise's registered activities. This application process has been burdensome, requiring suppliers and exporters to seek a variety of certifications within economic zones. While the Bureau of Internal Revenue has sought to reduce the burdens associated with processing and filing applications, stakeholders still cite application and refund delays as a constraint. One exporter claims that although the Bureau of Internal Revenue is required to process VAT refund or tax credit claims within 120 days, it "takes an average of four to six years to process and approve such claims" (Desiderio, 2024[9]).

The government has acknowledged these concerns in the Philippine Export Development Plan 2023-2028 (DTI, 2023[10]). In collaboration with the Department of Finance, the DTI continues to work towards a simpler and more efficient VAT regime through the CREATE MORE Bill, which is currently under consideration in the Philippine parliament. Aside from proposing amendments for a simplified tax refund system for registered business enterprises and implementing a risk-based classification of claims and audit framework in collaboration with the Commission on Audit, the bill also clarifies the VAT regime to make it clearer and transaction-based, while also improving its refund process, seeking to restore the VAT zero-rating of suppliers of registered export enterprises. The bill is expected to also refine the incentives available through the CREATE Act. As outlined in Chapter 1, ensuring a stable policy environment is essential for unlocking investments for the Philippine semiconductor industry.

Box 3.1. Efforts to build the local Philippine supplier ecosystem

The Philippine government supports efforts to diversify the sources of materials for local firms, including for the semiconductor industry. These efforts are relevant because a vibrant network of suppliers reduces lead times for semiconductor manufacturing and has been cited as a key factor in foreign investment decisions by semiconductor firms.

The DTI, through its various promotion agencies, including the BOI, has been working with the local industry and other relevant government agencies to promote local firms that target supply chain gaps in the government's priority industries. The Philippine government is also implementing raw materials localisation initiatives and seeking to diversify trade partners that could supply relevant materials. Relevant innovative initiatives from local companies to develop new products are also eligible for R&D tax incentives.

The Semiconductor and Electronics Industries in the Philippines Foundation Inc. (SEIPI), the largest local association representing the industry in the country, is actively implementing a localisation programme among its members. Through its Parts Localization Technical Working Group, SEIPI aims to enhance local sourcing capabilities for critical commodities and reduce dependence on imported materials by strengthening ties with local suppliers.

A survey was conducted among member companies to assess their parts requirements that could be sourced from local (Philippine) suppliers. Based on the survey, SEIPI identified imported items that members have either successfully localised or are in the process of doing so. These items were grouped into three categories:

1. Category 1 includes consumables and packing materials, with an estimated potential value of PHP 39 million.
2. Category 2 consists of imported process materials that could be sourced locally, amounting to approximately PHP 13 million.
3. Category 3, which includes constructive exports such as integrated circuits and passive components, has the potential to exceed PHP 123 million.

SEIPI is "matching" suppliers with excess capacity and local electronics firms to encourage more local suppliers. Moreover, it supports the local ecosystem in building demand for key inputs, thereby creating favourable conditions to attract new suppliers to the Philippine ecosystem.

Source: Interviews with Philippine stakeholders; Malaya Business Insight (2022[11]), "SEIPI to localize more parts", https://malaya.com.ph/news_business/seipi-to-localize-more-parts.

Key infrastructural requirements for semiconductor firms

Encouraging investments in energy in the Philippines

Sustainable and reliable electricity at competitive prices is necessary to operate semiconductor manufacturing facilities in the ATP phases. However, the provision of these basic services in the Philippines remains challenging. Firms report that energy costs in the Philippines are among the highest in Southeast Asia and electricity outages are common (Francisco and Abrigo, 2024[12]; Francisco, 2022[13]).

While the causes of high energy prices in the Philippines are multi-faceted, OECD and International Energy Agency analysis highlights a high reliance on fossil fuel imports and a fragmented grid infrastructure, which present challenges for the integration of renewable energy and contribute to higher prices (IEA, 2022[14]; OECD, 2024[15]). In this respect, public commitments to diversify energy sources and modernise energy infrastructure in the Philippine Development Plan, the Philippine Energy Plan and the National Renewable Energy Program are encouraging (Box 3.2).

Semiconductor companies increasingly consider renewable energy as part of their global environmental, social and governance goals. Enhancing efforts towards renewable energy while reducing the cost of electricity would increase the Philippines' attractiveness as a destination for semiconductor investment.

Extending fiscal incentives to firms with self-financing energy efficiency projects under the CREATE Act is also an improvement. Another relevant legislation is the Energy Efficiency and Conservation Act, which institutionalises energy efficiency and conservation, enhances the efficient use of energy and grants incentives to energy efficiency and conservation projects. The BOI has likewise issued Memorandum Circular No. 2023-006 that allows self-financed energy efficiency projects to be entitled to income tax holidays and duty-free exemption on importation of capital equipment, raw materials, spare parts or accessories. This policy is the government's response to the need for electronics companies to green their supply chains, including their power source, in order to remain competitive in the export market.

Box 3.2. The Philippines' clean energy ambitions and policies

The Philippine National Renewable Energy Program is a strategic framework designed to address the country's growing energy needs while promoting sustainability and resilience. Key targets include increasing the share of renewable energy sources to 50% of the total energy mix by 2040, with a significant emphasis on solar, wind and hydro power. The plan also aims to improve energy efficiency across all sectors by 20% by 2030 and enhance energy access in remote and underserved areas to provide 100% electrification by 2028. To achieve these targets, a total of 75 gigawatts (GW) of additional renewable energy capacity (more than 10 times the current level) would be required by 2040.

The plan mentions specific policy and regulatory measures, such as the Renewable Energy Act, implemented in 2008, which provides incentives for renewable energy projects, including income tax holidays, duty-free importation of equipment and tax credit on domestically purchased equipment and parts. Despite these incentives, the Philippines has only added 3 GW of renewable energy sources since the introduction of the Renewable Energy Act; of these, 1.4 GW was generated under a feed-in tariff programme suspended in 2019 (see also Box 3.3). It also includes regulatory support and reforms to ease investments in renewable energy, including through an energy virtual one-stop shop.

Source: DoE (2024[16]), Philippine National Renewable Energy Program, https://doe.gov.ph/national-renewable-energy-program; Republic of the Philippines (2008[17]), *Philippines Renewable Energy Act of 2008 - An Act Promoting the Development, Utilization and Commercialization of Renewable Energy Resources and for Other Purposes*, https://www.officialgazette.gov.ph/2008/12/16/republic-act-no-9513/; OECD (2024[15]), *Clean Energy Finance and Investment Roadmap of the Philippines, Green Finance and Investment*, https://doi.org/10.1787/7a13719d-en.

However, the Philippines could learn from lessons abroad when considering instruments designed to encourage investment in renewable energy. For example, production grants are a common mechanism to support the renewable energy ecosystem. At the same time, contracts for difference can provide a stable price over a long period, reducing the cost of capital and incentivising investment in energy production assets with high fixed, often sunk costs. A mix of such incentives could help to encourage firms to invest in renewable energy, boost energy supply and help to address high power costs (Box 3.3).

Box 3.3. Lessons from international efforts to bridge the clean energy investment gap

International policy actions increasingly seek to encourage investments in renewable energy. For example, the European Commission has adopted contracts for difference to incentivise investment in renewable energy projects, helping avoid wholesale electricity market volatility. Contracts for difference can provide a stable price over a long period of time, therefore reducing the cost of capital and incentivising investment in renewable energy production assets with high fixed, often sunk costs. Such programmes are increasingly found in Europe, including at the supranational level and in countries like Germany.

A two-way contract for difference is signed between an electricity generator and a public entity, typically the government, which sets a strike price, usually by a competitive tender. The generator sells the electricity in the market but settles the difference between the market price and strike price with the public entity. It thus allows the generator to receive stable revenue for the electricity it produces while at the same time providing a revenue limitation for generators when market prices are high. In a two-way contract, if the market price is below the strike price, the generator receives the difference; if the market price is above the strike price, the generator pays back the difference. A two-way system, therefore, ensures that both the government and consumers have low energy prices because generators must pay back the difference when the wholesale electricity price is high.

Production grants are also a key financial incentive used by many governments to support the generation of energy from renewable sources. Production grants typically offer lump-sum payments or financial assistance directly to renewable energy projects to cover various costs associated with production, such as equipment, installation and operational expenses. Unlike feed-in tariffs, which provide ongoing payments based on the amount of energy produced, experience shows that well-targeted grants can be among the most efficient support for renewable energy projects. Jurisdictions across the OECD, including the European Union and the United States and around the world, offer such grants.

Source: Montague, C., K. Raiser and M. Lee (2024[18]), "Bridging the clean energy investment gap: Cost of capital in the transition to net-zero emissions", https://doi.org/10.1787/1ae47659-en; EC (2023[19]), "Questions and Answers of the revision of the EU's internal electricity market design", https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_1593; IEA (2023[20]), *Government Energy Spending Tracker*, https://www.iea.org/reports/government-energy-spending-tracker-2.

Encouraging competition and investing in infrastructure can help reduce the costs of freight and logistics services in the Philippines

Freight and logistics services are required to receive the inputs necessary for semiconductor firms to operate within globally or regionally integrated production networks, facilitate reliable, just-in-time delivery of inputs and ship finished products to the end user. The high costs of freight and logistics services in the Philippines is noted as an issue for the semiconductor industry and other exporting industries in the Philippines.

While transport by air is a small share of overall freight, most semiconductor and other electronic products are exported by air to allow for just-in-time production processes in globally integrated production networks. In the case of the Philippines, almost all exports of semiconductor products are made through one airport, Ninoy Aquino International Airport, representing a possible bottleneck for the semiconductor industry and others that rely on air freight.

The Philippine government is increasing investment in infrastructure, including several projects and initiatives are now being implemented by the government to address concerns about the movement of goods within and outside the Philippines. The Department of Transportation is working on fully utilising Clark International Airport. Through the Build Better More infrastructure programme, the government is also building the New Manila International Airport in Bulacan and developing key road infrastructure projects to improve the access between industry and key ports.

As an archipelagic country, maritime freight is particularly important for the Philippines. It is used for imports of key semiconductor inputs, including those that are stable and less sensitive to light and heat. The OECD has highlighted key barriers to competition in the sector that affect maritime freight's competitiveness. Chief amongst these is a perceived or real conflict of interest and mandate from relevant regulatory port authorities, and barriers to foreign investment that stem from the legislative designation of seaports as a public utility (OECD, 2021[21]). Addressing these barriers and encouraging greater competition could further address the high costs for the Philippine semiconductor industry.

Better understanding the permitting and licensing requirements for semiconductor firms

Regulations, permits and licences required to certify compliance with them are a normal part of doing business for firms. Some permits, like business permits, are a prerequisite for business in many countries. For the semiconductor industry, chemicals required in the manufacturing process also often require specific permits associated with their use and storage. The Philippines has made important advances in the regulatory environment to improve the business climate for firms, notably passing the Ease of Doing Business Act in 2018, establishing the Anti Red-Tape Authority (OECD/ADB, 2020[22]) and developing the Green Lanes programme for strategic investments (Box 3.4).

Box 3.4. Green Lanes – A nascent regulatory success story in the Philippines

The nascent one-stop-shop mechanism under the Green Lanes mechanism Constituting Green Lanes for Strategic Investments (Executive Order 18 s.2023) could also provide lessons for regulatory streamlining priority projects in the semiconductor industry. This executive order mandates all national government agencies to establish green lanes that expedite obtaining necessary licenses and permits for investments deemed “highly desirable”, “foreign direct investments” or “strategic priorities”. The BOI reported that USD 35 billion in investments had been approved through Green Lanes by June 2024. These investments were mostly related to renewable energy projects; none were made in the electronics or semiconductor industry (DTI, 2024[23]; Desiderio, 2024[24]).

However, the Green Lanes System has already helped to address issues identified by semiconductor firms. For example, implementing the Electronic Transfer of Containerized Cargo (E-TRACC) system by the Bureau of Customs duplicated existing systems in economic zones, with semiconductor firms in those zones noting additional administrative requirements. In response, a data-sharing agreement between PEZA and the Bureau of Customs was established to help ensure access to data on the location and condition of cargoes and that importation and exportation of tax- and duty-free goods arrive and reach the intended PEZA economic zones. This agreement was highlighted as part of implementing and complying with the Green Lanes executive order (PEZA, 2023[25]).

Key to the success of the Green Lanes programme relates to BOI officers’ dedicated time and expertise in identifying and addressing regulatory bottlenecks for investors in other parts of government, including at the local level. For renewables energy projects, this has included identifying and unlocking bottlenecks in permits for land use and customs (BSP, 2023[26]). The government could consider proactively extending dedicated support to the existing semiconductor industry to help address regulatory bottlenecks through the Green Lanes or other investment promotion programmes.

Source: DTI (2024[23]), “DTI to Japanese businesses: Philippines is conducive for foreign investments”, https://www.dti.gov.ph/archives/news-archives/dti-japanese-businesses-philippines-conducive-foreign-investments/; Desiderio, L. (2024[24]), “BOI endorses P2.32 trillion projects for green lane processing”, https://www.philstar.com/business/2024/06/21/2364317/boi-endorses-p232-trillion-projects-green-lane-processing; PEZA (2023[25]), “PEZA, BOC sign Data Sharing Agreement on E-TRACC, reinforce support on eZTS implementation’, https://www.peza.gov.ph/press-releases/peza-boc-sign-data-sharing-agreement-e-tracc-reinforce-support-ezts-implementation; BSP (2023[26]), *Executive Order No. 18 Constituting Green Lanes for Strategic Investments - Briefer and Updates*, https://www.bsp.gov.ph/Pages/IRG/irg-files/EO%2018%20Briefer%20and%20Updates%20as%20of%201September2023%20with%20HB8039.pdf.

However, as acknowledged in the Philippine Export Development Plan (DTI, 2023[10]), some Philippine business community stakeholders, including those from the semiconductor industry, have highlighted ongoing practical issues with regulatory burdens in the Philippines, particularly in receiving key permits and licenses. This section provides two examples of permits where the Philippine semiconductor industry has noted concerns but neither provides an exhaustive analysis of the Philippine regulatory environment nor describes other regulations, like export and import licenses, which have also been mentioned as impeding business for some firms (BSP, 2023[26]; Shiga, 2024[27]).

Despite positive reforms, business permits can take time

As mandated by the Local Government Code of 1991, all businesses are required to obtain a business permit, also called a mayor’s permit or municipal license, from the city or municipality where they are located to ensure that standards are met and that businesses comply with the specific requirements of the local government unit (LGU). Obtained at the city or municipal hall's Business Permit and Licensing Office, business permits must also be renewed annually.

PEZA facilitates the process for semiconductor companies located in ecozones, enabling registration, licensing and issuance of permits to relevant enterprises. All government agencies involved assign their respective representatives in the zone for this purpose (PEZA, 2024[28]). While PEZA is the permit facilitator, the process still adheres to the existing policies and procedures of each specific LGU.

The prerequisites for acquiring a business permit differ based on the specific city or municipality. Some may necessitate a more extensive array of documents and licenses, with fees also exhibiting significant variation. Moreover, the requirements are contingent upon the nature and operational type of the business. The time associated with receiving each business permit can differ as well. For instance, according to their respective citizen's charters, the process should take approximately two days in the city of Manila (2024[29]), two hours in Batangas City (2023[30]), and around three hours in in the city of Binan (2022[31]). However, reports from businesses find that the entire process is longer, even under optimal circumstances (Filepino, 2024[32]) and some international firms report more than a year of delay (BSP, 2023[26]).

In an attempt to alleviate regulatory burdens by streamlining and digitising institutional and regulatory requirements and processes, the DTI is aiming to facilitate the integration of the DTI's Business Name Registration System (BNRS) into the respective online Business Permits and Licensing Systems (BPLS) of respective LGUs (DTI, 2023[33]). The DTI has signed eight memoranda of agreement (MOAs) with each of the LGUs of the cities of Bacolod, Baguio, Balanga in Bataan, Bislig, of Butuan, Carmona in Cavite, the municipality of Guiguinto in Bulacan and the city of San Pedro in Laguna for this purpose. The eight partner LGUs mentioned have automated business permitting and licensing systems for a more efficient business registration process. Integrating the DTI's BNRS with the LGU's automated BPLS, the registered business name can be automatically validated, eliminating the mandatory Certificate of Business Name Registration submission.

The Philippines has an advanced regulatory system for chemicals in comparison to others in the region but acquiring permits is considered burdensome by the industry

Risks associated with the use of industrial chemicals in the Philippines are governed by the Philippine Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990 (Republic Act No. 6969) (Republic of the Philippines, 1990[34]). This law is designed to regulate, restrict or prohibit the importation, manufacture, processing, sale, distribution, use and disposal of chemical substances and mixtures that present unreasonable risk and/or injury to health or the environment. It mandates the registration and inventory of chemicals and chemical substances, ensures the proper labelling and packaging of hazardous substances and establishes criteria for the handling and disposing of hazardous and nuclear wastes.

Administered by the Department of Environment and Natural Resources (DENR), the act aims to protect public health and the environment from the potential dangers posed by hazardous substances and waste through stringent monitoring, reporting and compliance requirements. Consistent with the act, the DENR, through its Environmental Management Bureau, also maintains a Priority Chemicals List (PCL), a list of chemicals that pose risks to human health and the environment, subject to a higher standard of regulation and control. This list is based on consideration of international standards related to key chemical-specific hazard criteria, like persistence, toxicity and bioaccumulation potential (Republic of the Philippines, 2020[35]) as well as the extent of exposure to the chemical during its use in the Philippines.

In addition, the DENR administers the Pre-Manufacture and Pre-Importation Notification (PMPIN) process, which requires mandatory notification of their intent to manufacture or import a new chemical that is not listed on the Philippine Inventory of Chemicals and Chemical Substances, at least 90 days but no sooner than 180 days before the activity, provided the annual volume is 1 000 kg or more (Republic of the Philippines, 2024[36]).

Firms use the PMPIN Abbreviated Form if a new chemical to be manufactured or imported is included in the chemical inventories from the United States, European Union, Canada, Australia, Japan and Korea, which have similar chemical review process as the Philippines. On the other hand, the PMPIN Detailed Form is used when a new chemical to be manufactured or imported from countries other than those listed in the PMPN abbreviated form.

Regulations are required to evaluate new chemicals adequately to protect health and the environment. Consistent with OECD standards on chemical safety, the PMPIN is a risk-based system that enables the Philippines to assess the risk of chemicals and prioritise those of higher risk for more stringent risk reduction measures (OECD, 2024[37]; 2024[38]). These regulations seek to ensure adequate evaluation of new chemicals to protect health and the environment. In this respect, the Philippines has a comprehensive regulatory scheme compared to other countries in the region. For example, Singapore's regulatory system does not require such notification of the importation of a new chemical substance under a system like the PMPIN.

Chemicals used in the electronic manufacturing process are subject to a higher regulation standard in many countries because they pose a higher potential risk to health and safety. However, care should be taken to ensure that these regulations provide the necessary safeguards against risk to health and safety while avoiding adding to an already high regulatory burden experienced by firms (DTI, 2023[10]). This is particularly important where certain permits are prerequisites for others, like import licenses, meaning delays can quickly propagate. As such, the Philippine Chemicals Industry Roadmap, completed in 2023 as commissioned by the BOI and Samahan sa Pilipinas ng Industriyang Kimika (SPIK), has identified regulatory simplification and deregulation as one of the key strategies to improve access to chemicals in the country (BOI-SPIK, 2024[39]).

The Philippine government is aware of and making progress on permitting chemicals. For example, the BOI in collaboration with SPIK, the local chemicals industry, is working closely with other government agencies to address prevalent concerns on chemicals regulated by the government. For example, the relationship between controlled chemicals under the purview of the Philippine National Police, and the additional regulations on chemicals from the Commission on Elections during election periods can affect the transport of over 30 chemicals, affecting supply chains (SPIK, 2024[40]). These regulatory streamlining efforts would benefit the semiconductor and electronics sector and other chemical user industries and should be continued.

Still, some stakeholders point to delays linked to unclear regulatory requirements, inconsistency, a lack of co-ordination or a lack of capacity or resources from the agency, echoing the results of a stakeholder consultation undertaken through the regulatory impact assessment process (NSI, 2022[41]). Providing clarity on definitions and thresholds for impurities, which previously complicated applications for new chemicals under the PMPIN, is a welcome first step in this respect (Republic of the Philippines, 2024[42]). Still, additional guidance, further regulatory simplification and better co-ordination may also be warranted.

Key policy areas to foster the downstream semiconductor ecosystem

Technology, research, innovation and business support

Policies and agencies involved in the innovation ecosystem

The innovation ecosystem of the Philippines involves a network of players, including large multinational corporations, small and medium-sized enterprises, start-ups, academic institutions and key government agencies including the DTI, DOST and CHED (DTI, 2018[43]).

The current Philippine Development Plan 2023-28 lays out a comprehensive strategy to boost the country's capabilities in R&D, technology and innovation (NEDA, 2023[1]). The approach aims to advance R&D, technology and innovation from knowledge creation to commercialising R&D products and reinforcing the innovation and entrepreneurship ecosystem. The anticipated outcomes depend on fortifying the foundation of basic R&D and knowledge generation, promoting research responsive to market needs and consumer demands, expanding the implementation and commercial viability of new technologies and accelerating innovation and business creation.

To foster a favourable policy environment that encourages advancements in science, technology and innovation, Republic Act No. 11293, known as the Philippine Innovation Act (PIA), was enacted in 2019 (Republic of the Philippines, 2019[44]). A key provision of the PIA is the establishment of the National Innovation Council led by the president of the Philippines, which guides a cohesive government effort towards innovation, ensuring collaboration and co-ordination across various sectors. Seventeen government agencies are tasked with executing the country's innovation strategies under a unified whole-of-government approach. Agencies such as the National Economic and Development Authority (NEDA), DOST, the DTI, the Department of Information and Communications Technology (DICT), DepEd, CHED, the Department of Labor and Employment (DOLE) and the Intellectual Property Office of the Philippines (IPOPHL) are critical in driving science, technology and innovation, especially in sectors like the semiconductor industry.

The collaborative roles of government agencies are also outlined in the Innovative Startup Act (Republic of the Philippines, 2019[45]). Enacted in 2019, it mandates the DTI, DOST and DICT to assess, monitor, develop and expand the Philippine Startup Development Program, which includes benefits and incentives like the Startup Venture Fund, the Grants-in-Aid programme, subsidies, a Startup Business One-Stop Shop and the Startup Investment Development Plan for start-ups and start-up enablers. Additionally, the act directs DepEd, CHED and TESDA to integrate entrepreneurial programmes into their curricula and incentives to academic institutions that support research projects conducted by students and faculty.

Industry, academia and governments collaborate effectively in the Philippine semiconductor innovation ecosystem

The Philippine semiconductor industry collaborates with the semiconductor ecosystem, with many examples of collaboration between industry, the local technical community and relevant government agencies. R&D and technology activities take place through partnerships between universities and industry, often in collaboration with DOST institutionalised initiatives, including the semiconductor-focused CIDR and the broader Engineering Research and Development for Technology (ERDT) (ERDT, 2013[46]; CIDR, 2022[47]). Some key companies feature a high degree of bilateral engagement with particular universities (Box 3.5), while the industry's interests are represented by active and influential industry associations (Box 3.6).

Box 3.5. Analog Devices in the Philippines: An example of bilateral industry-academia linkages

In 2023, Analog Devices, Inc. (ADI), a United States (US) multinational semiconductor company, announced a significant investment of USD 200 million (approximately PHP 11 billion) in a new R&D facility in the Philippines (Cervantes, 2023[48]). This investment marks an expansion of ADI's operations in the country and complements its existing Leadership in Energy and Environmental Design (LEED)-certified production facility at the Gateway Business Park in Cavite. Analog Devices General Trias, Inc. (ADGTI), the Philippine subsidiary of ADI, is actively involved in assembling and testing semiconductor devices and in dice inspection.

Furthermore, ADGTI is instrumental in implementing the ADI University programme in the Philippines, which aims to enrich engineering students' knowledge and practical experience in analogue circuit design. It involves various activities and collaborations with strategic partner universities, notably the University of the Philippines, which receives funding from ADI. This partnership enables the university to conduct research and collaborate closely with Analog Devices, fostering an environment of innovation and technological advancement in semiconductor design and production in the Philippines (Cervantes, 2023[48]).

Source: Cervantes, F.M. (2023[48]), "Analog devices to invest $200M in R&D facility", https://www.pna.gov.ph/articles/1200686.

As mentioned in Chapter 2, the ERDT is a consortium of eight universities aiming to produce a significant number of master's and doctoral graduates in various engineering fields. This initiative is geared towards conducting high-impact research, enhancing the qualifications of practicing engineers and cultivating a strong culture of R&D within the country. It is funded by DOST and the DOST-SEI, which monitors the scholarship programme.

The strategic direction for the consortium's R&D efforts is set by its Program Advisory Council, which consists of DOST officials and private sector representatives. It makes decisions regarding the R&D agenda, ERDT policies and special appointments, ensuring that the consortium's activities align with national priorities and contribute to the development of the engineering sector. The ERDT Fellowship and Scholarship Screening Committee, on the other hand, focuses on academic matters related to the ERDT programme. This includes discussing scholarships, research dissemination, visiting professorships and postdoctoral programmes. The committee's responsibilities extend to endorsing extensions for scholarships and appointments, facilitating the continuous flow of talent and innovation in engineering R&D (ERDT, 2013[46]).

The CIDR aims to bridge the academia, industry and government sectors by offering advanced graduate courses, the Mirror Laboratories programme, which provides joint graduate programmes with laboratory installation, operating resources and software to universities, and conducting collaborative applied research focused on integrated circuit design with industry partners. The objective is to conduct intellectual and creative R&D in partnership with the industry and also develop a skilled workforce of graduate-level integrated circuit designers who can meet the needs of academia, the industry and the public sector (CIDR, 2022[47]). The CIDR has established partnerships with several academic institutions, spearheaded by the University of the Philippines – Diliman and Mindanao State University – Iligan Institute of Technology (CIDR, 2022[47]).

The CIDR also collaborates with a range of companies to enhance its initiatives. These companies include Analog Devices General Trias, the Center for Applied Microelectronics and Programming, Embedded Silicon Technology Solutions, Lattice Semiconductor, Marquee Semiconductor, ROHM LSI Design Philippines, Seedeaplus and Xinyx Design Consultancy and Services. These partnerships play a vital role in ensuring that CIDR programmes are aligned with industry requirements and help facilitate the practical application of research and technology in integrated circuits (CIDR, 2022[47]).

Box 3.6. Fostering stakeholder engagement in the Philippine semiconductor ecosystem

The semiconductor industry in the Philippines is home to a unique degree of collaboration between key government, industry and technical community stakeholders, including through industry associations and regular, informal dialogue. Two key industry associations play a pivotal role in this regard. The Semiconductor and Electronics Industries in the Philippines Foundation, Inc. (SEIPI) is a non-profit organisation established to promote the growth and development of the semiconductor and electronics industries in the Philippines, which includes over 300 member firms, including foreign and Filipino electronics companies. Similarly, the Electronic Industries Association of the Philippines Inc. (EIAPI) takes a broader focus on electronic product design. Both associations represent the interests of their members through regular meetings and advocacy with other actors in the ecosystem, including government agencies and the technical community.

A unique platform for public-private partnership across stakeholders in the Philippine semiconductor industry is the Electronics Kapihan sa Calabarzon. The Kapihan is a forum held every two months for entities in the electronic, semiconductor and related services sectors within the Calabarzon area. Each Kapihan gathering is hosted by partners from either industry, academic institution or government body and the session begins by sharing key developments and experiences in the semiconductor and electronic ecosystem. It acts as an informal platform where industry representatives, academic institutions and government bodies can discuss challenges, share insights and forge beneficial connections.

Source: CMD (2023[49]), *Homepage*, https://cmdphilippines.com, (accessed June 2024); SEIPI (2024[50]), *About SEIPI*, https://www.seipi.org.ph/profile/about-the-industry/.

The Philippine government has successfully supported access to key technologies for the local semiconductor ecosystem

The Philippine government has a series of programmes enabling access to technology for industry and the research community in the semiconductor and electronics sector (Box 3.7). These include the Advanced Device and Materials Testing Laboratory (ADMATEL), the Electronics Product Development Center (EPDC), the Advanced Manufacturing Center (AmCen) and the Advanced Mechatronics, Robotics, and Industrial Automation Laboratory (AMERIAL), which are all described below.

Under DOST, the Industrial Technology Development Institute (ITDI) serves as a key facilitator for technical innovation in the industrial sector. The ITDI Materials Science Division oversees the operations of ADMATEL. Established in December 2012, ADMATEL came into being as a direct response to SEIPI's proposal and the broader industry's need for in-country failure analysis laboratories (ADMATEL, n.d.[51]). This national testing facility is equipped with a suite of 8 cutting-edge, accredited pieces of equipment, enabling it to offer 30 laboratory services focused on failure analysis and material characterisation failure analysis, serving as a resource for stakeholders from industry and academia. Since its establishment, ADMATEL has tested more than 13 500 samples and served more than 540 clients served from industry, academia and government. Currently, ADMATEL's clientele includes 70 semiconductor and electronics companies that pay fees for the use of its services.

Since 2012, ADMATEL has achieved significant accomplishments, notably receiving ISO/IEC 17025:2015 accreditation from the DTI Philippine Accreditation Bureau (DTI-PAB) in February 2015 and an update to the 2017 version of the standard in February 2020 (Layaoen et al., n.d.[52]). Its 3 laboratories – surface analysis, thermal analysis, and chemical and metallurgical – have consistently met industry standards for cleanroom conditions, including temperature, humidity and electrostatic discharge (ESD) safety, all while upholding a commitment to providing results within 24 hours at competitive prices. This operational excellence has led to a customer satisfaction key performance indicator that consistently exceeds targets and expectations (Layaoen et al., n.d.[52]). ADMATEL has planned an expansion of services requiring an investment of PHP 50 million and includes an additional scanning electron microscope unit. The funding is expected to come from DOST by the end of 2024.

The DOST-ASTI EPDC is also geared towards facilitating access to technology for electronics and semiconductor stakeholders. The EPDC is a facility that backs the electronics sector with technical services like prototype design and fabrication and assembly of printed circuit boards, as well as electronic product testing for electromagnetic compatibility and product safety to foster innovation and premium products. The EPDC project is being realised in two stages. Phase I involved the establishment of necessary infrastructure, tools and equipment essential for the centre's operations, which focused on electronics product development. It also included training and developing the human resources needed to operate and manage the centre, alongside facilitating the design flow of electronics products. Moreover, it laid the groundwork for future R&D projects by providing the necessary tools and equipment. Phase II, completed in 2020, finalised the electromagnetic compatibility testing facility equipped with electromagnetic susceptibility capabilities, enhanced the rapid printed circuit board prototyping facility's capacity and capabilities, assisted electronic designers across various regions and achieved international accreditation for the electromagnetic compatibility facility.

Additional DOST facilities include AmCen and AMERIAL. AmCen provides technical and business support in additive manufacturing or three-dimensional printing in partnership with the DOST-Metals Industry Research and Development Center and DOST-ITDI (AMCen, n.d.[53]). AMERIAL encompasses tools and equipment designed for training, simulation and R&D, including the Smart Factory. This fully integrated manufacturing system enhances control over manufacturing, maintenance, inventory and supply chain operations by connecting physical systems, operational data and human resources (AMERIAL, n.d.[54]).

Box 3.7. Best practices for publicly funded infrastructure for innovation

The Philippines has had notable success with government-funded laboratories that help access to key semiconductor technologies for the local ecosystem. Typically, programmes involving publicly funded shared facilities exhibit several key characteristics. They:

1. Respond to demand from local stakeholders.
2. Address a bottleneck that inhibited research or innovative activity.
3. Reduce or remove prohibitive fixed costs associated with developing and maintaining key equipment or services.
4. Feature a sustainable business model, e.g. fee-for-service.
5. Enable positive spillovers, e.g. innovative applications developed by the technical community for local commercial adoption.

ADMATEL meets these criteria. In addition, removing the need for expensive investment in failure analysis and materials characterisation supports local competitiveness by reducing production costs and lead time for testing semiconductor products abroad. Its fee-for-service model shifts a one-off large, fixed cost on expensive equipment to a smaller, ongoing cost, thus helping firms smooth their expenses and enable easy scalability. Moreover, as a site for additive materials testing for the research community, it facilitates technology transfer and encourages the local semiconductor ecosystem.

Some key industry actors advocate for the establishment of a lab-scale wafer fabrication facility in the Philippines to bolster the capabilities of the Science and Technology Center. To be managed by the Philippine government via the DTI and DOST, this proposed lab would employ generic technology for commercial and educational uses and would need an investment of about PHP 500 million for typical node sizes of about 1 to 5 microns. This facility aims to enhance the skills of the local workforce and facilitate the local industry’s ability to prototype and perform initial tape-outs of semiconductor chip designs domestically, reducing the need to send them to semiconductor fabrication facilities overseas for this purpose.

However, it should be noted that the Philippines currently lacks the trained human resources to set up and install such a laboratory-scale wafer fabrication facility and would seek international collaboration to train human resources. Similarly, local stakeholders do not cite a need for a local tape-out facility, noting that multi-project wafer manufacturing services are rapid and cost-effective and the envisaged node sizes would only correspond to legacy analogue chips; for these reasons, a path to a sustainable business model is less than assured. When using public funds, care should be taken to ensure that investments in core shared research infrastructure remain targeted and sustainable.

Typically, proposals for publicly funded infrastructure are administered by DOST, where the technical and financial viability of the project is assessed. Following this process, a Governing Council composed of several government agencies and private sector representatives assesses the proposal before it is finally approved by the DOST executive committee led by the DOST secretary. In the case of a laboratory-scale wafer fabrication facility, careful consideration, including possible eventual evaluation of other technical solutions, may suffice to support the local semiconductor industry.

Source: OECD (2023[55]), “Very Large Research Infrastructures: Policy issues and options”, https://doi.org/10.1787/2b93187f-en; OECD/Science Europe (2020[56]), “Optimising the operation and use of national research infrastructures”, https://doi.org/10.1787/7cc876f7-en; PCO (2023[57]), “PBBM: Govt ready to expand semiconductor industry”, https://pco.gov.ph/news_releases/pbbm-govt-ready-to-expand-semiconductor-industry; OECD interviews with key stakeholders.

The Philippines offers support for R&D in the semiconductor ecosystem, but these efforts could be expanded

DOST offers funding and grants to boost technology and innovation within the electronics industry, aiming to enhance knowledge generation and foster collaboration within the science, technology and innovation ecosystem. The DOST and DOST-PCIEERD Grants-In-Aid (GIA) programme supports science and technology (S&T) partnerships and applied research between higher education institutions (HEIs), government R&D institutes and non-profit S&T organisations. The GIA grant covers remaining project expenses, provided that the organisation applying contributes at least 15% of the cost in cash or through other kinds of support (like paying utilities or rent). For the 2024 call for proposals, the DOST can support PHP 30 million per project for semiconductor manufacturing services and PHP 20 million per project for electronics manufacturing services. The amount of R&D grants varies per call per year and the funding support to be provided is typically commensurate with the target deliverables committed.

Several programmes are designed to strengthen industry-academia collaboration and regional research capabilities (Quimba, Albert and Llanto, 2018[58]). The Collaborative Research and Development to Leverage Philippine Economy Program funds HEIs or R&D institutions to address private sector challenges, while the Niche Centers in the Regions for R&D Program provides grants to regional HEIs for S&T infrastructure improvements. The Business Innovation through S&T (BIST) for Industry Program supports Filipino companies in acquiring strategic technologies, including high-technology equipment and intellectual property rights.

DOST also supports the transition from R&D to market through the Funding Assistance for Spin-off and Translation of Research in Advancing Commercialization programme, which aims to commercialise PCIEERD-funded technologies into market-ready products or foster start-up initiatives. Additionally, the Innovative Startup Act establishes a Startup Grant Fund (SGF) under DOST, the DICT and DTI to finance start-ups and start-up enablers, with each agency responsible for allocating and replenishing its SGF through the annual General Appropriations Act (Republic of the Philippines, 2019[45]).

To foster advancements in science, technology and innovation, the DOST-SEI offers a variety of scholarship programmes aimed at nurturing talent in these critical fields (DOST, 2022[59]). These programmes include the DOST-SEI Undergraduate Scholarship Program and the Capacity Building Program in Science and Mathematics Education, which is designed for candidates pursuing master’s and PhD degrees. Additionally, the Accelerated Science and Technology Human Resource Development Program supports graduate scholars and further selectively includes some of its scholars in its Research Enrichment Program, allowing them to increase their research experience. Furthermore, ERDT scholars are provided with opportunities through the Research Enrichment (Sandwich) Program to conduct a portion of their research internationally. The SEI also supports master’s and PhD students under the Science and Technology Regional Alliance of Universities for National Development programme.

The function of the intellectual property system could be improved

In the Philippines, the Intellectual Property Office of the Philippines (IPOPHL) is the authority responsible for overseeing intellectual property (IP) regulations, as established by Republic Act No. 8293, also known as the Intellectual Property Code of the Philippines (IPOPHL, 2020[60]). The IPOPHL offers a range of services, including the issuance of patents, the registration of copyrights, industrial designs, trademarks, utility models, geographical indications, the layout of integrated circuits and the facilitation of technology transfer agreements. For IP rights enforcement, the IPOPHL IP Enforcement Office provides an administrative avenue for IP owners and businesses to file complaints and seek enforcement assistance (IPOPHL, 2020[61]).

Complementing the objectives of the Philippine Development Plan (PDP), the IPOPHL introduced the National Intellectual Property Strategy (NIPS) 2020-2025 in December 2019 (IPOPHL, 2022[62]). This strategy document delineates the agency's goals and approaches to fortify IP rights protection and bolster innovation and creativity in the Philippines. Among the suggested revisions is the introduction of liability measures for landlords and others in cases of trademark infringement (UK IPO, 2023[63]). Similarly, the PDP recommended that an interagency body on the formation and implementation of IP rights, the National Committee on Intellectual Property Rights, was mandated legislatively in order to institutionalise this committee and ensure a unit within the member agencies with a budget allotted for IP enforcement. Currently, this committee operates through executive order.

The IP system in the Philippines has seen improvements in recent years. Philippine IP regulations feature robust patent and trademark laws, and the Philippines is also currently implementing reforms and initiatives, while provisions to adapt the IP code and improve the administrative and enforcement capacity of the IPOHL are pending before Congress. International observers have recognised these advances: for example, the Philippines has not been featured in the United States Trade Representative Special 301 Report for the past decade, nor on the European Union Watch List since 2019. In addition, the IPOPHL was recently designated as a competent International Searching Authority and International Preliminary Examining Authority (ISA/IPEA) by the United States Patent and Trademark Office, highlighting the competency and capability of IPOPHL patent examiners. Similarly, the IPOPHL and the Department of Justice signed a memorandum of agreement (MOA) for enhanced IP rights protection on 17 November 2023. The MOA reflects a shared commitment to strengthen the protection and enforcement of IP rights.

Despite the *de jure* robustness of the Philippine IP regulation landscape, the enforcement of these laws has been questioned by some interlocutors (U.S. Department of State, 2023[64]). Since joining the World Intellectual Property Organization (WIPO) in 1980, the Philippines has faced challenges in the enforcement of IP laws (WIPO, 2024[65]), which is attributed to factors that include a lengthy and complex judicial process. In the Philippines, special commercial courts have jurisdiction over civil and criminal actions involving IP, while administrative actions can be filed with the IPOPHL as a quasi-judicial body. Still, some interlocutors highlight concerns about slow and unpredictable litigation processes (U.S. Department of State, 2023[64]). Furthermore, the responsibility for enforcement costs and handling seized goods typically falls on the IP owners. As a result, many IP owners opt for out-of-court resolutions such as settlements, preferring these to navigate the challenges of the court system (U.S. Department of State, 2023[64]).

Still, despite these improvements, IP in the Philippines has had low take-up within the semiconductor industry: for instance, no integrated circuit layout has been registered with the IPOPHL despite several calls for registration from the office to the semiconductor industry. The IP sharing agreement is included in the signed memoranda for bilateral partnerships with academic partners. Moreover, many key stakeholders have identified patent filing as troublesome in the Philippines, with excessively long process times. Such patterns are prevalent in developing countries where innovation activities are nascent. However, such concerns may affect firms with incentives to patent and commercialise their innovations.

Human capital

In a 2023 meeting with the US Semiconductor Industry Association, Philippines' President Ferdinand Marcos, Jr. highlighted that boosting the semiconductor industry was among the government's top priorities, including efforts to build capacity and train a competitive workforce (PCO, 2023[57]). The Philippines is one of the 8 government partners for the US government under the International Technology Security and Innovation (ITSI) Fund, created by the US CHIPS and Science Act. The BOI has announced a target of 128 000 engineers and technicians trained for the semiconductor industry by 2028, although it has not unveiled the exact plan to accomplish this number

Chapter 2 highlights that workers in electronic components require more on-the-job training than in other manufacturing industries and labour productivity has declined over time. This reflects the anecdotal views of the semiconductor industry, which highlight the country's engineering graduate population but acknowledge that industry-backed up- and re-skilling programmes are necessary to meet industry workforce needs (Mapua Cayas, Grepo and Lachica, 2021[66]). A demand-driven approach to filling existing gaps in human resource supply and steps to retain the developed workforce could help to address these issues. The Philippines should also ensure that the primary and secondary education systems can adequately equip future technical workers with the foundational numeracy, literacy and critical thinking skills required for their future careers.

This section outlines approaches in the Philippines to building skills for the semiconductor industry at the national and local levels, including an extensive focus on partnerships with industry, bilateral partnerships between key universities and industry players, workplace-based training opportunities and industry contribution to some curricula. This section describes the governance of skills and employment in the Philippines, and efforts to improve the semiconductor human capital in the country.

Understanding the governance of human capital in the Philippines

A set of national workforce development strategies governs both central and regional skill and employment programmes. The policy plan underpinning development, including workforce capacity in key industries, is the PDP 2023-2028, which prioritises legislation in key areas of education and reskilling (NEDA, 2023[1]). The plan also lays out a legislative agenda for the five-year period, including a review of the basic education system, extending the Government Assistance to Students and Teachers in Private Education programme, ensuring the TVET Enterprise-Based Training Program meets the nation's workforce needs and promoting upskilling and reskilling of the labour force (NEDA, 2023[1]).

The National Technical Education and Skills Development Plan (NTESDP) 2023-2028 (TESDA, 2023[67]) represents the most comprehensive ongoing national strategy for workforce modernisation and human capital development in the Philippines. The NTESDP acknowledges the country's need to modernise and restructure education and workforce development programmes, identifying trends in the composition of TVET enrolees and industry requirements (TESDA, 2023[67]). The strategy outlines five strategic pillars of a modern workforce for the Philippines: modern technical and vocational training, enhanced workforce employability, quality assurance on standards, multi-stakeholder collaboration and stronger innovation in the TVET system.

At the national level, the DOLE administers workforce training programmes in the Philippines. At the core of the Philippines workforce development policy is TESDA, which manages the TVET system, the educational network encompassing both the school system and non-formal classes (TESDA, n.d.[68]), and CHED, which governs both public and private institutions of higher education as well as degree-granting programmes in all post-secondary educational institutions, public and private.

TESDA is the main source of institutionalised training programmes to meet industry needs in the Philippines. TESDA-administered programmes fall into four major categories: school-based, centre-based, community-based, and enterprise-based (ADB, 2021[7]). Of these, the least formalised and most responsive are community-based programmes, which are undertaken in conjunction with local governments and non-profit organisations, and particularly target marginalised groups, and enterprise-based programmes, which are implemented with companies (ADB, 2021[7]). Collectively, these delivery modes make up much of the formalised skill training outside of traditional education in the Philippines. Most TVET providers (90%) are from the private sector, with 10% from technical training institutes and other government units (TESDA, 2023[67]).

When looking at workforce development, the current strategies, activities and programmes highly emphasise TVET as seen by the integrated and expansive roles of TESDA in the PDP and NTESDP. However, TESDA does not cover workforce development in parallel with higher education and degree-granting institutions. The governance of post-secondary higher education falls under the responsibility of CHED.

CHED's role in the PDP 2023-2028 have been identified along the lines of harmonising basic engineering, technical-vocational and higher education in conjunction with DepED and TESDA. The latest publicly available roadmap from CHED on public higher education reform was published in 2017 (CHED, 2017[69]) and the latest annual report available is from 2016 (CHED, 2017[70]). Furthermore, CHED does not have an NTESDP-equivalent strategy to participate in improving education infrastructure, promoting upskilling and reskilling of the labour force and advancing R&D and innovation, as designated by the PDP in Chapters 12, 4 and 8 respectively. For the advanced skills required by the semiconductor industry, it is essential that higher education, and notably the policies, standards and guidelines for engineering and other semiconductor-related degrees, remains responsive to workforce needs.

Higher education in the Philippines is administered and governed by CHED. At the institutional level, HEIs are classified as colleges or universities (CHED, 2012[71]). According to this horizontal typology, colleges are tertiary degree-granting institutions that offer specialised degree-granting courses. In contrast, universities must offer at least two graduate-level courses leading to doctoral degrees and undergraduate courses. HEIs are also categorised as public or private institutions. For the accreditation of private institutions, organisations authorised by CHED operate under the umbrella of the Federation of Accrediting Agencies of the Philippines, including the Philippine Accrediting Association of Schools, Colleges and Universities, the Philippine Association of Colleges and Universities Commission on Accreditation and the Association of Christian Schools, Colleges and Universities Accrediting Association Inc. (CHED, 1995[72]). Accrediting agencies for government-supported institutions are the Accrediting Agency of Chartered Colleges and Universities in the Philippines and the Association of Local Colleges and Universities Commission on Accreditation (CHED, 1995[72]).

HEIs in the Philippines also utilise a vertical typology based on programme excellence and institutional quality (CHED, 2012[71]). CHED's Office of Institutional Quality Assurance and Governance formulates and implements policies for quality assurance and governance, co-ordinates HEI development, supports institutional mergers and facilitates collaborations among HEIs (CHED, 2024[73]). The three types of HEIs are autonomous, deregulated and regulated. Autonomous HEIs, designated by evaluation, demonstrate outstanding performance in research, professional development and creative work through internal quality assurance systems, allowing them to launch new courses/programmes without securing permits. Deregulated HEIs perform well but still need licenses for new programmes and campuses. Regulated HEIs are institutions that must demonstrate good programme excellence and institutional quality. CHED regularly reviews its list of autonomous and deregulated institutions. As of May 2023, there are 71 autonomous HEIs and 16 deregulated HEIs (CHED, 2023[74]).

Based on autonomy and flexibility, it is relatively straightforward for autonomous institutions to integrate semiconductor industry-friendly amendments like curriculum updates, reintroduction of bachelor of technology programmes, incorporation of academic training and revising metrics for performance evaluation to train human capital beyond TVET.

Efforts to bridge the gap in skills supply and retention in the Philippines

Typically, collaboration between universities and the Philippine semiconductor industry, particularly in workforce development, has been largely ad hoc and bilateral. While the CIDR and ERDT collaborate with companies and firms on R&D and training human resources, typically, these collaborations are structured such that a firm partners with a single university at any given time, formalising their co-operation through a memorandum of understanding. For example, Xinyx Design works with students from Mindanao State University - Iligan Institute of Technology and University of the Philippines – Diliman through the CIDR and Integrated Microchips Inc. (IMI). IMI has collaborated with De La Salle University under a bilateral MOU (as highlighted in OECD interviews with key stakeholders). Similarly, some bilateral partnerships in curriculum design, student internships and training, and faculty development have been forged between SEIPI and Caraga State University (CSU, 2023[75]).

Scholarships are available for students in national priority programmes through CHED and DOST to promote the supply of skills in a sector. In response to the needs of the Philippine labour market, CHED, in consultation with the technical working groups from various sectors including CHED, DOST, NEDA, DOLE, the DTI and TESDA, has identified national priority programmes for the CHED Merit Scholarship Program (CMSP) for the academic years 2023/24 to 2027/28 (Republic of the Philippines, 2023[76]). The CMSP is a scholarship provided by the government to assist students with exceptional academic talents to pursue undergraduate education in both private educational institutions and public universities, including state and/or local universities and colleges (Republic of the Philippines, n.d.[77]). This support encompasses tuition, other school fees and a monthly allowance for living expenses. A significant focus is placed on science, technology, engineering and mathematics (STEM) fields for the CMSP, allocating 50% of the national budget for these areas, with an additional 15% directed towards engineering technology subjects, particularly to support the semiconductor and electronics industries (Republic of the Philippines, 2023[76]).

In addition to the DOST-SEI Undergraduate Scholarship Program and the Capacity Building Program in Science and Mathematics Education, CHED scholarships would play a crucial role in encouraging the path to semiconductor fields for STEM enrolees. DOST also offers scholarships for undergraduate students pursuing STEM studies, which aligns with the Republic Act No. 7687 or the Science and Technology Scholarship Act of 1994.

In addition, a Transnational Higher Education Law was developed as part of a memorandum of understanding between BOI and CHED in 2020 which aims to enhance the quality and standards of education, by enabling universities and HEIs to establish transnational campuses in selected countries around the world. The law also allows educational institutions in the Philippines to establish networks and alliances with universities and higher education institutions abroad, enabling the free exchange of information, personnel and academic programs. This law can be used to help encourage greater international links between the local Philippine innovation system and the wider global semiconductor industry.

A step towards addressing issues related to skills retention, particularly in the higher education and research field, includes the Balik Scientist Program (BSP). This initiative was first introduced in October 1975 through Presidential Decree No. 819 and updated in 2007 with policies and financial backing (Montoya, 2022[78]). In 2018, the Philippine government passed the Balik Scientist Act to bolster the programme (Republic Act No. 11035). The BSP was established to facilitate the exchange of information and hasten the introduction of new technologies by reinforcing the capacities of academic, public and private sector scientists and technologists. Its primary mission is to attract Filipino scientists and technologists living abroad to come back and contribute their knowledge to the nation’s development.

Participants in the BSP are entitled to a range of benefits, incentives and privileges across short-, medium- and long-term engagements. These advantages encompass airfare, a daily stipend, health coverage, assistance with visa applications, grant funding based on proposals, memberships in the National Research Council of the Philippines and various professional organisations, as well as support for travel and lodging for conferences within 12 specified fields of priority such as electronics, manufacturing and semiconductors (Montoya, 2022[78]). Since the programme's inception in 1975, it has successfully involved 631 Balik scientists, who have contributed their expertise across 150 host institutions in 16 different regions throughout the Philippines (Daily Guardian, 2023[79]). However, this programme is restricted to Filipino scientists and others working in the research sector and is not currently targeted towards talented workers in the private sector.

Developing the human capital required for the Philippine semiconductor industry

Some semiconductor firms conduct training through TESDA’s enterprise-based programmes. These programmes can take the form of an apprenticeship or leadership programme, designed to provide certification for skilled workers who learn the trade through a position within a company, or a dual training programme, which combines education at a school or training centre combined with onsite training at a business. An apprenticeship programme is a training and employment programme involving a contract between an apprentice and an employer on an approved apprenticeable occupation. Generally, it aims to provide a mechanism that will ensure the availability of qualified, skilled workers based on industry requirements. The period of apprenticeship covers a minimum of four and a maximum of six months.

Only companies with approved and registered apprenticeship programmes under TESDA can hire apprentices. The goal is to meet industry demand and establish a national apprenticeship programme with standards for the protection of apprentices. The enterprise-based programmes include training for 21 electronics and semiconductor skills, such as semiconductor back-end operation, semiconductor front-end operation and electronics/semiconductor production line machine servicing, for which the duration ranges from 80 to 500 working hours (TESDA, 2020[80]), although other institution-based and community-based semiconductor and electronics training is available. In 2020, 15.45% (77 179) of all TESDA certification assessment takers were in Electrical & Electronics sector TESDA Training Programmes with a pass rate of 90.16% (TESDA, 2021[81]). In 2021, 10.25% (65 365) of all TESDA certification assessment takers were in the TESDA training programmes with a pass rate of 88.97% (58,156) (TESDA, 2022[82]). In 2022, 9.91% (89 896) of all TESDA certification assessment takers were in the TESDA training programmes with a pass rate of 90.17% (81 033) (TESDA, 2022[83]).

In addition to TESDA enterprise-based training, semiconductor companies also offer on-the-job training for operators and engineers. Based on the skills requirement of the company, the training programmes are specific to the company. For example, a research report compiled by Hong Kong (China) industry researchers found that schools in the Clark Freeport and Special Economic Zone established vocational programmes tailored to businesses operating in the zone (HKTDC, 2017[84]). Additionally, PEZA has initiated a number of programmes to train administrators and workers with the skills necessary to fill the employment needs of companies in special economic zones, including the SEZ Institute and the PEZA Academy (PEZA, 2020[85]).

While the Philippines has acknowledged trends in workforce demand and has a national and regional network of job training programmes to build from, most key reforms are recent, pending or prospective (TESDA, 2023[67]). For example, the 2023-28 iteration of NTESDP lists among its objectives increased stakeholder and employer ownership of programming, skill-based benchmarking, youth-targeted employment and entrepreneurship initiatives, increased capacity for training programmes, and innovative efforts specifically designed around reskilling and upskilling for workers (TESDA, 2023[67]). TESDA researched and published a series of labour market intelligence reports, identifying and responding to stakeholder needs and inputs (TESDA, 2023[67]). While encouraging, these reforms are recent or forthcoming, meaning that neither their success nor impact on the semiconductor ecosystem can be evaluated at this early stage.

Many encouraging signs, including the creation of industry boards for technical and vocational training programmes, the use of partnerships with foreign governments and the private sector to fund targeted workforce programmes, and the publication of a series of labour market research reports indicate that the Philippines is making informed decisions to restructure its workforce development strategy. However, there is room for improvement in fully utilising existing deep links between academia and the private sector to meet the semiconductor industry’s needs and ensuring policy making in this area remains targeted and demand-driven.

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Annex A. Understanding the semiconductor value chain

The semiconductor value chain involves a complex system of processes and inputs undergoing substantial change due to technology, geopolitical and business developments. To help policy makers read this report, this annex provides a simplified overview of the semiconductor supply chain, key inputs and common business models. For more detailed OECD analysis on this topic, please refer to the paper "Mapping the Semiconductor Value Chain" (OECD, forthcoming[1]).

The semiconductor value chain

Semiconductors vary in their complexity, function and size, and some semiconductors require unique manufacturing processes (Haramboure et al., 2023[2]; BCG/SIA, 2021[3]). At a high level, semiconductors are produced through four simplified steps: design; wafer production; fabrication and assembly, testing and packaging.

Design involves determining the chip's requirements, planning the chip's architecture and using a test bench to validate the final design. It requires relatively little physical capital expenditure compared to the other stages but accounts for approximately half of the total value-added in the semiconductor supply chain (BCG/SIA, 2021[3]). Chip designers make important decisions that determine processes undertaken in the fabrication and assembly testing and packaging process.

- ***Inputs to the design process***: Design is reliant on specialised software inputs, especially **electronic design automation tools**, which are crucial to managing the billions of transistors, circuit elements and other components found on semiconductors. Semiconductor designs rely on building blocks known as **intellectual property (IP) cores**, which are modular components or logic blocks that can be reused in semiconductor design.

Wafer production involves the production of raw wafers of a semiconductor material, typically silicon. Specialist producers create a pure silicon cylinder (boule or ingot) by heating and cooling silicon to form a highly ordered crystal structure. Wafers are sliced from this cylinder using specialist equipment and polished to remove surface imperfections. The semiconductivity of a wafer can be adjusted by adding tiny amounts of other elements (dopants) using a tool called an ion implanter.

- ***Inputs to wafer production***: Key inputs to this step include raw semiconducting materials, typically silicon, dopant materials (like boron or phosphorus) for modifying electrical properties, ion implanters tools for controlled doping, and crystal machining tools, crystal growing furnaces and other capital equipment.

Fabrication (also known as front-end manufacturing) is the process of etching an integrated circuit design onto a wafer of semiconducting material (often silicon). The wafer fabrication process typically involves several repeated steps to build the final chip. First, the wafer is polished for a smooth surface. Next, a layer of material is deposited onto the wafer, followed by the application of a light-sensitive coating called "photoresist." Using lithography, specific patterns are created by exposing parts of the photoresist to light. The wafer is then etched to remove unwanted material, and ion implantation is used to embed dopants in targeted areas to control electrical properties. Finally, the photoresist is removed, and these steps are repeated for each layer required to create the complete chip structure. Fabrication is among the most complex and expensive manufacturing processes known to man, involving hundreds of highly sensitive processes.

- ***Inputs to fabrication***: This step of the semiconductor manufacturing process requires hundreds of inputs, which vary based on semiconductor type, design and technology. Key material inputs often include photomasks, photoresists, speciality gases and chemicals. Specialist tools are also required for the major process steps – lithography, etching, deposition – as well as cleaning, chemical mechanical planarisation, process automation and metrology and inspection.

Assembly, testing and packaging (also known as back-end manufacturing) produces the final semiconductor for inclusion in electronic products. The processed wafer from fabrication is sliced into individual dies, which are then encased in protective frames to prepare them for soldering onto printed circuit boards. Each chip undergoes rigorous testing for defects and performance to ensure quality before final assembly into products.

- ***Inputs to assembly, testing and packaging***: Key material inputs include metal lead frames to hold the chips, packaging materials like plastic or ceramic, bonding wires to connect the chip to the packaging or other electronics, and materials to attach the chip to other components, like epoxy resins. The process relies on dicing tools, assembly tools, and testing equipment.

Key business models in the semiconductor ecosystem

- The term **foundry** refers to companies that operate front-end production facilities (also known as "fabs") to produce semiconductors for other companies, usually on a contract basis.
- **Outsourced assembly, testing and packaging** (OSAT) firms are typically third-party service providers that offer assembly, testing and packaging services to external customers, like fabless design firms.
- "**Fabless firms**" create semiconductor designs but outsource their manufacturing to foundries and OSAT firms. As new electronic and digital applications drive demand for highly specialised and complex chips, a wide variety of firms carry out semiconductor design but outsource front-end or back-end manufacturing processes.
- **"System firms"** design semiconductors for use in their own products, like cars, smartphones or services, typically relying on OSAT firms and foundries for semiconductor production. In contrast, fabless firms typically design and sell chips.
- **Semiconductor IP vendors** design and sell pre-designed, reusable functional blocks (IP cores) used in chip designs.
- **Integrated device manufacturers** (IDMs) are vertically integrated manufacturers that can perform all processes of the value chain, from design to final packaging. IDMs may also offer front-end or back-end contract manufacturing services to fabless or system firms, or outsource some manufacturing processes to OSAT firms or foundries.

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Annex B. List of identified semiconductor-related products

HS code	Label	Type
854110	Electrical apparatus; diodes, other than photosensitive or light emitting diodes	Chips
854121	Electrical apparatus; transistors, (other than photosensitive), with a dissipation rate of less than 1W	Chips
854129	Electrical apparatus; transistors, (other than photosensitive), with a dissipation rate of 1W or more	Chips
854130	Electrical apparatus; thyristors, diacs and triacs, other than photosensitive devices	Chips
854140	Electrical apparatus; photosensitive, including photovoltaic cells, whether or not assembled in modules or made up into panels, light emitting diodes	Chips
854150	Electrical apparatus; photosensitive semiconductor devices n.e.s. in heading no. 8541, including photovoltaic cells, whether or not assembled in modules or made up into panels	Chips
854160	Crystals; mounted piezo-electric	Chips
854190	Electrical apparatus; parts for diodes, transistors and similar semiconductor devices and photosensitive semiconductor devices	Chips
854231	Electronic integrated circuits; processors and controllers, whether or not combined with memories, converters, logic circuits, amplifiers, clock and timing circuits, or other circuits	Chips
854232	Electronic integrated circuits; memories	Chips
854233	Electronic integrated circuits; amplifiers	Chips
854239	Electronic integrated circuits; n.e.c. in heading no. 8542	Chips
854290	Parts of electronic integrated circuits	Chips
852351	Solid-state, non-volatile data storage devices for recording data from an external source [flash memory cards or flash electronic storage cards]	Chips
852352	Cards incorporating one or more electronic integrated circuits "smart cards”	Chips
852359	Semiconductor media, unrecorded, for the recording of sound or of other phenomena	Chips
853290	Parts of electrical "pre-set" capacitors, fixed, variable or adjustable, n.e.s.	Chips
853390	Parts of electrical resistors	Chips
841459	Air or vacuum pumps (excl. gas compound elevators and pneumatic elevators and conveyors); air or other gas compressors and fans; ventilating or recycling hoods incorporating a fan, whether or not fitted with filters; gas-tight biological safety cabinets, whether or not fitted with filters; parts thereof	Manufacturing equipment
841950	Heat-exchange units (excl. those used with boilers	Manufacturing equipment
842129	Machinery and apparatus for filtering or purifying liquids (excl. such machinery and apparatus for water and other beverages, oil or petrol-filters for internal combustion engines and artificial kidneys)	Manufacturing equipment
842139	Machinery and apparatus for filtering or purifying gases (excl. isotope separators and intake air filters for internal combustion engines, and catalytic converters and particulate filters for purifying or filtering exhaust gases from internal combustion engines	Manufacturing equipment
842199	Parts of machinery and apparatus for filtering or purifying liquids or gases, n.e.s.	Manufacturing equipment
903082	Instruments and apparatus for measuring or checking semiconductor wafers or devices, incl. integrated circuits	Manufacturing equipment

HS code	Label	Type
903084	Instruments and apparatus for measuring or checking electrical quantities, with recording device (excl. appliances specially designed for telecommunications, multimeters, oscilloscopes and oscillographs, and apparatus for measuring or checking semiconductor wafers or devices)	Manufacturing equipment
903300	Regulating or controlling instruments	Manufacturing equipment
900699	Photographic flashlight apparatus	Manufacturing equipment
848610	Machines and apparatus of a kind used solely or principally for the manufacture of semiconductor boules or wafers	Manufacturing equipment
848620	Machines and apparatus of a kind used solely or principally for the manufacture of semiconductor devices or of electronic integrated circuits	Manufacturing equipment
848630	Machines and apparatus of a kind used solely or principally for the manufacture of flat panel displays	Manufacturing equipment
848640	Machines and apparatus of a kind used solely or principally for the manufacture or repair of masks and reticles, assembling semiconductor devices or electronic integrated circuits, or for lifting, handling, loading or unloading items of heading 8486	Manufacturing equipment
848690	Machines and apparatus of heading 8486; parts and accessories	Manufacturing equipment
900120	Sheets and plates of polarizing material/sheets of semiconductor	Foundry inputs
900190	Lenses, prisms, mirrors and other optical elements, unmounted	Foundry inputs
900219	Objective lenses	Foundry inputs
900220	Optical filters	Foundry inputs
900290	Lenses, prisms, mirrors and other optical elements, mounted	Foundry inputs
901210	Electron microscopes, proton microscopes and diffraction apparatus	Foundry inputs
901290	Parts and accessories for electron microscopes, proton microscopes and diffraction apparatus	Foundry inputs
903141	Optical instruments inspecting semiconductor devices	Foundry inputs
280421	Argon	Raw materials
280429	Rare gases (excl. Argon)	Raw materials
280461	Silicon; containing by weight not less than 99.99% of silicon	Raw materials
284920	Silicon Carbide	Raw materials
282560	Germanium oxides and zirconium dioxide	Raw materials
283325	Sulphates, copper	Raw materials
285000	Hydrides, nitrides, azides, silicides and borides, whether or not chemically defined (excl. compounds which are also carbides of heading 2849, and inorganic or organic compounds of mercury whether or not chemically defined)	Raw materials
284019	Borates; disodium tetraborate (refined borax), other than anhydrous.	Raw materials
252800	Natural borates and concentrates thereof (whether or not calcined), but not including borates separated from natural brine; natural boric acid containing not more than 85% of H3BO3 calculated on the dry weight	Raw materials
284011	Borates; disodium tetraborate (refined borax), anhydrous	Raw materials
811299	Articles of niobium "columbium", gallium, indium, vanadium and germanium, n.e.s.	Raw materials
370130	Photographic plates and film in the flat, sensitised, unexposed, with any side > 255 mm	Inputs for wafers
370199	Photographic plates and film in the flat for monochrome photography, sensitised, unexposed, of	Inputs for wafers
370790	Photographic goods	Inputs for wafers
381800	Silicon wafers	Silicon wafers

Annex C. Notes on patent data

Explanation for IP5 patent families

Patent indicators used throughout the report mainly rely on IP5 patent families that identify the most valuable patents protected on the largest markets, as discussed by Dernis et al. (2015[1]) and Amoroso et al. (2021[2]). The value of patents is often associated with the number of patent jurisdictions in which the invention is protected: patentees will only take on the additional costs and delays of extending protection to other countries if they deem it worthwhile in terms of economic returns (OECD, 2009[3]). IP5 patent families are defined as sets of patent applications protecting the same invention filed in at least two intellectual property (IP) offices, with at least one application filed in one of the five largest IP offices worldwide (IP5): the European Patent Office, the Japan Patent Office, the Korean Intellectual Property Office, the State Intellectual Property Office of the People's Republic of China (CNIPA) or the United States Patent and Trademark Office.

Keywords used to identify trends in patents related to semiconductors

- semiconductor
- transistor
- integrated circuit
- silicon wafer
- logic chip
- memory chip.

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Promoting the Growth of the Semiconductor Ecosystem in the Philippines

The Philippines stands as the world's ninth-largest chip exporter, and the semiconductor sector is the country's largest export industry. However, there are untapped opportunities to boost labour productivity and address infrastructural and regulatory bottlenecks for the semiconductor industry. This report examines opportunities and challenges for the Philippines' semiconductor ecosystem, particularly in assembly, testing, and packaging, and provides recommendations to unlock its growth. The report combines quantitative and policy analysis of the Philippine semiconductor ecosystem – including infrastructure, human capital, and integration into global value chains. Its recommendations target critical areas: improving the business and operational environment for the Philippine semiconductor industry, boosting investments in R&D and technology, and achieving ambitious workforce development plans through industry-academia partnerships and international collaboration. This report provides strategic guidance to strengthen the Philippines' position in global semiconductor value chains and address current productivity trends. By implementing the policy recommendations, the Philippines can capitalise on emerging opportunities and unlock growth in the semiconductor ecosystem, particularly in assembly, testing and packaging.

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