Appendix A

Methodology

Our calculations for workforce supply were based on a country's total workforce, including both the working population and the unemployed. We adjusted the overall workforce in terms of head count, factoring in part-time employees via full-time equivalents for the simulations. The biggest factors that increase the national workforce supply are graduates and net migration. The biggest factors that decrease supply are retirements and general mortality.

To model these factors, we used national labor data to classify the workforce supply by age groups and job family groups. The number of graduates was calculated from official forecasts, adjusted by probabilities of entry into the labor force, and assigned to job families according to the current distribution. Migrant entries were determined by net migration projections for working-age people and allocated according to the current distribution of non-national workers. Retirements and mortality were drawn from official numbers by the government and pension bodies. We used a variety of sources to estimate these values, including working population and unemployment numbers from federal statistics offices, employment agencies, and other government entities.

For workforce demand, our model included both the total working population and currently open positions. To calculate future workforce demand at the detailed level of job families, we considered traditional nontechnology factors, such as GDP growth, as well as a variety of technology-specific factors. For demand reduction through labor productivity gains, we assumed that all labor productivity gains in the coming years will be driven by advancements in technology and thus would include one of the technologies in our analysis. All these factors were calculated for the industries, countries, and job families separately.

Because the pandemic is still so unpredictable, we modeled its potential economic impact by using two GDP growth projections. Both are from Oxford Economics and entail industry-specific GDP forecasts for the United States, Germany, and Australia. In the first projection, the peak of infections and lockdown measures is followed by a rapid return to economic growth, with only some lingering impact on global GDP growth. A second, more severe, projection assumes that another, longer-lasting infection wave will result in renewed strict lockdowns and persistent public-health concerns that reduce confidence, leading to a considerable impact on economic activity in the medium term.

To analyze the impact of technology on workforce demand, the Faethm predictive model created proprietary adoption rates for 17 automation and augmentation technologies, using 150 metrics (including, for example, a country's political and regulatory situation, business and innovation climate, and technical infrastructure). Methods used include neural networks, natural-language processing, support vector machines, boosted decision trees, and random forest modeling. Adoption was calculated at a task level, considering both the availability and uptake for each technology-task combination. A low rate of technology adoption (25% slower than the medium scenario) would lead to fewer jobs being automated and augmented and thus larger future workforce demand. A higher rate of technology adoption (25% faster than in medium scenario) would lead to lower future workforce demand.

The resulting surpluses and shortfalls were calculated by subtracting demand scenarios from supply and can be seen in all levels of the calculation. The more granular in terms of job family groups and job families, the more pronounced the gaps become. An overall slightly positive balance on a workforce level might still mean that there are steep surpluses and shortfalls in specific job families.