ENTREPRENEURSHIP AND INNOVATION POLICY AND THE ECONOMY:

INTRODUCTION TO VOLUME 3

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This volume is the third installment in the National Bureau of Economic Research (NBER) *Entrepreneurship and Innovation Policy and the Economy* (EIPE) series. Entrepreneurship and innovation, by developing new ideas and bringing them into practice, are widely recognized as key drivers of economic dynamics and economic growth. The EIPE series engages recent insights on entrepreneurial and innovative activity, engaging new issues and technologies that are shaping the landscape of progress.

The EIPE volume, and its associated conference, have two overarching goals. First, the contributions synthesize and communicate key findings about entrepreneurial and innovative activity across the economy, conveying insights on contemporary opportunities and challenges and seeking to inform policy. Second, the EIPE meeting and volume, by cultivating dialogue between researchers and policymakers, seeks to surface critical open issues that can shape the direction of future research.

This year's conference was held in May 2023, with an in-person meeting in Washington, DC, virtual attendees online, and a live-stream open to the public. The five presentations, each corresponding to a chapter in this volume, address current, critical innovation issues. The first two chapters examine industrial policy in contemporary forms.

The first chapter considers regional innovation engines, which can both underpin regional economic success and help drive technological advance in the economy as a whole. The chapter integrates research and practice to analyze how government, the private sector, and other stakeholders can identify key, place-specific interventions and successfully build local clusters of entrepreneurship and innovation.

The second chapter engages industrial policy in China. It analyzes China's successes and failures in driving technological advances, studying multiple sectors, and draws relevant lessons for industrial policy in other countries. In particular, it highlights that despite the Chinese government's ambitions to shape the direction of the economy, this task has become increasingly difficult, reflecting both the move from being a follower to a leader in many areas of innovation and policymakers' desire to simultaneously achieve multiple policy goals.

The third chapter turns to climate change, focusing on the long life of many durable capital assets, such as vehicles and residential appliances, which can greatly slow transitions to less-

polluting technologies. This chapter analyzes policy levers that could hasten the replacement of old durables in light of efficiency, equity, and political economy considerations.

The fourth chapter examines cryptocurrencies and their regulation. This chapter assesses regulatory approaches amidst the dual goals of limiting risks and encouraging innovation. Finally, the last chapter considers science in Ukraine, studying how the Russian invasion has undermined Ukrainian science and the implications going forward.

In "Accelerating Innovation Ecosystems: The Promise and Challenges of Regional Innovation Engines," Jorge Guzman, Fiona Murray, Scott Stern, and Heidi Williams provide a new synthesis of research and practice in building local innovation clusters. While the success of places like Silicon Valley has drawn enormous interest among local, state, and national policymakers all over the world, effective recipes for building successful innovation clusters have remained difficult to elucidate. At the same time, many governments, including the U.S. government, are developing novel approaches to spurring regional innovation. These include the National Science Foundation's new Technology, Innovation and Partnerships (TIP) Directorate and its Regional Innovative Engines (RIE) program.

This chapter provides an integrated framework to define place-specific actions that can catalyze and drive regional innovative success. In highlighting the key ingredients, the framework further pinpoints the bottlenecks that a given region must identify and overcome, and the key roles of different stakeholders – from the government to the private sector to universities – in overcoming specific obstacles. The chapter further considers methods and approaches to aligning efforts across stakeholders. As such, grounded in deep research and practice, the chapter provides a cutting-edge guide that can help advance the activities of policymakers and other participants in catalyzing regional innovation.

In "Picking Winners or Propping Up Losers? Challenges of Chinese Industrial Policy," Lee Branstetter and Guangwei Li review long-standing efforts of the Chinese government to advance particular technologies and industrial sectors. The authors develop a set of insightful themes, based on China's experience historically and today, as China returns to a stronger state-controlled economic model and with an increasing orientation on pushing the technology frontier.

A key theme of the chapter lies in the principle-agent problem frequently explored by economists. The difficulty of the central government in defining and measuring appropriate outcomes allows opportunism in implementing industrial policy, where local government leaders, businesses, and other actors have the ability to use resources allotted to the industrial policy in ways that do not fulfill the central government's goal. This problem becomes more acute when the government is trying to push the technology frontier, as fundamental uncertainties in what is feasible or how much effort is required provide actors with still greater scope for opportunistic behavior. In developing these themes, the authors consider several

examples of China's industrial policies – including investments in shipbuilding, microchips, and electric vehicles - and argue that the track record is, at best, mixed.

The electric vehicle case, however, is a relatively promising exception. Here explicit, market-based outcomes (electric vehicle sales) were used to incentivize industrial activity, and this sector has arguably been relatively successful in achieving program goals. This suggests that market-based outcomes can help solve the measurability problems that can otherwise undermine policies. Overall, however, the distilled themes are cautionary, pointing to fundamental challenges in industrial policy that are not unique to China.

In "Retiring Old Capital to Foster Decarbonization," James Sallee engages a critical issue in policy discussions around global warming. Greenhouse gas emissions come in substantial part from durable capital equipment, including cars, furnaces, and electricity plants. Climate policy often focuses on the creation and diffusion of new, clean types of capital equipment that can replace the older capital stock. Sallee emphasizes a central challenge in this replacement process: Existing capital equipment tends to last decades, which can greatly slow the adoption of any new technologies and delay reductions in greenhouse gas emissions. For example, light-duty cars have a typical life expectancy of twenty years, so that even if all new trucks and cars sold were fully electric, many vehicles on the road would continue to burn fossil fuels decades to come. Further, the slow depreciation of the existing capital stock limits demand for new equipment, reducing the market size and hence market incentives to develop these new technologies.

Building on these insights, the chapter considers a menu of policies that can hasten the retirement of older capital goods. These include taxing the pollution itself, taxing older capital equipment, retirement mandates, subsidizing the purchase of clean alternatives, and subsidizing the retirement of older capital equipment. Each policy alternative can work to accelerate the diffusion of clean alternatives, with various efficiency consequences that Sallee discusses. Additional insights concern inequality. Higher-income consumers tend to purchase newer capital equipment (e.g., new cars), while lower-income consumers tend to purchase and use older capital equipment. Consequently, subsidizing the purchase of new, clean vehicles tends to support higher-income households, while subsidizing the retirement of older capital tends to support lower-income households. Subsidizing the retirement of old capital can then have advantages on both efficiency and equity grounds.

In "Cryptic Regulation of Crypto-Tokens," Joshua Gans tackles one of the most contentious areas of innovation policy today: the treatment of novel cryptocurrencies and other crypto-based products, from non-fungible tokens to stablecoins. These novel instruments do not fit comfortably within existing regulatory frameworks (not for the first time when it comes to innovative products and services, as Gans point out). Many government bodies, including the U.S. Securities and Exchange Commission, have sought to "fit a square peg in a round hole," attempting to design regulations by applying existing frameworks that did not foresee the complexity and new features of these novel instruments. Other governments, such as those of

Singapore and the United Arab Emirates, have meanwhile sought to embrace these instruments, in the hopes of establishing themselves as hubs of this nascent financial sector.

Gans looks in depth at the nature of these crypto-token based instruments, as well as the broad range of (especially U.S.) government responses to them. He does not offer a simple formula that regulators and practitioners ought to follow. But given the well-documented weaknesses of the U.S. financial system, he concludes that greater regulatory clarity and sensitivity to the potential benefits of financial innovation warrant consideration.

The final chapter considers implications of Russia's invasion of Ukraine, focusing on the science community. In "War and Science in Ukraine," Ina Ganguli and Fabian Waldinger present novel data on Ukrainian science. They further synthesize research, from many historical contexts, about how conflict impacts the present and long-run capacity of a nation to conduct scientific research. The authors show that published scientific output from Ukraine had already declined by ten percent in 2022 from its pre-conflict level. Further, a sizable number of top Ukrainian scientists took up positions at foreign research institutions. Looking at physical infrastructure, twenty percent of the top 100 universities in Ukraine had experienced substantial physical damage, and five of these top universities had been forced to relocate.

Ganguli and Waldinger consider these findings in light of prior research. The decline in scientific output, loss of scientific human capital, and physical destruction of research facilities have been regularly seen in prior conflicts. These historical experiences indicate long-run consequences from human capital loss: local universities can take many decades to recover. The loss of scientific human capital can occur because war not only reduces scientific output directly but can also reduce teaching and research mentoring that build future generations of scientific and technical human capital. The destruction of physical capital, by contrast, appears to have less persistent effects. Ukraine appears to be following historical patterns, in both the declining output and outmigration of its scientists. The authors discuss potential policy interventions both today and in the post-war environment that can help mitigate the damage of the war on science in Ukraine.

Collectively, these five contributions engage key issues in innovation and entrepreneurship policy today. Regional and national industrial policy, climate change, cryptocurrency, and the war in Ukraine all stand at the forefront of policy discussions. By synthesizing research literatures and developing clear frameworks to address these contemporary issues, these chapters provide substantive conceptual and empirical insight to advance understanding among researchers and policymakers and to highlight and assess numerous policy opportunities.