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# Mizuho Economic Outlook & Analysis

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## *Will AI take away our jobs?*

*Our concern should not be the loss of jobs but the mismatch*

### < Summary >

- ◆ While AI-based automation is said to run the risk of taking away our jobs, some views state that job losses will be limited to only part of the job categories. If we take into account AI's job creation effect, the use of AI may not necessarily lead to the loss of employment.
- ◆ In Japan, where the labor supply and demand situation is tight, AI may be effective across a wide range of fields, such as manufacturing, construction and services. On the other hand, in other job fields, such as clerical work, a mismatch of employment may occur because of increasing oversupply.
- ◆ Our estimate suggests that AI will also lead to a widening of the wage gap in Japan. With a view to alleviating the job mismatch and eliminating the wage gap, it is essential to develop a system to retrain working people to encourage a shift in employment to AI-related jobs or jobs less affected by AI.

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Mizuho Research Institute Ltd.

**Kentaro Arita**, Senior Economist, Economic Research Department

kentaro.arita@mizuho-ri.co.jp

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**1. AI will replace only some jobs; considering AI’s job creation effect, the total number of jobs may not necessarily fall**

Recently, there are rising expectations that AI (Artificial Intelligence) will lead to the creation of new businesses and the improvement of productivity. Mizuho Research Institute (MHRI) also estimates that AI use will generate an economic effect worth approximately 45 to 75 trillion yen on a cumulative basis over the next 10 years<sup>1</sup>. On the other hand, there are rising concerns that the further spread of AI-based automation will take away people’s jobs.

According to various studies, many analyses have been conducted on how automation technology such as AI may affect employment (**Chart 1**). Of these studies, the one that has drawn the most attention is Frey and Osborne (2013, 2017), which claims that about 47% of all jobs in the US face the risk of becoming computerized<sup>2</sup> over the next 10 to 20 years. In addition, Nomura Research Institute, Frey and Osborne (2015) employed the same method to analyze AI’s impact in Japan and concluded that Japan faces the risk of about 49% of the nation’s jobs being replaced by computers.

**Chart 1: Major studies on the potential effects of automation technology such as AI on employment**

| Studies  | Targeted country | Impact on employment   |
|--|------------------|--|
| Frey and Osborne (2013, 2017)                      | US               | 47% of US jobs are at high risk of being computerized in the coming 10 to 20 years (probability of computerization is over 70%).   |
| Nomura Research Institute, Frey and Osborne (2015) | Japan            | 49% of Japan's jobs are at high risk of being computerized in the coming 10 to 20 years (probability of computerization is over 70%).  |
| Arntz, Gregory and Zierahn (2016)                  | OECD             | From a task basis, job categories with a good chance of their tasks being automated account for 9% of total jobs. For most job categories, only part of their tasks will become automated.                                   |
| Bessen (2016)                                      | US               | As the use of computers progresses, employment has increased in job categories where computer use is more prevalent and decreased where computer use is less common (overall job increase effect was about 0.45% per annum). |

Source: Made by MHRI.

Meanwhile, there are also studies pointing out that Frey and Osborne’s evaluation of employment loss risk is overstated. According to research conducted by Arntz, Gregory

<sup>1</sup> According to MHRI’s estimate based on the economic effect of mobile communication and broadband, AI’s economic effect will amount to approximately 45 to 75 trillion yen on a cumulative basis over the 10-year period from FY2017 to 2027. The economic effects are characterized by high upside and downside risks, so we need to be aware that there is a certain range.

<sup>2</sup> The probability of computerization means the probability of mechanization and robotization, in addition to automation driven by AI.

and Zierahn (2016) using the data of 21 OECD countries, analyzing not the jobs but the tasks that comprise the jobs, job categories where most of the tasks will become automated only account for about 9% of the job categories, and for most jobs only part of their tasks will undergo automation.<sup>3</sup>

The above-mentioned analyses focused only on the job loss effect, but there are studies suggesting that employment will increase thanks to the job creation effect of AI and other new technologies. According to Bessen (2016), as the introduction of computers progresses in the US, employment in job categories where computer use is more prevalent is actually increasing, and the job growth rate has surpassed the rate of job loss where use of computers is less common. (If we look at the labor market as a whole, the job increase effect has been estimated at about 0.45% on an annualized basis.) The results of these studies suggest that while employment in some job categories may be lost, it seems that most automation technologies including AI will be used to supplement work. Also, if we take into account the job creation effect, AI may not always lead to a loss in employment.

## **2. AI is effective in Japan which faces a tight labor market, but it runs the risk of expanding the employment mismatch**

If automation technology such as AI is used to supplement work, we hold that AI can serve as an effective means to deal with labor shortages in Japan, where the labor supply and demand situation is already tight and the number of workers is expected to continue declining in the future. Nonetheless, according to the analysis conducted by Frey and Osborne (2013, 2017), the risk of computerization varies depending on the type of job, and the labor supply and demand environment also greatly differs depending on the job category. Hence, AI's impact on the labor market will naturally depend on the job category.

**Chart 2** depicts the probability of computerization by job type on the vertical axis and the active job openings-to-applicants ratio on the horizontal axis. It should be noted that the probability of computerization by job type was calculated based on the Population Census in line with Hamaguchi and Kondo (2017).<sup>4</sup> Using this chart, we categorized the job types into three groups by considering differences in the potential impact of AI on employment.

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<sup>3</sup> Even in the event that only part of the tasks are automated, there are views that there will be a significant impact because the number of workers required will decline due to the rise of productivity.

<sup>4</sup> We used the probability of computerization based on the small job classification of the Population Census calculated by Hamaguchi and Kondo, and used the number of employees as a weight to estimate the probability of computerization for the large job classification.

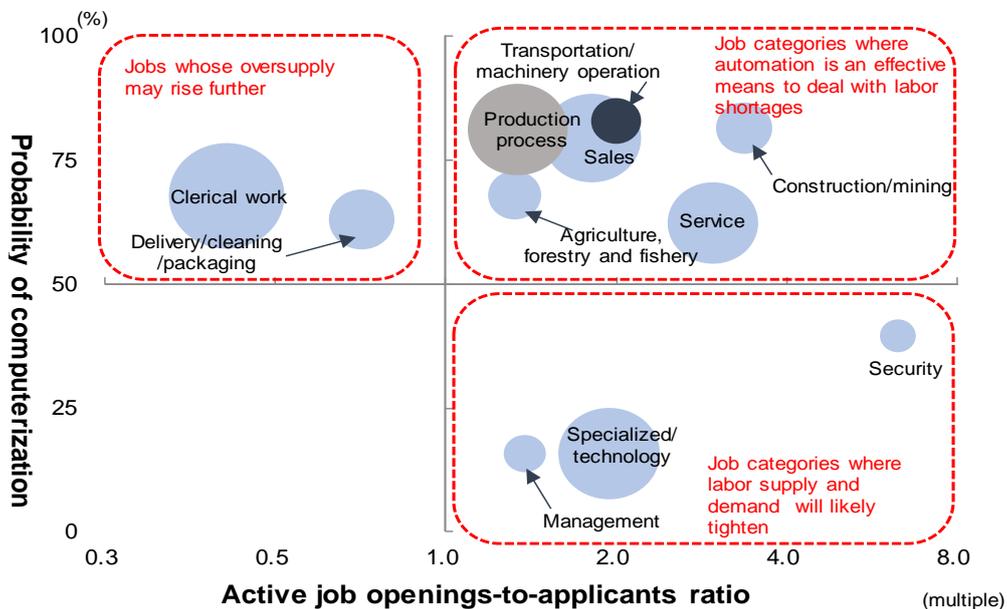
The first job group includes jobs where automation including AI may function effectively; it contains not only jobs related to production, such as production processing, but also a wide variety of work such as construction, mining, services and sales.

The second group comprises jobs whose supply has been excessive from long before, for example, clerical work. Our study showed that AI may heighten the oversupply of jobs in this group even further.

The third group includes jobs whose supply and demand situation may tighten even further going forward. Jobs such as management and specialized/technical work cannot be replaced easily by AI, and hence the labor shortage due to the declining population may become more serious in the future. Also, Bessen (2016) points out that a job creation effect may be generated in specialized/technical jobs such as software engineers, and the rise of AI may exacerbate the labor shortage even further.

Based on the above analyses on the potential impact of automation technology such as AI on employment, Japan should be alert to the risk of expanding the job mismatch rather than overall loss of jobs. In particular, since clerical jobs are supported by a vast number of employees, the potential impact on this sector is of the greatest concern.

**Chart 2: Probability of computerization and active job openings-to-applicants ratio (and number of employees) by job category**



- Notes: 1. The probability of computerization means the probability of mechanization and robotization, in addition to automation driven by AI.  
 2. Note that this does not include job creation resulting from new technology such as AI.  
 3. Bubble size suggests the number of employees.

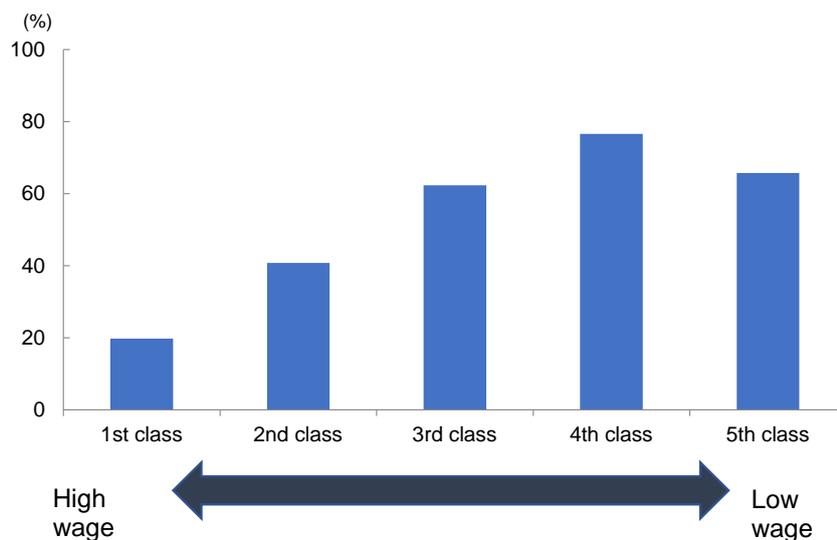
Source: Made by MHRI based on Frey and Osborne (2017), Hamaguchi and Kondo (2017), the Ministry of Internal Affairs and Communications, *Population Census*, and the Ministry of Health, Labour and Welfare, *Employment Referrals for General Workers*.

### 3. AI will likely expand the wage gap in Japan as well

In addition to the impact of AI by job category, we also need to consider whether automation technology such as AI will generate a wage gap. For example, Bessen (2016) has concluded that the wage gap widens between jobs that use computer more commonly than those that do not. Also, according to Frey and Osborne (2013), in the US the lower the average annual income and education level, the higher the risk of being replaced by a computer. Furthermore, the study by Arntz, Gregory and Zierahn (2016) also points out that the lower the skill and income of workers, the higher the risk that their jobs will be automated and replaced by computers. Therefore, when we look at these studies, we recognize the high possibility that Japan will also see a widening of the income gap resulting from the heightened replacement risk by automation, especially among low-wage workers.

In this report, we calculated the probability of computerization by dividing 129 job types into five wage classes based on the Ministry of Health, Labour and Welfare's *Basic Survey on Wage Structure* (**Chart 3**). As a result, in the 1st and 2nd classes, whose wages are relatively high, the risk of computerization was relatively low, whereas the risk of computerization was relatively high in the remaining classes. This suggests that automation technology such as AI may work in ways that widen the income gap in Japan as well.

**Chart 3: Probability of computerization by wage class**



Notes: 1. The probability of computerization means the probability of mechanization and robotization, in addition to automation driven by AI.

2. Note that this does not include job creation resulting from new technology such as AI.

Source: Made by MHRI based on Frey and Osborne (2017), Hamaguchi and Kondo (2017), and the Ministry of Health, Labour and Welfare, *Basic Survey on Wage Structure*.

#### **4. Given the limit to what individuals and firms can do to eliminate the labor mismatch, policy support is indispensable**

In conclusion, AI is a useful measure to deal with labor shortages as Japan suffers from an ever-tighter labor supply and demand situation, but at the same time it also runs the risk of generating an employment mismatch and widening the wage gap. Its impact may be particularly negative on oversupplied jobs such as clerical work. With a view to relieving the labor mismatch and correcting the wage gap through career change, initiatives should be taken by individuals and firms, along with policy support.

Jobs expected to absorb the oversupplied occupations are AI-related jobs (including assisting work), such as software development, whose labor needs are expected to increase along with the advent of new technology. Also, from the perspective of AI utilization, we hold that the demand for personnel currently engaged in other jobs will rise if such workers are equipped with AI knowledge and can utilize such knowledge in their present works (such as new business creation using AI). In addition, the demand for management positions less affected by AI is also expected to further increase in the future, amid strong sense of a labor shortage.

But such job categories require personnel to have acquired certain expertise and know-how. For the AI-related work mentioned above, candidates are required to have education/training in computer programming and data analysis skills. For other occupations that use AI, workers need to have a certain understanding of such expertise, in addition to their existing job skills. Also, for specialized technical jobs and management positions, the acquisition of knowledge on their respective technology and management know-how is indispensable.

However, we believe there is a limit to what individuals and firms can do alone. For individuals to accumulate knowledge, not only will there be monetary and time losses but also a revisiting of career paths, and this will create a substantial burden on career changes, including psychological stress. In addition, firms do not have sufficient staff with AI utilization know-how, so it is likely that the accumulation of know-how through in-house on-the-job training (OJT) will have limits. Thus, more than ever we need policy support to retrain workers and provide career counselling. We will also need to develop an employment safety net during this retraining period.

If we look at the situation from a wider perspective, as the utilization of AI advances, the way of work, or the way of employment itself, may be subject to review. Since job categories easy to automate belong to areas where job descriptions are clear, jobs whose demand is expected to be maintained or increase in the future, including more creative jobs such as management and business creation, will belong to more atypical areas.

Hence, companies will ultimately be required to change their organizational structure to enable their employees to exercise more individual creativity than before. Also, the use of AI and IT will most probably remove restraints in the workplace, and companies will therefore need to adopt a more flexible employment system.

Refer to the original Japanese report at the following with respect to reference material.

<https://www.mizuho-ri.co.jp/publication/research/pdf/insight/jp170718.pdf>