

PART I: ANALYSIS OF THE PARTICIPATION OF WOMEN IN HIGH SKILLED, DIGITALLY DELIVERED SERVICES IN APEC AND CURRENT CHALLENGES

Section I. Economic Gender Equality Gaps

KEY TAKEAWAYS

- **Gender Equality Gaps Limit APEC's Economic Potential.** The underutilization of women in economic, social, and political roles results in significant economic losses for APEC economies, estimated at USD 17 trillion. Closing these gaps is essential for strengthening economic performance, resilience and agility.
- **Progress Toward Gender Parity is Too Slow.** While APEC has made progress, reducing the gender gap by only 5.7 percentage points since 2006 is insufficient. At the current pace, achieving full parity will take another 84 years.
- **Gender Disparities in Economic Participation and Opportunity Persist.** Women face disparities in labor force participation, wage levels, and representation in senior decision-making roles. Structural barriers, limited career advancement opportunities, and wage inequality across sectors, including high-skill services drive these gaps.
- **Wide Disparities Exist Across APEC Economies.** Progress is uneven, with economies like New Zealand approaching parity, while others, such as Japan, lag. This variation slows overall regional progress and requires targeted policy responses in falling behind economies

1. Framing the issue

APEC economies have registered solid economic performance over the last decade, despite the shocks brought about by the COVID-19 pandemic. In 2023, the real GDP per capita for the APEC region grew by 3 percent.³ Still, this performance could have been even stronger if APEC economies had achieved gender parity. As estimated by McKinsey & Co (2015) and the APEC PSU (2024), the underutilization of women as economic, social, and political resources resulted in significant economic losses for APEC economies, quantified at USD 17 trillion.⁴

³ APEC PSU, 2024, APEC in Charts 2024, https://www.apec.org/docs/default-source/publications/2024/11/224_psu_apec-in-chart-2024.pdf?sfvrsn=1699dc13_1. Furthermore, the estimates for 2024 and further indicate slowing down of this growth- see more in <https://www.apec.org/publications/2024/11/apec-regional-trends-analysis--november-2024>

⁴ Cf. McKinsey report (<https://www.mckinsey.com/mgi/overview/in-the-news/the-economic-benefits-of-gender-parity>)- Closing the global participation gap alone will deliver USD 28 trillion in GDP annually. This equates to USD 17 trillion in the Asia-Pacific. We are leaving USD 46 billion on the table every day in lost productivity. APEC's Crucial Role in Championing Gender Equity in the Asia-Pacific; By Chantelle Stratford PSM, Arequipa, Peru | 16 May 2024

Given the increasingly complex international environment for growth and development, it is crucial to maximize efforts in addressing challenges that are largely within domestic influence and control—such as economic gender inequality. **This project focuses on identifying strategies to better utilize the opportunities presented by the digitalization of high skill services to enhance the participation of and benefits for women as service providers.**

The rationale for this focus stems from empirical evidence highlighting the dynamism of sectoral growth of digitally delivered services (DDS) in APEC economies, particularly as a response to the transformative changes driven by digital technology. Digitally delivered services, particularly those requiring high-level skills, are a crucial avenue for harnessing women’s potential in the workforce, given their pivotal role in shaping evolving economic structures and driving technological progress.

The scope of this research is framed by several dimensions of the current gaps in economic gender equality. It is further informed by an understanding of the estimated time required to achieve gender parity, particularly in high skill, digitized service sectors. Addressing these gaps effectively could accelerate progress towards gender equality while bolstering the overall economic resilience and inclusivity of APEC economies.

2. Focusing on the economic dimension of gender equality gaps

It is useful to begin by defining the key terms and concepts that will underpin the analysis in this study of existing gender equality gaps, both in APEC economies and globally. This approach ensures a common understanding of the metrics and issues involved. This section draws content from the WEF Global Gender Index Reports and ILO statistics and covers as many individual APEC economies as are available in these sources.

While there are numerous indicators and measures of gender inequality, spanning social, economic, and political dimensions, this analysis focuses specifically on those reflecting the economic status of women in APEC economies.

When discussing **economic equality, it is crucial to consider gender inequalities in both access to and utilization of economic opportunities.** Therefore, we track and compare several indicators, including disparities in access to job opportunities (such as labor market participation), employment in selected sectors, career advancement, and decision-making roles in public and private sectors.

Additionally, another important insight into gender inequality comes from examining gender wage gaps. This dimension of the overall gender inequality is incorporated in the key metrics used in the study to track inequality in economic opportunities for women— the Gender Global Gap Index (see more in the next subsection).

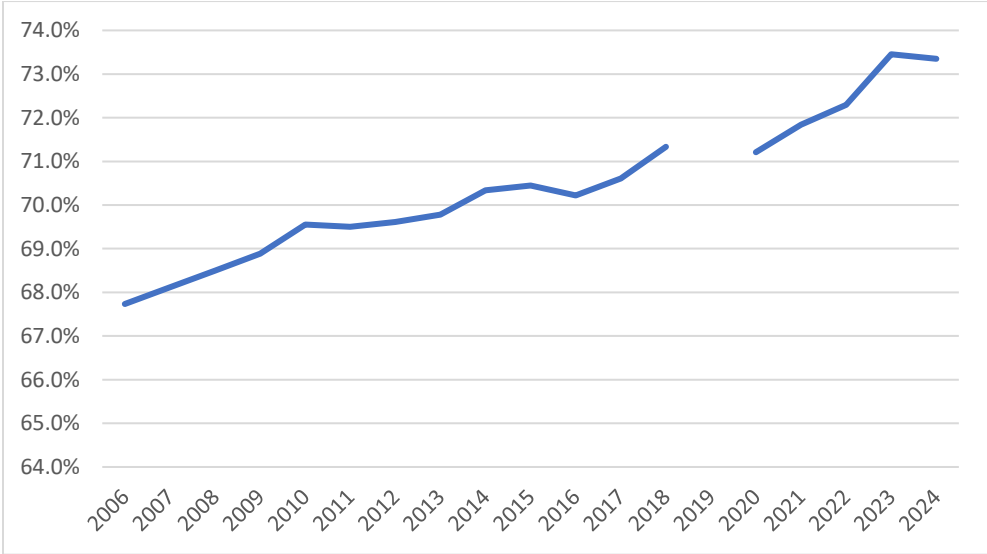
A complementary dimension of monitoring gender economic inequality involves estimates of the time required to close the current economic gender gaps. The WEF Global Gender Gap 2024

Report⁵ underscores the sobering reality that generations may still be needed to fully eliminate the current gender gap. These projections serve as a call to action, reinforcing the urgency of addressing gender inequalities in the economic domain.

3. Data tell the story

Let us start with the trends in the global gender gap index across APEC economies (Figure I.1) as presented in the 2024 Report.

Figure I.1: Global Gender Gap Index for APEC, 2006 – 2024



Note: 100%=gender parity, 0%=maximum gender disparity; no data for 2019
Source: Data extracted from [WEF Global Gender Gap Report | Download Dataset](#) (downloaded January 2025).

To assist in following the story told by the data, it is helpful to be reminded of the three concepts underlying the Global Gender Gap index:

- the index focuses on measuring gaps rather than levels;
- it captures gaps in outcome variables rather than gaps in input variables; and
- it ranks economies according to gender equality and not women’s empowerment.⁶

The Global Gender Gap Index for APEC shown in Figure I.1 is constructed as a simple average of the indices for all those APEC economies with available data, ignoring some significant

⁵ World Economic Forum. (2024). [Global Gender Gap Report 2024](#)

⁶ For more details on these distinguishing features, see the Global Gender Gap Index 2024, World Economic Forum, Appendix B, p. 64-65.

variations between individual APEC economies⁷ It is notable that APEC as a group has progressed significantly towards closing this gender gap, but as of 2024 a 26.65 percent gap to parity still exists (compared to a 32.3 percent gap in 2006). The gap closed in 18 years was less than 6 percentage points (5.7 to be exact). This means that in order to close the remaining gap of 26.65 percentage points for the APEC region, it will take **another 84 years under a ‘business as usual’ model**. While this is roughly three generations beyond the 2030 Sustainable Development Goal target for gender parity, it is relatively better than the prospect at the global level, which will require 134 years to reach full parity.

However, given the dispersion of scores among individual economies in APEC,⁸ some economies are much further than others from reaching this target in three generations. For example, New Zealand has achieved the highest score in the APEC region, with a 2024 gender gap score of 84 percent, indicating significant progress toward parity. In contrast, Japan, with a score of 66 percent, lags behind other economies, reflecting persistent structural barriers to gender equality. Moreover, eight out of 19 economies with data for 2024 score less than the APEC average of 73.3 percent. This highlights the need for heightened awareness and targeted policy responses in those economies lagging behind. Otherwise, such economies may continue to face prolonged disparities in achieving gender parity, pulling the region’s progress downward and impacting its growth potential.

The Global Gender Gap Index,⁹ which benchmarks the current state and annual evolution of gender parity combines four key dimensions

- Economic participation and opportunity
- Educational attainment
- Health and survival, and
- Political empowerment

These four sub-indices are divided into components which are constructed from a total of 14 indicators. Table I.1 provides details on the composition of each of the sub-indices.

⁷ The WEF data does not include Hong Kong, China and Chinese Taipei. Data are not available for Brunei Darussalam for 2006 and 2007, Papua New Guinea for 2006-2028 and from 2022 onwards, and for the Russian Federation from 2022 onwards.

⁸ Please see Part I – Appendix 1 for more details on the Global Gender Gap Index for each APEC economy individually.

⁹ The WEF Global Gender Gap Report that publishes this information states that it is the longest-standing index tracking the progress of major economies’ efforts towards closing these gaps over time since its inception in 2006. See [WEF Global Gender Gap Report 2024](#)

Table I.1 Composition of Four Sub-indices in the Global Gender Gap Index

Sub-index	Components	Description/Measure
Economic participation and opportunity	The participation gap	The difference between women and men in labor-force participation rates.
	The remuneration gap	The ratio of estimated female-to-male earned income Wage equality for similar work (an indicator gathered through the WEF's annual Executive Opinion Survey).
	The advancement gap	The ratio of women to men among legislators, senior officials and managers The ratio of women to men among technical and professional workers
Educational attainment	The education enrolment gap	The ratios of women to men in: i) primary-, ii) secondary- and iii) tertiary-level education
	The literacy gap	The ratio of women's literacy rate to men's literacy rate
Health and survival	The sex ratio at birth	Sex ratio at birth (aims specifically to capture the phenomenon of "missing women" prevalent in places with a strong son preference)
	The gap between women's and men's healthy life expectancy.	Estimates of the number of years that women and men can expect to live in good health by accounting for the years lost to violence, disease, malnutrition and other factors.
Political empowerment	The gap between men and women at the highest level of political decision-making	The ratio of women to men in ministerial positions The ratio of women to men in parliamentary positions. The ratio of women to men in terms of years in executive office (prime minister or president) for the last 50 years.

Source: Global Gender Gap Index 2024, World Economic Forum, Appendix B, Table B1, p.64-65.

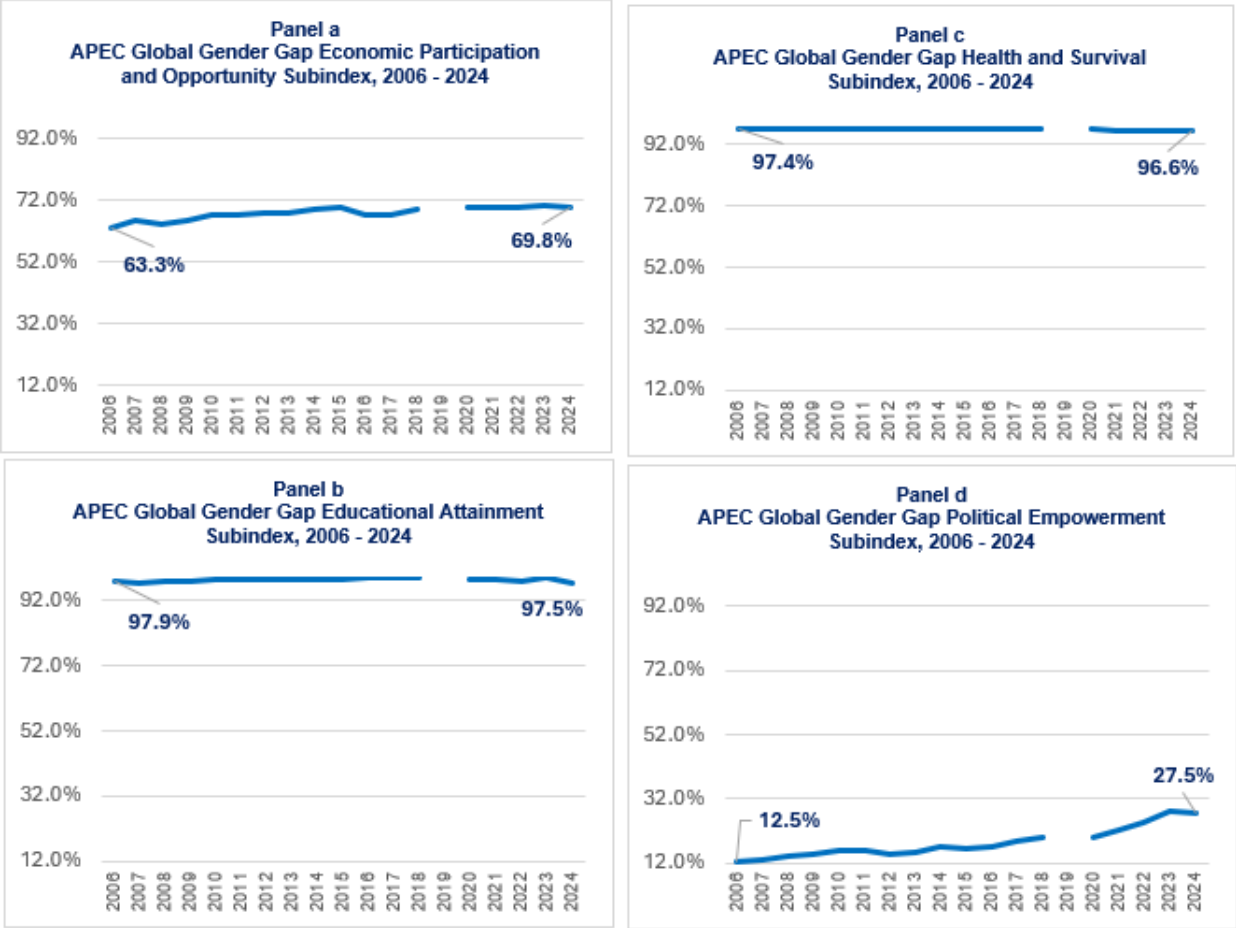
The status in each of these sub-indices as an average for APEC as a whole is shown in Figure I.2 (Panels a-d). Understanding the trends in the evolution of these sub-indices offers insights into what drives the overall gender gap score.¹⁰

The APEC region on average outperforms global results in each one of the sub-indices. The region's score for educational attainment and health and survival gender parity both stand close to parity, reflecting remarkable achievements in the region in both areas. However, both suffered a small dip in the recent years holding the progress towards the full parity. This is more pronounced in health and survival, as the pandemic period caused the sub-index for health and survival to move in an opposite direction since 2020 reflecting a disproportionate health burden in last three years on women.

¹⁰ Please see Part I – Appendix 2 for more details on the Global Gender Gap Subindexes for APEC, for the years from 2006 to 2022.

A considerable difference is noted for the economic participation and opportunity subindex (the focus of this study), which shows the APEC region at 69.8 percent of parity only, indicating slow progress with a reduction of the gap of only seven percentage points since the start of the monitoring in 2006. The Part I- Appendix 1 (Table 2) reveals significant disparities between APEC economies in labor-force participation rates and workforce representation, which underlie this regional score. Lastly, the political empowerment score is the subindex that has improved the most overall in APEC since 2006 (an increase of 15 percentage points), although its 2024 level of 27.5 percent is still very low and a far cry from parity.

Figure I.2: The State of Gender Gaps in APEC, by Sub-indices (2006-2024)



Source: Data extracted from [WEF Global Gender Gap Report 2024](#) | [Download Dataset \(extracted October 2024\)](#)

As noted above, the economic participation and opportunity gap which is our focus in this study is based on three underlying gaps – participation in the workforce, remuneration and advancement. While full details on the progress of individual APEC economies can be found in the WEF 2024 Report (economy profiles), we would like to draw attention to these three drivers of economic inequality by drawing upon some additional / complementary data.

With respect to the labor force participation gap, Figure I.3 based on ILO statistics, indicates an upward trend in female to male labor force participation rate in APEC.¹¹ This ratio increased steadily from 76.3 percent to 78.8 percent in all years over the decade except for 2020 when APEC economies experienced the pandemic shock and a temporary dip of female-to-male participation, reflected in both the economic participation and opportunity sub-index and the overall score.

It is important to note that the COVID-19 pandemic has significantly exacerbated gender disparities in the labor market across APEC economies. Women have faced increased demands for unpaid care and domestic work, leading to declines in productivity and, in many cases, decisions to exit the workforce. This surge in unpaid responsibilities is attributed to factors such as school closures, heightened care needs for the sick and elderly, and the reduction of external support services during lockdowns. Consequently, the pandemic has widened existing gender gaps in labor force participation.

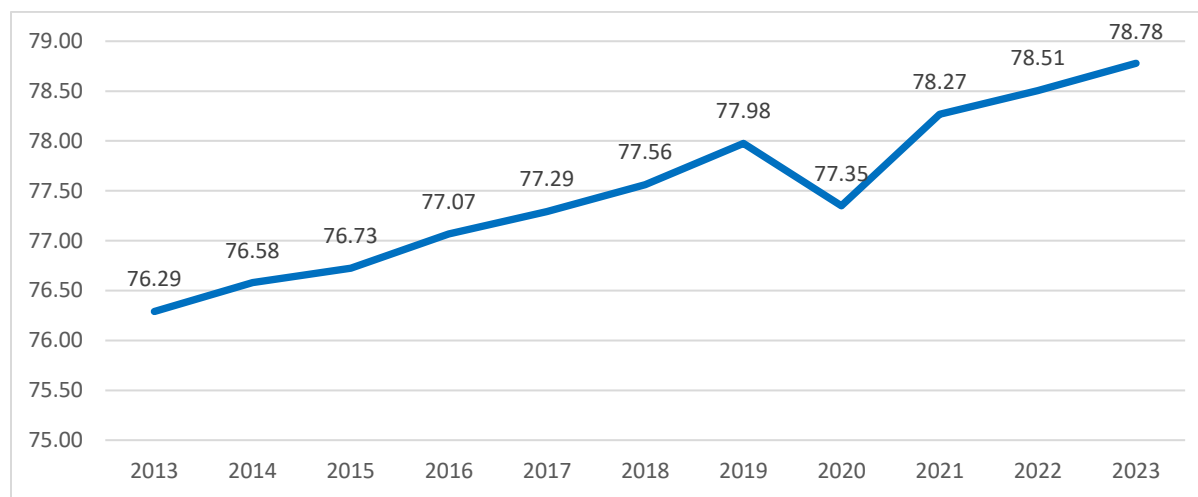
Prior to the pandemic, women in the APEC region already shouldered a disproportionate share of unpaid care work, averaging around 4 hours and 20 minutes daily—almost three times the amount undertaken by men. The onset of COVID-19 intensified this imbalance, further limiting women's opportunities for paid employment and career advancement. The compounded responsibilities have not only strained women's economic participation but also underscored the critical need for policies that address unpaid care work and promote gender equality in the labor market.¹²

Overall, the APEC region has diminished the gap in female to male labor rate participation by two and a half percentage points during the decade 2013-2023. This alignment of market participation rates and overall gender equality underscores the fact that a sustained increase in the inclusion of women in the workforce contributes positively to closing the overall gender economic equality gap.

¹¹ The ILO defines labor force participation rate as the proportion of the population ages 15 and older that is economically active: namely all people who supply labor for the production of goods and services during a specified period. The ratio of female to male labor force participation is calculated by dividing female labor force participation rate by male labor force participation rate and multiplying by 100. Closer to 100=more equality, further away from 100=greater disparity.

¹² See more in Women, COVID-19 and the Future of Work in APEC, APEC PSU, December 2020, <https://www.apec.org/publications/2020/12/women-covid-19-and-the-future-of-work-in-apec>

Figure I.3: Ratio of Female to Male Labor Force Participation Rate for APEC 2013–2023 (percentage, modelled ILO estimates)



Note: The trend of APEC ratio of female to male labor force participation rate (in percent) is constructed as an average of 20 APEC economies' participation rate, ignoring some significant variations between individual APEC economies. Please see Part I - Appendix 3 for more details on the ratio of female to male labor force participation rates for each APEC economy, from 2013 to 2023. **Source:** ILO, [Statistics on women - ILOSTAT \(downloaded October 2024\)](#)

With respect to the remuneration gap, both globally¹³ and in many APEC economies,¹⁴ women earn less than men for performing similar roles in high-skill service sectors like IT, financial, and professional services. This wage (or pay) gap often persists even after controlling for education, experience, and other factors.¹⁵

For instance, in Australia, recent data indicates that women earn approximately A\$28,425 (USD 18,590) less annually than men, reflecting a gender pay gap of 21.8%. This gap has seen a marginal decrease of 0.6 percentage points as of March 2024, partly due to wage increases in female-dominated sectors like aged care.

¹³ A 2023 report from the International Labour Organization (ILO) estimated global gender wage gaps at 20 percent, with high-skill service sectors showing smaller but still significant disparities, particularly in leadership and senior roles.

¹⁴ The 2022 APEC Women and the Economy Dashboard highlighted that, on average, women earn 15–20 percent less than men in the digital sector across the region. Economies like Japan, Republic of Korea, and China report some of the largest gaps, while Australia and New Zealand show smaller disparities.

¹⁵ The remaining gap in wages between men and women is mostly driven by cultural biases and norms. Data show that the key contributors to the gender wage gaps are 1) concentration of women in lower-paying jobs, and 2) underrepresentation in leadership position. Women are overrepresented in lower-paying, less specialized roles within high-skill services (e.g., administrative support in IT or customer relations in tech), while men dominate higher-paying, specialized roles (e.g., software engineering or data science). Likewise, women are underrepresented in senior or executive positions across high-skill service sectors, further exacerbating the wage gap since leadership roles often command significantly higher pay. (cf. Enhancing Women's Economic Empowerment in APEC through Greater Participation in High skill Digitally Delivered Services, Discussion Paper presented at APEC SOM3 Lima, Peru, August 2024, mimeo)

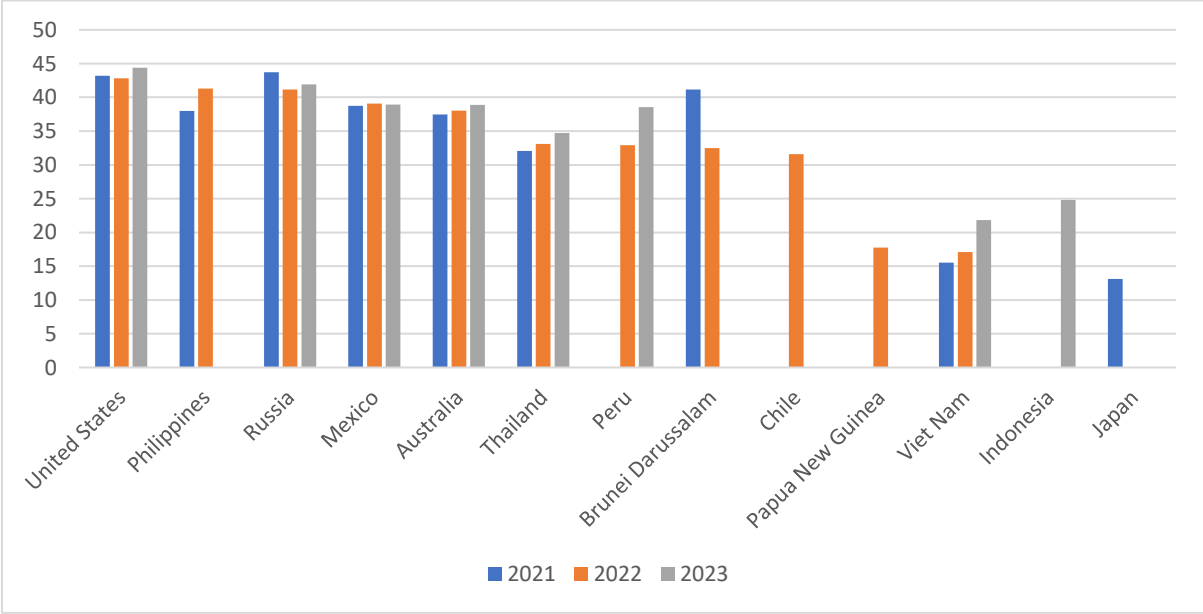
In the Republic of Korea, the gender wage gap is among the highest among the OECD economies. As of 2018, women earned about 65.4 percent of what men did on average, resulting in a wage gap of 34.6 percent. Factors contributing to this disparity include occupational segregation and a higher prevalence of part-time work among women.

Conversely, New Zealand has made notable progress in reducing its gender wage gap. In 2022, the gap stood at 10 percent a significant decrease from 16.3 percent in 1998. This improvement is attributed to various factors, including policy interventions and increased awareness of gender equality issues.

These disparities underscore the ongoing challenges within APEC economies to achieve gender pay equity. Addressing these gaps requires comprehensive strategies, including policy reforms, organizational commitment to equitable pay practices, and societal shifts towards valuing women's contributions across all sectors.

Lastly, the advancement gap indicator highlights the trend in women share of senior / managerial positions (relative to men) in the private sector. Figure I.4 provides the latest data for 13 APEC economies which collect these statistics (the fact that many economies do not have this information speaks for itself). This gap in all APEC economies shown in the figure is significant, with none of the economies reaching even a 50 percent ratio and for several showing this ratio at 25 percent or below. Clearly this gap impacts negatively the overall economic opportunity gap.

Figure I.4. Women’s Share of Employment in Senior and Middle Management in APEC (2021-2023, in percent)



Source: Data extracted from World Bank Group, Gender Data Portal | [Download Dataset](#)

The findings on gender equality gaps discussed above reflect the status across all the activities of formal economies. We investigate the impact of employment in services on the status of gender inequality and women’s economic empowerment in greater detail subsequently in section III of this study. We will see that many services sectors, and especially digitally delivered services, provide better access to work for women with potentially higher remuneration, but there are still systemic and policy barriers that prevent women from exploiting the full potential benefits from employment in DDS.

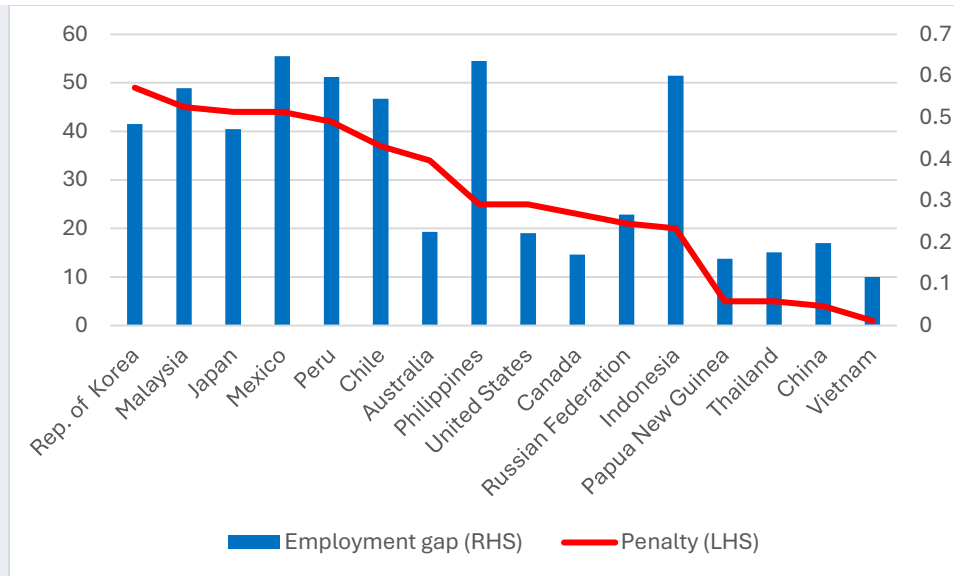
Box I.1: Child Penalty and Economic Opportunities for Women

The connection between the **child penalty** and the employment gender gap in selected APEC economies highlights how parenthood influences gender disparities in labor markets. As shown in Kleven et al. research (2024), the child penalty is the differential impact of having a first child on the employment of mothers relative to fathers. The child penalty contributes significantly to persistent gender gaps in employment and earnings, as well as to slower and lower career advancements, even in regions with relatively high gender equality.

The data from *The Child Penalty Atlas* (Kleven et al., 2024) is extracted for 17 APEC economies covered in the Atlas to show how much childbirth decreases mothers' employment probability compared to fathers.¹⁶ For example if the child penalty is 20 percent it means that women’s employment fell 20 percent behind men’s employment after having children (in contrast, a child penalty of 0 percent would imply that there is perfect equality in how men’s and women’s employment are affected by the arrival of a child).

Figure I.5 Child Penalty and Employment Gender Equality Gaps in APEC

¹⁶ See the details on methodology and the data for all 134 economies covered in the atlas at <https://childpenaltyatlas.org>. Using a pseudo-event study approach, the Atlas captures the effect of parenthood even in contexts without longitudinal data, making it particularly relevant for various APEC economies. The methodology controls for the effects of age and year, to remove potential confounding factors influencing women’s and men’s employment.



Source: The Child Penalty Atlas, 2024, accessed February 2025 (<https://childpenaltyatlas.org/>)

Figure I.5 reveals that child penalties vary across the region and in most cases is directly linked to women lagging behind in labor market participation. The linkages reflect differing cultural norms, policy environments, and labor market structures. For example:

- **High child penalties** are observed in economies (Republic of Korea, Japan) where traditional gender roles persist, and access to family-friendly policies (such as paid parental leave and childcare support) is limited.¹⁷
- **Lower penalties** are often found in economies with stronger labor market policies aimed at reconciling work and family life, including flexible working arrangements and incentives for paternal involvement.

The relationship is also driven by economic development levels. In low-income economies, the employment gender gap may be more related to structural barriers, such as limited access to formal jobs or education. As APEC economies grow and industrialize, child penalties become a more dominant factor in explaining the gender gap, particularly in middle-income economies where women face challenges in balancing family and professional responsibilities.

In conclusion, addressing the child penalty through targeted policies—like affordable childcare, parental leave, and gender-sensitive workplace regulations—can be critical in narrowing the

¹⁷ For more sources on these linkages see, for example, Jayachandran, S. (2021). "Social norms as a barrier to women's employment in developing countries." *IMF Economic Review*, 69(3), 576-595; Das, S. and Kotikula, A. (2019). "Gender-based employment segregation: Understanding causes and policy interventions." World Bank; OECD (2022). "Parental leave systems and their impact on gender equality." OECD Publishing; APEC Policy Support Unit (2021). "Women in the economy: Barriers and opportunities for greater participation"; Kleven, H., Landais, C., Posch, J., Steinhauer, A., & Zweimüller, J. (2019). "Child Penalties across Countries: Evidence and Explanations." *AEA Papers and Proceedings*, 109, 122–126.

employment gender gap across APEC. The Atlas's findings underscore the need for tailored policy solutions, as the magnitude of the penalty depends on both socioeconomic and cultural factors.

Source for the BOX: Based on Kleven et al. (2024) "The importance of parenthood for gender inequality around the world" VoxDev, available at <https://voxdev.org/topic/labour-markets/importance-parenthood-gender-inequality-around-world> and other references cited above.

Section II. Growth of Trade in Digitally Delivered Services

KEY TAKEAWAYS

- **All digitally delivered trade is a service, and only services can be delivered digitally.**
- **Digitally delivered services (DDS)** are the **fastest growing** component of international trade and of trade within APEC (growing at more than double the rate of trade in goods and trade in other services), showing a much faster inflection point as of 2016.
- The **services sectors** that demonstrate the **greatest digital intensity** (i.e. those with the largest digital component) in the APEC region are **ICT services** (29 percent), **financial services** (21 per cent), and **professional services** (15 percent). These three sectors, together with computer services, constituted over three-fourths (77.7 percent) of total DDS exports worldwide in 2023.
- These are also the services that have shown the **greatest dynamism in trade** in APEC and have thus been selected as the focus sectors of this study.
- Any exploration of ways to reduce the gender gap around economic empowerment must focus on enhancing the ability of **women to participate more** in both absolute and relative terms in these dynamic digitally delivered services sectors.

There are three reasons why we focus on a subset of digitally delivered services (DDS) in this project on women's economic empowerment. First, DDS in totality are the fastest growing component of international trade, as well as trade within the APEC region. Second, as discussed in Section I, DDS are assumed to be those services that require the highest skill levels to provide, which applies to women as well as men.. Third, the selected sectors of DDS are those that feature prominently in discussion on the economic empowerment of women due to their economic importance and dynamism.

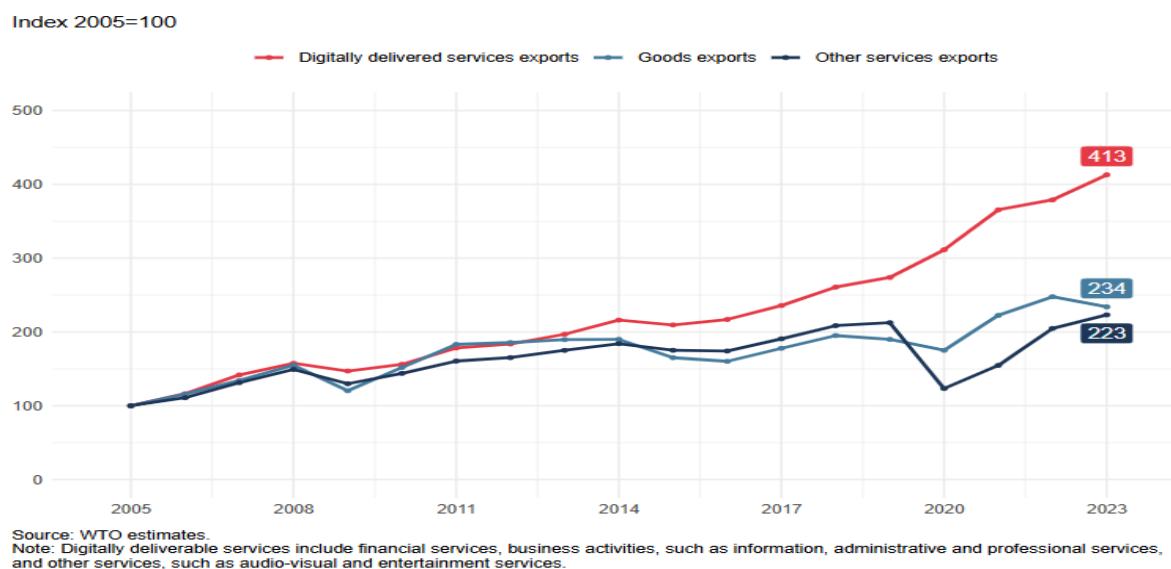
Any exploration of ways to reduce the gender gap around economic empowerment must focus on enhancing the ability of women to participate more in both absolute and relative terms in the economy and especially in the dynamic and high skill digitally delivered services sectors. This section will provide more background on the first and third of the above reasons by presenting statistical evidence of the increased digitalization of services and the recent growth in digitally delivered services exports and imports in APEC. In particular, it will highlight the dynamism of the growth in certain services categories, which are selected as the sectors of focus for Part II of this study. The skills required for these digitally intensive and fastest growing DDS sectors will be discussed in Section IV that examines training, education and women.

1. Dynamic growth of digitally delivered services

Digitally delivered services exports have experienced a rapid expansion, particularly since 2016. As shown in Figure II.1, the growth of global DDS exports was nearly double that of both goods exports and other services exports in 2023.

According to the WTO, digitally delivered services have experienced a fourfold increase in value since 2005, with the value of global exports of digitally delivered services reaching US \$3.82 trillion. This was due to the rapid average annual growth rate of 8.2 percent over the period 2005-2023. This growth rate has outpaced that of goods exports (5.6 percent) and of other services exports (4.2 percent). Digitally delivered services accounted for over 54 percent of total services exports in 2023 (compared to 8 percent in 2005).¹⁸ However, the WTO notes that these trends are influenced by the period of COVID-19 when it was difficult to impossible to trade many services in person due to mobility restrictions. Therefore, the growth of digitally traded services received a tremendous boost. But digitally delivered services have continued to grow dynamically even after the COVID-19 period ended, with some regional and individual economy variations, as consumers largely changed their consumption patterns during the pandemic.

Figure II.1: Growth of Global Digitally Delivered Services Exports 2005 – 2023



¹⁸ See WTO, *Thirty Years of Trade Growth and Poverty Reduction*, Data Blog by the WTO Secretariat, April 2024, https://www.wto.org/english/blogs_e/data_blog_e/blog_dta_24apr24_e.htm See also the joint report on Digital Trade for Development, 2023, which was prepared by the staffs of the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), the United Nations Conference on Trade and Development (UNCTAD), The World Bank, and the World Trade Organization (WTO). https://www.wto.org/english/res_e/booksp_e/dtd2023_e.pdf

2. What constitutes digitally delivered services?

Though there is no agreed international definition of what constitutes digitally delivered services, there has been detailed discussion on this in the relevant economic literature. A joint effort of the IMF, OECD, WTO and UNCTAD resulted in a *Handbook* in 2023 that both defines digital trade and describes the various existing ways to measure it. The Handbook sets out this definition of digitally delivered trade:¹⁹

Digitally delivered trade, as defined in this Handbook, refers to “All international trade transactions that are delivered remotely over computer networks”.

And

“.....digitally delivered trade can involve participants from all institutional sectors, and covers deliveries made over the internet (including via mobile devices) and via private networks”.

It is important to keep in mind that the *Handbook* explicitly states that **all digitally delivered trade is a service**. It also makes explicit the understanding that only services can be delivered digitally. The Handbook emphasizes that the range of technologies relevant to digital delivery is wider than that for digital ordering; services delivered through video calls and manually typed emails, as well as voice calls, fax messages and any other digital communication devices, and through cloud networks, are included in digitally delivered trade.²⁰ It should also be kept in mind that while services are traded through four modes of supply, digital trade in services refers to mode 1 only. It is also important to note that data flows are considered to be cross-border services, as cross-border data flows refer to the transfer of information across international borders, essentially constituting a service that crosses economy-wide boundaries.

While all types of goods and services can potentially be digitally ordered, the *Handbook* specifies that all goods and some services cannot be delivered digitally. As such, certain services are the only “items” or products that are digitally deliverable. These are the services of concern to this study. The *Handbook* lists those services considered to be “digitally deliverable”, derived from the components of the Extended Balance of Payments Services Classification (EBOPS 2010). These services are reproduced in Table II.1.

¹⁹ See Chapter 4 on “Digitally Delivered Trade” in the *Handbook on Measuring Digital Trade, Second Edition*, OECD Publishing, Paris/International Monetary Fund/UNCTAD/WTO, Geneva, 2023, <https://doi.org/10.1787/ac99e6d3-en>. This definition builds upon a statistical definition of digital trade which appeared in an earlier edition of this *Handbook* and which combined the two key criteria of digital ordering and digital delivery to formalize for the first time to produce a definition of digital trade as “.....all international trade that is digitally ordered and/or digitally delivered”. See *Handbook on Measuring Digital Trade, First Edition*, prepared by OECD, WTO and IMF, 2020, <https://unstats.un.org/unsd/statcom/51st-session/documents/BG-Item3e-Handbook-on-Measuring-Digital-Trade-E.pdf>

²⁰ Ibid, page 66.

Table II.1: List of Digitally Deliverable Services (supplied cross border by Mode 1)

Insurance services
Financial services
Charges for the use of intellectual property
Telecommunications, computer and information services
Research and development services
Professional and management consulting services
Architectural, engineering, scientific and other technical services
Trade-related services
Other business services n.i.e.
Audio-visual and related services
Education services
Health services
Heritage and recreation services

Source: [Digitally delivered services trade dataset, Global Services Trade Data Hub](#)

The WTO has also developed another data base on trade in services (the *Trade in Services by Mode of Supply* or *TISMOS dataset*) with the purpose of providing statistics on services trade by all four modes of supply.²¹ Digital trade is captured through estimates and statistics on mode 1 of supplying services, which is carried out across borders. Since the other three modes of service supply are not delivered on a cross-border basis, these modes are not considered to be digitally delivered.²²

It should be clarified that as of 2022 the services categories included in the TISMOS dataset are not identical to those in the *Extended Balance of Payments Services Classification* (EBOPS 2010) list above since the TISMOS dataset provides a more disaggregated sectoral breakdown of DDS categories. The main categories in the latter are shown in Table II.2.

Table II.2: Services included in the WTO Trade in Services by Mode of Supply dataset

Business and professional services: Accounting, legal, architectural, and engineering services
Communication services: Audiovisual services, postal, courier, and telecommunications
Construction services: Construction and related services
Distribution services: Distribution services
Educational services: Educational services

²¹ See WTO Trade in Services by Mode of Supply dataset which covers over 200 economies and regions for 55 service sectors for the period 2005-2022. The dataset builds upon the WTO-EUROSTAT allocation of service sectors to the four GATS mode of supply for the purposes of international trade. The data set also includes economy survey statistical results.
https://www.wto.org/english/res_e/statis_e/gstdh_mode_supply_e.htm#:~:text=The%20Trade%20in%20Services%20by,2005%2D22%20for%2055%20sectors.

²² See discussion on the four modes of service supply in the WTO General Agreement on Trade in Services (GATS) and the chart on “Digitally delivered trade and related statistical concepts” on page 25 of the *Handbook on Measuring Digital Trade*, Second Edition, op. cit.

Energy services: Energy services
Environmental services: Environmental services
Financial services: Insurance and financial services
Health and social services: Health services
Tourism services: Tourism and business travel
Transport services: Air, land, and maritime transport; services auxiliary to all modes of transport
Other business services: Other business services, excluding trade-related services
Trade-related services: Distribution services
Maintenance and repair services: Maintenance and repair services not included elsewhere
Charges for the use of intellectual property: Charges for the use of intellectual property
Manufacturing services: Manufacturing services on physical inputs owned by others
Heritage and recreational services: Heritage and recreational services

Source: [Trade in services by mode of supply dataset, Global Services Trade Data Hub](#)

Those service sectors that are of primary interest to this study are highlighted in bold in both tables and will be discussed in further detail below, and in Part II. The charts in this section will draw upon both datasets as appropriate.

3. Digitalization of services and digitally delivered services trade in APEC

A recent APEC report estimates the extent of digitalization in the APEC region through the development of a measure of digital intensity.²³ It finds that services sectors demonstrate a higher level of digital intensity than non-service sectors and shows that these sectors have ‘digitalized’ at a faster pace between 2000 and 2020. The pace of increase in services digitalization in APEC shown in Figure II.2 was fastest in the commercial services sectors, with the digital intensity of these sectors increasing by nearly 60 percent between 2000 and 2020, compared to a 44 percent increase for non-commercial services sectors and a 12 percent increase for non-services sectors.²⁴ This greater digital intensity in the services area is primarily attributed to the high levels of digitalization in three sectors: ICT services (29 percent), financial services (21 per cent); and professional services (15 percent). All three showed the highest digital intensities of all service sectors in APEC in 2020.

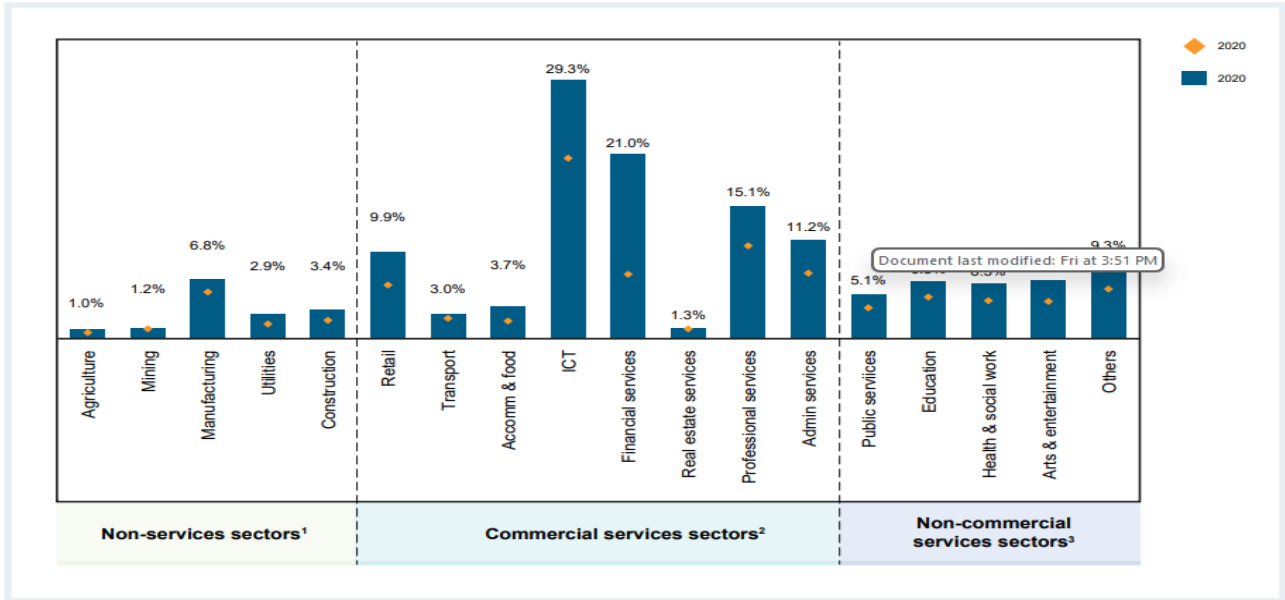
²³ *Understanding the Economic Impact of Digitalisation on Digital Trade, report for the APEC Committee on Trade and Investment*, Digital Economy Steering Group, December 2024, https://www.apec.org/ds/default-source/publications/2024/12/224_desg_understanding-the-economic-impact-of-digitalisation-on-digital-trade.pdf?sfvrsn=f4f82549_1. It should be noted that this study relies on the definition of digital trade set out in the OECD-WTO-IMF-UNCTAD Handbook on Measuring Digital Trade (Second Edition), discussed in the previous section.

²⁴ Commercial services are those services which are produced and sold on a “for-profit” basis by privately owned services providers, while non-commercial services are generally made available for the benefit of public welfare or public interest by the government or non-profit organizations and are provided at a low cost or no cost.

Figure II.2: Digital Intensity by Sectors in APEC in 2000 and 2020 (percentage)

Across the APEC economies, the ICT, financial services and professional services sectors had the highest digital intensity in 2020

Digital intensity by sectors in 2000 and 2020, %



Notes:

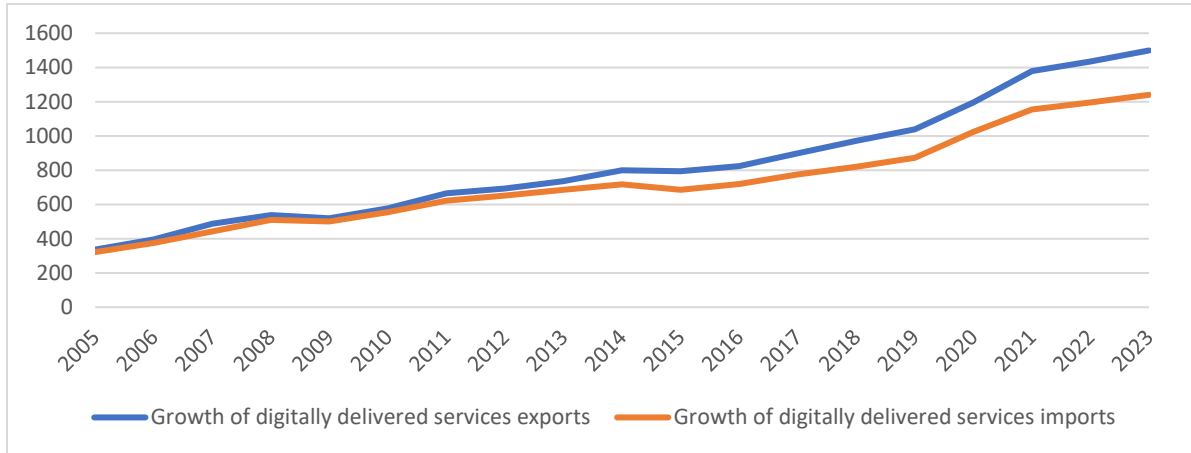
1. Non-services sectors include agriculture, forestry and fishing (ISIC 01 to 03); mining and quarrying (ISIC 05 to 09); manufacturing (sector ISIC 10 to 33); utilities (ISIC 35 to 39); and construction (ISIC 40 to 43).
2. Commercial services include distributive trade, transport, accommodation, and food services (ISIC 45 to 56); real estate services (ISIC 68); information and communication services (ISC 58 to 53); financial and insurance activities (ISIC 64 to 66); professional, scientific, and technical activities (ISIC 69 to 75); and administrative and support services (ISIC 77 to 82).
3. Non-commercial services sectors include public services (ISIC 84); education (ISIC 85); human health and social work (ISIC 86 to 88); arts, entertainment and recreation (ISIC 90 to 93); and other services activities (ISIC 94 to 96).

Source: : Access Partnership analysis, OECD Inter-Country Input-Output Database, The Conference Board

Source: Access Partnership analysis, OECD Inter-Country Input-Output Database, Figure shown as Exhibit 9 on page 20 of the report on [Understanding the Economic Impact of Digitalisation on Digital Trade](#)

The increase in digitalization of services has been reflected in the growth of digital services trade in the APEC region as well as the world. Figure II.3 shows the growth of digitally delivered services exports and imports by APEC economies over the past nearly two decades. Although the growth of DDS has been steady since 2005 when the data were first published, the inflection point for much faster growth appeared as of 2016. The past decade has witnessed a considerable dynamism in both DDS exports and imports by APEC economies, with a nearly doubling in value. Export growth of digitally delivered services has slightly outpaced that of import growth.

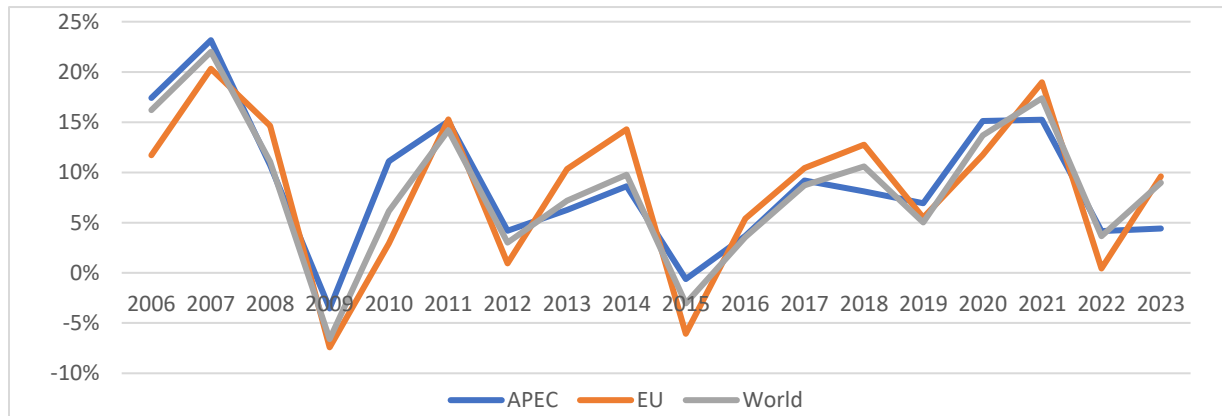
Figure II.3: Growth of APEC Exports and Imports of Digitally Delivered Services 2005 - 2023 to and from World (in US dollar billions)



Source: Data from WTO [Digitally delivered services trade dataset, Global Services Trade Data Hub](#)

Examining the growth rates for digitally delivered services exports in APEC in a global context of the past nearly three decades, Figure II.4 shows that the growth trajectory for the APEC region for digitally delivered services exports has closely tracked that of both the European Union (a very dynamic region for DDS output and trade) and the world economy. This is to be expected, as many of the most important commercial services exporters in the world economy are members of the APEC group.²⁵

Figure II.4: Growth of Digitally Delivered Services Exports for APEC, the European Union and the World (percentage) 2005 – 2023

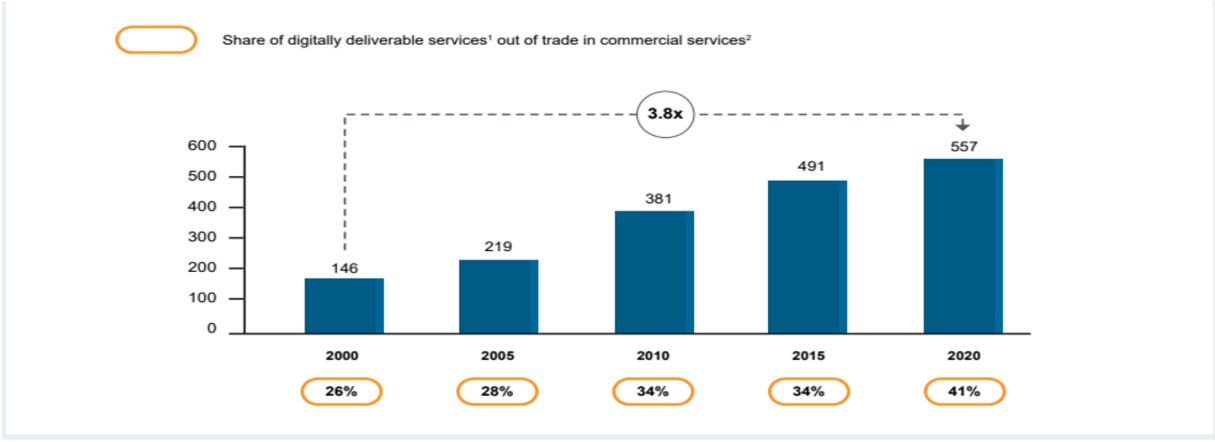


Source: Data WTO [Digitally delivered services trade dataset, Global Services Trade Data Hub](#)

²⁵ Among the top 20 commercial services exporters in the world are seven APEC economies (in order of export value), namely the United States; Singapore; Peoples Republic of China; Japan; Republic of Korea; Canada; and Hong Kong, China. See WTO Digitally delivered services trade dataset, https://www.wto.org/english/res_e/statis_e/gstdh_digital_services_e.htm

Digitally delivered services trade has been growing sharply in APEC as a share of trade in commercial services. Using the definition in the OECD-WTO-IMF-UNCTAD *Handbook on Measuring Digital Trade* (Second Edition), the recent APEC DESG report estimates that trade in DDS more than tripled in value between 2000 and 2020 in the APEC region. As a share of total trade in commercial services – which includes both digitally deliverable services and services that are not digitally deliverable, – trade in digitally deliverable services grew sharply from 26 percent to 41 percent in the same period, as shown in Figure II.5.

Figure II.5: Increased Importance of Trade in Digitally Delivered Services in APEC as a Share of Trade in Commercial Services (2000 – 2020, US Dollars Billion)



Notes:

1. Digitally deliverable services include publishing, audio-visual, and broadcasting activities (ISIC 58 to 60); telecommunications services (ISIC 61); IT and other information services; (ISIC 62 to 63); financial and insurance activities (ISIC 64 to 66); professional, scientific, and technical activities (ISIC 69 to 75); and administrative and support services (ISIC 77 to 82). Trade data includes all bilateral digital trade within 20 APEC economies (excluding Papua New Guinea due to lack of data).
2. Commercial services include distributive trade, transport, accommodation and food services (ISIC 45 to 56); real estate services (ISIC 68), and digitally deliverable services as defined below. Trade data includes all bilateral digital trade within 20 APEC economies (excluding Papua New Guinea).

Source: Access Partnership analysis, Trade in Value Added (TIVA) database

Source: Access Partnership analysis, OECD Inter-Country Input-Output Database, Figure shown as Exhibit 3 on page 12 of the report on [Understanding the Economic Impact of Digitalisation on Digital Trade](#)

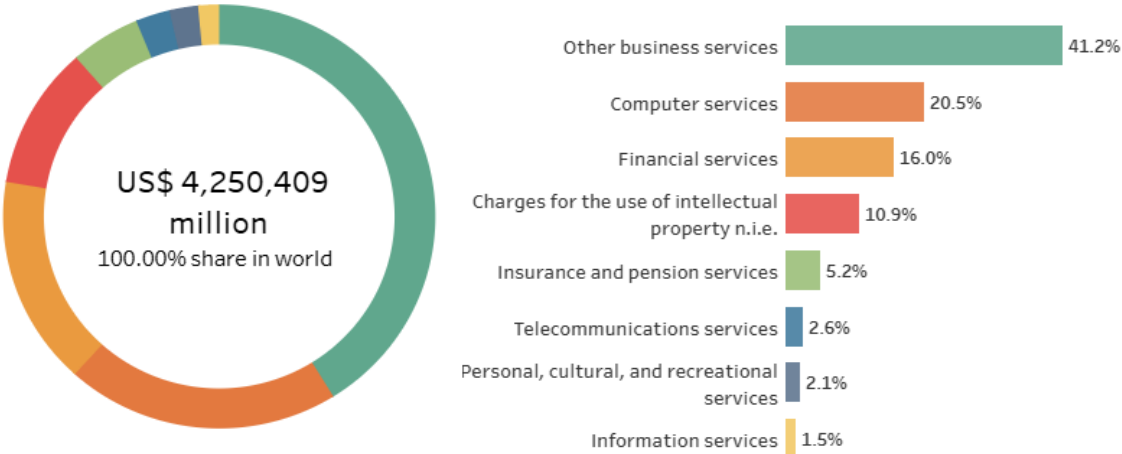
4. Most important sectors for DDS trade in world economy and in APEC

The main services sectors that were digitally traded in the world economy in 2023 are shown in Figure II. 6. The most prominent sector by far is the category of business services (which in the WTO Global Services Trade Data Hub dataset includes the professional services categories). Together with the other two important categories of computer services, and financial services, these three key sectors constituted the large majority or over three-fourths (77.7 percent) of total digitally delivered services exports worldwide in 2023.²⁶ The importance of the other commercial services exports in the world economy was considerably smaller, at five percent or less (for

²⁶ These figures are also cited in the report on Digital Trade for Development, 2023, op.cit.

insurance services, telecommunication services, personal, cultural and recreational services, and information services).

Figure II.6: Structure of Digitally Delivered Services Exports in the World Economy, 2023



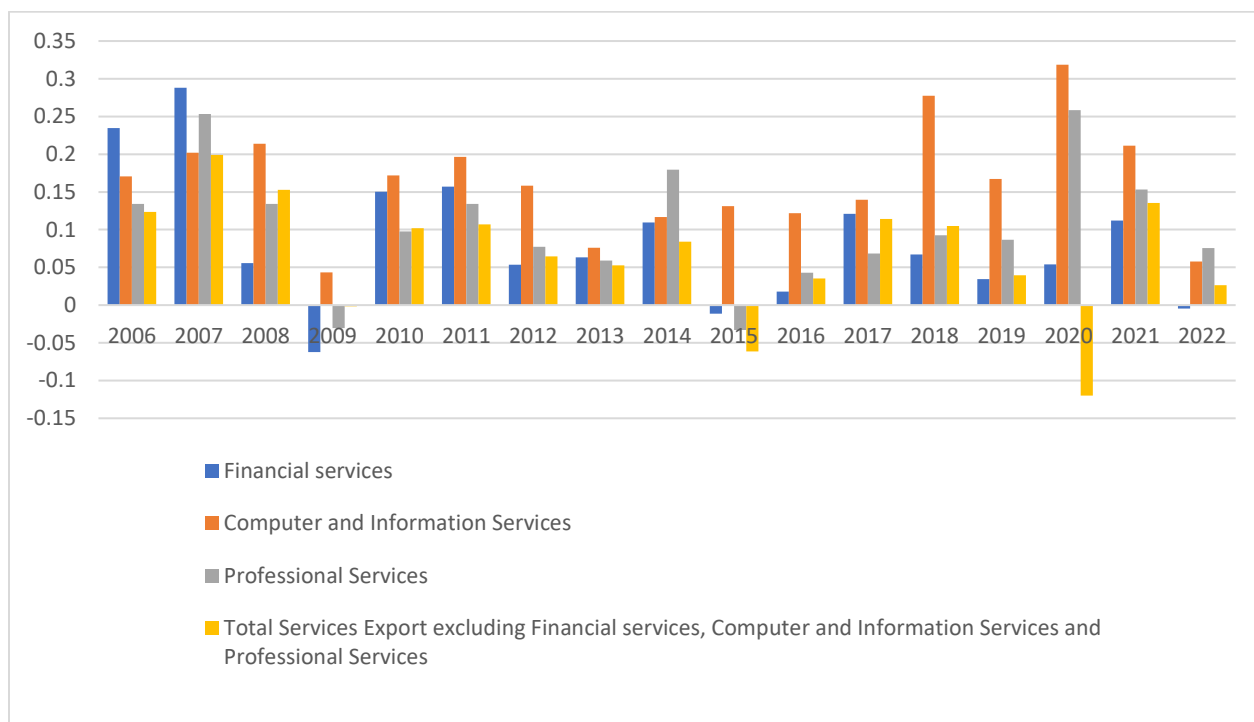
source: WTO estimates

Note: The sector composition of the three most important categories is the following: Computer and Information Services include computer services and information services. Financial services include insurance services and financial services. Professional services include advertising, market research, public opinion polling; architectural engineering, scientific and other technical services; legal, accounting, management, consulting and public relations; professional and management consulting services; and technical, trade-related, and other business services.

Source: WTO, [Digitally delivered services trade dataset, Global Services Trade Data Hub](#)

These same three sectors have shown the greatest trade dynamism in APEC as well over the past two decades. Examining the growth of DDS trade in these three areas using data extracted from the WTO trade in services by mode of supply dataset (TISMOS) for 21 APEC economies gives the results shown in Figure II.7. The financial services, computer and information services, and professional services sectors showed a faster annual rate of export growth on a cross-border basis (mode 1) in all but a few years during the period in question 2006-2022, when compared with the annual rates of growth for exports of the remaining services sectors. The dynamism of these three DDS sectors has thus been striking, particularly that of computer and information services, when compared with the growth rates of other services sectors over these 17 years. Professional services also showed very dynamic annual growth in several of these years, while the performance of financial services fluctuated more widely.

Figure II.7: Annual Percentage Changes in Cross-Border Services Exports (Mode 1) in APEC for the Three Focus Sectors (Financial Services, Computer and Information Services and Professional Services), 2006-2022



Source: Data from WTO [Trade in services by mode of supply dataset](#), [Global Services Trade Data Hub](#)

5. Selection of service sectors of focus for this study

For the purposes of this study, we will focus on the three main sectors of DDS services which have been shown to be both the most digitally intensive as well as the most dynamic in terms of their trade growth as compared with other services sectors, namely computer and ICT services; financial services; and professional services.²⁷ These sectors are also those characterized by a considerable degree of digital skills and can therefore be considered among those services activities requiring the most highly skilled workers, as discussed in Box IV.1 of Section IV on “skills required for digitally delivered services”. These three sectors are key for the economic empowerment of women in services trade and will be the focus for the case studies in Part II.

²⁷ It is also notable that these three sectors are often used as intermediate or inputted services into other services or into manufactured or agricultural output, thereby making them among the most “in demand” services across the economic spectrum.

Section III. Women’s employment in digitally delivered services

KEY TAKEAWAYS

- More women work in services in the APEC region than in manufacturing and agriculture combined; this proportion more than tripled between 2013 and 2022.
- The **more highly skilled jobs are those of managers, professionals, and technicians/ associate professionals (as per the ILO International Standard Classification of Occupations). These occupations most closely correspond to the high skill, digitally delivered services of focus in this study.**
- In APEC, only the **professional occupation** has shown a marked increase in the number of **women employed** between 2013 and 2023; the number of **women managers** employed in the region actually **declined**.
- According to a survey conducted among firms in APEC economies, those barriers which most hold women back from being employed in these high skill, digitally intensive and dynamic services occupations are:
 - **Skills barriers (access to IT and STEM education and training)**
 - **Cultural and attitude barriers**
 - **Finance barriers (difficulties for women to obtain access to capital)**
 - **Regulatory barriers affecting trade in digitally delivered services**

1. Introduction

This section discusses several aspects of women’s employment in digitally delivered services. The shift towards greater participation of women in the services sector over the past two decades, both worldwide and within APEC is illustrated. However, the negative impact of the COVID-19 pandemic has slowed down this trend and left numerous impacts on women’s employment, negatively affecting their ability to engage in work in the services sector in multiple ways. Limitations on data availability preclude the examination of women’s employment on a sectoral basis, but an alternative approach to examining the employment of women by occupation in higher skilled services categories in APEC is adopted, with a discussion of existing barriers and how they are impacting women’s ability to engage in these more digitally advanced areas.

2. Evolution and status of women’s employment in the world economy and in APEC

Globally, the labor force participation rate for women on average (i.e. across all sectors in the economy) is just over 50 percent compared to 80 percent for men, highlighting a significant gender gap in workforce participation which drives the gap in women’s ability to access economic

opportunities, discussed in Section I.²⁸ The World Bank points out in its Gender Data Portal that women's labor force participation in the world economy has remained fairly flat over the last three decades, and that women are less likely to work in formal employment and have fewer opportunities for starting a business or progressing to leadership roles in their career.²⁹ It also underscores that women's engagement in work brings in less remuneration than does that of men and creates a gender wage gap, as was shown in Section I and will be further discussed in Section IV. The COVID-19 pandemic years accentuated these differences and set women's participation in the work force back considerably.³⁰ It also pushed back the projected timeline for achievement of full gender equality.³¹

There are, however, considerable differences between regions in the current situation of women's employment and how it has evolved as well as between economies in different income levels.

The World Bank notes that the gender employment gap is the largest in the lower middle-income economies but decreases with an increase in levels of development and per capita income.³² For the upper middle-income and high-income economies (which encompass all but three APEC economies), the rate of women's labor force participation in these two groupings reached 61.4 percent and 67.6 percent in 2020.³³ However, within the region the picture is more nuanced.

The APEC Women and the Economy Dashboard (2023) report highlights the positive fact that APEC economies have progressively removed restrictions to encourage more women to participate in the labor market. Despite this, the report indicates that women's labor force participation in APEC has done the opposite and shown a steady decline over the past 15 years, from 59.8 percent in 2008 to 57.9 percent in 2022. Much of this decline was due to a significant drop in women's employment at the height of the COVID-19 pandemic. Since that time women's workforce engagement in the region has remained below pre-pandemic levels.³⁴

²⁸ UN Women, *Facts and figures: Economic empowerment*, <https://www.unwomen.org/en/what-we-do/economic-empowerment/facts-and-figures#:~:text=Globally%2C%20the%20gender%20gap%20in,90.6%20per%20cent%20for%20men>. Globally, the gender gap in labor force participation has hovered at 30 per cent since 1990.

²⁹ World Bank Group, Gender Data Portal, January 2022, <https://genderdata.worldbank.org/en/data-stories/flfp-data-story>.

³⁰ Sofia Sprechmann, *Covid-19 is the biggest setback to gender equality in a decade*, World Economic Forum blog, July 2020, <https://www.weforum.org/stories/2020/07/gender-equality-women-employment-covid19/>. The author notes that the overwhelming burden of unpaid work which increased during Covid-19 fell on women.

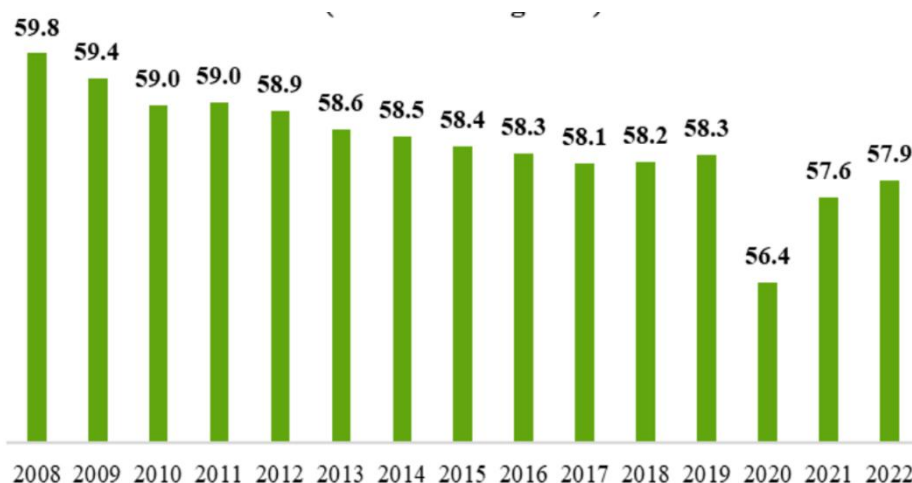
³¹ As reported in Section I, based on current data, it will take 134 years to reach full parity – roughly five generations beyond the 2030 Sustainable Development Goal (SDG) target.

³² See World Bank Group Gender Data Portal, op.cit. Note that this gender wage gap is part of the Global Gender Gap discussed in Section 1.

³³ The only APEC economies that do not fall into the upper middle- or high-income categories as of 2024 are the Philippines, PNG and Viet Nam. See World Bank country classifications by income level for 2024-2025 at <https://blogs.worldbank.org/en/opendata/world-bank-country-classifications-by-income-level-for-2024-2025>

³⁴ The APEC Women and the Economy Dashboard, Report by the APEC Policy Support Unit, Executive Summary, August 2023, https://www.apec.org/docs/default-source/publications/2023/8/223_psu_apec-women-and-the-economy-dashboard.pdf?sfvrsn=bf5084d_2

Figure III.1. APEC Women’s Labor Force Participation Rate, 2008-2022



Source: World Bank Gender Statistics and International Labor Organization (ILO)

Source: Figure Page v, in the [APEC Women and the Economy Dashboard 2023, APEC Policy Support Unit, August 2023](#)

A study by the APEC PSU provides more details of the various ways that the COVID-19 pandemic has affected women in the recent period, with detrimental impacts on their ability to improve their economic situation and thus constituting a major setback to their economic empowerment.³⁵ The pandemic increased demands for unpaid care work that drew women out of the work force (formal or informal) and obliged them to take up caretaking responsibilities instead. It adversely affected women-led MSMEs which tend to be smaller and are more likely to be informal and often could not obtain the capital required to keep afloat. These small women-led businesses are also less likely to engage in international trade.³⁶

Importantly for the focus of this study, the pandemic accelerated the adoption of new digital technologies which led to job displacement for women who were not educated in the STEM areas (science, technology, engineering and mathematics) or unable to find or pursue digital training or reskilling opportunities. In APEC, women continue to be underrepresented in the STEM fields which have become increasingly in demand in the workforce, as discussed in Section IV of this study. The APEC PSU study cautions as well that data from some APEC economies suggest that women are more likely than men to be employed in an occupation that is at high risk of automation, affecting women’s future of work.³⁷

³⁵ APEC Policy Support Unit, Women, COVID-19, and the Future of Work in APEC, Policy Brief No. 38, December 2020, https://sea-vet.net/images/seb/e-library/doc_file/841/220psuwomen-covid-19-and-the-future-of-work-pdf.pdf. The study underlined that sectors hardest hit during the COVID-19 pandemic were those that employed the largest proportion of women workers, particularly the informal sectors.

³⁶ OECD blog, Women are less engaged in trade: why and what to do about it, at <https://oecdstatistics.blog/2023/10/18/women-are-less-engaged-in-trade-why-and-what-to-do-about-it/>

³⁷ APEC Policy Support Unit, Women, COVID-19, and the Future of Work in APEC, Ibid.

3. Women’s employment in services worldwide is growing

The services sector is well known for being the largest area of the economy to employ women. A World Bank-WTO report indicates that in 2021, 59 percent of employed women globally worked in the sector, up from 44 percent in 2000.³⁸ The report emphasizes the beneficial impact for women’s economic well-being of this evolution, stating that “*services have a positive gender dimension and play an important role in women’s empowerment*”.

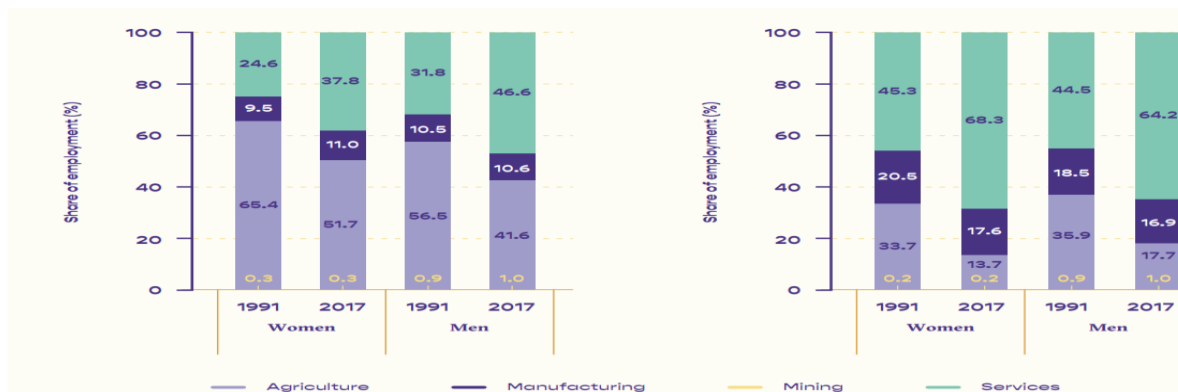
Figure III.2 shows that this shift for women into services has been experienced across all economies but has been more pronounced in the upper middle- and high-income economies as contrasted with the low- and lower-middle-income economies. More than two-thirds of women in the former were working in services in 2017, up from 45 percent in 1991, while the proportion of women in the services sector in the latter group of economies increased to 38 percent from 25 percent over this period. Male workers followed a similar but less pronounced trend in both cases. This trend is expected to continue, as several World Bank and other studies have shown a strong correlation between increased employment in the service sector and rising per capita income.

Figure III.2. Women’s Employment has Shifted into Services

2017 compared with 1991

Low and lower-middle-income economies

Upper-middle- and high-income economies



Source: International Labour Organization Department of Statistics, https://www.ilo.org/shinyapps/bulkexplorer46/?lang=en&segment=indicator&id=EMP_2EMP_SEX_ECO_NB. Note: Employment by sector based on modeled estimates from the International Labour Organization, May 2018. Construction and utilities are included as Services.

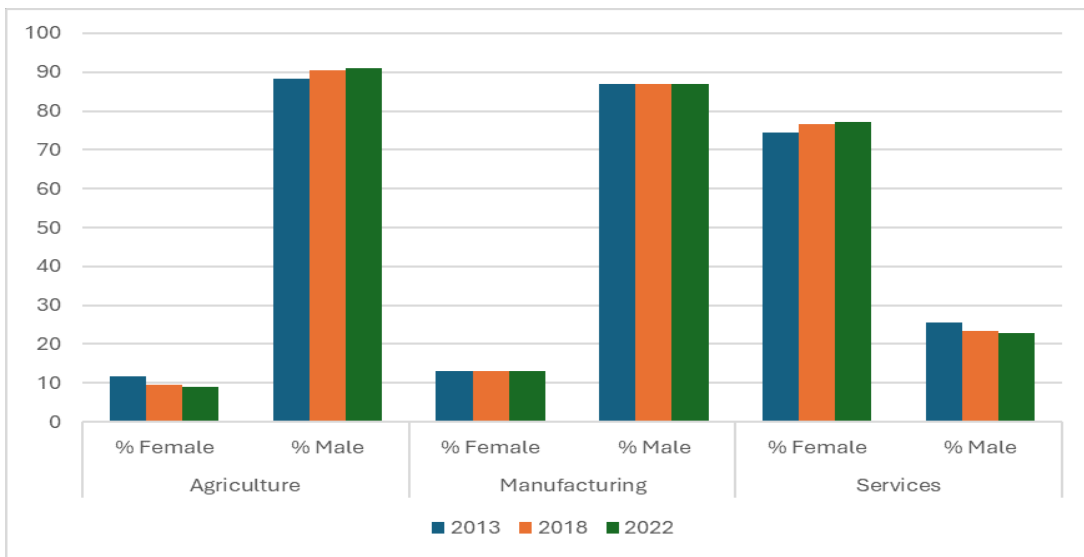
Source: Figure 0.5, page 8, in the report [Women and Trade: The Role of Trade in Promoting Gender Equality](#), a joint report by the World Bank and the World Trade Organization (WTO).

³⁸ World Bank-WTO, Women and Trade: The Role of Trade in Promoting Gender Equality, 2020, https://www.wto.org/english/res_e/booksp_e/women_trade_pub2807_e.pdf In contrast, services accounted for 45 percent of total male employment in 2021.

4. Women’s employment in services in the APEC region

In the Asia Pacific region, there are fewer women working than men in all APEC economies as discussed in Section I. The ratio of women’s to men’s labor force participation ranged from a high of 87 to a low of 57 for APEC economies over the period 2013-2023. In the services sector, however, the situation is reversed. Proportionally, more women work in services in the APEC region than in manufacturing and agriculture combined. Figure III.3 (based on ILOSTAT data) shows how the proportion of women employed in the services sector in APEC more than tripled that of men for the three years 2013, 2018 and 2022, and has been on the increase.

Figure III.3. Percentage of Women’s Compared with Men’s Employment in the Services, Manufacturing and Agricultural Sectors in APEC, 2013, 2018 and 2022



Source: ILO, [Statistics on women - ILOSTAT – \(modelled ILO estimate\)](#)

5. Women’s employment in higher skilled occupations in APEC

Ideally for this study and project, we would like to be able to show the share and evolution of women’s employment in the high skilled service sectors of focus identified in Section II, namely computer and information services, financial services, and professional services. Unfortunately, for reasons of data limitations, it is not possible to do this for all APEC economies over the period in question, as employment data are not collected on a sectoral basis by the ILO and are likewise not available in any OECD or World Bank statistical publication. The ILO publishes employment data (broken down between women and men) by list of occupations rather than by sectoral categories. Selected occupations are shown in Table III.1.

Table III.1. List of Occupations Available in the ILO dataset

Occupation (Detailed): Total
Occupation (Detailed): 1. Managers
Occupation (Detailed): 2. Professionals
Occupation (Detailed): 3. Technicians and associate professionals
Occupation (Detailed): 4. Clerical support workers
Occupation (Detailed): 5. Service and sales workers
Occupation (Detailed): 7. Craft and related trades workers
Occupation (Detailed): 8. Plant and machine operators, and assemblers

Source: ILO, [Statistics on women - ILOSTAT](#)

The occupations that are the most relevant for this study are those that require higher skills and a large digital content to provide. Fortunately, it is possible to align the above list of occupations with the skills they require by using the International Standard Classification of Occupations (ISCO-08 Framework) used by the ILO.³⁹ Table III.2 below provides information on the ILO description of skills for each of these occupational categories.

Table III.2. Skills Required for the Occupations Listed in the ILO Dataset

Occupation	Skills Required
1. Managers (ISCO-08 Group 1)	Leadership, strategic planning, decision-making, project management, financial management, organizational skills, problem-solving, communication, and team coordination.
2. Professionals (ISCO-08 Group 2)	Analytical thinking, subject-matter expertise (e.g., legal, medical, IT, engineering), research skills, critical thinking, writing and reporting, creativity, innovation, and advanced technical skills related to their discipline.
3. Technicians and Associate Professionals (ISCO-08 Group 3)	Technical knowledge, practical problem-solving, data analysis, software use (for IT-related positions), field-specific technical expertise (e.g., engineering, healthcare), operational monitoring.
4. Clerical Support Workers (ISCO-08 Group 4)	Office administration, data entry, computer proficiency (e.g., spreadsheets, word processing), customer service, record-keeping, organizational skills, communication; attention to detail.
5. Service and Sales Workers (ISCO-08 Group 5)	Customer service, sales techniques, persuasion, interpersonal skills, problem-solving, hospitality management (if relevant), adaptability, cash handling, and product knowledge.

³⁹ ILO, International Standard Classification of Occupations, <https://webapps.ilo.org/ilostat-files/ISCO/newdocs-08-2021/ISCO-08/ISCO-08%20EN%20Vol%201.pdf> ³⁹ Note that ILOSTAT data are available for all 21 APEC economies on employment by sex and the occupations shown in Table 1 and Table 2 for the period 2013 through 2023. Source: ILOSTAT Data Explorer

https://rshiny.ilo.org/dataexplorer12/?lang=en&id=EMP_2EMP_SEX_OCU_NB_A

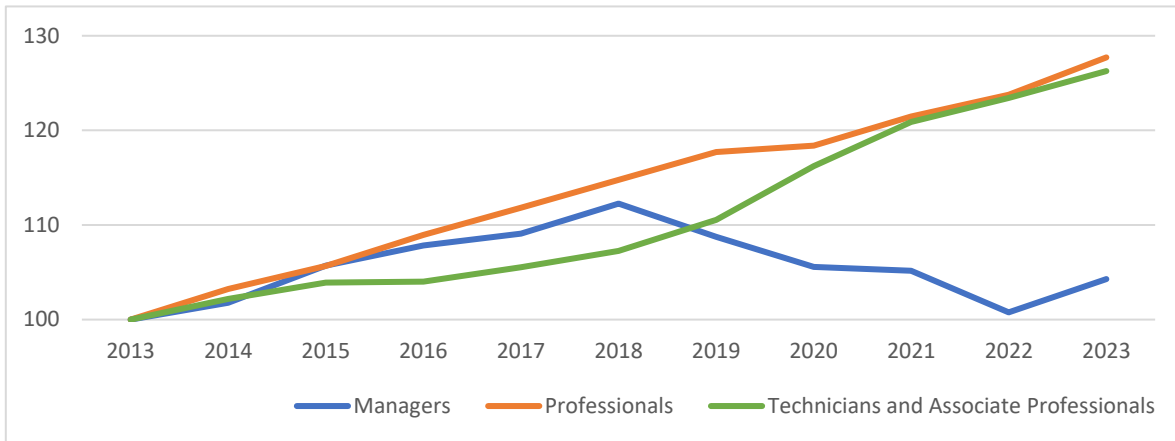
7. Craft and Related Trades Workers (ISCO-08 Group 7)	Manual dexterity, craftsmanship, trade-specific skills (e.g., construction, welding, carpentry), tool operation, blueprint reading, mechanical problem-solving, and safety compliance.
8. Plant and Machine Operators and Assemblers (ISCO-08 Group 8)	Machine operation, production process understanding, maintenance, troubleshooting, assembly techniques, mechanical knowledge, and safety awareness.

It is evident that the first three occupational categories require higher skills than the other occupations. Of relevance to digitized service activities, the ‘professional’ category requires workers to have subject-matter expertise, which includes IT skills, along with research, critical thinking, innovation, and advanced technical skills. “Technicians and associate professionals’ are required to have several skills for IT-related positions, including data analysis and software use. ‘Managers’ are expected to have leadership, strategic planning, and decision-making skills, and to understand the use of IT in problem solving and communication. The IT skills required in the other occupational categories are much less advanced. The skills required for women to work in digitally delivered high skill services are discussed in detail in Section IV of this part of the study.

In the absence of three-dimensional data on women’s employment in APEC in the digitally delivered service sectors of focus, we have opted to show what is available according to the ILO occupational categories above for the three occupations that require more highly skilled service workers, namely: Managers; Professionals; and Technicians and Associate Professionals (ISCO-08 Groups 1, 2 and 3). **These are the categories likely to encompass the high skill, digitally delivered services of focus in this study.** The figures that follow in this discussion have been developed using employment data for these three categories for the APEC economies.

Figure III.4 shows how women’s employment in the three higher-skilled occupational categories above has evolved in the APEC region during the decade 2013-2023. It is interesting to note that only the category of ‘professionals’ shows a marked increase in number of women employed in APEC. The number of women ‘technicians and associated professionals’ employed increased slightly in the region, while the number of women managers employed actually declined.

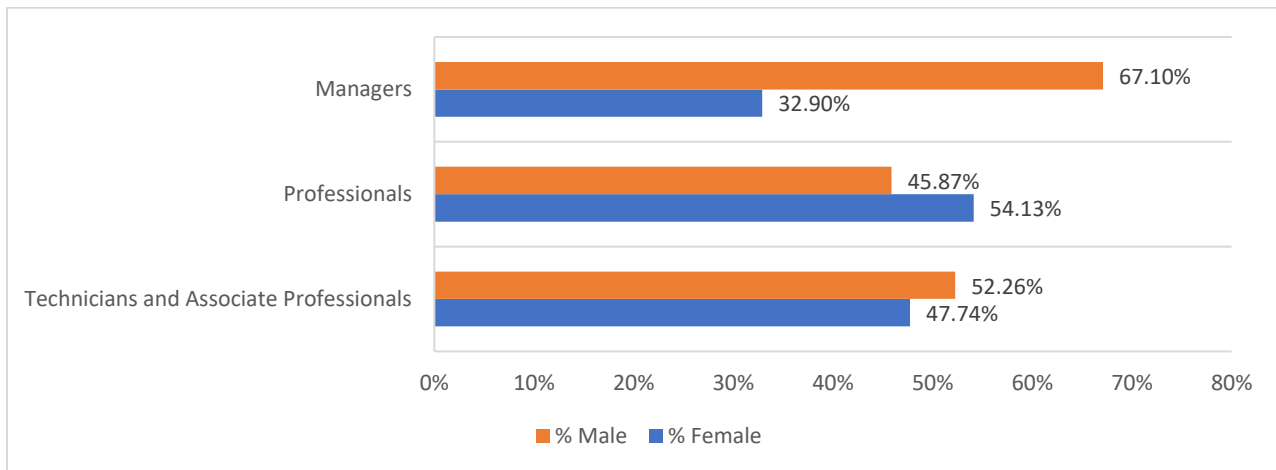
Figure III.4. Employment Trends in the Higher Skilled Occupations in APEC (2013 = index 100)



Source: [Statistics on women - ILOSTAT](#).

Figure III.5 provides a snapshot of the share of female vs. male employment for the three higher skilled occupations in 2023 for the APEC region. While women professionals constituted more than half of the work force, women managers constituted less than one-third, a stark difference between the two.

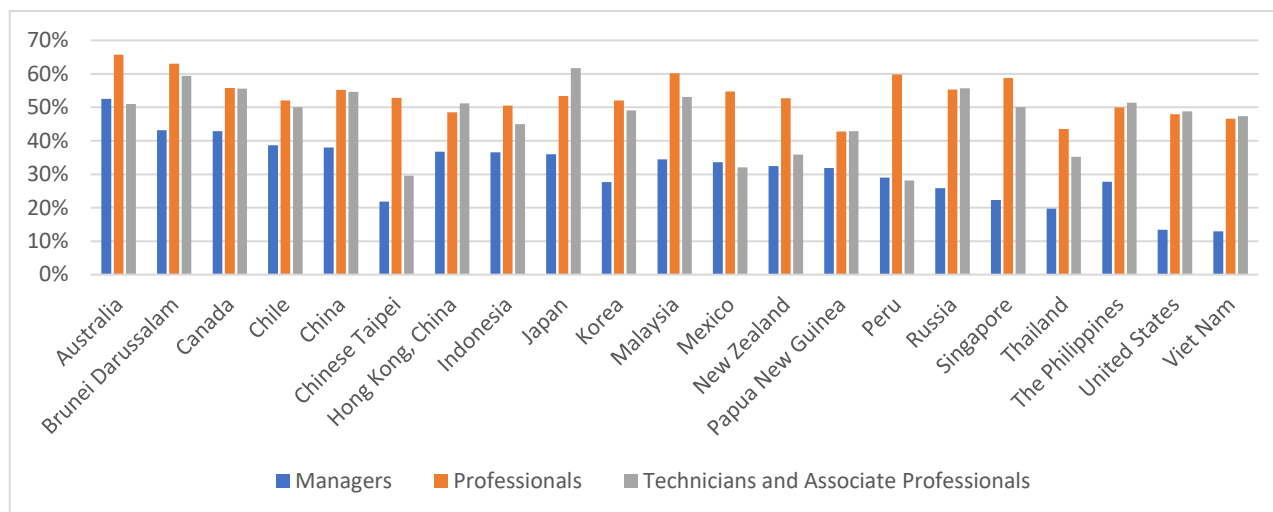
Figure III.5: Share of Women’s vs. Men’s Employment in the Higher Skilled Occupations in the APEC Region, 2023



Source: [Statistics on women - ILOSTAT](#).

Figure III.6 provides more detail on the breakdown for women’s employment in the three higher skilled occupations in each of the 21 APEC economies. While women constitute the highest percentage of professionals in more than half of the APEC region, in only two APEC economies are women managers slightly more prominent than technicians/associate professionals.

Figure III.6: Women’s Employment in APEC in the Higher Skilled Occupations, (percentages, 2013 – 2023, modeled ILO estimates)



Source: ILO, [Statistics on women - ILOSTAT](#)

Note: The data for this chart represent the average number of women employed in the three high skill occupational categories in each APEC economy between 2013 and 2023.

6. Barriers to increasing women’s employment in high skilled digitally delivered services in APEC

The earlier study carried out for the APEC Group on Services that examined *Knowledge Intensive Business Services (KIBS), Digital Services (DS) and Barriers Faced by Women in International Trade in Services* examined some of the reasons why women’s participation in the more highly skilled occupational categories above has not increased at all or only shown a moderate increase (in the case of professionals) over the previous decade.⁴⁰ The services examined by this study overlap with two service sectors that are being examined in this study.⁴¹ However, as previously noted, the approach and focus are different, as the KIBS study approached the issue from the perspective of women-owned services businesses and challenges they face related to their ability to export digital services as women-led MSMEs. But many of the same findings reached from the survey administered to firms in the APEC region can be inferred to apply to women’s employment and advancement in digitally intensive sectors, whether it be in home markets or in trade with other APEC economies.

⁴⁰ Knowledge Intensive Business Services (KIBS), Digital Services (DS) and Barriers Faced by Women in International Trade in Services, GOS 02 2022, finalized report circulated in January 2025.

⁴¹ The services included in knowledge-intensive business services (KIBS) study cited above do not appear to be clearly defined in the study, which mentions that the KIBS sectors include professional, scientific, and technological services, content development, telecommunications, information and communications technologies, along with other knowledge-intensive business services (page 15). These categories encompass two of the three digitally intensive service sectors identified as the focus of this paper, namely computer and information services, financial services, and professional services, they do not include financial services and do include other services that are broader than these three sectors.

The KIBS study conducted a survey among firms and associations or institutions representing business in APEC containing questions to identify what barriers are considered by the private sector to hold back the ability of women-led firms to participate in digital services trade. The relevant responses are summarized below as falling into four areas, under the assumption that these barriers also stifle women's employment in higher skilled services occupations in general.

a) Skills barriers (access to IT and STEM education and training)

The firms surveyed reported significant challenge in finding technologically trained workers to meet their needs. The survey findings show that factors such as technological skills and digital marketing capabilities are frequently rated as very important. For instance, 47 percent of respondents rate technological skills as very important, and 48 percent consider digital marketing capabilities as very important.⁴² This mismatch between women who are available to work in digitally intensive sectors and the demand for these workers underscores the finding in this study that women are less educated in the STEM and related fields than men (as shown in Section IV). To the extent that women lack education and training in these technological and digital skills, this will act as a barrier to their employment in these sectors.

b) Cultural and attitude barriers

The firms surveyed also reported cultural and social factors that contribute to the underrepresentation of women in digitally intensive services. Such cultural and social barriers that prevent gender equality in the workplace preclude greater employment and advancement of women in DDS. A significant percentage of respondents reported that legal frameworks promoting gender equality in business are still insufficient or inadequately implemented in APEC economies.

c) Finance barriers (lack of women's access to capital)

Respondents to the survey also cited unequal access to financial resources as a primary concern affecting women's ability to be engaged in high skill digital services, both through assisting with access to educational and training opportunities and to help women entrepreneurs set up firms in the digitally intensive, high skill services sectors.

d) Regulatory barriers affecting trade in digitally delivered services

Barriers that block the expansion of international trade in high skilled digitally delivered services also serve to hold back women's ability to pursue work in these sectors. The KIBS study highlighted various regulatory barriers that affect trade in digitally delivered services, which are shown in Figure III.7. These regulations, although often legitimate and

⁴² Ibid, page 19. The survey responses provide a view of the main challenges women face and of the factors that need to be addressed to expand their opportunities to engage in exporting digital services.

necessary (such as online consumer protection, privacy, and data protection, among others) can negatively impact cross-border trade in DDS in APEC, depending upon how they are written and implemented.

Figure III.7. Regulatory Barriers to Digital Trade in APEC Economies



Source: Digital Trade Restrictiveness Index, DTRI. European Centre for International Political Economy. https://ecipe.org/wp-content/uploads/2018/05/DTRI_FINAL.pdf

The content of the 2023 edition of the APEC PSU Women and the Economy Dashboard Report supports and confirms several of the results of the survey carried out for the KIBS study.⁴³ The Dashboard Report provides the following insights on four key areas.

a) On the benefits of upgraded digital skills for women’s employment

The PSU Dashboard report underscores the important of upgraded digital skills, particularly STEM education and skills, to help bridge the digital gender divide and open up more opportunities for women to participate in “*high-growth and high-paying sectors such as information technology, artificial intelligence and robotics, among others*”.⁴⁴ These areas are critical ones for employment in digitally delivered services sectors. Women still represent a minority in the areas of STEM and research and innovation in many APEC economies, as is discussed in Section VI of this part of the study.

⁴³ *The APEC Women and the Economy Dashboard*, Report by the APEC Policy Support Unit, Executive Summary, August 2023, op.cit.

⁴⁴ *Ibid*, page xiii.

b) On protection against sexual harassment in the workforce

While the PSU Dashboard report applauded the fact that the majority of APEC economies have established laws against domestic violence and sexual harassment together with dedicated courts to respond to such cases. However, it advocated for all 21 APEC economies to put in place laws that protect women from all forms of violence and in all settings: private, public and online. This protection would also improve women's ability to enter the workforce at all levels.

c) On women's access to digital finance

The PSU Dashboard report emphasized how access to digital platforms, mobile money and financial services could open a whole new array of opportunities for women to earn more income with better-paying digital work, entrepreneurship or financial investments. The PPWE added an indicator on women's access to digital finance to strengthen the Dashboard in its 2023 Report. However, it also underlined a crucial policy gap in this area, pointing out that most APEC economies do not have laws in place mandating non-discrimination in credit access based on sex.

d) On the importance of innovation and technology in advancing women's empowerment

While the PSU Dashboard does not focus on women's participation in trade *per se* as part of its 90 indicators, the 2023 Report does highlight the importance of innovation and technology for women's empowerment. These are areas that need open markets with unencumbered cross-border data flows to the greatest extent possible so that ideas and skills can flourish in the most productive way possible in the APEC region.

Section IV. Skills and Education for Enhancing Women’s Participation in Digitally Delivered Services

KEY TAKEAWAYS

- **Skills Mismatch and Gender Gaps** – Women often lack the digital, financial, and managerial skills required for high-paying DDS jobs due to unequal access to training.
- **STEM Education and Employment Deficit** – Less than one-third of STEM graduates in APEC are women, impacting their access to tech-driven and innovation-led careers.
- **Digital Divide** – Women’s lower access to digital tools and infrastructure limits their participation in education and skill acquisition.
- **Growing Importance of Digital Skills** – By 2030, 39 percent of core job skills will shift towards AI, big data, and digital literacy, areas where women are currently underrepresented.

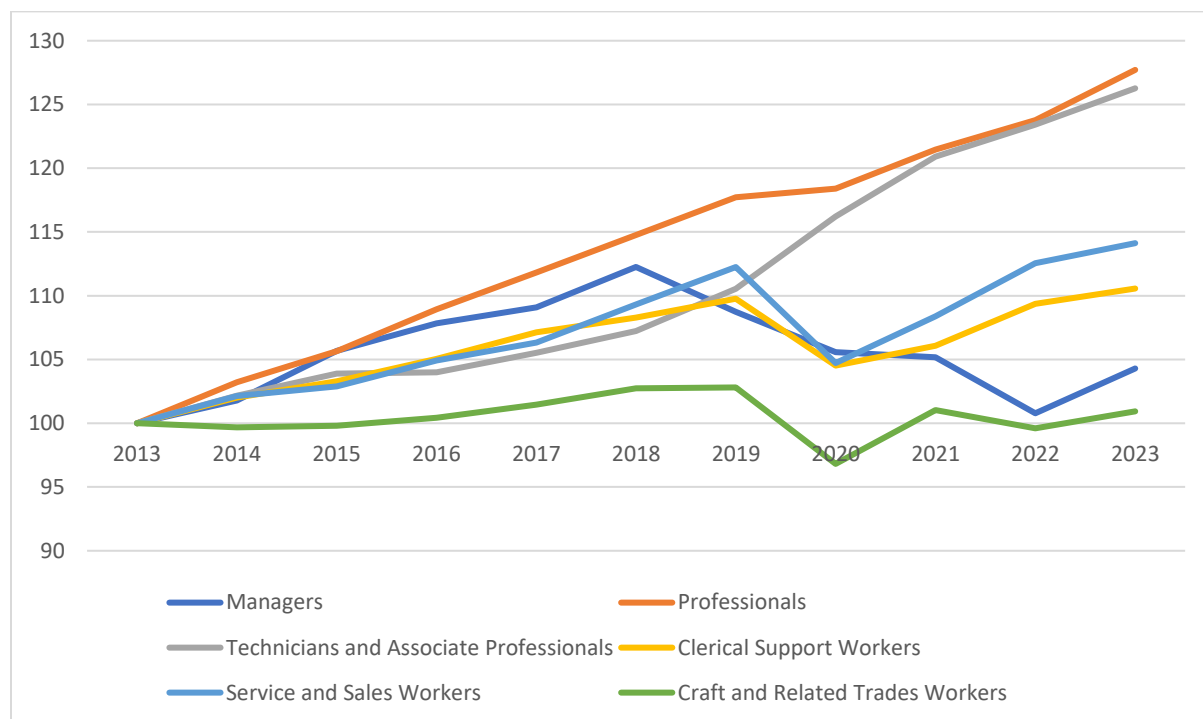
1. Introduction

Digitally delivered services (DDS) encompass services that are supplied from one economy to another via digital means, without the supplier and consumer being in the same location (so-called, mode 1 of service supply). As demonstrated in Section II, these services have expanded significantly with technological advancements in the last two decades. Trade in the three digitally intensive sectors which are the focus of this study (financial services, professional services, and telecommunication/ICT services) have on average grown faster than the rest of trade in most APEC economies as well as globally (cf. Section II, Part I).

This section explores the skills required to participate (i.e. be employed) in these sectors and the gender disparities in possessing / acquiring these skills. Furthermore, it examines how education and training can enhance women’s access to such skills and thus potentially boost their participation, quality of employment, and career progression in these services.

The section builds upon the statistics and material presented in the previous sections, especially in Section II on the growth of DDS’ trade and in Section III on the employment of women in DDS based on the occupational categories that are linked to the DDS of focus. Section III in particular reports on gender disparity in employment in the three occupations most closely linked to digitally delivered services. Figure IV.1 below shows that employment trends in other, less skilled and less digitally intensive occupations, are lagging behind those of professionals and technicians/associate professionals in APEC. Nevertheless, women still fall behind men with respect to managerial jobs. Other relevant studies also point to the same conclusions: while women’s employment in services in general has increased over time, this growth has been concentrated in occupations which are associated with lower skills and lower responsibility/seniority (and thus usually lesser income).

**Figure IV.1. Employment Trends in Higher-skill and Other Selected Occupations in APEC
(2013=100)**



Source: Source: [Statistics on women - ILOSTAT](#).

If APEC economies are to design policies and measures to enhance women’s employment in the DDS of focus, better insights are needed on how women can be equipped with skills required for work in these digitally intensive sectors. It is also important to understand what barriers impede women from moving upward once they land a job. While competency and capability are related to knowledge and the skills associated with a particular job/occupation, career advancement is often related more to social and cultural norms.

2. Skills for today’s and future jobs

Skills are the capabilities needed to complete a task and therefore execute a job. They are different from ‘knowledge’ which refers to the body of facts, principles, and theories related to a field of work acquired through education or experience. Skills are the practical abilities to apply knowledge effectively in real-world scenarios. They are developed through practice and involve the proficient use of tools, techniques, and methods. With respect to the financial sector, for

example, knowledge would be the understanding of financial regulation while a skill would be the ability to analyse financial statements.⁴⁵

While knowledge provides the foundation, skills enable the practical application of that knowledge. The two are interdependent; possessing knowledge without corresponding skills can limit effectiveness, just as having skills without a solid knowledge base can lead to errors.

Existing literature typically measures the skills of an economy's workforce through years of schooling. This does not, however, accurately capture the level of digital skills in the workforce as digital skills are not always adequately taught in schools and the full acquisition of such skills typically happens in formal work or training settings. Therefore, it is not straightforward to understand what type of educational path women should follow to increase their level of skills for future of work in services relying on digital technologies (more on education later in this section).

The recent World Economic Forum 2025 *Future of Jobs Report*⁴⁶ usefully informs our thinking about the state of skills in the present workforce and the impact of technological changes on the evolution of skills for the future. The Report provides an in-depth analysis of the global labor market, highlighting key trends expected to shape employment by 2030. Drawing insights from over 1,000 leading global employers across 22 industry clusters and 55 economies (14 of which are from APEC), the report identifies several macro trends influencing job creation and displacement. These include technological advancements, green transition, demographic shifts, geoeconomic fragmentation and economic uncertainty. The estimated impact of these trends will result in a net increase of 78 million jobs by 2030, with 170 million new roles created and 92 million displaced.

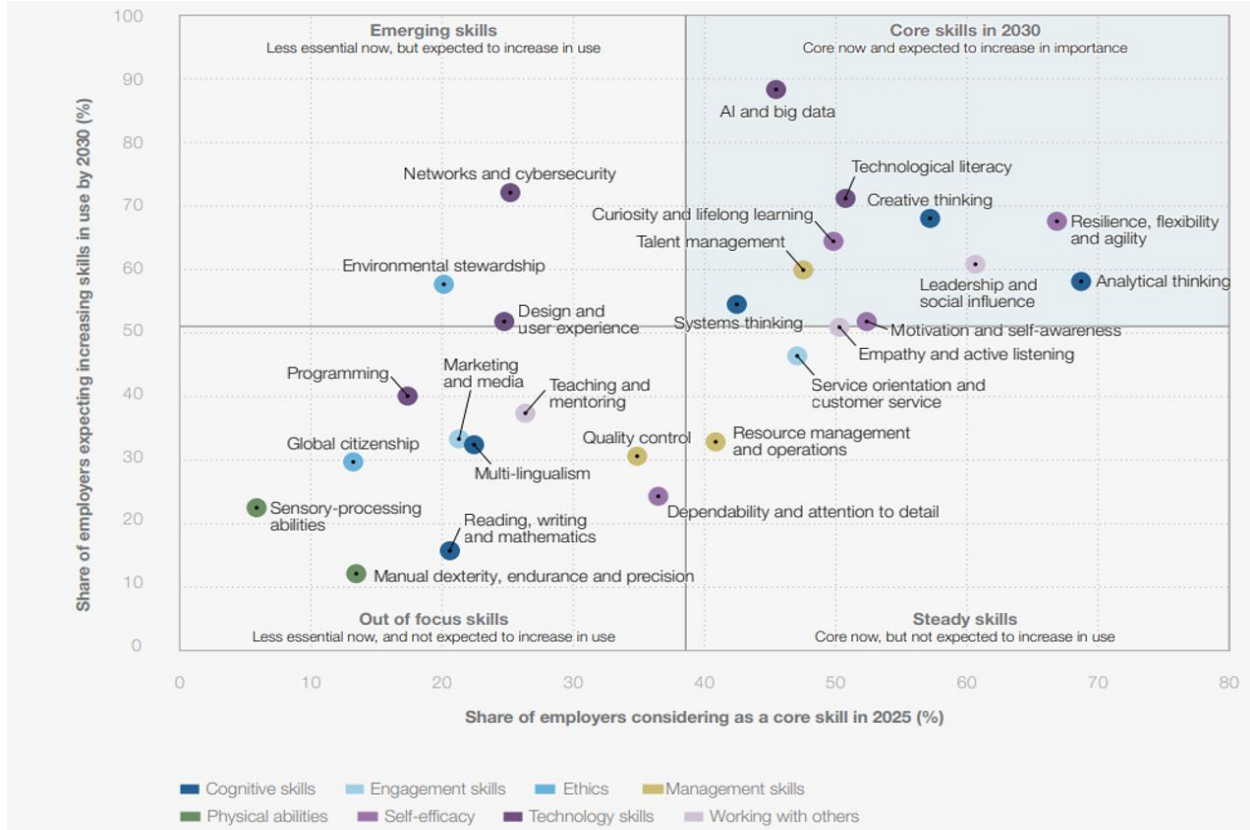
The skills necessary to either keep a current job or to get a new one in 2030 are shown in Figure 4.2 below which illustrates the anticipated shifts in skill requirements by 2030. Employers expect that 39 percent of core skills will change, especially due to the growing importance of technological proficiency, particularly in AI and big data. Additionally, human-centric skills such as creative thinking, resilience, flexibility, and agility will be increasingly valued alongside and to accompany the technological skills. This underscores the necessity for continuous learning and upskilling to adapt to the evolving job market. These issues are discussed below.

⁴⁵ In addition to knowledge and skills, to get a job one also needs to display a positive attitude and possess necessary abilities. Attitudes are learned behaviors, emotional intelligence traits and beliefs that individuals exhibit that influence their approach to ideas, persons and situations. Abilities are possession of the physical, psychomotor, cognitive and sensory means to perform a job. See more in WEF 2025 Future of Jobs Report.

⁴⁶ World Economic Forum (2025) Future of Jobs 2025 Report https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf?_gl=1*iq8rq8*_up*MQ..*_gs*MQ..&qclid=CjwKCAiA2cu9BhBhEiwAft6lxEO4rZyOG6x-YaL5iUbelopUeY7JUtmHNX2HYCUMBGUE3XkEZSqlifRoCV0cQAvD_BwE

Figure IV.2 Core Skills Required for Employment in 2030

Share of employers considering skill to be a core skill in 2025 and share of employers expecting skill to increase in importance by 2030



Source: [WEF 2025 Future of Jobs Report](#), Figure 3.6.

The skills currently identified as core and expected to grow in importance by 2030 show significant—though not complete—overlap with those associated with high-skill occupations in digitally delivered services (DDS).⁴⁷ Many of the key competencies listed in the ILO ISCO-08 classification, such as technological literacy, subject matter expertise, leadership, strategic planning, resource management, and creativity, align with those highlighted in the WEF Future of Jobs 2025 report. However, several critical skills emphasized in the WEF report—such as resilience, agility, flexibility, empathy, social influence, networking and environmental stewardship—are notably absent from the ILO classification. This omission likely reflects the fact

⁴⁷ These occupations were set out in the Section III on Employment and drawn from the ILO ISCO-08 list of occupations, as follows: Group 1: Managers required skills: leadership, business strategy, financial acumen, digital transformation management; Group 2: Professionals required skills: advanced ICT skills, financial analysis, programming, cybersecurity, legal expertise; Group 3: Technicians and associate professionals: IT support, data analysis, digital marketing, compliance and customer service.

that ILO ISCO-08 was developed in 2008, before the widespread acceleration of automation and AI integration in the workforce.

The skills missing from the ILO framework are precisely those that enhance adaptability and human-centered capabilities, which are increasingly essential to be combined with technological literacy, STEM skills, or big data for navigating the evolving nature of work in an AI-driven economy. These are also the skills that are part of so-called emotional intelligence. Women are often perceived as having higher emotional intelligence than men. However, it turns out while women and men are about equal in overall emotional intelligence, they possess different strengths or competencies that are considered gender specific. In general, women tend to score higher than men in areas of empathy, interpersonal relationships and social responsibility. Men tend to score higher in areas of assertiveness, stress tolerance and self-regard (or confidence). Recent work on emotional intelligence suggests these differences may play a role in the leadership gender gap.⁴⁸ These differences often advantage men and disadvantage women at work which is also valid when looking at DDS.

Findings of the World Bank’s 2021 report *“At Your Service- The Promise of Service-led Development”*⁴⁹ provide additional insights. The report categorizes services into different groups mostly based on underlying skills, one of which is Global Innovator Services—a high-skill, knowledge-intensive set of industries that includes **IT services, financial services, professional services (legal, consulting, engineering, R&D, etc.), and creative industries**. These industries require a workforce that also possesses strong digital, cognitive, and socio-emotional skills, particularly as automation and digitalization transform job roles.

BOX IV.1 Skills required for women to participate in digitally intensive, high skill service sectors

Group of skills	Related work /job with sample of skills needed
1. Advanced digital and technical skills	Programming & software development (especially for IT and digital finance roles) Data analytics & AI literacy (ability to interpret and work with AI-driven tools) Cybersecurity awareness (particularly relevant in financial and IT services) Cloud computing & digital infrastructure management

⁴⁸ See for example UNSSC (2021) “Emotional Intelligence and Leadership Development: A Gender perspective”, Blog 21 February, <https://www.unssc.org/news-and-insights/blog/emotional-intelligence-and-leadership-development-gender-perspective?utm>

⁴⁹ World Bank (2021) *At Your Service- The Promise of Service-led development*, <https://openknowledge.worldbank.org/entities/publication/b5f153be-e867-5746-ad02-e12a0774e2d1>

	Tech-enabled problem-solving (applying technology to enhance service delivery)
2. High-level cognitive skills	<p>Complex problem-solving & critical thinking (necessary for consulting, legal, and R&D work)</p> <p>Strategic planning & decision-making (especially for leadership roles in professional services)</p> <p>Numeracy & financial literacy (critical for financial services and business consulting)</p> <p>Research and innovation management (vital for R&D, engineering, and high-value knowledge services)</p>
3. Socio-emotional and leadership skills	<p>Emotional intelligence & empathy (important for client-facing roles, team collaboration)</p> <p>Negotiation and persuasion (especially for women in leadership or consulting)</p> <p>Social influence and networking (crucial for career advancement in male-dominated industries)</p> <p>Resilience and adaptability (to navigate technological disruptions and career transitions)</p> <p>Cross-cultural communication and teamwork (important for global service firms)</p>
4. Entrepreneurship and business development skills	<p>Digital marketing and branding (important for independent consultants, creative industries)</p> <p>Project management and agile work methods (widely used in IT, consulting, and finance)</p> <p>Regulatory and compliance knowledge (particularly in law, finance, and consulting)</p>
Additionally, women would need to have industry-specific skills and subject-matter expertise.	

Source: Adapted from World Bank (2021) [At Your Service- The Promise of Service-led Development](#)

3. Men and women are not equally equipped with skills for DDS

Women face significant barriers in acquiring the necessary skills that allow them to participate in the dynamic digitally delivered services sectors of focus. Research shows that:

Women are underrepresented in ICT-intensive roles that are often indispensable for participation in high-skill digitally delivered services, particularly in programming, cybersecurity, and fintech.

Women face barriers to acquiring such skills for various reasons, including limited access to STEM education or digital training (formal or informal training; on-the-job or otherwise).⁵⁰

The OECD 2023 *Survey of Adult Skills*⁵¹ highlights that women score lower in digital problem-solving and numeracy skills, which are essential for many financial and professional services.

ILO 2023 research⁵² reports gender gaps in AI and data-related professions, with men occupying the majority of high-paying digital jobs.

The OECD's 2023 *Survey of Adult Skills* offers a comprehensive assessment of adults' proficiency in literacy, numeracy, and adaptive problem-solving across 31 economies (seven of which are from APEC). The OECD survey provides a detailed examination of gender disparities in skills, education, and labor market outcomes.

The report reveals a mixed global picture of proficiency in key information-processing skills (referring to literacy, numeracy and adaptive problem-solving skills all of which have an essential role in achieving positive economic and social outcomes). While some economies have made progress, others show stagnation or decline (with Japan performing well across all three skill domains). Eleven APEC economies (including Chile and Republic of Korea) consistently perform below the OECD average in all skill domains. Literacy proficiency has declined more strongly among men than women, resulting in gender gaps narrowing in some economies and women displaying higher literacy skills on average than men at present. On the other hand, men continue to outperform women in numeracy, as well as in adaptive problem solving (albeit by much less).⁵³

These persistent skill gaps translate into labor market and wage disparities. Although skills proficiency is a key determinant of wages, the OECD survey hints that “on average, years of education explain a larger share of variation in wages for women than for men, whereas numeracy and literacy proficiency accounts for a greater share of variation for men than for women. This is consistent with research that finds that women’s wages are more closely linked to formal education, as they are often concentrated in sectors where qualifications are crucial for advancement (notably the public sector), and they may face greater barriers to being rewarded for skills acquisition alone.” (pp.159-160).⁵⁴ This distinction highlights the structural and social factors influencing women's economic opportunities and remuneration.

⁵⁰ World Bank (2021), Op.cit.

⁵¹ OECD (2023) Do Adults Have the Skills They Need to Thrive in a Changing World?, *Survey of Adult Skills*, https://www.oecd.org/en/publications/do-adults-have-the-skills-they-need-to-thrive-in-a-changing-world_b263dc5d-en.html

⁵² ILO (2023) *Generative AI and Jobs: A global analysis of potential effects on job quantity and quality*, ILO Working Paper 96, <https://www.ilo.org/publications/generative-ai-and-jobs-global-analysis-potential-effects-job-quantity-and>

⁵³ For more details check OECD (2023), Op. cit.

⁵⁴ However, these gender differences are relatively small across economies. “The OECD averages for men and women differ by 2 percentage points in favor of men for skills proficiency and 4 percentage points in favor of women for years of education. Differences are much more pronounced in e.g. Canada where the gender gap in the share of variation explained by years of education is greater than 8 percentage points.” Ibid, page 160.

3.1. Contributing factors to gender skill disparities

The disparities highlighted above can be attributed to several interrelated factors: educational achievement and specialization, access to technology, access to training, workplace dynamics, social norms, personal attitudes / confidence, and so on. More detail on Other contributing factors to gender skill disparities are discussed below. Below we only provide more comments on access to education, and technology but that does not render other factors irrelevant.

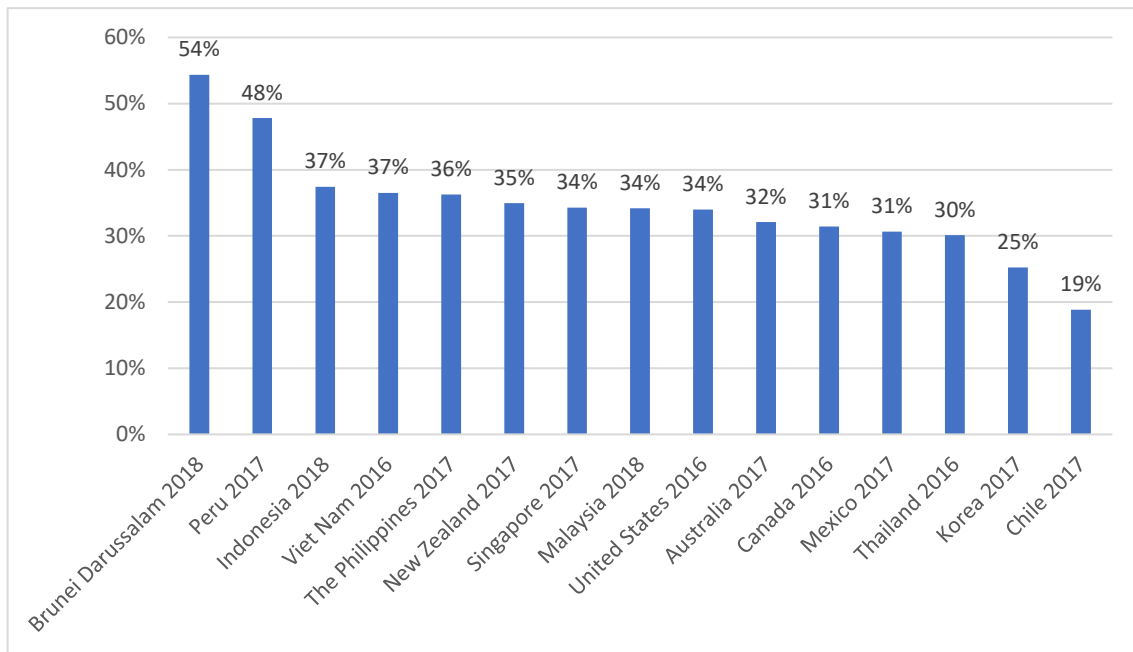
- Educational pathways

The underrepresentation of women in STEM fields remains a critical concern, with significant implications for gender wage disparities and economic participation. On average, less than one-third of STEM graduates in APEC economies are women, though this varies widely; for example, in Brunei Darussalam, women account for over 50 percent of STEM graduates (Figure IV.3), whereas in some economies, including Japan, the share remains below 20 percent. In contrast, women are heavily overrepresented in non-STEM fields, making up about 65 percent of graduates. This trend suggests that while access to higher education has improved for women, their participation in STEM disciplines—key drivers of technological innovation and economic growth—continues to lag.

Societal norms and stereotypes play a crucial role in shaping these educational disparities. From an early age, gendered expectations and confidence gaps in mathematics contribute to fewer women pursuing STEM education. Although the relative share of women STEM graduates in APEC economies is above 30 percent, there is significant attrition when it comes to actual employment in STEM-related jobs. As shown in Figure IV.4, a relatively low proportion of female STEM graduates transition into STEM occupations and into high-paying sectors such as IT and professional services. This "leakage" in the education-to-employment pipeline further exacerbates the persistent gender wage gap.

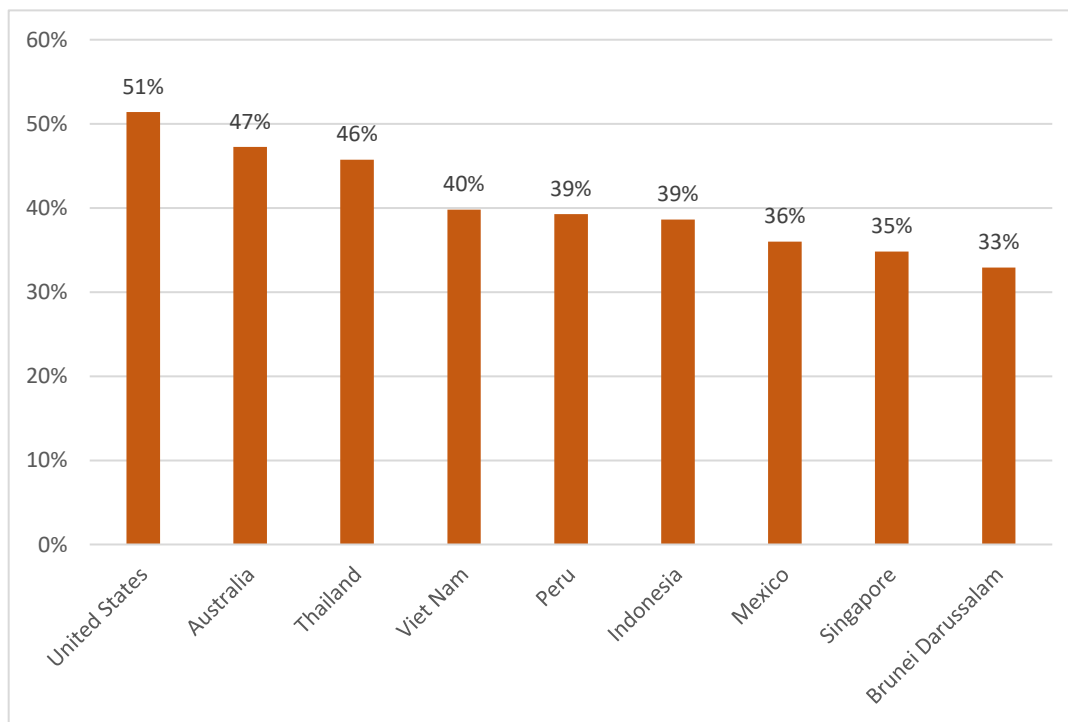
Women's underrepresentation in high-paying STEM occupations (see also Figure IV.5 below) is not merely a reflection of individual career choices but is shaped by systemic barriers, including workplace biases and limited access to leadership roles (as discussed in Section III). Addressing these disparities requires targeted interventions to challenge societal norms, support confidence-building in STEM skills from an early age, and create inclusive policies that ensure women's full participation in the digital and technological workforce.

Figure IV.3. Share of Women Graduates in STEM Programmes, Tertiary (%) in APEC economies (2016-2019)



Source: ILOSTAT, Figure sourced from [Workers in STEM occupations | Download Dataset](#)

Figure IV.4 Share of Women Employment in STEM Occupations in APEC Economies, 2023



Source: ILOSTAT, Figure sourced from [Workers in STEM occupations | Download Dataset](#)

Access to Technology

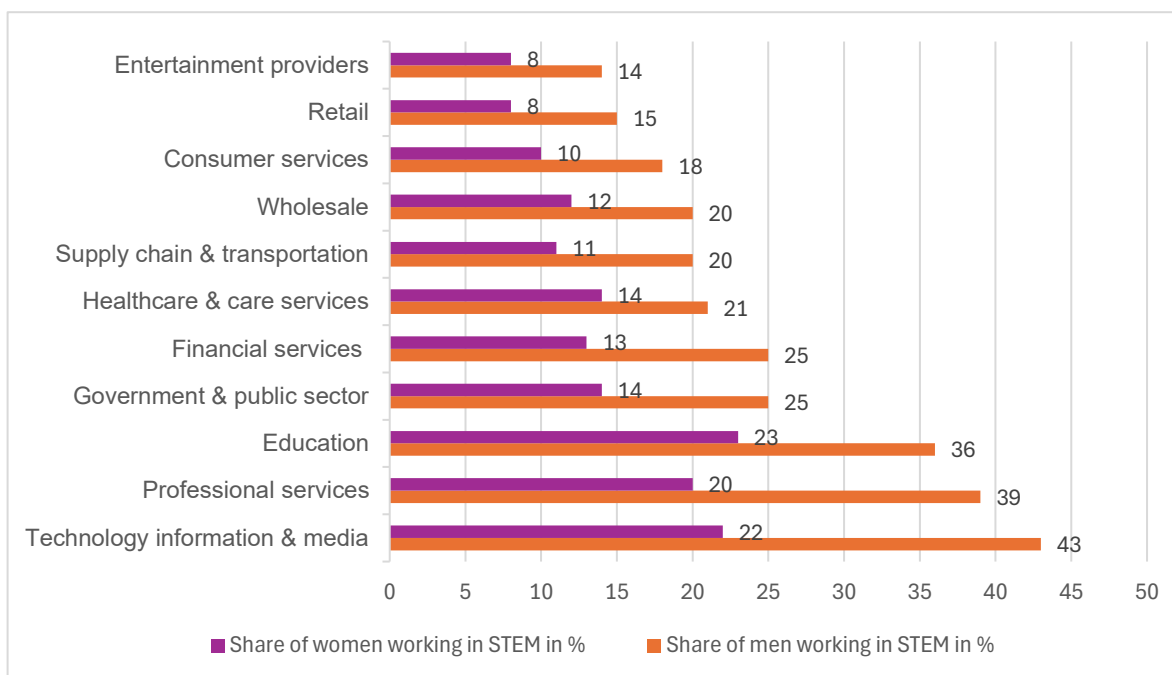
In many APEC economies, women face substantial barriers to accessing digital devices and the internet, which are essential for participation in high-skill occupations.⁵⁵ Data from 2020 indicates that approximately 55 percent of men were internet users compared to 48 percent of women globally. Within the APEC region, women use the internet to a lesser extent than men in almost every economy in APEC (exceptions in 2020 are China, the United States, Chinese Taipei, and The Philippines) with the widest gaps observed in Peru, Japan, and Viet Nam.⁵⁶ This digital divide is further exacerbated by disparities in mobile phone ownership; since 2017, women have been approximately 10 percent less likely than men to own a mobile phone, limiting their access to mobile internet services. These technological access gaps hinder women's ability to acquire digital skills, engage in online professional development, and compete for high-skill positions that increasingly rely on technological proficiency.

The factors above that contribute to gender disparities have resulted in a very skewed and disproportionate share of women working in the most dynamic high skill digitally delivered service sectors at present, as shown in Figure 4.5 which highlights a significant gender disparity between men and women working in STEM-related fields across various occupations. The DDS sectors which are the focus of this study perform rather badly with two associated with the largest gap: Technology, Information & Media (43 percent men vs. 22 percent women); and Professional Services (39 percent vs. 20 percent). The representation of both men and women in STEM is lower overall in financial services, but men still hold a much larger share (25 percent vs. 13 percent). These disparities suggest that structural barriers, societal expectations, and unequal access to STEM education and career opportunities discussed above continue to limit women's participation in high skill, high-paying STEM fields. Addressing these gaps will require targeted policies that promote career advancement opportunities for women in STEM professions.

⁵⁵ Access to AI as one of the crucial digital 4.0 technologies is discussed in the next Section of this paper.

⁵⁶ See more details in <https://www.apec.org/publications/2022/09/the-untapped-economic-potential-of-including-women-in-the-digital-economy-in-the-apec-region#:~:text=This%20study%20aimed%20to%20perform%20an%20economic%20estimate,of%20access%20to%20the%20internet%20and%20STEM%20careers> .

Figure IV.5 Shares of Women and Men in STEM Occupations, by Industry



Source: Extracted and redrawn from Figure 2.16 in World Economic Forum, [Global Gender Gap Report 2024](#), p. 51

Acquiring digital education for women to participate in DDS

In the context of APEC economies, acquiring knowledge and skills is essential for fostering economic growth and competitiveness. Here are the key channels:

- **Formal education:** Academic programs offer structured learning, providing foundational knowledge and, in some cases, practical skills through labs and projects. There should be more encouragement to pursue degrees in computer science, data analytics, and digital finance in all APEC economies and particularly in those which are relatively lacking in these STEM and ICT competencies.
- **Vocational training:** Focuses on hands-on experience, allowing individuals to develop specific skills pertinent to their field. Programs targeting cybersecurity, fintech, and cloud computing.
- **On-the-Job training (informal education):** Real-world experience where individuals learn and refine skills under actual working conditions. The World Bank emphasizes that digital channels now open more possibilities, improving the matching of job seekers' skills and experience with job vacancies, thereby enhancing on-the-job learning opportunities.

- **Continuous professional development:** Engagement in workshops, seminars, and online courses enables professionals to stay abreast of industry trends and enhance their competencies. Continuous professional development is vital for career advancement in high-skill digitally intensive occupations. However, women in APEC economies often encounter obstacles in accessing such training due to caregiving and other unpaid responsibilities and the limited availability of flexible training programs.
- **Leadership training programs:** Equipping leaders and leader-to-be with the skills needed to navigate and drive digital transformation within their organizations. These courses cover topics like digital disruption, AI applications in business, and managing digital economies, preparing women for executive roles in the digital age.

APEC economies are prioritizing the development of soft skills and business acumen, including leadership, digital communication, and negotiation training. Furthermore, the APEC Women in STEM initiative aims to address gaps and promote best practices in the region, focusing on the advancement of women in science, technology, engineering, and mathematics fields. Active engagement and deliberate practice are crucial in transitioning from knowledge acquisition to skill proficiency.⁵⁷

The APEC Gender Equality Structural Reform Voluntary Principles and Recommendations emphasize the need to support women's education, training, and skills development, particularly in STEM fields and emerging industries. Despite these initiatives, the 2023 APEC Women and the Economy Dashboard reports that women's participation in STEM, research, and R&D remains below 35 percent in many APEC economies. This underrepresentation is partly attributed to the lack of accessible training opportunities that accommodate women's schedules and responsibilities. Moreover, the COVID-19 pandemic has intensified these challenges, as increased caretaking duties have further limited women's capacity to engage in professional development. Addressing these issues requires implementing policies that promote flexible, inclusive training programs and support systems to balance professional and personal responsibilities.

4.1. Capacity Building Network Roadmap (2022-2025)⁵⁸

APEC has in place the *Capacity Building Network (CBN) Roadmap 2022-2025* which was put in place to address the impact of the COVID-19 pandemic on APEC economies. However, it also refers to the impacts of the Fourth Industrial Revolution (4IR) which makes it relevant for the purposes of this study. The *Roadmap* emphasizes the need for capacity building to adapt to technological transformations, digitization, and new work practices. The mission of the *CBN Roadmap* is to facilitate knowledge sharing, skills development, human resource management,

⁵⁷ Key models of success: Finland and Estonia: Strong emphasis on digital skills for women through early STEM education, and Singapore and Canada: Targeted programs to increase women's representation in fintech and AI.

⁵⁸ See https://www.apec.org/docs/default-source/groups/hrd/2024/capacitybuildingnetwork_cbn_roadmap2022-2025.pdf

and vocational training to support post-pandemic recovery and build a resilient and inclusive Asia-Pacific community.

The *Roadmap* outlines four strategic directions:

- Foster an Environment for Capacity Building:
- Promote sharing of best practices and benchmarking activities.
- Conduct regional studies and research on digitalization and skills development.
- Improve labor market information systems.

Strengthen Digital Capacity:

- Advocate the use of 4IR and emerging technologies in capacity-building programs.
- Promote digitalization of skills assessment and certification.
- Share best practices for effective online training, particularly for underserved populations, including women.

Reskill and Upskill Workers:

- Integrate 21st-century skills and digital skills in training curricula.
- Improve digital competencies of trainers.
- Facilitate lifelong vocational skills training.
- Foster green skills development.

Restyle Capacity Building Initiatives:

- Support flexible and responsive TVET systems, including micro-credentialing.
- Improve access to vocational training programs for vulnerable populations, including women.
- Pursue greater industry involvement and alignment in capacity-building initiatives.
- Promote mutual recognition of skills among economies.

The *Roadmap* highlights the importance of skilling and training for women. First, it emphasizes the importance of strengthening digital skills through formal and informal means, particularly for women. This includes advocating for the use of emerging technologies and sharing best practices for online training. Secondly, it highlights the need to create targeted and tailored gender-sensitive training programs and improve access to vocational training for women, especially in digital and green skills. Lastly, it encourages women to take executive courses in digital business transformation and participate in regional policy dialogues to enhance cooperation and collaboration among stakeholders.

Section V. Issues of Concern Around Women’s Participation in Digitally Delivered Services

1. The Distinction Between Formality and Informality in Services: Implications for Women in APEC Economies

KEY TAKEAWAYS

- **Informality is Prevalent in Low-Skill Service Roles.** While services account for over 60 percent of GDP and employment in many APEC economies, informality is widespread in low-skill roles like caregiving, retail, and hospitality. In contrast, high skill digitally delivered services have lower levels of informality, reflecting different barriers and opportunities.
- **Women Face Unique Challenges in Informal Service Work.** Women in informal service roles earn lower wages, face job insecurity, and lack social protections, limiting their economic mobility. However, women with secondary or tertiary education are less exposed to informality than similarly educated men, particularly in middle-income economies.
- **Barriers to Transitioning into Formal, High-Skill Services Persist.** Limited access to digital and professional skills, gender disparities in STEM education, and caregiving responsibilities restrict women from advancing into formal, high-skill service roles. Addressing these barriers is essential for women to move from informal to formal employment.
- **Digital Platforms Create Both Opportunities and Risks.** Online freelancing and digital nomadism provide new work opportunities, but many roles lack formal contracts, labour protections, and income stability. Women are more likely to be concentrated in lower-paid digital roles, while men dominate higher-paying fields like software development and digital marketing.

The distinction between formality and informality is crucial across all economic sectors, including services.⁵⁹ However, in services because of the nature of service work itself, informality often revolves around employment status, regulatory compliance, pay, and access to labor protections rather than the production and sale of physical goods. The digital economy has further blurred the boundaries, making informality more complex and less visible. In APEC, where services account for a significant portion of GDP and employment, understanding how this distinction impacts women is essential. This subsection explores the prevalence of informality in services, its

⁵⁹ Informality and formality here are inked to informal and formal economic concepts. The informal economy refers to all economic activities, excluding illicit activities, by workers and economic units that are, in law or in practice, not covered or insufficiently covered by formal arrangements. ILO (2023) *Women and men in the informal economy: A statistical update* available at https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_protect/%40protrav/%40travail/documents/publication/wcms_869188.pdf

gendered impacts, barriers to transitioning into formal, high-skill services, the role of digitalization and digital nomadism, and policy implications, with a focus on APEC economies.

1.1. Prevalence of Informality in Services

Services contribute over 60 percent of GDP and employment in many APEC economies, yet a significant portion of this workforce operates informally. Informality is prevalent in activities such as domestic work, caregiving, retail, hospitality, and personal services. Informality in the services sector is relatively high in low-income economies, and much lower in high-income economies where the administrative capacity to capture earnings is more developed. However, in both income categories informality is less prevalent for the high skill DDS that are the focus of this study, as shown in Table Vi.1.

Table V.i.1 The Sectoral Dimension of Informality, by Economy Income Group (%), 2019

Sector/ activities	World	Low-income economies	High-income economies
Services (average)	47.0	57.5	14.9
Professional, scientific and technical activities	31.3	31.3	--
Information and communication	22.0	32.5	8.6
Financial and insurance activities	17.8	24.0	7.3

Source: Extracted from Figure 10 in ILO (2023) *Women and men in the informal economy: A statistical update*, https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_protect/%40protrav/%40travail/documents/publication/wcms_869188.pdf

This informality in services contrasts with both the agricultural and industrial sectors. In the former, informal work is often seasonal or family-based, while in the latter, formal labor regulations are more common. Informality persists in services due to the sector’s fragmented nature, reliance on low-skilled labor, and regulatory gaps.

1.2. Gendered Impact of Informality

The gendered impact of informality in services is evident in wage disparities, job insecurity, and limited career advancement. Women in informal service roles typically earn less than their male counterparts, reflecting both occupational segregation and gender discrimination. For example, in Thailand and Viet Nam, women in informal services earn significantly lower wages than men with similar qualifications.⁶⁰

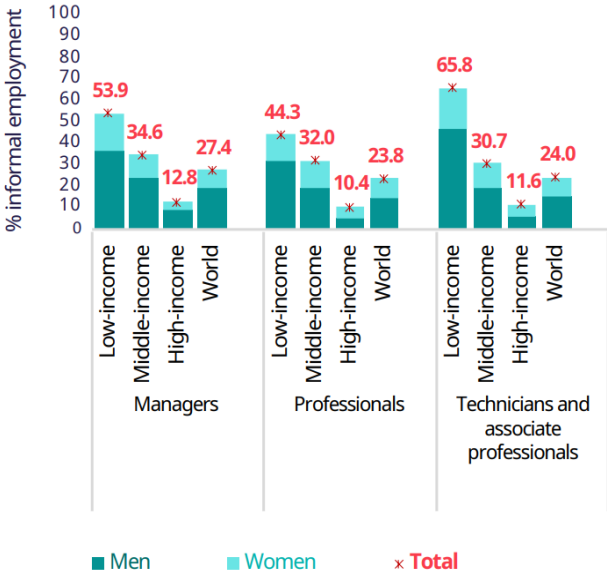
⁶⁰ See more in World Bank (n.d.) Gender and informal work in Thailand available at <https://openknowledge.worldbank.org/server/api/core/bitstreams/5ae590ef-4e5d-43fa-90af-2fbfb447853d/content> and ILO et al (2021) Country Gender Equality Profile -Viet Nam (2021) available at https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40asia/%40ro-bangkok/%40ilo-hanoi/documents/publication/wcms_825087.pdf?utm_source=chatgpt.com

Job insecurity is another critical issue. Informal workers often lack contracts, social insurance, and legal protections, making them vulnerable to job loss and exploitation. This insecurity is exacerbated for women, who face additional barriers such as unpaid care responsibilities and limited access to skills development. Furthermore, the absence of formal career pathways restricts women’s upward mobility, confining them to low-wage, precarious jobs.

Whether in low-, middle- or high-income economies, women with a low level of education (primary education or less) are more exposed to informality than men with a similar level of education. In contrast, when they reach secondary and tertiary levels of education, women are less exposed to the risk of informality than men with a similar level of education. This holds true especially for middle-income economies as observed in Figure V.i.1.

Women in informal employment, both globally and in low- and middle-income economies, are over-represented at lower levels of education compared to men. By contrast, women in formal employment, both globally and in high-income economies, have a higher share than men of tertiary-level education (ILO, 2023, *ibid*, figure 13, panel B).

Figure V.i.1 Share of Informal Employment, by Occupation and Sex



Source: Extracted from ILO (2023) *Ibid*, [Women and men in the informal economy: A statistical update](#), Figure 14, page 33

1.3. Barriers to Transitioning into Formal, High-Skill Services

Several barriers prevent women from transitioning into formal, high-skill service roles, including skills gaps, social norms, and structural inequalities. Digitalization has created new opportunities in financial services, ICT services, and professional services, but as pointed out in Sections III and IV, women often lack the digital and professional skills required to access these roles.

As shown in Section IV, according to the ILO's ISCO-08 classification, high-skill service occupations (managers, professionals, and technicians) require advanced cognitive, technical, and digital skills. However, women in many APEC economies still face gender disparities in access to education (especially in STEM fields), digital technology and training, limiting their ability to acquire these skills.

Social norms also play a role in limiting women's participation in formal services. In some APEC economies, cultural expectations regarding women's caregiving responsibilities (refer also to child penalty in Section I) restrict their availability for full-time, formal employment. Additionally, gender biases in hiring and promotion processes further limit women's career advancement in high-skill services.

1.4. Impact of Digitalization and Digital Nomadism on Informality

Digitalization is reshaping the services sector, offering both opportunities and challenges for women. Digital platforms have created new work opportunities in areas such as online freelancing, virtual assistance, and e-commerce. However, many of these opportunities are characterized by informal working conditions, with limited labor protections and income stability.

The growing trend of digital nomadism is often linked to informality due to the freelance nature of most digital nomad work, which typically lacks formal contracts, social protections, and stable income. Like other informal workers, digital nomads face income volatility and limited access to benefits such as health insurance and pensions. This instability disproportionately affects women, who may also encounter gender biases on digital freelancing platforms (see Box Vi.1) – resulting in men accounting for roughly six in ten digital nomads worldwide (March 2024).⁶¹

Box V.i..1. Digital Nomadism and Informality in Services Sectors

Digital nomadism illustrates the growing overlap between formal and informal economies in the digital age. While some digital nomads work for established companies with formal contracts, many rely on gig platforms (e.g., Upwork, Fiverr) that offer little job security or legal protection normally linked to formal employment contracts. Many digital nomads work as freelancers or independent contractors, which mirrors the characteristics of **informal work**, where individuals lack job security, legal protections, and benefits like health insurance, pensions, and paid leave. For example, a freelance software developer or online

⁶¹ According to Barry Elad (2024) Digital Nomad Statistics 2024 By Demographics, Gender, Background, Salary, Education Level, Nationality And Preferred Activities

consultant working remotely across APEC economies might not be eligible for social security or labor protections in their host or home economy.

Digital nomadism often exists in a legal grey area. Many economies, including some in APEC, lack clear regulations regarding the taxation, visa status, and labor rights of digital nomads. This can result in informal working arrangements, where individuals operate outside traditional tax and labor systems. Even with dedicated digital nomad visas (e.g., Thailand's Smart Visa program), labor protections typically apply only to locally employed workers, not remote freelancers.

Like informal workers, digital nomads often face income volatility due to short-term contracts, fluctuating client demand, and lack of guaranteed work. Without employer-provided benefits, digital nomads must rely on personal savings or private insurance to bridge periods without contracts, increasing their financial vulnerability. This instability can be especially challenging for women, with economic and social implications for women digital nomads.

Women digital nomads may face greater barriers to securing well-paid, stable work due to gender biases in digital freelancing platforms. They are more likely to take on lower-paid remote jobs like virtual assistance or online tutoring, while men dominate higher-paying digital services such as software development or digital marketing.

Care responsibilities can also limit women's ability to travel freely, reducing their access to digital nomad opportunities compared to men. In 2023, men comprised 56 percent of digital nomads, women 43 percent, and nonbinary individuals one percent.

While "platformization" of work appears to offer a degree of formality, it often replicates informal conditions, with individuals bearing the risks of unstable income and lacking access to collective bargaining or social security. Women have a disadvantage in such situations.

The rise of digital nomadism presents policy challenges for governments, particularly in regulating cross-border remote work. Clearer regulations on taxation, labor rights, and social protections are needed to prevent digital nomadism from perpetuating informality.

For APEC economies, balancing the benefits of attracting digital nomads (e.g., economic growth and knowledge exchange) with the need to ensure fair labor conditions is crucial. For example, offering social security options for self-employed digital workers could help reduce informality.

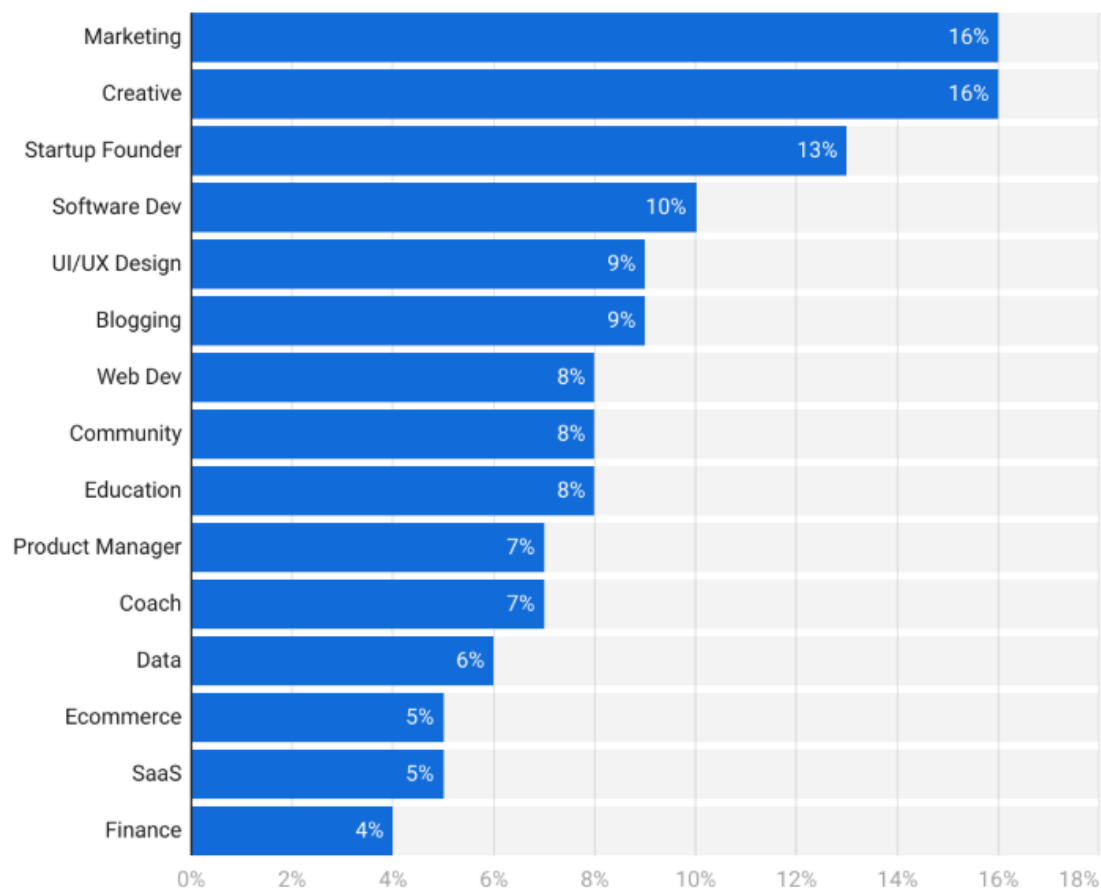
As of March 2023, Information technology was the leading profession of most of the digital nomads resulting in 19 percent. Creative services and education and training were other commonly seen professions contributing 14 percent and 9 percent respectively. The areas of work involved were primarily finance and accounting, sales, marketing and public relations, and research, coaching, and consulting.⁶²

Figure Vi.2 illustrates the most populous occupations by women digital nomads (as of March 2023). The leading occupations were marketing (16 percent), creative industry (16 percent) and startups founder (13

⁶² Source: Enterprise Apps Today available at <https://www.enterpriseappstoday.com/stats/digital-nomad-statistics.html>

percent). In contrast, for men the leading occupations are software developer (34 percent), web developer (29 percent), and startup founder (28 percent).

Figure V.i.2. Leading Occupations for Women Digital Nomads Worldwide as of March 2023



Source: Enterprise Apps Today

Source: Enterprise Apps Today available at <https://www.enterpriseappstoday.com/stats/digital-nomad-statistics.html>.

The digital gig economy often replicates informal conditions, with women concentrated in lower-paid roles such as virtual assistance or online tutoring, while men dominate higher-paying digital services like software development or digital marketing. Regulatory gaps in cross-border remote work further contribute to informality, as many digital nomads operate outside traditional tax and labor systems.

Despite these challenges, digitalization can also offer pathways for women to transition into formal, high-skill services. Online learning platforms and digital skills training programs can help women acquire the competencies needed for work in financial services, ICT services, and professional services. Initiatives such as APEC's Women in STEM program aim to increase women's participation in digital and high-skill sectors, promoting greater economic empowerment.

2. Artificial Intelligence, Women and Digitally Delivered Services

KEY TAKEAWAYS

- **Artificial intelligence (AI) can be viewed as a technology that is delivered by a service so that it may be applied by individuals and companies.**
- **AI is being adopted faster than PCs or the Internet were in the previous technological revolutions.**
- It is unclear at present what type of impact AI technologies will have on women; however, occupations involving creative and professional skills should be enhanced rather than displaced by AI, whereas the 'person to person', less digitally intensive jobs risk being negatively affected.
- Ingrained attitudes and biases exist in AI development and application at present that work against women.
- **Digital Skills are of the essence for women to be able to participate in digitally intensive services that require AI applications; large gaps that exist between men and women in STEM occupations at present must therefore be reduced through education and skill acquisition.**

Our world is increasingly permeated by artificial intelligence (AI) where our production, consumption and scientific research are being shaped by the application of AI and other new technologies. AI is viewed as potentially one of the most controversial and disruptive technologies in this decade. It is also not well understood.

Generative AI (or GenAI) can be thought of as a process or technology where large language model (LLM) computer systems learn to perform human-like tasks by extrapolating from past experiences, learning in an iterative fashion, and solving problems at speeds which are tremendously fast. They do this through being provided huge amounts of data that enables them to then recognize and repeat patterns and synthesize information in order to generate high-quality text, images, and other content based on the data they were provided.⁶³ Broadly, disparate technologies such as AI, machine learning (ML), natural language processing (NLP), computer vision, and robotics all come under the roof of digital frontier technologies.⁶⁴

⁶³ One of the controversies at present around Generative AI (of several) is the compensation and attribution of the intellectual property rights over the data and information fed into the large language model computers for the process of generating synthesized output. This controversy over intellectual property rights involved in the development of Generative AI is ongoing and has not yet been resolved. For a comprehensive overview of the issues involved in this debate see Robyn Chatwood, *AI and Intellectual Property Rights*, Dentons, January 28, 2025, <https://www.dentons.com/en/insights/articles/2025/january/28/ai-and-intellectual-property-rights> and Matt Blaszczyk, Geoffrey McGovern, and Karlyn D. Stanley, *Artificial Intelligence Impacts on Copyright Law*, Expert Insights, Rand Corporation, November 20, 2024, <https://www.rand.org/pubs/perspectives/PEA3243-1.html>

⁶⁴ See WIPO, Fact Sheet on Frontier Technologies, https://www.wipo.int/export/sites/www/about-ip/en/frontier_technologies/pdf/frontier-tech-6th-factsheet.pdf

The importance of AI in business and investment decisions is already economically large, as witnessed by the extremely high valuations of the ‘tech’ companies that are putting millions of dollars into AI research and development.⁶⁵ It is also a volatile and rapidly moving field and one which is now perceived to create not only economic dislocations but domestic security threats. Significant shake-ups in the AI marketplace are occurring at present, with the appearance of new firms (such as DeepSeek) which are challenging the competitive advantage of the long-standing incumbents.⁶⁶

2.1. Potential economic impact of AI

The real economic impact of AI application seems likely yet to come, but it could be significant. A report by Price Waterhouse Cooper estimates that AI could increase global GDP by up to 14 percent as of 2030, contributing \$15.7 trillion to the global economy.⁶⁷ This would be more than the current output of China and India combined. Of this amount the report estimates that \$6.6 trillion will come from increased productivity and \$9.1 trillion from consumption side effects.

Economic gains from the adoption and application of AI technology are expected to come from three areas.⁶⁸ These include:

- i) Productivity gains from businesses automating processes (including use of robots and autonomous vehicles).
- ii) Productivity gains from businesses augmenting their existing labor force with AI technologies (assisted and augmented intelligence).
- iii) Increased consumer demand resulting from the availability of personalized and/or higher-quality AI-enhanced products and services.

While some markets, sectors, and individual businesses have more familiarity and are more advanced than others, Generative AI is still felt by many to be at an early stage of development

⁶⁵ The major tech companies have been spending billions over the past two years since the introduction of ChatGPT in November 2022, to further develop AI capacities and applications. It is reported that Amazon, Alphabet, Meta, and Microsoft intend to spend as much as \$320 billion combined on AI technologies and datacenter buildouts in 2025. Amazon has outlined the most ambitious spending plan, at around \$100 billion. These numbers are up from \$230 billion in total capital expenditures for AI development in 2024. Samantha Subin, *Tech megacaps plan to spend more than \$300 billion in 2025 as AI race intensifies*, CNBC, 8 February 2025, <https://www.cnbc.com/2025/02/08/tech-megacaps-to-spend-more-than-300-billion-in-2025-to-win-in-ai.html>

⁶⁶ Kelly Ng, Brandon Drenon, Tom Gerken and Marc Cieslak, *DeepSeek: The Chinese AI app that has the world talking*, BBC news, 4 February 2025. Deep Seek is an AI-powered chatbot that operates very much like ChatGPT but requires a fraction of the cost and computing power to function. For the consumer, DeepSeek is currently free to use while ChatGPT requires a subscription, with the basic access plan costing around \$20 per month. <https://www.bbc.com/news/articles/c5yv5976z9po> In response, ChatGPT launched the DeepResearch tool on February 2, 2025, a new agentic capability that conducts multi-step research on the internet for complex tasks and which can accomplish in tens of minutes what would take a human many hours. See <https://openai.com/index/introducing-deep-research/>

⁶⁷ Price Waterhouse Cooper report, *Sizing the prize What's the real value of AI for your business and how can you capitalize?* At <https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf>. See figure on page 5 which shows that labor productivity improvements are expected to account for over 55 percent of all GDP gains from AI over the period 2017 – 2030.

⁶⁸ *Ibid*, page 4.

and economic application overall. The impact it will have on different regions is predicted to be uneven and will depend largely upon the speed with which it is adopted and put into application in the workplace. The major economic gains are predicted to accrue in the U.S., China, Europe and developed Asian economies, at least in the short term.⁶⁹ An OECD report indicates that its real impact may in fact be felt in innovation, though this remains to be seen.⁷⁰

2.2. Relationship of AI to services

There is no general agreement on whether AI falls into the goods or services area. However, artificial intelligence is most often viewed as a service transmitting technology. From this perspective it can be defined as **“a service that outsources AI to enable individuals and companies to explore and scale AI techniques at minimal cost”**.⁷¹ Under this definition, AI would be considered a service delivering Generative AI technology, or the application of iterative learning, by companies to potential end users. In terms of AI use and application, this would be realized primarily through digitally delivered services. To date there has been no move to incorporate AI technology into any of the existing services classification systems for digital trade.

AI is expected to lead to the development of new services and to the upgrading of traditional services, both of which could potentially result in higher welfare and productivity.^{72, 73}

2.3. Speed of adoption of GenAI

It is becoming a bit clearer as to the expected speed at which the adoption of GenAI will occur. According to a recent NBER research paper, its adoption is happening at a faster pace than was the case for the take-up of personal computers or the Internet.⁷⁴ Figure 1 shows this comparison, with the dot in the figure (at 39 percent) representing the adoption rate for GenAI (in the United States) at two years since the first mass-market product of ChatGPT was introduced (November 2022). If the depiction in Figure 1 is accurate, the uptake on the new AI technology in the coming decade could be very significant. The NBER paper indicates that generative AI and PCs demonstrate very similar early adoption patterns by education, occupation, and other

⁶⁹ Ibid, page 7. The report details the determinants of these GDP gains in several economies, including the U.S. and China, and develops an AI Impact Index, to help firms target their investment opportunities.

⁷⁰ OECD Artificial Intelligence and International Trade, OECD Trade Policy Papers, 2022. <https://doi.org/10.1787/13212d3e-en>.

⁷¹ *What is artificial intelligence as a service? Definition, architecture and trends*, Spiceworks, 10 February 2022, <https://www.spiceworks.com/tech/cloud/articles/artificial-intelligence-as-a-service/>

⁷² Treffer, Daniel, and Ruiqi Sun, *AI, Trade and Creative Destruction: A first look*, NBER working paper 29980, National Bureau of Economic Research, 2022. <https://doi.org/10.3386/w29980>.

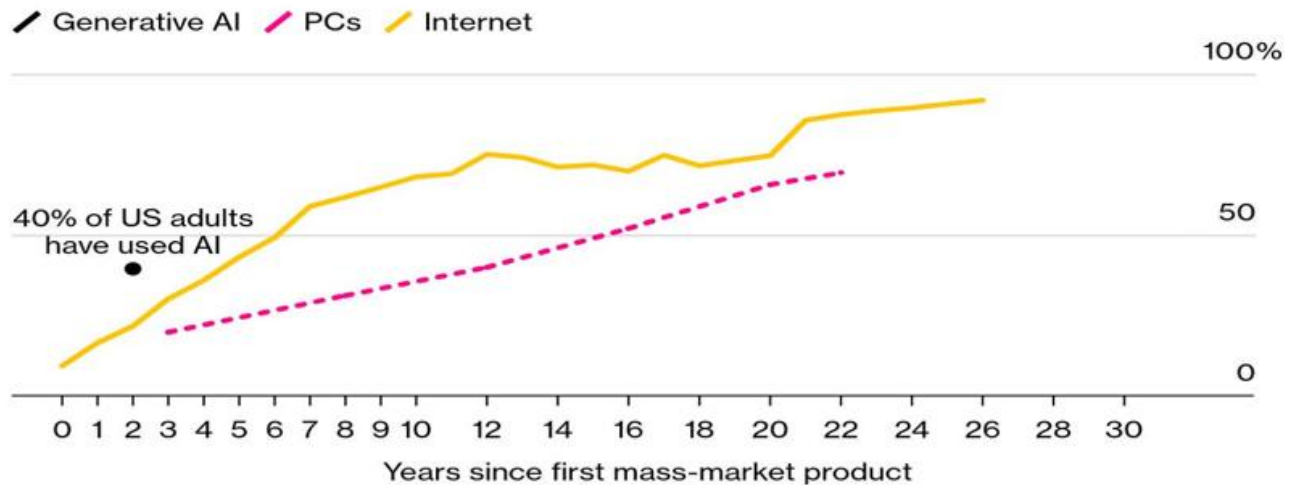
⁷³ Furman, Jason, and Robert Seamans, *AI and the Economy*, NBER working paper 24689, National Bureau of Economic Research, 2018. <https://doi.org/10.3386/w24689>.

⁷⁴ Alexander Bick Adam Blandin David J. Deming, *The Rapid Adoption of Generative AI*, National Bureau of Economic Research, Working Paper 32966, February 2025, page 13. https://www.nber.org/system/files/working_papers/w32966/w32966.pdf

characteristics.⁷⁵ In particular, the lower cost of GenAI applications as compared with PCs or the Internet should prove to be a major boost to its use both by individuals and by firms.

Figure V.ii.1: AI is Being Adopted Faster Than PCs Or the Internet

Adoption rates following first mass-market product.



Source: "The Rapid Adoption of Generative AI," by Alexander Bick, Adam Blandin and David J. Deming, NBER

Bloomberg

Source: Figure from "[Do Marketers Need to Be Writing for AI?](#)" Bloomberg, 9 Feb. 2025.

2.4. Impact of AI on women’s employment in high skill DDS

Given the period of transition in which we are currently living, it is unclear at present what type of impact that GenAI and new AI technologies will have on women. To try and answer this question, it would be necessary to explore what impact AI might have on different types of economic activities or occupations. A report by the McKinsey Global Institute put forward the view that the biggest impact of automation would be felt on those occupations involving repetitive tasks, particularly customer-facing jobs, such as office support, customer service, health services, etc.) where employment could well decline in favor of robots or online AI applications.⁷⁶ This view has also been put forward by several other studies. An OECD study emphasized the risk of AI adoption for female workers (as well as older workers and those without tertiary education) as

⁷⁵ The NBER working paper cited in footnote 5 points out that the choice of whether to adopt a given technology is a function of both its benefits and its cost. Many genAI products are currently free or inexpensive and user-friendly. These lower adoption costs relative to PCs and the internet (which require equipment purchase to use and access) may allow GenAI to diffuse more rapidly. *Ibid*, page 14.

⁷⁶ McKinsey Global Institute, *Generative AI and the Future of Work in America*, July 26, 2023 <https://www.mckinsey.com/mgi/our-research/generative-ai-and-the-future-of-work-in-america> . For the case of the United States, the report estimates that activities that account for up to 30 percent of hours currently worked across the US economy could be automated by 2030 —a trend accelerated by Generative AI. However, this trend would not significantly affect high skill services activities.

they are expected to lose out given their more limited access to AI-related employment opportunities and to productivity enhancing AI tools in the workplace.⁷⁷

In contrast the McKinsey study indicates that those occupations involving creative and professional skills should be enhanced rather than displaced by AI applications. Following this line of reasoning, the high skill, DDS services occupations that are the focus of this study should experience few occupational shifts by 2030. Therefore, the more women are able to acquire the requisite education, skills, and training to be able to shift into these digitally intensive service activities dependent upon AI applications, the better off they will be to insulate themselves from the employment impacts of AI.

The relative strengths that women possess as some of the necessary skills for participating in the jobs of the future have been emphasized by Sue Duke, the Head of Global Public Policy and Economic Graph Team at LinkedIn. The data at Linked-In found that women had a 28 percent larger share than men of essential soft skills for jobs of the future, including strategic leadership and collaboration, allowing Duke to emphasize that “.....*the growing number of female AI talent and the advent of GenAI presents an opportunity to help close the gender gap*”.⁷⁸ However, this will very much depend upon the qualifications and skill levels of the women in the labor force who will be expected to understand how to use the hard skills required by GenAI applications and to apply them to their fields of work. And it will also depend upon how the soft skills will be translated into positions of decision-making and leadership in data-driven and AI intensive industries.

Drawbacks to this possible positive impact include current gender differences in skilling profiles between men and women – which skew how they are engaging in the technological transition. An examination of the current situation does not look promising. Coursera data shows gender parity remains low in AI and big data (30 percent), programming (31 percent), and other category (31 percent).⁷⁹ This reinforces the findings in this study in Section IV that a lack of skilling and technological access gaps (to computers and Internet use) has hindered women's ability to acquire digital skills, engage in online professional development, and compete for high-skill positions that increasingly rely on technological proficiency in the digital area.

These limitations to access have thus created a situation of large gaps between women and men in STEM occupations by industry (see Figure IV.4 in Section IV). It would appear easy to conclude

⁷⁷ Lane, M. (2024), “Who will be the workers most affected by AI?: A closer look at the impact of AI on women, low-skilled workers and other groups”, OECD Artificial Intelligence Papers, No.26, OECD Publishing, Paris, <https://doi.org/10.1787/14dc6f89-en>

⁷⁸ Quote from Sue Duke, the Head of Global Public Policy and Economic Graph Team at LinkedIn. Cited in the WEF blog on *Gender Gap: This is the state of work for women in 2024*, June 27, 2024 <https://www.weforum.org/stories/2024/06/women-work-gender-gap-2024/#:~:text=Women%20make%20up%2042%25%20of,cited%20in%20the%20Forum's%20report.>

⁷⁹ World Economic Forum, 2024 Global Gender Gap Report, Geneva, <https://www.weforum.org/stories/2024/06/women-work-gender-gap-2024/#:~:text=Coursera%20data%20shows%20gender%20parity,the%20closure%20of%20workforce%20gaps.>

from this that any widening gaps in education and training on AI applications for women would only serve to widen this existing gap even further. Therefore, how women are educated and trained for future employment in high skill DDS industries that require AI use and application will be critical to access these opportunities.

2.5. Ingrained attitudes and biases in development and application of artificial intelligence that work against women

Much of the challenge around women's ability to take advantage of the AI 'revolution' in the workplace revolves around the existence of ingrained attitudes and biases in AI development and application. This aspect of AI is not well appreciated but has important implications and consequences both in practical terms and in the extra challenges it poses for women in the digital fields. The presence of ingrained attitudes and biases comes from the information and materials that are fed into the LLMs for the creation of GenAI applications, most of which are created by and for the large technology corporations, which are led and staffed mainly by men. The gender bias inherent in their actions, guidelines and decisions is then translated into GenAI responses and applications. As long as women (employees) are not present in greater numbers and especially in decision-making roles of seniority in the digitally intensive services firms that are developing GenAI applications, these ingrained biases will continue to be propagated.⁸⁰

Simon Johnson, author of *Progress and Prosperity*, and 2024 recipient of the Nobel Prize in Economic Sciences, made the very pertinent remarks that are included in Box V.ii.1 during a recent IMF podcast (February 2025) which illustrate these points. In his remarks he emphasizes the reality around the vision and the decisions which lie behind the making and exploiting of AI and other technologies.

Other consequences of this ingrained bias in the development and application of GenAI which are not mentioned by Johnson in the podcast include those of an economic nature which result in lower incomes for women in their employment. This often translates into lower social status and less ability to have a voice in household and enterprise decisions, as well as political consequences which deny women the voice they would otherwise be able to exercise.

⁸⁰ The 2023 APEC Women and the Economy Dashboard cites the 2022 report from Equileap on gender equality in the corporate sector covering Asia-Pacific economies which points to uneven progress in gender equality in the workplace, with women making up only 4 percent of chief executive officers (CEOs), 10 percent of chief financial officers (CFOs) and 5 percent of board chairs in the Asia Pacific. Globally, women make up 31 percent of business leaders, with varying shares per industry, according to high-frequency data from LinkedIn. However, the 2023 OECD-Social Institutions and Gender Index (SIGI) shows that of these business leaders, globally women hold only around 25 percent of management positions. And the WEF Global Gender Gap Report underlines that the "drop to the top" from entry-level to C-suite positions is more pronounced in STEM occupations than in non-STEM roles. See APEC Policy Support Unit, *Women and the Economy Dashboard*, August 2023, page x. <https://www.apec.org/publications/2023/08/the-apec-women-and-the-economy-dashboard-2023>

Box V.ii.1: Ingrained Attitudes and Biases in AI Development and Application

"Well, this is obviously the age of AI and artificial intelligence, and there are great claims being made for the improvements that will permeate all of human societies as a result of making computers and algorithms more potent and more able to do thinking for us. And we think that is possible; it could happen.

But also,,,,, based on our reading of history and our thinking about the theory of economics as well, that it is not necessarily the case. Improving technology, making technology more productive, expanding the capabilities of some people may not necessarily translate into an improved standard of living for everyone. It can....it should.... we want it to.... that's what we work on.... trying to push it.

But if you look at the vision of a lot of big tech, it is currently more intensely focused on improving the capabilities of people like themselves (i.e. the creators and users of this new AI technology)

So these are highly educated people. They're mostly white people. They're mostly men. They have a certain view of the world. They have a certain view of what they want technology to do for them. And they have a view of where the market is. Where's the money? What are people willing to adopt? It is quite natural that they would be pulled towards inventing things that favor that vision."

Simon Johnson, recipient of the 2024 Nobel Prize in Economic Sciences, former IMF chief economist and currently professor at MIT in the Sloan School of Management

Remarks made in a podcast produced for the IMF on Technology, Institutions and Prosperity, 14 February 2025, at https://www.imf.org/en/News/Podcasts/All-Podcasts/2025/02/14/simon-johnson?utm_medium=email&utm_source=govdelivery .

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Appendices

Part I – Appendix 1: Overall Global Gender Gap Index for APEC Economies, 2006 – 2024

Economy	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2020	2021	2022	2023	2024
Australia	0.72	0.72	0.72	0.73	0.73	0.73	0.73	0.74	0.74	0.73	0.72	0.73	0.73	0.73	0.73	0.74	0.778	0.78
Brunei Darussalam			0.64	0.65	0.67	0.68	0.68	0.67	0.67	0.68	0.67	0.67	0.69	0.69	0.68	0.68	0.693	0.68
Canada	0.72	0.72	0.71	0.72	0.74	0.74	0.74	0.74	0.75	0.74	0.73	0.77	0.77	0.77	0.77	0.69	0.77	0.76
Chile	0.65	0.65	0.68	0.69	0.7	0.7	0.67	0.67	0.7	0.7	0.7	0.7	0.72	0.72	0.72	0.74	0.777	0.78
China	0.66	0.66	0.69	0.69	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.67	0.67	0.68	0.68	0.68	0.678	0.68
Indonesia	0.65	0.66	0.65	0.66	0.66	0.66	0.66	0.66	0.67	0.68	0.68	0.69	0.69	0.7	0.69	0.7	0.697	0.69
Japan	0.64	0.65	0.64	0.64	0.65	0.65	0.65	0.65	0.66	0.67	0.66	0.66	0.66	0.65	0.66	0.65	0.647	0.66
Korea, Rep.	0.62	0.64	0.62	0.61	0.63	0.63	0.64	0.64	0.64	0.65	0.65	0.65	0.66	0.67	0.69	0.69	0.68	0.7
Malaysia	0.65	0.64	0.64	0.65	0.65	0.65	0.65	0.65	0.65	0.66	0.67	0.67	0.68	0.68	0.68	0.68	0.682	0.67
Mexico	0.65	0.64	0.64	0.65	0.66	0.66	0.67	0.69	0.69	0.7	0.7	0.69	0.72	0.75	0.76	0.76	0.765	0.77
New Zealand	0.75	0.76	0.79	0.79	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.79	0.8	0.8	0.84	0.84	0.856	0.84
Papua New Guinea														0.64	0.64			
Peru	0.66	0.66	0.7	0.7	0.69	0.68	0.67	0.68	0.72	0.68	0.69	0.72	0.72	0.71	0.72	0.75	0.764	0.76
Philippines	0.75	0.76	0.76	0.76	0.77	0.77	0.78	0.78	0.78	0.79	0.79	0.79	0.8	0.78	0.78	0.78	0.791	0.78
Russian Federation	0.68	0.69	0.7	0.7	0.7	0.7	0.7	0.7	0.69	0.69	0.69	0.7	0.7	0.71	0.71			
Singapore	0.66	0.66	0.66	0.67	0.69	0.69	0.7	0.7	0.7	0.71	0.71	0.7	0.71	0.72	0.73	0.73	0.739	0.74
Thailand		0.68	0.69	0.69	0.69	0.69	0.69	0.69	0.7	0.71	0.7	0.69	0.7	0.71	0.71	0.71	0.711	0.72
United States	0.7	0.7	0.72	0.72	0.74	0.74	0.74	0.74	0.75	0.74	0.72	0.72	0.72	0.72	0.76	0.77	0.748	0.74
Viet Nam		0.69	0.68	0.68	0.68	0.67	0.69	0.69	0.69	0.69	0.7	0.7	0.7	0.7	0.7	0.7	0.711	0.72

Note: 100%=gender parity, 0%=maximum gender disparity; no data for 2019

Source: Data extracted from [WEF Global Gender Gap Report](#) | [Download Dataset](#) (downloaded January 2025).

Part I – Appendix 2: Global Gender Gap, by Sub-indices, APEC, 2006 – 2024

Subindexes	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2020	2021	2022	2023	2024
Overall Global Gender Gap Index	0.68	0.68	0.69	0.69	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.71	0.71	0.72	0.72	0.73	0.73
Global Gender Gap Economic Participation and Opportunity Subindex	0.63	0.65	0.65	0.66	0.67	0.67	0.68	0.68	0.69	0.70	0.68	0.68	0.69	0.70	0.70	0.70	0.71	0.70
Global Gender Gap Political Empowerment subindex	0.13	0.13	0.14	0.15	0.16	0.16	0.15	0.15	0.17	0.17	0.17	0.19	0.20	0.20	0.22	0.25	0.28	0.27
Global Gender Gap Health and Survival Subindex	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Global Gender Gap Educational Attainment Subindex	0.98	0.97	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.99	0.97

Note: 100%=gender parity, 0%=maximum gender disparity; no data for 2019

Source: Data extracted from [WEF Global Gender Gap Report](#) | [Download Dataset](#) (downloaded January 2025).

Part I – Appendix 3: Ratio of Female to Male Labor Force Participation Rate (%) (modelled ILO estimate) for APEC Economies, 2013–2023

Economy	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Australia	82.23	82.69	83.15	84.07	84.67	85.29	85.73	85.97	86.68	86.26	86.20
Brunei Darussalam	76.73	77.94	79.21	80.57	82.00	78.79	75.55	75.69	76.61	75.54	76.25
Canada	87.72	87.23	86.71	87.21	87.63	88.03	87.66	86.70	87.07	88.14	88.20
Chile	66.53	67.64	67.54	67.44	68.15	69.64	70.58	67.29	67.74	70.97	72.80
China	82.17	82.42	82.68	82.96	83.27	83.61	83.92	83.74	84.79	84.14	83.95
Hong Kong, China	78.74	79.25	79.53	79.88	80.69	80.50	81.51	81.92	82.42	81.77	81.81
Indonesia	61.17	61.23	61.56	62.31	63.71	64.60	65.31	65.15	65.30	64.46	65.03
Japan	69.24	69.91	70.38	71.35	72.44	73.67	74.65	74.40	75.09	75.91	76.67
Korea	69.09	69.92	70.57	71.02	71.67	72.16	73.16	73.10	73.82	74.72	76.05
Malaysia	62.95	64.46	64.87	65.37	65.89	66.07	66.09	65.96	66.60	66.14	66.18
Mexico	56.04	54.93	55.63	55.90	55.45	56.13	58.04	57.17	57.81	59.12	60.49
New Zealand	85.06	85.29	85.19	85.56	85.65	86.25	87.24	86.41	87.46	88.17	88.02
Papua New Guinea	97.24	96.92	96.83	96.76	96.74	96.78	96.72	96.72	97.56	96.55	96.52
Peru	81.98	81.58	80.26	81.42	81.88	82.52	82.56	76.57	81.88	83.62	82.87
Russia	78.68	78.39	77.92	77.85	77.73	78.10	78.23	78.54	78.47	79.08	78.86
Singapore	76.17	77.39	78.61	79.15	78.47	79.08	80.28	80.62	82.66	81.30	80.89
Thailand	78.61	78.19	78.40	78.28	77.96	77.94	78.16	78.47	78.74	78.80	78.30
The Philippines	64.56	65.02	65.38	64.02	61.27	62.62	64.15	63.62	64.05	64.12	64.59
United States	81.93	82.18	81.92	81.93	82.44	82.54	82.97	82.99	82.91	83.25	83.86
Viet Nam	88.97	89.01	88.18	88.34	88.13	86.93	86.98	85.97	87.66	88.05	88.03
APEC Average	76.29	76.58	76.73	77.07	77.29	77.56	77.98	77.35	78.27	78.51	78.78

Source: ILO, [Statistics on women - ILOSTAT \(downloaded October 2024\)](#)

Labor force participation rate is the proportion of the population ages 15 and older that is economically active: all people who supply labour for the production of goods and services during a specified period. Ratio of female to male labour force participation rate is calculated by dividing female labour force participation rate by male labour force participation rate and multiplying by 100. Closer to 100=more equality, further away from 100= greater disparity