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‘Labour scarcity, technology adoption and innovation: Evidence from the cholera pandemics in nineteenth-century France’

To explain technology adoption, theoretical studies have developed the macroeconomic implications of production factors which can be either complementary or substitute. If labor and technology are complementary factors of production, then labor scarcity, whereby skilled and/or unskilled workers are needed to operate machinery, is detrimental to technology adoption. If they are substitute, then labor scarcity leads to high wages and is conducive to technology adoption. However, there is no clear empirical answer regarding the effects of labor scarcity on technology adoption because obtaining a quasi-experimental framework that could provide causal evidence has turned out to be challenging.

This study makes use of data about the cholera pandemics in 1832, 1849 and 1854 across France to provide reduced form estimates for the effect of labor scarcity on technology adoption and innovation. In so doing, it asks the following questions: (i) is labor scarcity conducive to technology adoption in agriculture and in industry or not, i.e., are production factors in agriculture and in industry complementary or substitute?, (ii) is labor scarcity conducive to technological innovation? and (iii) does labor scarcity have a short-term effect and/or also a long-term effect on the process of economic development?

The results suggest that a larger share of cholera deaths in the population, which can be causally linked to summer temperature levels, had a positive and significant, although quantitatively limited, effect on technology adoption and innovation in agriculture in the mid-run. Furthermore, the results suggest that labor scarcity had a negative and significant effect on technology adoption in industry in the short-run. As such, our results suggest that labor and capital are substitute factors of production in agriculture and complementary in the industrial sector.

In addition, our study suggests that the positive impact of labor scarcity on human capital accumulation may explain the substitutability of labor and capital in agriculture and their complementarity in industry, as population loss increased the expected returns to literacy. This rise in the share of literacy workers in the population offset the immediate negative effect of population drop on technology adoption in industry since literate workers were sought out in industrial work. In parallel, this increase in literate workers, who would most likely avoid low-paying work in agriculture, fostered agricultural mechanization. Additional empirical analyses show that this human capital channel for our results is robust to accounting for migration, urbanization, a cultural shift as proxied by a change in religiosity, fertility, nuptiality patterns and local finance.