The Material Basis of Modern Technologies. A Case Study on Rare Metals

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The unique properties of a wide range of Rare Metals (RMs) are crucial to achieve the functionality of modern technologies. By text mining 5,146,615 USPTO patents during the period 1976-2015, this paper systematically studies the technological dependence of new inventions on 13 key RMs, with the aim of exploring the link between critical raw materials and frontier technological innovation. We find that RMs play an increasing role as the material basis for modern technologies: the dependence varies significantly across technological areas and metal types, and it is particularly high for some emerging technologies such as semiconductors, nanotechnology, and green energy technologies. Further, we use a panel of technology-RM pairs over four decades to assess the impact of RM
supply on innovation dynamics. The results show that increases in the supply of an RM significantly improve the patent output of technology areas based on it, contributing to the understanding of how innovation dynamics are shaped by the availability of natural resources
with technological criticality.