The Productivity J-Curve: How Intangibles Complement General Purpose Technologies

Erik Brynjolfsson, Daniel Rock, Chad Syverson

General purpose technologies (GPTs) such as AI enable and require significant complementary investments, including business process redesign, co-invention of new products and business models, and investments in human capital. These complementary investments are often intangible and poorly measured in the national accounts, even if they create valuable assets for the firm. We develop a model that shows how this leads to an underestimation of output and productivity in the early years of a new GPT, and how later, when the benefits of intangible investments are harvested, productivity will be overestimated. Our model generates a Productivity J-Curve that can explain the productivity slowdowns often accompanying the advent of GPTs, as well as the follow-on increase in productivity later. We use our model to assess how AI-related intangible capital is currently affecting measured total factor productivity (TFP) and output. We also conduct a historical analysis of the roles of intangibles tied to R&D, software, and computer hardware, finding substantial and ongoing effects of software in particular and hardware to a lesser extent.