A Framework for Economic Growth with Capital-Embodied Technical Change

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Technological advance is often embodied in capital inputs. This paper develops a model where capital innovations occur on two margins: (1) vertically, where a capital input becomes more productive at a given task; and (2) horizontally, where a capital input replaces labor at a given task. These two forms of technological advance engage in a macroeconomic “tug of war” when capital and labor have less than a unitary elasticity of substitution, and the resulting framework can meet numerous macroeconomic regularities. First, it can produce a balanced growth path and satisfy the Uzawa Growth Theorem—even though all technological progress occurs in capital inputs. Second, it can produce intuitive macroeconomic dynamics, adding perspectives on the apparent productivity slowdown and declining labor share of income. Third, it can produce rich industry dynamics and inform structural change, including declining GDP shares of agriculture and manufacturing, sectoral bottlenecks, the role of general purpose technologies, and the limited macroeconomic impacts of computing. Overall, this tractable framework can help resolve puzzling tensions between micro-level observations of technological advance and macroeconomic features of economic growth.