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Promoting Innovation Ecosystems in Antitrust

A Framework for Antitrust Analysis Applied to Emerging AI Technologies

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About the Author

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Acknowledgments

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Introduction

Innovation is key to improving economic growth and people's standard of living. Approaches to antitrust should therefore focus on mitigating harms to innovation, in addition to "static" welfare measures like prices. Yet while antitrust cases often mention innovation, litigators rarely center cases around it, and courts almost never intervene in the name of harms to innovation. This is in part because antitrust focuses on innovators' incentives, guided by the (limited) understanding that innovation happens because firms work hard at solving problems. We'll call this understanding the **"Innovation-as-Incentives" paradigm**.

Yet in practice, firms' ability to innovate matters just as much as their incentive to innovate. Innovators' ability to innovate comes from a supportive ecosystem that gives them access to different capabilities and technologies that they can combine to make new products and services. Innovation in this way often involves knowledge sharing across communities and organizations, transmitting knowhow through open access to products and services, movement of employees with specific knowledge, and collaboration rather than atomistic competition. We'll call this understanding of innovation the **"Innovation-as-Capabilities" paradigm**.

Driving digital innovation is becoming critically important as the US vies with China for technological leadership in artificial intelligence capabilities and tries to ensure that the domestic benefits of AI are broadly shared. Innovation happens quickest when a wave of different start-ups experiment with different approaches, rather than when concentrated in monopolies. Antitrust policy can play an important role in building a strong AI ecosystem that supports many start-ups with the capabilities they need to innovate. The sector might otherwise be at risk of monopolization by a few Big Tech platforms that have managed to shape innovation ecosystems to serve them in other technology domains (Ezrachi & Stucke 2022). By opening up economic opportunity to more firms, giving more innovators the ability to innovate in AI will also help make the AI revolution fairer.

In practice, the Innovation-as-Incentives paradigm leads antitrust judges not to intervene in innovation cases, as judges focus on the need to protect companies' rights to profit from their investments in innovation. By contrast, Innovation-as-Capabilities concerns suggest a policy geared toward sharing knowledge and critical resources and enabling collaboration. But these concerns are largely absent from antitrust law and debates on innovation.

Centering antitrust around innovation objectives demands that it supports the ability to innovate, not just the incentive, by helping innovators access required capabilities to make new products and services. This brief aims to provide practical guidance on how to bring these Innovation-as-Capabilities concerns into antitrust law, as a complement

to a 2022 report, Innovating Antitrust Law, which originally introduced these innovation paradigms (Ahuja 2022). This brief illustrates how these ideas apply in practice, using examples of OpenAI and generative AI technologies.

Two Models of Innovation: Incentives and Abilities to Innovate

The Innovation-as-Incentives approach suggests that innovation happens because innovators have incentives to work hard at a problem, that innovation is the product of incentive-oriented agents that try to stay ahead of their competitors, and that this same mechanism drives reductions in price and improvements in quality in competitive markets. This approach is rooted in neoclassical economic traditions, which typically understand innovation as arising from the efforts of appropriately incentivized market actors. This approach typically analyzes innovation as something that happens within a particular firm, and that responds to clear material rewards. On this (limited) understanding, innovation policy should aim to maximize the financial incentives of discrete market actors (usually individual firms) to innovate. Antitrust judges, agencies, and litigators have largely adopted the Innovation-as-Incentives paradigm. The traditional approach to antitrust analysis generally reflects this paradigm—defining narrow markets and evaluating horizontal competition between substitutable products within these markets according to well-understood mechanisms of economic harm oriented around firms' incentives.

In practice, the Innovation-as-Incentives way of thinking has led judges to avoid intervening in antitrust cases by focusing judicial attention on the need to preserve the incentives of innovators to invest in innovation. Innovation-as-Incentives arguments thereby operate like an "immune system" against antitrust challenges on innovation grounds, with the pattern of reasoning set out in Figure 1.

Under this innovation immune system, enforcers raise concerns that a firm's conduct harms innovation. Litigators and the court, relying on neoclassical economic reasoning and legal precedent, invoke Innovation-as-Incentives arguments, to see if the conduct increases or reduces innovation incentives. This triggers neoclassical antitrust's "antibodies" to fight antitrust intervention: The court then homes in on the need to protect a firm's ability to profit, and declares that innovation arguments favor non-intervention, rendering the firm immune to reforms that prioritize access to innovative capabilities. Each new innovation case adds to the weight of precedent, strengthening this immune system each time it is triggered.[1]

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[1] See Ahuja 2022 for more details and exploration of case law.

Figure 1: Antitrust's Innovation Immune System
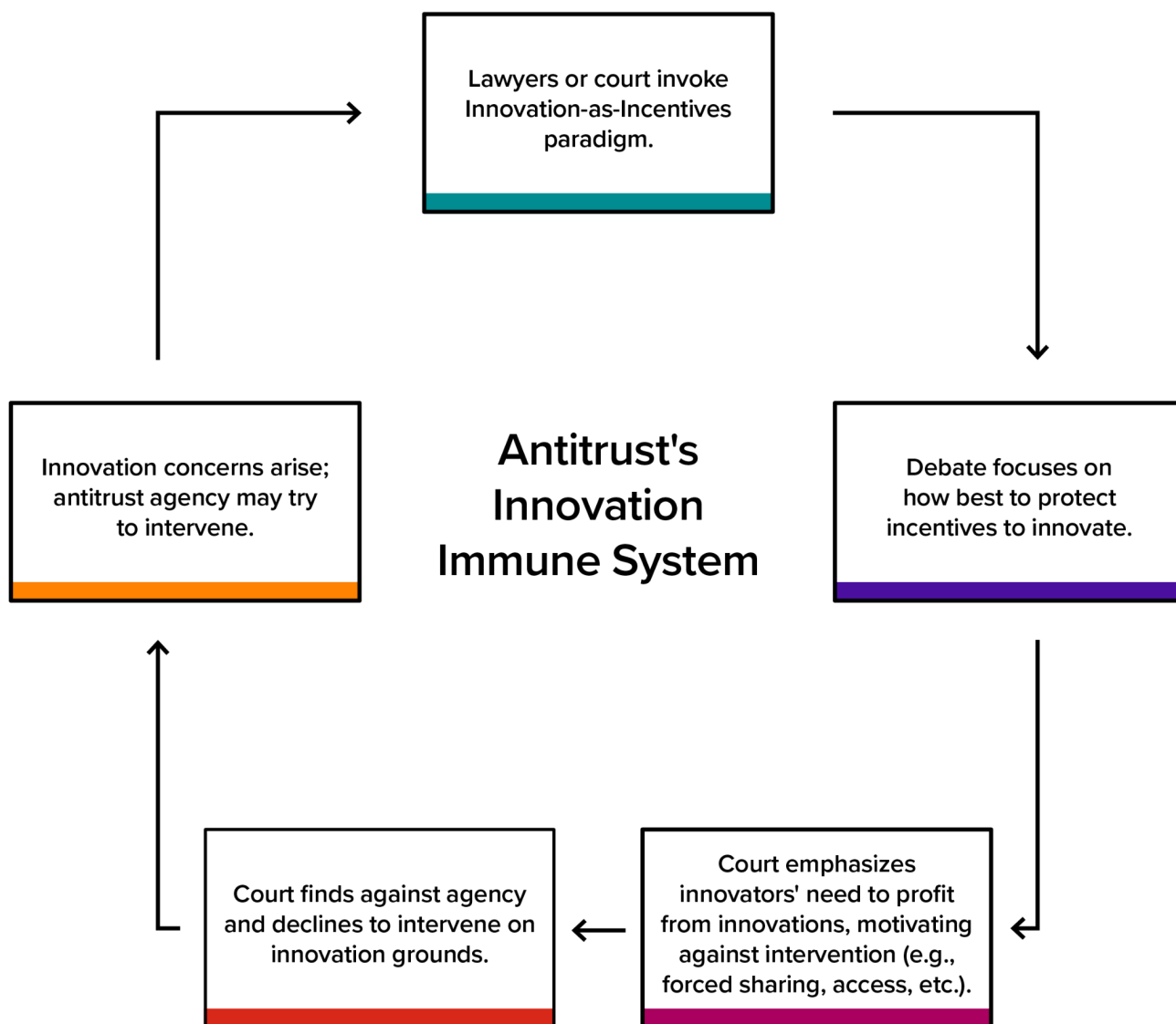
The Innovation-as-Capabilities approach, by contrast, focuses more on the ability to innovate—and understands innovation as "emerging" from a structure of social and technological relations that are conducive to innovation. This approach focuses more on the relationships between firms, talent, customers, investors, research institutions, and partners, and understands innovation to come from sharing knowledge and resources among a variety of actors. This approach draws broadly on research from different fields in the social sciences and suggests that innovation policy should aim to structure social and technological relationships in ways that support innovation.[2]

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[2] Innovation has been heavily studied in the social sciences over the last 50 years. Research has arisen from many different perspectives, and there may be other paradigms on innovation that are relevant to

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<u>OpenAI Demonstrates How Sharing Knowledge, Resources, and Capabilities Drives Innovation</u>

OpenAI is a leading artificial intelligence start-up in the US, and the creator of ChatGPT. It was founded in 2015 as a nonprofit research institute, researching AI, that was committed to open-sourcing and publishing its research. Khalifeh Al Jadda, Google's director of data science, explained in a March 2023 LinkedIn post how the sharing of information and capabilities accelerated AI research:

OpenAI is no longer "open"! The co-founder has stated that it was a mistake to open-source GPT and that they will no longer open-source their models or share details on how they trained them because of a fear of losing competition. This is a dangerous development, as the advancement we have seen in AI is a result of the open-source mindset. . . . it's frustrating to see GPT-4 closed off by a company that has benefited the most from open-source. This is a move back to the "trade-secret" era, which will stifle innovation and progress in AI. Open-source software is a critical part of the AI ecosystem. It allows researchers to share ideas and build on each other's work. It also allows companies to build products and services on top of open-source software. OpenAI's decision to close off its models and training data will have a negative impact on the AI community. It will make it more difficult for researchers to advance the field and for companies to build innovative products and services.

OpenAI's decision is also a missed opportunity. The company could have used its platform to promote the open-source mindset and encourage others to contribute to the AI ecosystem. Instead, it has chosen to close itself off and stifle innovation. (Al Jadda 2023)

Al Jadda's comments demonstrate how sharing knowledge across organizations, firms, and teams is critical to driving innovation—in AI and more broadly. Sharing drives innovation independently of firms' incentives to invest in innovation.

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Economic research supports both the Innovation-as-Incentives and Innovation-as-Capabilities paradigms. Each paradigm focuses on different aspects of innovation, which leads to complementary policies (see Table 1).

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antitrust. The vast and diverse literature on innovation is difficult to summarize comprehensively, and this paper does not attempt to do so. See Ahuja 2022 for a fuller description of this literature.

Table 1: Contrasting the Incentive and Ability Approaches to Innovation

	Incentive to Innovate ("Innovation-as-Incentives")	Ability to Innovate ("Innovation-as-Capabilities")
Approach to Innovation Focuses on:	Agents or innovators (generally firms)	Relationships between agents; the ecosystem
Innovation Happens Because:	Innovators apply effort to a problem motivated by incentives	Innovators have access to all the capabilities or technologies they need to create new products and services
Innovation Policy Should:	Maximize innovators' incentives to innovate	Maximize innovators' access to necessary capabilities

But antitrust law primarily adopts the Innovation-as-Incentives approach, and neglects the Innovation-as-Capabilities approach (Ahuja 2022).[3] This matches the claim that is gaining traction in antitrust circles that antitrust law is missing some relevant "ecosystem" dimension of innovation (Caffarra 2023; Jenny 2021). Traditional approaches have led courts to avoid intervening in many innovation-focused cases that have broadly concerned antitrust enforcers, such as in Google's acquisition of Fitbit,[4] Microsoft's acquisition of Activision,[5] and Meta's acquisition of Within,[6] as well as in several unilateral conduct cases (such as *New York et al. v. Facebook*).[7]

> ### Antitrust's Traditional (Innovation-as-Incentives) Approach Will Struggle to Properly Govern Big Tech's AI Investments
>
> Big Tech companies are driving huge investments in generative AI technologies, with Microsoft and Amazon providing around two-thirds of all investment in generative AI start-ups in 2023 (Hammond 2023). Many in the antitrust

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[3] Some features of antitrust incorporate an implicit "nod" to a capabilities-based approach to innovation (such as provisions condoning research collaborations in the EU's Research and Development Block Exemption and the US's National Cooperative Research Act of 1984). But where these solutions appear, they feel more like an afterthought carved out in marked contrast to antitrust's governing incentive-oriented economic reasoning.

[4] "Mergers: Commission Clears Acquisition of Fitbit by Google," Text, European Commission - European Commission, accessed July 6, 2022, https://ec.europa.eu/commission/presscorner/detail/en/IP_20_2484.

[5] FTC v. Microsoft Corp., 2023 __ F.Supp.3d __ (United States District Court for the Northern District of California, July 10, 2023).

[6] FTC v. Meta Platforms Inc. Case No. 5:22-Cv-04325-EJD.

[7] New York v. Meta Platforms, Inc., 66 F.4th 288.

community have raised concerns about this attempt by the largest tech platforms to build stakes in generative AI frontrunners, as it threatens to cement Big Tech's dominance in the digital economy (West 2023). Driven by these concerns, President Biden issued an Executive Order on AI that aims to help small businesses access AI resources (White House 2023). The US Federal Trade Commission (FTC), the European Commission, and the UK Competition and Markets Agency have all launched investigations into Big Tech's investments in generative AI start-ups (FTC 2024; European Commission 2024; CMA 2023).

A traditional antitrust approach to these transactions would involve defining specific product markets around use cases for generative AI technologies, assessing overlap with specific product markets that Big Tech platforms compete in, and then characterizing the relationship between the AI start-up and the Big Tech platform as horizontal, vertical, or conglomerate.

Analysis would then assess whether an activity relevant to antitrust (such as an investment, merger, exclusivity agreement, or potentially abusive unilateral conduct) would create or contribute to market power in any specific product market in a way that antitrust prohibits. The nature of the analysis depends on the specific enforcement event, but would likely have to overcome the following substantial hurdles:

1. The product markets in which generative AI companies compete are nascent; few start-ups (except OpenAI) have clear leadership positions or large market shares.
2. AI start-ups and Big Tech platforms will often be in vertical or conglomerate relationships rather than direct horizontal competitors. Analysis may have to articulate "vertical leveraging" theories of harm that have been hard to argue successfully in cases.
3. Many of the transactions that concern antitrust enforcers are minority investments that don't meet antitrust's change of control thresholds for mergers, or exclusive licensing arrangements that antitrust courts typically don't consider to be abusive.
4. Defendants will argue that intervention will chill innovation incentives in a fast-changing and dynamic field. This will trigger antitrust's innovation immune system, leading to nonintervention.

Antitrust's traditional Innovation-as-Incentives approach will likely fail to adequately capture the antitrust community's concerns or ensure that the public will benefit from generative AI. It will instead allow the large technology platforms that use generative AI to cement their dominance. Academics such as Tejas Narechania and Ganesh Sitaraman (2023) have accordingly concluded that *ex ante* regulation and industrial policy initiatives are likely to be more effective

As agencies increasingly make innovation arguments (without also challenging antitrust's underlying incentive paradigm), they trigger antitrust's "innovation immune system," which is reinforced as each case adds to the weight of legal precedent. This overactive immune response is damaging its host by preventing a more balanced approach to innovation within antitrust law that is better supported by economic research.

Reorienting antitrust to promote innovation demands that we prevent this "innovation immune system" from misfiring, by complementing the underlying paradigms around Innovation-as-Incentives with an appreciation of how innovators also need required capabilities to innovate. The next section explores how to bring this perspective into antitrust law.

Bringing Innovation-as-Capabilities into Antitrust Law: Objectives of a Capabilities-Oriented Antitrust Framework

Operationalizing the Innovation-as-Capabilities approach requires a simple, tractable model of how innovation happens. This model is that innovation happens when people can combine capabilities in different ways to create new products and services. The rest of this paper aims to develop these policy approaches and legal tests for antitrust regulators and courts.

An Innovation-as-Capabilities approach would focus on the following issues (which antitrust currently neglects):

- The capabilities that firms have access to, which define the products and services firms can create;
- The relationships between agents who do or do not collaborate or share capabilities;
- The inputs and outputs to technical processes;
- Tacit knowhow that is hard to transfer;
- The diverse motivations of innovators that may not be captured in a model of economic incentives; and
- The process of experimental recombination in search of a product that fills a need that is inherent to the innovation process.

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To promote the ability to innovate, antitrust should make it easier for innovators to access important capabilities as inputs into the innovation process. It could do so by ensuring important capabilities are tradable as market commodities (for fair compensation), making technologies interoperable to create an open, modular innovation ecosystem, applying nondiscrimination remedies and structural separations where appropriate, and helping workers move freely between firms, taking their knowhow with them ([Ahuja 2022](#)). This parallels facets of industrial policy, in which the government coordinates innovation communities, facilitates clusters or ecosystems, and shapes the pace and direction of innovation (Mazzucato 2013).

Access to capabilities can be a remedy (mandating access to solve a competitive harm in a marketplace), or an abuse (where competitors prevent access to capabilities as a competitive harm). An open list of considerations involved in promoting access would include:

- *Geographic access to capabilities.* This would include, for example, ensuring mergers do not remove important capabilities from a region by closing an important R&D facility.
- *Prohibiting exclusivity relationships that reduce access to capabilities*. Exclusivity relationships can tie capabilities to particular companies or customers.
- *Access to components or modules*. Using antitrust to package components into modules tradable on an open market would enhance access to capabilities for innovators.
- *Interoperability*. Controlling key interfaces to make different technologies interoperable would promote innovation by helping innovators combine capabilities more easily.
- *Access to talent*. Freeing workers to move around—for example by banning worker noncompetes—would make it easier for firms to adopt new capabilities. The FTC has recently used its rulemaking powers to ban worker noncompetes, partly to promote innovation.

This approach needs a limiting principle: Antitrust should open access to capabilities to as many potential innovators as possible, *without undermining incentives to innovate*. Policymakers should thereby find a balance between Innovation-as-Incentives and Innovation-as-Capabilities in determining antitrust's overall approach to innovation cases.

Generally, antitrust inquiry focuses on *substitutes*—defining a set of substitutable products that constitutes a market and assessing conditions of competition for that set. A capabilities approach would focus instead on *complements*—sets of new or unique capabilities that are synergistic with what a firm already has and thereby add value. Capabilities matter to competition *in their diversity*, *not in their substitutability*. This approach understands that capabilities are highly heterogenous (rather than fungible)

and difficult to replicate, and that capabilities become more valuable the more one has, as they allow one to make a wider variety of products and services (Hausmann et al. 2014). Seen in this way, analysis should focus less on monopolizing a new static vertical and more on efforts to control a new set of capabilities that can add value to a platform or ecosystem as a whole.

<u>Corporate Executives and Industrial Policymakers Adopt a "Capabilities" Approach to AI Innovation</u>

Microsoft executives see generative AI as a broad, complementary capability that the company can infuse across many of its product lines, rather than as a substitutable competitive product ([Microsoft 2023](#)). This gives Microsoft an "ecosystem advantage," where control over its ecosystem offers it better access to monetize AI through existing market channels than competitors.[8] Microsoft's strategy in AI is therefore to secure the best AI resources and assets, while also depriving its competitors of these assets where possible. Antitrust enforcers need to respond to this commercial strategy by adopting a similar perspective.

President Biden's October 2023 Executive Order on AI also demonstrates this capabilities-oriented understanding of what drives AI innovation. Its policies to promote innovation include providing resources, data, and technical assistance to small businesses, researchers, and entrepreneurs that may struggle to access these essential capabilities. It also helps talented AI experts from abroad work on AI in the US ([White House 2023](#)).

[8] With thanks to Amba Kak for "ecosystem advantage" terminology.

A New Lexicon for Applying an Innovation-as-Capabilities Framework in Antitrust

The antitrust community needs a new lexicon to debate arguments based on the Innovation-as-Capabilities paradigm. We have a common language to speak about incentive-oriented topics, like market definition; horizontal, vertical, and conglomerate markets; and competitive abuses like cross-market leveraging. We need a similar lexicon for the Innovation-as-Capabilities approach, and what follows aims to provide a groundwork of key concepts. A full glossary of Innovation-as-Capabilities terms is included in Appendix 1.

Capability: The ability to do or make something that is economically valuable (i.e., applied knowledge that a firm can trade). Capabilities are easily transferred as knowledge embodied in products (it is easier to buy a component, product, or service than to learn how to produce it yourself) or by hiring workers and teams with knowledge of a certain domain (Balland et al. 2022). A capability could be contained in a firm, product, or team. Its importance arises because it is an ingredient, node, or resource within an ecosystem or production network, rather than itself an actor. An Innovation-as-Incentives approach, by contrast, focuses on incentives of firms as actors, competing within product markets.

Figure 2. Capabilities and Their Transmission
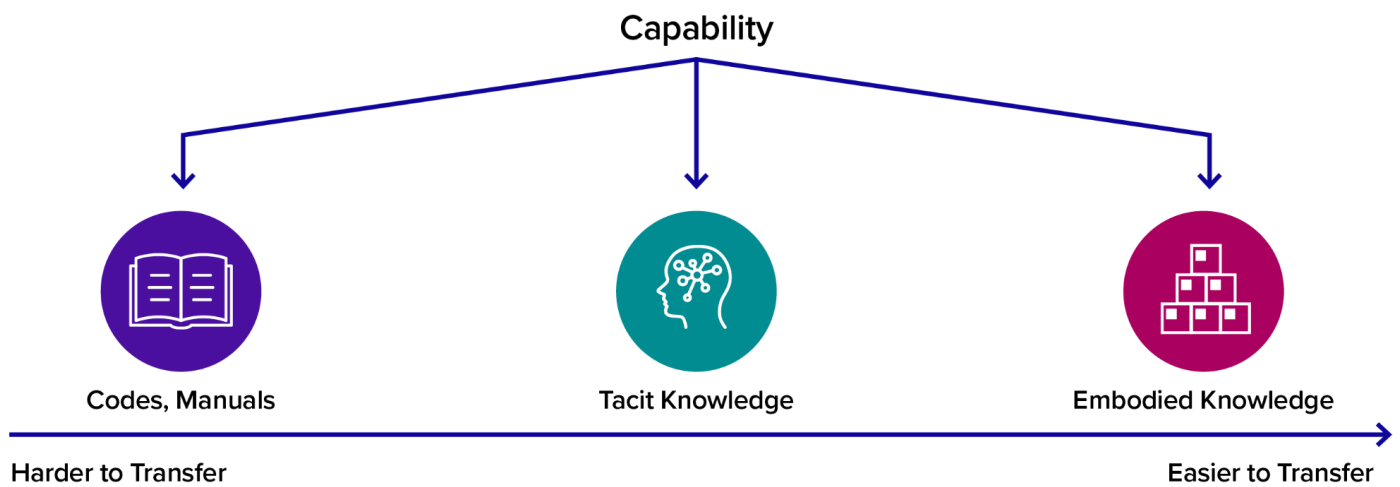
Technoeconomic Domain: The collection of capabilities that define a specific category or region for innovation. For example, innovating in AI foundation models requires a technology stack including cloud computing, GPU chips, AI engineers and researchers, and a very large corpus of data on a topic. Incentive-oriented antitrust rules start with market definition, which implicitly adopts neoclassical paradigms. Capabilities-oriented rules need to start at a different point: focusing on the inputs to and outputs of the innovation process that collectively form an ecosystem that can enable collaboration.

Figure 3. Contrasting Market Definition (Based on Incentives) and Technoeconomic Domain (Based on Capabilities)
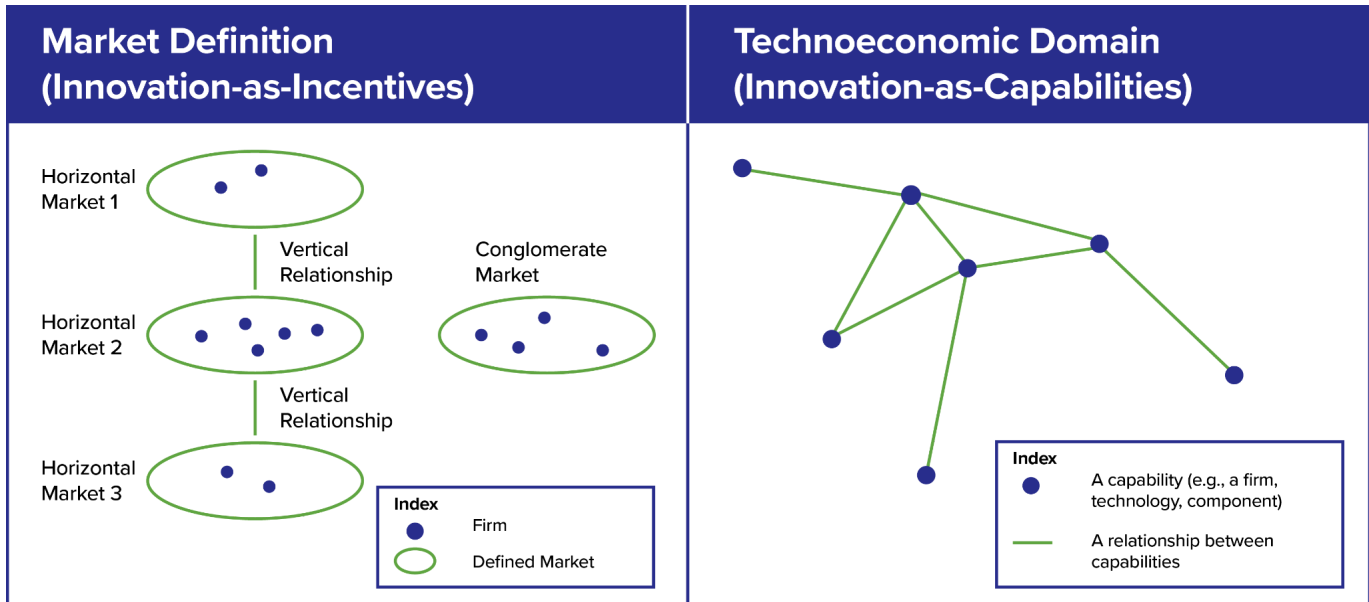
Modules: Collections of capabilities that are organized into tradable products, services, or units of production. A module can operate as a going concern on a standalone basis: A company built around commercializing one module could in principle be successful—a module is not merely a feature that can only exist as part of a wider product. Modules empower innovators to create new products and services (Baldwin and Clark 2000). Creating something new involves developing the ability to do many new things all at once. Being able to 'import' components by purchasing them on the open market makes it easier to develop new products and services. A module is best thought of as a firm or independent business unit built around one product or service; its corollary under the Innovation-as-Incentives paradigm might be a firm, product, or business unit that may compete with others in a product market.

Modularization: The process of ensuring that modules of production are tradable as commodities on the open market on a nonexclusive basis.

Application in Antitrust Law: Abuses (Protecting Innovation) and Remedies (Promoting Innovation)

Innovation-as-Capabilities arguments address the *ability* to innovate rather than the *incentive*; in each case, litigators should ask whether the harm addresses the ability or the incentive to innovate. Innovation-as-Capabilities arguments apply both to efforts to protect innovation (through findings of abuse), and to promote innovation (through application of appropriate remedies).

Because Innovation-as-Capabilities reasoning targets different issues from Innovation-as-Incentives reasoning, agencies should therefore apply legal tests based on Innovation-as-Capabilities in addition to existing analyses. For the most part, these tests add to but do not change existing tests, allowing us to target newly recognized competitive harms in addition to the ones we already understand well.

Some cases may raise issues about both the ability and incentives of innovators to innovate. Agencies should bear in mind our limiting principle: Antitrust law should promote the *ability* to innovate, so long as it does not undermine the *incentive* to do so. This demands that in each case, antitrust enforcers and courts assess whether innovation incentives are meaningfully reduced for real world actors. Innovation payoffs are highly uncertain, with a high degree of success based on luck. Practical judgment is required; complex, theoretical modeling exercises may be less useful.

Protecting Innovation: Abuses

Abuses that could harm innovation involve denying access to important capabilities. This can happen across the three pillars of antitrust: anticompetitive agreements, mergers, and unilateral conduct.

Abusive Agreements

Standard antitrust analysis of agreements suggests that they are abusive when they try to limit competition or inflate prices, such as with price fixing or market sharing arrangements. By contrast, agreements between companies can harm innovation (under a capabilities lens) when they attempt to control or prevent others from accessing a certain set of capabilities. The harm lies in using agreements to cultivate preferential access to a set of capabilities needed for innovation in a technoeconomic domain.

Agreements that may harm innovation include:

- *Exclusivity agreements that tie up important technologies or capabilities through exclusive partnerships.* Agreements that *nonexclusively* license capabilities can improve access to those capabilities for the parties to the agreement, without reducing access to those capabilities for other members of the ecosystem as a whole. *Exclusivity* agreements, however, erode access to a set of capabilities for third parties who are not part of the agreement. Agreements to nonexclusively license capabilities generally promote innovation, whereas exclusivity agreements may undermine innovation when they remove a set of capabilities from open access within an ecosystem.
- *Employee noncompetes that prevent employees from changing jobs*. This affects the transmission of capabilities, particularly when employees have specialized knowhow, since one of the fastest ways to transfer capabilities is through the movement of people who understand a topic.

Exclusivity Agreements and Employee Noncompetes Have Shaped the AI Ecosystem

Many Big Tech investments into generative AI companies have involved exclusivity agreements. Microsoft's initial investment into OpenAI, for example, stipulated that Microsoft would have first rights to commercialize OpenAI's technology ([Bradshaw, Criddle, and Murgia 2023](#)). These exclusivity agreements are under investigation by the FTC, the European Commission, and the UK Competition and Markets Authority, but the incentive-oriented structure of antitrust would make intervention against these agreements difficult. This clearly represents an attempt to tie up an important emerging capability. Analysis under the Innovation-as-Capabilities paradigm could control this attempt more directly than the prevailing Innovation-as-Incentives approach, which would involve assessing whether these agreements have changed actors' incentives and thereby miss the commercial rationale for these activities.

The FTC has banned employee noncompetes, which could encourage employees to move between firms, thereby promoting innovation. For example, California does not enforce employee noncompetes,[9] and many leading AI start-ups have emerged from AI researchers breaking away from other organizations (such as the start-up Anthropic, founded by former OpenAI employees).

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[9] See Section 16600 of the California Business and Profession Code which states that "every contract by which anyone is restrained from engaging in a lawful profession, trade, or business of any kind is to that extent void."

Mergers

Merger policy should keep important capabilities independent and make them available to many innovators, not just to aggressive and well-funded acquirers. A merger policy guided by the Innovation-as-Capabilities approach would favor licensing capabilities to different market actors on a nonexclusive basis over consolidation within a single firm through a merger.

Established thinking in US antitrust law suggests vertical and conglomerate mergers only matter when they might affect horizontal competition within a market. An Innovation-as-Capabilities perspective would take vertical and conglomerate mergers much more seriously. Its focus would be on vertical and conglomerate relationships of *complementary* products, rather than horizontal competition between *substitutable* products.

Mergers may have innovation benefits in that they give the acquirer greater access to the target's technology than an arms-length open-market agreement can ever achieve. This can be helpful when the acquirer and the target need to codevelop new technology. Courts and enforcers must weigh this benefit against the harm of restricting access to the target's capabilities by others in the marketplace, both at the time of acquisition and into the future. Protecting efficiencies therefore means a different thing in mergers that raise Innovation-as-Capabilities arguments: not cost savings from removal of overlapping or duplicative assets, but innovation benefits that arise from combining complementary assets, and giving the acquirer greater access to the target's capabilities.

Unilateral Conduct

Innovation-as-Capabilities perspectives would support a strong essential facilities doctrine in innovation cases, alongside other vertical theories of harm like margin squeezing. US courts today are largely reluctant to intervene in these cases to protect innovation incentives. Focusing instead on the ability of innovators to innovate suggests that antitrust should adopt a much more assertive essential facilities doctrine.

The current focus of essential facilities and other vertical harms is to demonstrate an abuse by showing that a dominant company uses market power in one market to leverage its position in another market. These arguments trigger antitrust's innovation immune system: Courts then defend firms' right to profit from their innovations. Capabilities-oriented reasoning allows us to focus on what we really care about in these situations: whether innovators have nondiscriminatory access to important capabilities to create new products and services.

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AI Foundation Models, Platform Strategy, and Essential Facilities

Emerging generative AI companies that seek to commercialize foundation models as technology platforms can be considered essential facilities in that they control an important, hard to replicate platform technology that is expected to be essential for competition in many domains. These companies have so far opened up their capabilities extensively through Application Programming Interfaces (APIs). OpenAI, for example, offers its GPT-4 model's functionality through an API. This reflects best-practice strategy for an aspiring platform company in its early stages, which is to invite many platform collaborators to drive network effects around that platform as opposed to alternative platforms. Facebook used a similar strategy of open access to its social graph through APIs in its early years.

As platforms become more established, frontrunners may control access to their technology more tightly, cutting off access to their capabilities for potential innovators. This reflects Facebook's strategy as its platform became dominant.[10] Antitrust regulators should remain astute to ensure emerging generative AI platforms maintain open access to their capabilities as their platforms mature.

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Balancing Efficiencies and Applying a Limiting Principle

"Efficiencies" and "Balancing" concerns arise in two forms:

1. Transactions such as mergers and exclusive licensing agreements can bring two sets of complementary capabilities together, facilitating innovation between the transacting parties while reducing access to the merger or licensing target's capabilities for third parties. Antitrust may need to balance these innovation benefits and harms. We shall call these arguments "efficiency" arguments.
2. The Innovation-as-Capabilities and Innovation-as-Incentives approaches to understanding innovation are not mutually exclusive—they explain different parts of the innovation puzzle. They are mostly complementary, but antitrust needs to balance between them when they are in tension. We shall call these arguments "limiting principle" or "balancing" arguments.

Regarding efficiency arguments, in practice, Innovation-as-Capabilities reasoning more often supports intervention. Innovation-as-Capabilities arguments generally promote modularizing knowhow into tradable products and services, sharing of capabilities, and giving as many firms as possible access to needed capabilities. In most circumstances,

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[10] See the FTC's litigation against Facebook.

opening up access to capabilities to more innovators will drive more innovation than trying to privatize a set of capabilities as the exclusive domain of one firm.[11]

Accordingly, suggesting that mergers of complementary capabilities within ecosystems are generally good for innovation—as Hovenkamp ([2024](#)) recently has—demonstrates a serious misunderstanding of the economic literature around Innovation-as-Capabilities. The right unit of analysis for an Innovation-as-Capabilities lens is the *ecosystem*, not the *firm*. Buying a complementary capability will always benefit the acquirer, just as buying a horizontal competitor will always benefit the acquirer. What matters to antitrust is that nobody else now has access to that complementary capability—that the acquisition has weakened the strength of the ecosystem or network of knowledge-sharing. In a merger context, antitrust has to balance between innovation benefits to the acquirer and innovation harms to the ecosystem.

As such, nonexclusive licensing or modularizing capabilities will, in most cases, promote innovation more than exclusive licensing or merging capabilities into an acquiring firm. Nonexclusive licensing and modularizing capabilities preserve access for everyone; exclusive licensing and mergers keep capabilities in the hands of only a few, reducing access to capabilities for other innovators.

Regarding limiting principle arguments, Innovation-as-Capabilities and Innovation-as-Incentive arguments are mostly complementary, but occasionally they conflict when providing an innovator with access to another's capability reduces the ability to earn a return from an innovation and thereby reduces the incentive to innovate in the first place.

There's a fair argument that capabilities-based reasoning to promote innovation is more important in antitrust than incentive-based reasoning to promote innovation. If you don't have the ability to innovate, it doesn't matter if you have weak incentives to innovate. Similarly, economic literature recognizes that the need to stay ahead of competitors gives companies a strong incentive to innovate. Innovation-as-Incentives arguments can therefore support antitrust intervention when intervention subjects dominant firms to more competition (for example, by giving a firm's competitors access to its essential facilities), and thereby increases their incentives to invest in innovation. Incentive-based reasoning in favor of this sort of intervention contains a hidden step in the argument: Intervention improves competition by *giving third parties the capabilities needed to enter the market* and thereby increases incentives of dominant players to continue to innovate. Focusing on the *ability* to innovate rather than the *incentive* lets us home in on what we really care about here: the capabilities and inputs that third parties need to enter a market or become competitive in a new domain. The ability to

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[11] See the discussion above, and in particular ([Liang et al. 2024](#))

innovate is therefore, in some sense, more important to antitrust than the incentive to innovate.

Antitrust should scrutinize limiting principle arguments very closely. The payoff to innovation is often so uncertain that it is essentially incalculable. Innovation is synonymous with risk and luck. Most start-ups fail; put another way, in most cases, an entrepreneur's expected payoff in the value of their equity from starting a business is zero. Any precise calculation of innovation incentives falling because of antitrust intervention is phantom econometrics: an effort to calculate an unknowable quantity in conditions of fundamental uncertainty. So long as innovators can still earn a fair return from their successful innovation, antitrust intervention will not discourage other innovators. In other words, this limiting principle should not deter policy from seriously adopting an Innovation-as-Capabilities approach alongside its existing incentive-oriented approach.

Legal Tests to Protect Innovation

Current effects-based analysis[12] in antitrust generally adopts the following process: 1) defining the market; 2) assessing market power of various market players; and 3) assessing whether the conduct or transaction in question harms competition (balancing any efficiencies).

Legal tests around Innovation-as-Capabilities arguments would instead focus on whether innovators can access the capabilities they need to innovate in a technoeconomic domain.

Table 2. Legal Tests Under the Innovation-as-Capabilities Paradigm, Applied to AI

	Test	Application to Generative AI
1.	*Assess the technoeconomic domain.* What inputs and outputs are needed for innovators to innovate in a specific class of technologies? Where do the capabilities in question relate to this input-output network? Are there technological adjacencies between fields that the capabilities in question might	AI start-ups require cloud computing, GPU chips, AI engineers and researchers, a very large corpus of data on a topic, and existing models to tune, among other things.

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[12] Analysis of activities that are 'per se' illegal or anticompetitive 'by object' (such as naked cartels) proceeds differently—often focusing on establishing the facts of the illegal conduct.

	bridge, leading to mixing of capabilities in different ways?	
2.	*Assess whether the capabilities are particularly important.* Are the capabilities in question packaging general-purpose technologies that are applicable to many different functions or industries? Do they embody (or "productize") a particularly complex set of knowledge, or perform a particularly difficult or novel task that incorporates knowhow at the leading edge of a discipline? Are there alternatives to this specific set of capabilities that are broadly accessible to other innovators?	Generative AI technologies are important capabilities in that they can perform many different functions and they embody particularly complex frontier knowledge. There are many generative AI start-ups, but the market is consolidating toward a few core "foundation models" as platforms that can be applied to different purposes. Foundation models are very expensive and difficult to develop and train, with strong platform economics and network effects that drive this part of the AI technology stack to concentrate around a few companies. The tech venture fund Andreessen Horowitz has suggested Generative AI may produce the next consumer platform ([Chan and Moore 2023](#)). A Meta employee recently leaked a highly capable foundation model to the general public, making an open-source foundation model broadly accessible to innovators. Early in its history, OpenAI made its models open source, but for the last several years it has controlled them tightly ([Patel and Ahmad 2023](#)).
3.	*Assess if many market participants can access the capabilities in question.* Do the capabilities constitute a "module" of production that many	Many core generative AI foundation models are not available for market participants to license on equal terms. Research teams at Big Tech companies do not release their generative AI advances to the other start-ups. Start-ups similarly tend to

	participants can trade or license on a nonexclusive basis?	tightly control their research: OpenAI, for example, no longer open sources its foundation models, but it does give Microsoft (its lead investor) rights to commercialize its technology. The recent leak of a capable foundation model developed at Meta has created an open-source foundation model in the public domain (Patel and Ahmad 2023). *Outputs* of foundation models are generally available for innovators to use. OpenAI, for example, lets engineers incorporate its GPT-4 model's functionality through its APIs and lets users create their own custom GPTs.
4.	*Assess whether the conduct will increase or reduce access to the capabilities in question.* Will a merger reduce access to the merger target's capabilities by third parties? Will a company's unilateral conduct throttle or condition access to technologies over time? Will an exclusivity agreement gatekeep or otherwise limit access to a set of capabilities?	This depends on the circumstances. Concerning conduct could include exclusive licenses of AI technology to particular Big Tech companies, acquisitions of companies or teams developing foundation models, and cloud-computing infrastructure providers denying service to start-ups with which their parent companies do not have an investment relationship.
5.	*Balance efficiencies or trade-offs related to access to technologies.* In some cases, transactions or conduct might increase access to capabilities for some innovators and reduce it for others. For example, a merger will increase the acquirer's access to the target's capabilities, but may reduce it for other market participants. Analysis would focus	This depends on the circumstances. These "efficiencies" arguments should generally be strictly constrained, as the focus of analysis is on how a transaction removes a capability from open access by an ecosystem (see the discussion above on efficiencies). Nonexclusive licensing and modularization should accordingly be mandated over

	on how access to capabilities changes between the acquirer, the target, and third parties. We'd consider questions such as the following: Does the acquirer's innovation objective mean that it needs greater access to the target's capabilities? Would the merger bring new capabilities into a preexisting technoeconomic domain? Would the merger cut off access to the target's capabilities by third party innovators? Should the target capabilities remain modularized (i.e., accessible to all innovators in a predefined package), or would it better enable innovation to integrate them more closely with one use case?	exclusive licensing and mergers, where practical.
6.	*Apply our limiting principle.* Open up access to capabilities to improve the *ability* to innovate, so long as antitrust doesn't unduly undermine the *incentive* to innovate on the facts of the case.	In most cases innovation incentives are not meaningfully reduced by antitrust intervention, given that the expected payoff of innovation is fundamentally uncertain (see discussion above). Generative AI offers companies immense commercial potential (Casado 2023). Given the unpredictability of entrepreneurship and innovation, an innovator's reasonably foreseeable expected payoff may remain high even in a world where antitrust authorities intervene in the generative AI ecosystem in a considered way.

In essential facilities cases, the EU's approach to essential facilities questions is a good starting point for a legal test that incorporates Innovation-as-Capabilities arguments.

In the EU, a company with market power[13] will be obliged to share an essential facility where:

1. The company's refusal to share its facility prevents a new product from arising;
2. The refusal was not justified; and
3. The refusal prevents competition on a distinct secondary market.[14]

This approach frames a rule around using an existing facility to create a new product or service. This seems congruent with the Innovation-as-Capabilities paradigm in that it uses antitrust to open up access to existing capabilities that are not traded on the market and are required to produce an innovation.[15]

> ## Open Source and Power over the AI Ecosystem[16]
>
> All else equal, highly capable open-source AI foundation models enable more innovators to innovate in generative AI, as these models give innovators access to a body of source code they can apply to different applications. But open-source models alone won't be enough to empower innovators outside Big Tech companies in generative AI.
>
> Open-source software can be more or less "open." Some open-source software systems are only somewhat open: They are not transparent or reusable to outsiders. Big Tech companies often exercise leadership and curation among open-source communities to shape these communities to their ends. Open source is a spectrum between partial and fully open software programs.
>
> And even maximally open AI foundation models don't solve for problems of access and power over the AI ecosystem. Concentration on other levels of the AI tech stack such as chips, cloud resources, and platform intermediaries remain unaffected by open-source software models. And tech companies that control

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[13] In European framing, a position of dominance.

[14] *IMS Health GmbH & Co OHG v NDC Health GmbH & Co KG*, Case C-418/01, Court of Justice, [2000] ECR I-5039.

[15] Note that European courts did not frame this rule based on an explicit understanding of economic innovation as a process of recombination of capabilities. The key European decisions that created the EU's essential facilities doctrine were short and legalistic, and these rules largely grew out of the facts presented to the European courts in quite a narrow way. The European Court of Justice's decision in *IMS Health GmbH & Co OHG v NDC Health GmbH & Co KG*, Case C-418/01, Court of Justice, [2000] ECR I-5039 is the primary authority for the three-part test above: In *IMS Health*, one company wanted to license a data structure that was protected under IP law from another company to produce a new product. The Court relied on this "new product" element in the facts of the case to distinguish previous authority (Such as *Oscar Bronner GmbH Co KG v Mediaprint*, Case C-7/97 Court of Justice, [1998] ECR I-7791) and establish the test set out above, without reference to any economic understanding of innovation (whether incentive- or capabilities-based).

[16] Thanks to Amba Kak for sharing insights on this topic.

these layers can bend open-source projects to their advantage, absent structural separations and nondiscrimination rules ([Widder, West, and Whittaker 2023](#)).

Promoting Innovation: Remedies

Agencies and courts could also apply Innovation-as-Capabilities reasoning to structure remedies that promote the ability of innovators to innovate. Efforts here would involve designing remedies that improve access to capabilities by modularizing capabilities, technologies, or business units into standalone entities that many market participants can access on a nonexclusive basis (while ensuring the entity that developed the capability earns a fair rate of return to protect its incentive to innovate). Remedies target similar issues in a market's economic structure: exclusivity arrangements, essential facilities that only a restricted set of market participants can use, mergers that aim to remove "modules" of production from open market access, etc.

These remedies may look similar to certain remedies that are currently widely debated in antitrust communities, like interoperability, structural separations, and divestitures. But basing them on economic reasoning around the *ability* to innovate rather than the *incentive* to innovate allows for agencies and courts to reach these remedies on clearer economic reasoning and to design them more appropriately. Reasoning that structural separations, nondiscrimination, divestitures, and interoperability improve innovation incentives by making leaders in a market work harder to stay ahead of their competitors always feels a little convoluted, and it is no wonder that an incentive-oriented mindset biases courts and agencies toward nonintervention (as argued above).

In fact, current incentive-based reasoning in favor of these sorts of remedies contains a hidden step in the argument: Interoperability remedies improve competition (by giving third parties the capabilities needed to enter the market) and thereby increase incentives of dominant players to continue to innovate. Focusing on the *ability* to innovate rather than the *incentive* lets us home in on what we really care about: the capabilities that third parties need to enter a market or become competitive in a new domain. Focusing on the ability to innovate stops incentive-oriented reasoning from getting in the way in this sense.

Innovation-as-Capabilities arguments apply to competition policy more broadly than merely in antitrust actions: They apply also to industrial strategy and competition regulation. The US government's efforts to open up Tesla's supercharger network to many different EV companies is a good example of this: It represents an attempt to open up access to capabilities by many different market players, and thereby make it easier for new competitors that seek to challenge Tesla's dominance to emerge. Similar

efforts by European regulators have helped Europe develop a more dynamic and mature EV market faster than the US (Patel and Ahmad 2023).

> ### Complementary Antitrust and Industrial Policy in AI
>
> One of the biggest costs for AI start-ups is the enormous cost of computing power to train AI models. This makes computing resources a key constraint on innovation, and gives Big Tech platforms that offer commercial cloud computing power over AI ecosystems. Some have suggested that the government develop a nonprofit cloud computing platform for small AI start-ups using government supercomputers as part of its industrial policy, to accelerate AI innovation in the US and level the playing field for small start-ups that want to innovate in AI (Narechania and Sitaraman 2023). President Biden's Executive Order on AI similarly aims to give entrepreneurs and small businesses resources and technical assistance. This industrial policy could complement antitrust actions to keep commercial cloud computing platforms open and nondiscriminatory.

Conclusion

It's worth reflecting on what really changes by adopting a "capabilities" approach to innovation in antitrust analysis. An incentive-oriented approach to innovation questions suggests that we should balance between letting companies profit from their innovations and ensuring that they face sufficient competitive pressure from rivals to keep innovating and stay ahead of their competition. In principle, this perspective supports a balanced approach to intervention on innovation grounds—that is, intervening in certain circumstances to preserve competitive market structures, mandate access to essential facilities, ban mergers, etc. These arguments implicitly assume that when we do intervene, we give upstart competitors a better shot at competing in the market, thereby improving their ability to innovate.

More generally, Innovation-as-Capabilities arguments don't change the fundamental trade-offs that antitrust action involves. Intervention still encroaches on property rights, limits commercial freedom, intermediates private power relationships, mandates sharing, can involve tricky-to-manage government oversight of private affairs, and overrides investors' abilities to maximize the value of their assets. Intervention still enmeshes government regulators in context-specific questions around how to manage the economy. Antitrust remedies also offer a limited menu of options to choose from, including structural separations, nondiscrimination, interoperability, prohibiting mergers, or requiring divestments. A capabilities-based approach to innovation questions still must apply remedies from this same possible universe of antitrust authority.

But approaching innovation issues solely as questions of maximizing incentives shapes the questions we ask, what we focus on, and ultimately the way we craft and apply antitrust remedies. Innovation is about incentives, but it is also about creating supportive ecosystems. In focusing only on incentives to innovate, courts, agencies, and antitrust economists adopt an orientation toward allowing innovators carte blanche to profit from their efforts, biasing against intervention. This becomes the easiest story to tell. Overall, exclusively focusing on innovation incentives gives antitrust its innovation "immune system," which leads courts and agencies to pull back from potentially beneficial interventions out of a theoretically motivated fear of chilling innovation.

The Innovation-as-Capabilities framework rebalances our mental models, focusing not just on the incentive to innovate, but also on an approach to understanding the ability to innovate that is well-grounded in economic research. This makes for better economic reasoning in antitrust cases by expressing more clearly how and why intervention can promote innovation. Most importantly, it dampens antitrust's innovation "immune system." It counterbalances our impulse to let innovators exploit their innovations with an understanding that today's innovators could access all the capabilities they needed to innovate in their technoeconomic domain, and that we should empower tomorrow's innovators with similar access to needed capabilities.

We should bring this "capabilities" approach to innovation into antitrust today, even though we don't currently have good empirical tools to analyze Innovation-as-Capabilities arguments in antitrust situations. Making progress in the short term relies on adopting robust research-backed paradigms and mental models on Innovation-as-Capabilities to integrate an understanding of innovation dynamics in specific cases. Given appropriate signals from policymakers, researchers can develop richer and more empirical tools that structure assessments of the ability to innovate in particular contexts (adapted from disciplines such as network science, input-output analysis, and economic geography).

Innovation is one key to long-run advances in human well-being and economic growth. Adopting the Innovation-as-Capabilities paradigm with vigor would help us center antitrust analysis around innovation and move beyond a myopic focus on measurable prices or product quality. Focusing our assessment on what promotes the ability to innovate, alongside questions related to innovation incentives, is key to making this progress.

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Appendix 1. Glossary of Innovation-as-Capabilities Terms

Capability	1. The ability to do or make something that is economically valuable.
	2. Applied knowledge that a firm can trade, contained in codes, manuals, or tacit knowhow, or embodied in products.
	Capabilities are most easily transferred as embodied knowledge: It is easier to buy a component, product, or service than to learn how to produce it oneself. Capabilities are also easily transferred by hiring workers and teams with tacit knowledge of how to undertake certain activities.
Embodied Knowledge	Knowledge that goes into making a product and that is transferred whenever a product is traded. The recipient of the product gets the benefit of the knowledge that went into making it without themself having to learn how to make it.
Tacit Knowledge or Knowhow	Knowledge at the frontier of a discipline that experts know but that is not written down or codified.
Technoeconomic Domain	The collection of capabilities, products, and technologies that define a specific category or region for innovation. For example, innovating in AI foundation models requires access to a technology stack that includes cloud computing, GPU chips, AI engineers and researchers, a very large corpus of data on a topic, and existing models to tune, but does not require aerospace engineers.
	Antitrust analysis starts with market definition, which aims to specify a collection of products or services that compete directly with each other for the same customers (Figure 3). This implicitly adopts the paradigms inherent in neoclassical economic analyses of competition.
	Legal tests based on research into Innovation-as-Capabilities need to start at a different point: focusing on the inputs and outputs to the

innovation process that collectively form an ecosystem that can enable collaboration. Under this model, innovation happens because innovators can combine different capabilities into new products and services. What matters is that innovators have access to the right capabilities; it matters less whether these capabilities are in horizontal, vertical, or conglomerate relationships (according to their current use cases).

Figure 3 visualizes a technoeconomic domain as a network graph with nodes (points that represent firms, products, or capabilities) and edges (lines representing directional input-output relationships).

Subsystem	A set of capabilities within a technoeconomic domain that have strong relationships with each other, but relatively weak relationships with other parts of the system. Capabilities are nested within each other, forming components and subsystems that go all the way down to the smallest building blocks of production. For example, to a customer, ChatGPT represents a capability. To OpenAI, its engineering team, research team, and computing infrastructure all represent capabilities, organized as subsystems.
Hierarchy	Relationships that organize subsystems within technoeconomic domains, by controlling how different subsystems interact, communicate, and take instruction from each other.
	Subsystems that are closely related to each other in purpose or function will have stronger relationships with each other than with more functionally distant subsystems. For example, in a generative AI firm, AI researchers will collaborate more closely with data engineers than with the firm's legal department. Relationships of hierarchy organize subsystems within systems, by controlling how different subsystems interact, communicate, and take instruction from each other.
Economic Structure	How capabilities are organized into subsystems of varying hierarchy and proximity.

Module	1. A collection of capabilities aggregated into something that someone can trade on an arms-length basis (for example, a component, product, or service traded on the open market). 2. A tradable component of production. A module can operate as a going concern on a standalone basis: A company built around commercializing one module could in principle be successful; a module is not merely a feature that can only exist as part of a wider product. Modules are important because they are how we transmit embodied knowledge: When we buy a product or service, we import all the knowledge required to make or do something without having to master that knowledge ourselves. For example, a user of a generative AI chatbot gains access to all knowledge that went into making it without needing to learn how to program an AI model. Modules that do something very complex, or package unique capabilities, are particularly important. Modules empower innovators to create new products and services. Creating something new involves developing the ability to do many new things all at once. Being able to "import" components by purchasing them on the open market makes it easier to develop new products and services.
Modularization	The process of ensuring that modules of production are tradable as commodities on the open market on a nonexclusive basis. Modularization can be relevant to antitrust in several ways. In merger policy, for example, a merger remedy could carve out a module into a standalone business to open access to those capabilities.
Productize a Capability	Making a product that embodies a complex set of knowledge or performs a particularly difficult or novel task that incorporates knowhow at the leading edge of a discipline.