
CHAPTER

# New Insights for Innovation Policy

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# New Insights for Innovation Policy

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**ABSTRACT**

The US economy has been suffering from weak productivity growth, business dynamism, and competition for the past several decades. The loss of a vibrant economy is even more concerning as the economy faces new challenges such as the transition to green energy that call for novel technological advancements. Reduced technological diffusion in the economy has been impairing the competitive environment favoring established market leaders, with patents and inventors being hoarded by these firms, hampering overall innovativeness and dynamism of the economy. We argue that policies to alleviate these concerns and enhance competition can boost overall innovativeness of the economy. Reducing barriers to foreign competition is an effective option to achieve this goal. Similarly, tapping into global talent is a viable policy to improve the level of human capital.

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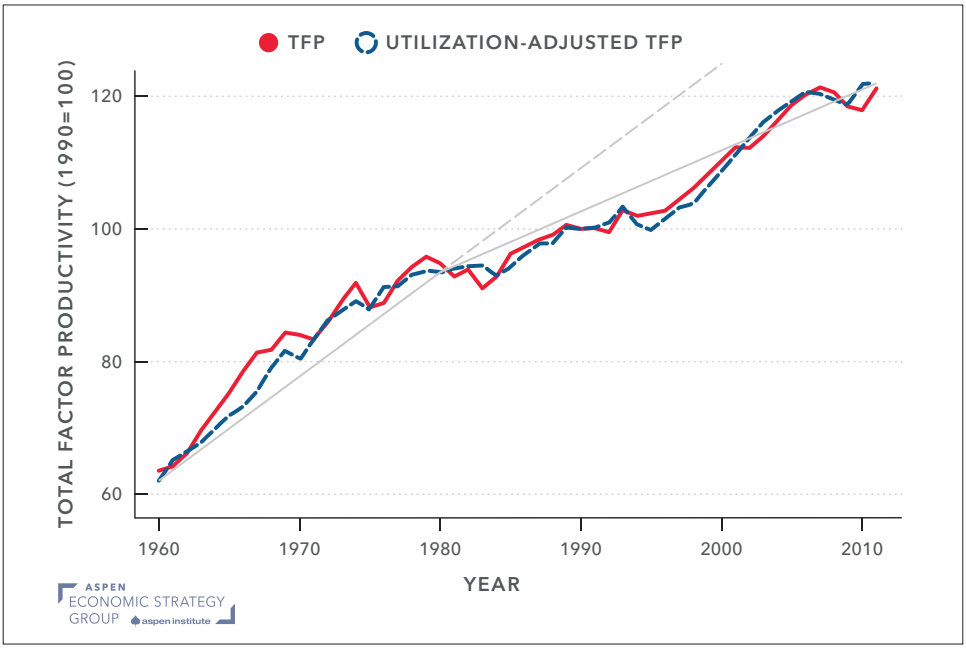
** Federal Reserve Board; the views expressed are those of the author and do not necessarily reflect those of the Board of Governors or the Federal Reserve System.

## 1. Introduction

A central tenet of the literature on economic growth is that innovations and consequent gains in productivity are the main sources of a sustained rise in aggregate output. Recent data on average productivity growth in the United States, as measured by total factor productivity (TFP) growth, therefore present cause for concern. TFP growth witnessed a dramatic decline at the turn of the 1980s and has since remained weak except for a short period during the late 1990s and early 2000s (Figure 1). Meanwhile, business dynamism in the US economy—the perpetual process of firms entering, growing, downsizing, and ultimately exiting the market—through which labor and capital are reallocated toward more productive uses, has weakened considerably since the 1980s, as evidenced by declines in firm entry rates and job reallocation rates. This slowdown is alarming; a healthy degree of dynamism reflects a vibrant business environment in which firms are incentivized to outperform their competitors, and in which resources flow to more productive uses, improving overall productivity. Against this relatively stagnant backdrop enter further challenges, such as the transition to green energy, that will require the US economy to demonstrate vibrancy. The need for technological advances and appropriate policies to foster their development has become ever more pressing.

**Figure 1. Average TFP Growth in the United States**




**Source:** Fernald and Jones (2014).

**Note:** The thin solid line illustrates the pre-1980 (1960-80) and post-1980 (1980-2011) trends in utility-adjusted TFP growth. The average trend growth declines from 1.57 percent in the earlier period to 0.92 percent in the later. For comparison, the straight dashed line extends the pre-1980 trend into the late 1990s.

In this paper, we first describe the factors that have negatively impacted US business dynamism and productivity growth over the past several decades and then discuss policy proposals to overcome those challenges. While we analyze certain innovation policies as key parts of the industrial toolkit, a central and more nuanced theme in our discussion is how these policies interact with the economy's competitive environment. A large body of empirical work documents that competition and innovation are closely related. As canonical theories of economic growth posit, close competition can incentivize firms to invest in innovations that will help them to outperform their close rivals. But growing distortions in the competitive environment, leading to a widening technological gap between market leaders and followers, are a primary factor depressing US business dynamism. Because innovation subsidies are less necessary in more competitive environments, we emphasize that understanding the link between competition and innovation can help to reduce the cost of policy interventions.

*"Reducing barriers to foreign investment in domestic firms fosters innovation and growth even in the presence of most national security concerns about technology flows abroad."*

We start our discussion with a diagnosis of the recent trends in firm entry, growth, and exit dynamics, which point to a marked slowdown accompanied by increases in market concentration across US industries. We also document a reduction in the flow of technical and innovative knowledge from industry leaders to the rest of the market. This reduction in the dissemination of knowledge plays a large role in accounting for these trends, as emphasized in Akcigit and Ates (2022). This widening gap between industry leaders and their competition removes vital incentives for firms to improve and to compete: laggard firms are discouraged, anticipating fewer opportunities to catch up with the industry leader, while leading firms face less competitive pressure to defend their advantages. Relatedly, we discuss empirical evidence that patents and inventors are increasingly concentrated in more established firms.

A primary justification for research and development policies are knowledge spillovers, which create large social returns to innovation, in addition to private returns (Bloom et al., 2013; Lucking et al., 2019; Jones, 2021). Barriers to competition reduce positive knowledge spillovers and thus reduce the return to research and development policies.

Competition from foreign rivals can enhance domestic firms' incentives to innovate. While R&D subsidies are prudent policy options to manage foreign competition, the optimal subsidy rate may be lower in a more globally integrated setting in which

more domestic firms are exposed to foreign competition. By providing the necessary private incentives to innovate, higher competition reduces the need for and cost of government intervention. We subsequently highlight that reducing barriers to foreign investment in domestic firms fosters innovation and growth even in the presence of most national security concerns about technology flows abroad. All told, our analysis of firm dynamics implies that greater foreign competition can serve as an important driver of innovation, especially in the presence of declining domestic competition.

We switch gears in the last part of our analysis and focus on individuals, starting with inventors—the people behind innovations. We begin by noting that immigrant inventors have played key roles in many developed countries' technological evolutions, including in the United States. We then note that immigrant talent responds to incentives just as firms do. Accordingly, we explore policies that affect international talent's choices about where to live and to work. Higher top income tax rates can create significant disincentives for migration, discouraging foreign inventors from relocating and limiting an important source of human capital. We finish by briefly discussing inequality. Although innovation promotes social mobility, it can also exacerbate economic inequality. We argue that some innovation policies, however, may be less prone to these concerns than others.

In sum, countries can benefit from enacting appropriate policies to foster innovation, enhancing competition and human capital in the economy. As productivity measures such as TFP continue to lag behind rates seen in past generations, global resources—whether competitive firms, technology investments, or individual talent—can provide valuable channels to revitalize dynamism and productivity growth in the US economy.

## 2. Slowing US Business Dynamism: Symptoms and Causes

In this section, we first summarize the empirical trends documented in the literature that demonstrate various symptoms of declining dynamism and increased concentration in the US business environment over the past several decades. We then discuss the underlying drivers of these trends, which point to a particular cause: a decline in knowledge diffusion and a deteriorating competitive environment. Next we present new empirical evidence on patents and inventors that echo our earlier findings: increased concentration of innovative resources and outcomes in the hands of established firms. We lastly turn to policy options that could help to reinvigorate the US economy's dynamism and potential for innovation.

### *2.a. Recent Trends in US Business Dynamism*

**Market concentration has increased.** The trend toward increased market concentration—as measured by the fraction of sales captured by the largest firms within industries—has been documented (Autor et al., 2017a,b; Philippon, 2019). Concentration, measured by the Herfindahl-Hirschman index, exhibits similar results though some economists, including Rose (2019), have noted that measurement challenges and the need to disambiguate industries makes this conclusion less certain. Grullon et al. (2017), analyzing Standard and Poor's Compustat data, arrive at a similar conclusion, documenting the marked increase in market concentration in most US industries in the post-2000 era.[1,2]

**Markups have increased.** As documented in Philippon (2019), markups—the amount that firms charge for a good or service above production costs—have been rising in the United States since the 1980s, and more markedly since the early 2000s. Using broader, international data, Calligaris et al. (2018) find a global rise in markups, driven by firms in the top decile of the markup distribution, and a widening average markup gap between digitally intensive firms and other sectors. The research literature pays particular attention to the rise in markups, since markups are thought to serve as a proxy for market power and concentration.[3,4]

**Profit share of GDP has increased.** The profit share of GDP—total corporate profits of nonfinancial domestic US firms scaled by GDP—has likewise been on the rise. Some recent papers investigate the implications of this trend. Gutiérrez and Philippon (2016) argue that higher within-industry concentration, as measured by profitability, is associated with weaker investment. This result resonates with the findings of Eggertsson et al. (2018), who explore mechanisms that can result in higher profitability and a lower investment-to-output ratio, along with other changes.

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1 For other studies on rising market concentration and its aggregate implications, see Barkai, 2017; Gutiérrez and Philippon, 2016, 2017; Eggertsson et al., 2018, among others. In a similar vein, Azar et al. (2017) document concentration in the US labor market using disaggregated data at the geographical-occupational level.

2 In his *Wall Street Journal* column, Larry Summers suggests that a rise in market power may be driving the symptoms of what he dubs "secular stagnation" (https://wapo.st/1UUF0sm?tid=ss_tw&utm_term=.4df9b0193380). In a recent speech, Stiglitz (2017) emphasizes the role of regulation in the rise of firms' market power across the US economy and discusses the adverse economic and political consequences of this shift, particularly increased inequality.

3 Eggertsson et al. (2018) argue that the rise in firms' market power and markups, coupled with a lower natural rate of interest, are responsible for several macroeconomic and asset-pricing trends in the United States observed since the 1970s. Similarly, Farhi and Gourio (2018) find a notable contribution from rising market power to several macro-finance trends. Barkai (2017) also focuses on the effect of declining competition and establishes a similar link between higher markups and lower capital and labor shares.

4 See Nekarda and Ramey, 2013; De Loecker et al., 2017; Gutiérrez and Philippon, 2017; Eggertsson et al., 2018; Hall, 2018, among others; see De Loecker and Eeckhout (2018) for an international comparison. Some recent work (e.g., Karabarbounis and Neiman, 2018; Traina, 2018) disagrees with the evidence regarding the rise in markups on the grounds of measurement concerns, arguing that earlier work dismissed "selling, general and administrative expenses" from variable input costs when computing markups.

**The labor share of output has declined.** The United States has witnessed a steady decline in the labor share of output since the early 1980s (Karabarbounis and Neiman, 2013; Elsby et al., 2013; Lawrence, 2015). A study by Kehrig and Vincent (2018) highlights an even more pronounced drop in the labor share of output within the US manufacturing sector between the late 1960s and early 2010s. This trend is also observed internationally, as demonstrated by Karabarbounis and Neiman (2013) and Autor et al. (2017b).

**Market concentration and labor share are negatively correlated.** Autor et al. (2017b), Barkai (2017), and Eggertsson et al. (2018) document a negative correlation between market concentration and the labor share across US industries.

**The labor productivity gap between industry (technology) leaders and other competitors has widened.** A widening labor productivity gap between industry leaders in terms of productivity level and other competitors provides key evidence for explaining declines in business dynamism. Figure 2A shows that this gap—measured in real value added per worker—has recently widened (Andrews et al., 2015, 2016).[5] Importantly, the authors also find that the aggregate productivity performance is weaker in industries where the divergence between industry leaders and their competitors is larger. This trend resonates with the findings of Decker et al. (2018), who show that TFP dispersion across US firms has risen, as shown in Figure 2B.

**Firm entry rates and the economic share of young firms have both declined.** A widely debated symptom of declining business dynamism in the United States is the decline in firm entry (see Decker et al., 2016a; Karahan et al., 2016; Gourio et al., 2014, among others). Figure 3A illustrates this phenomenon using Business Dynamics Statistics data. The pattern is also common to individual industries.[6] Meanwhile, the share of young firms in economic activity has been steadily declining since the early 1980s (Figure 3B).[7] While several other advanced economies have undergone similar shifts (Criscuolo et al., 2014; Bijnens and Konings, 2018), the decline is particularly worrisome given the substantial role that surviving young firms play in job creation.[8]

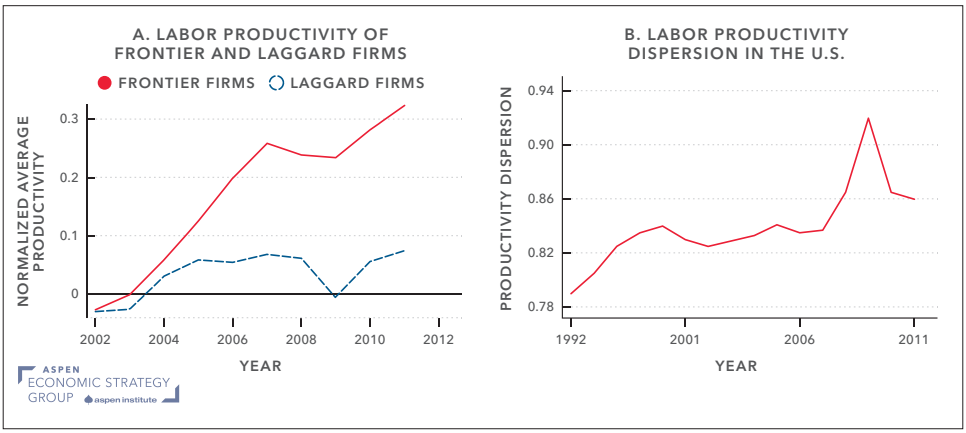
5 This figure reproduces the findings of Andrews et al. (2016), who present a cross-country comparison of five percent of firms with the highest labor productivity (the "frontier" firms) against all remaining firms (the "laggards"). Although the Orbis database used in their study has rather limited coverage of US firms, the authors claim in a complementary work that the firms from advanced economies are well represented in the frontier group (Andrews et al., 2015).

6 Gourio et al. (2014, 2016) find substantial losses in employment and output growth owing to the forgone "missing generations" of firms.

7 Goldschlag and Miranda (2016) document that the decline has been especially pronounced in tech-intensive sectors in the post-2000 period.

8 See Haltiwanger et al., 2013, in the context of the United States and Bravo-Biosca et al., 2013, for an international comparison.

**Figure 2. Widening Labor Productivity Gap**




**Source:** Andrews et al. (2016) for panel A and Decker et al. (2018) for panel B.

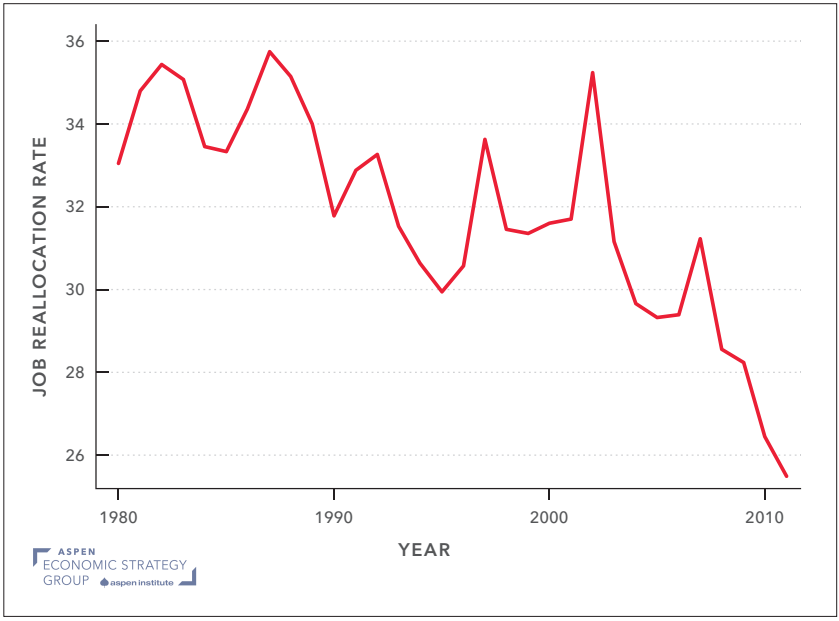
**Note:** Labor productivity is defined as real value added per worker. Panel A derives from OECD countries.

**Figure 3. Firm Entry and Exit Rates and the Employment Share of Young Firms in the United States**


**Source:** Authors' calculations from BDS database for panel A and Decker et al. (2016a) for panel B.

**Job reallocation and churn have receded.** Figure 4 exhibits the secular decline in the gross job reallocation rate, defined as the sum of job creation and destruction rates, in the United States since 1980 (Decker et al. 2016a). The decline has been apparent in the retail trade and services sectors dating back to the 1980s—due in large part to productivity-enhancing consolidation of activity into larger chains at the expense of mom-and-pop shops—whereas in the information sector, a pronounced decline started in the early 2000s.

**Figure 4. Gross Job Reallocation**




**Source:** Decker et al. (2016a).

**The dispersion of firm growth rates has decreased.** As activity by young (and high-growth) firms has declined, the dispersion of firm growth has decreased as well (Figure 5). This shift is particularly notable when juxtaposed against the concurrent rise in the dispersion of productivity across firms. Using data from the US Census Bureau, Decker et al. (2016a) show that the decline in growth dispersion accelerated in the post-2000 period.[9]

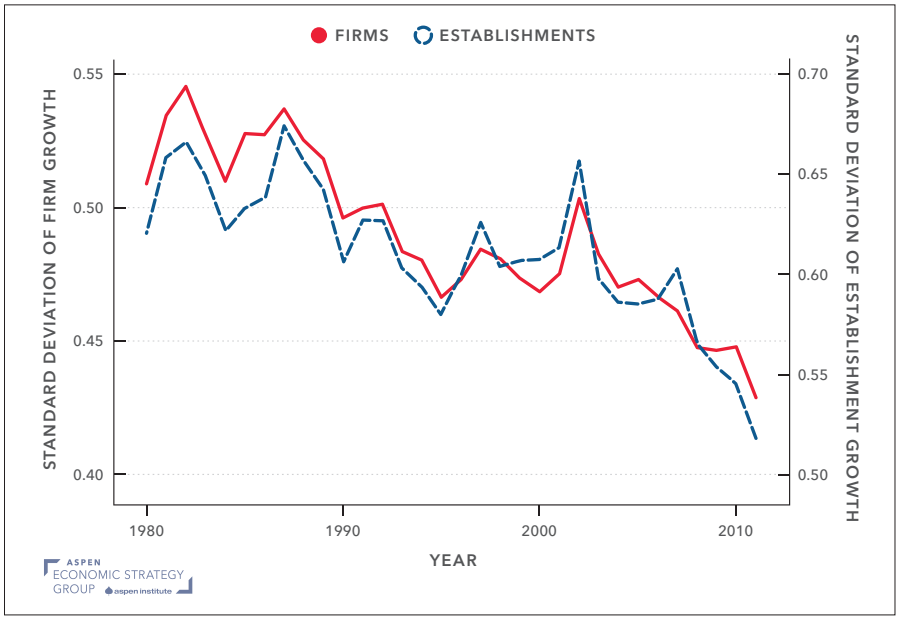
**Productivity growth has fallen.** Finally, a heated debate on which our discussion of declining business dynamism could potentially cast light concerns trends in US aggregate productivity growth (labor or multi-factor) over the past several decades. Except for a short period between roughly the mid-1990s and mid-2000s, US productivity growth appears to have slowed down notably (Gordon, 2012; see Figure 1).[10] Gordon (2016) concludes that broad-impact innovations have been depleted, implying that structurally low aggregate growth will mark the foreseeable

9 The authors argue that this acceleration can be attributed to the decline in young firm activity in high-tech sectors—the sectors that exhibited high growth dispersion in the earlier decades.

10 Syverson (2017) and Ahmad et al. (2017) refute the argument that the measured slowdown in aggregate productivity growth may reflect measurement problems. The studies conclude that mismeasurement could only account for a small part of the decline, if any.

future, a prediction shared by Fernald (2014). Brynjolfsson and McAfee (2014) and Brynjolfsson et al. (2017) disagree, arguing that the diffusion of new technologies such as artificial intelligence will soon boost productivity growth, whereas Nordhaus (2015) expects the opposite.[11]

**Figure 5. Firm Growth Rate Dispersion in the United States**




**Source:** Decker et al. (2016a).

Overall, this body of evidence suggests a decline in business dynamism coincident with weakening competition—that the firm entry rate and the job reallocation rate are falling, among others, while market concentration and markups are rising. Identifying the driving forces behind these trends is still a subject of debate in the academic literature (see Akcigit and Ates, 2021 for a comprehensive review). Our holistic theoretical and empirical approach (Akcigit and Ates, 2022), however, considers all these indicators jointly and examines a variety of potential causes to explain these observations. In the next part, we highlight relevant findings for policy.

11 Fernald and Jones (2014) also point to a possible pickup in aggregate productivity growth due to AI's productivity-improving contributions. They also mention potential spillovers from R&D conducted in developing countries such as South Korea and China, which are poised to provide vast resources for innovative activity.

### *2.b. Knowledge Diffusion and US Business Dynamism*

In Akcigit and Ates (2022), we use economic theory and computational methods to evaluate several candidate explanations for slowing US business dynamism. Our analysis is premised on the model of a perpetual rivalry between two types of firms within a given industry: a "best" leading firm and the "rest" of the rival followers which are competing for market leadership. Using that rivalry as a baseline, our model explicitly formulates the relationship between market competition and firms' strategic investment behavior. We briefly describe here that theoretical model and its application to data.

An important model component is knowledge diffusion, which is important for follower firms that depend on learning from the best practices and technologies of the market leaders to remain competitive and to grow. When knowledge diffusion slows over time, market leaders are shielded from copycat firms, which helps them to establish stronger market power. When the gap between market leaders and their rivals is substantial, market followers become discouraged; their growth is consequently slowed and the productivity gap between leaders and followers widens even further. The first implication of this widening is that market composition shifts to more concentrated sectors. Second, strong market leaders leverage their market advantage to charge higher markups, increasing the profit share and decreasing the labor share of GDP.

Potential entrant firms are discouraged by the relative strengthening of incumbents, and entry decreases, reducing competitive pressure on the market leader. Facing less of a threat to their business models, market leaders relax and experiment less. Overall dynamism and experimentation in the economy decreases. Lower innovation investment by firms contributes to lower productivity growth over time, causing the equilibrium interest rate to fall.

Using quantitative methods to test this theory, the results mirror the economic trends we describe above: a sharp decline in knowledge diffusion in the US economy that results in greater concentration, higher markups and profits, a lower labor share, and reduced business dynamism as reflected by fewer young firms, less job reallocation, and slower productivity growth.[12]

12 Akcigit and Ates (2022) account for all economic indicators discussed above in Section 2. Applying quantitative methods, we use the model to mimic salient features of the US economy prior to the 1980s and the shifting dynamics it has exhibited since then. The model replicates the observed shifts in the US economy via changes in certain components of the model such as government policies (including corporate taxes) and knowledge diffusion. We then use the model to run a horse race between a variety of channels that could have contributed to slowing business dynamism. The model allows us to remove each component individually and to ascertain the extent to which each channel could account for the observed dynamics. The results clearly indicate a sharp decline in the knowledge diffusion in the US economy and reveal the dominant role of this margin for accounting for the observed trends.

### *2.c. Symptoms of Declining Knowledge Diffusion and Potential Drivers*

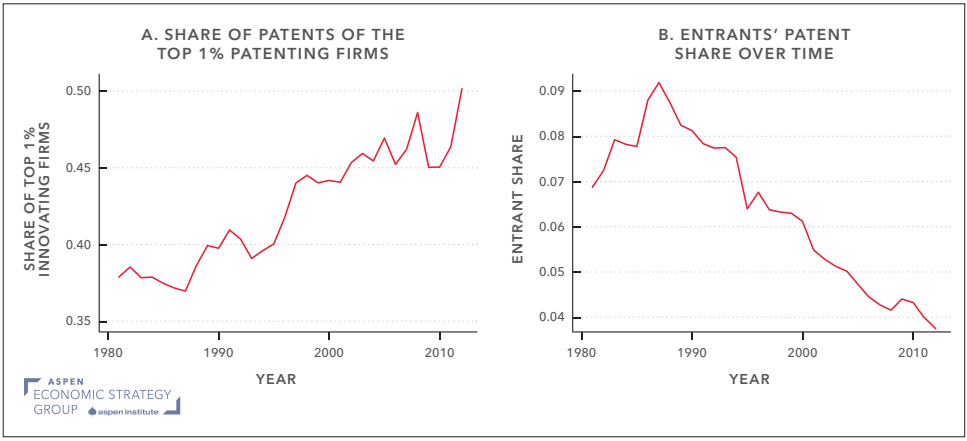
Patents are increasingly being accumulated in the hands of firms that already own the largest shares of them, both via new production or via purchases of existing patents. Both the concentration of patents and the fraction of litigated patents are positively correlated with measures of market power at the industry level. For instance, firms could potentially leverage these large patent arsenals to deter other firms from developing competing inventions, as in the case of patent thickets, which we discuss below. As a mirror image of this patent concentration, we also observe that inventors are increasingly employed in large and established firms rather than at small and young firms. Importantly, such a shift induces a decline in inventors' productivity despite a rise in their wages.

### *2.d. Patent Concentration and Post-1980 Trends*

Patents may limit the flow of knowledge from frontier firms to their competitors. A decline in imitators' ability to copy and to learn from market leaders' technology (or to implement improvements on the existing technologies) due to the leaders' heavier and strategic use of patents reduces knowledge diffusion and its efficient use among firms. Patent and reassignment data from the US Patent and Trademark Office (USPTO) provide a fertile ground for investigating these patterns, as firms rely heavily on patent protection to shield themselves from imitators. Because many indicators of business dynamism suggest a declining trend since the 1980s, coincident with rising market concentration, we first investigate the potential for concomitant changes in patenting concentration. To answer this question, Figure 6A describes the share of patents registered by the 1 percent of firms with the largest patent stocks. The ratio exhibits a dramatic increase. While in the early 1980s about 35 percent of patents were registered by firms sitting on the largest patent stocks, within three decades this ratio reached almost 50 percent.[13] The share of patents registered by new entrants (firms that patent for the first time) meanwhile exhibits the opposite trend: after a small pickup in the early 1980s, there has been a dramatic secular decline in the entrants' share since then, with the ratio falling by more than 50 percent in 25 years, as seen in Figure 6B.

13 Notice that the increase in this ratio has been larger than the rise in market concentration (see Autor et al., 2017b).

**Figure 6. Registry of Patents**



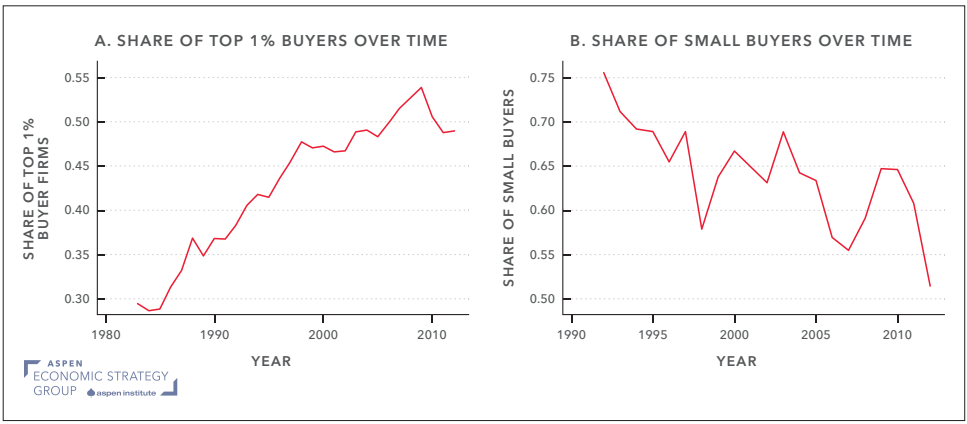

**Source:** Authors' own calculation using US Patent and Trademark Office data.

A common practice among market leaders is to buy patents in the market to strengthen their intellectual property arsenals. In this way, industry leaders can create a dense web of patents, known as "patent thickets" (Shapiro, 2001), which dissuades competitors from approaching the leader's technology domain and trying to overtake the leader. For instance, Argente et al. (2020) show that while market leaders introduce new products less frequently, they are more likely to patent these inventions, and those patents are associated with a declining rate of product innovation among competitors. The authors also show that as firm size increases, firms are more likely to use their patents to deter competition, with the protective value of their patents rising relative to their productive value.

Figure 7A illustrates the purchasing trends of the 1 percent of firms with the largest patent portfolios. While 30 percent of all transacted patents in the 1980s were reassigned to the firms with the largest patent stocks, the share increased to 55 percent by 2010. This drastic increase has crowded out small players in the market, as illustrated in Figure 7B, which shows the likelihood that a patent is assigned to a small firm, conditional on that patent being transacted from another small firm and recorded.[14] In the past two decades, the fraction of transacted patents that are reassigned to small firms has dropped dramatically from 75 percent to just over 50 percent. All told, the data indicate a shift of patent ownership from small firms to larger competitors.

14 The designation as a "small business concern" derives from the USPTO's US Patent Grant Maintenance Fee Events database, which records information on patent renewals.

**Figure 7. Reassignment of Patents**




**Source:** Authors' calculations using US Patent and Trademark Office data.

Concentration in patent production and reassignment has surged, and firms with the largest patent stocks have only further expanded their intellectual property arsenals. Matching patent data with data on patent litigations, we show that the more patents have been subject to litigation within an industry since 2000, the higher market power indicators have surged during the same period. This recent correlation is particularly interesting in conjunction with evidence that Decker et al. (2016b) compiled from Census data indicating that the decline in business dynamism accelerated after 2000, especially in some high-tech sectors. A closer look at the patent data reveals corroborating evidence on the potential strategic use of patents, which we discuss next.

### *2.e. Trends in the Post-2000 Period: Strategic Use of Patents*

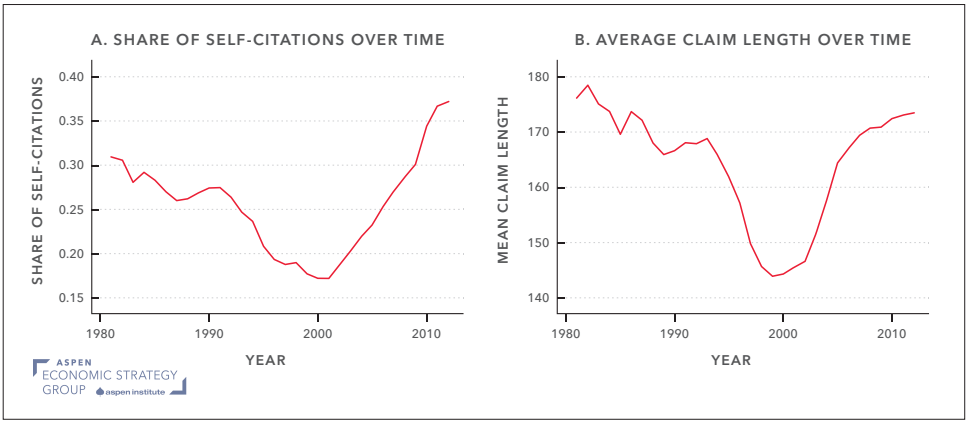
Patent records provide useful information for exploring whether firms produce strategic patents—patents firms can potentially use to build thickets around their core businesses and to ensure that those core technologies are not easily adopted or challenged by others. Two key variables in this respect are citations and the text of claims. We explore the strategic aspects of patents by looking at how these two variables have evolved over time.

Firms have the option either to expand into new fields by exploring new areas of research, or to focus on their existing technologies by protecting them in patent thickets. Akcigit and Kerr (2018) dub the former exploratory patents as "external" and the more exploitative ones as "internal" patents. If a firm's aim is mostly to protect its core technology, new internal patents will cite many patents from the firm's existing portfolio. In contrast, if a firm's aim is to expand into new fields, more citations will

be made to patents that are not in the firm's portfolio. In this regard, the fraction of self-citations is informative about whether the patent is internal and how likely it is to serve as one patent among a thicket. Figure 8A explores these self-citation dynamics over time. While patents were becoming more explorative until 2000, this trend then reversed; patents became more exploitative and internal over the ensuing decades.

Similar inferences can be drawn from the length of a patent's claims. We would expect that patents making broad contributions to their field, filed by firms interested in pursuing novel technology, would include a relatively short claim, reflecting the innovation's broader scope. Conversely, we would expect that patents making marginal contributions to an already crowded field, filed by firms interested in tightening their hold on existing technologies, would have relatively longer claims that include details of the incremental contribution but that are much narrower in scope. Figure 8B shows the evolution of average patent claim length over time. Until recent decades, patent claims had been becoming shorter, suggesting that patents were becoming broader in scope; again this trend reversed around 2000. Since then, claim length has been increasing steadily, indicating that patents are becoming narrower in scope and less original.

**Figure 8. Self-Citation and Claim Length Patterns**



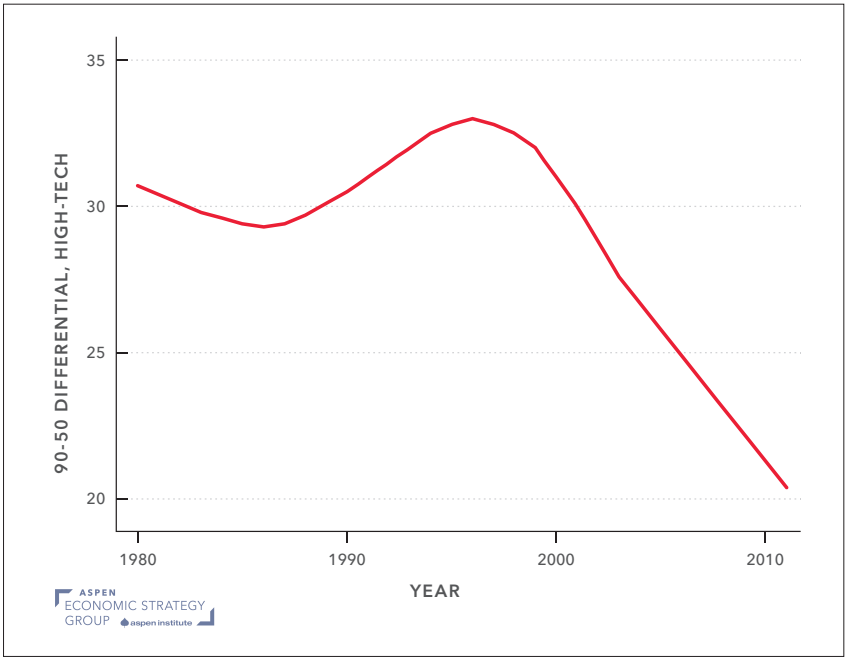

**Source:** Authors' calculations using US Patent and Trademark Office data.

Our observations on patents filed since 2000 likely imply that patents have recently been used to crowd existing technology fields with incremental additional information, limiting the scope for spillovers to competitors. The timing of these dramatic changes coincides with a period when business dynamism has substantially slowed down. While several measures of business dynamism have indicated a slowdown in most sectors of the US economy since the 1980s, the decline in the high-tech sector has become most visible since the 2000s (Decker et

al., 2016b). As shown in Figure 9, the dispersion of firm growth in high-tech sectors started to decline steadily around 2000. Decker et al. (2016b) document that other measures of business dynamism, such as gross job reallocation, reverberate with this post-2000 pattern, again especially in high-tech sectors. In this regard, our post-2000 findings tell a coherent story with these empirical regularities, suggesting a concurrent slowdown in knowledge diffusion and business dynamism.

In sum, our results constitute strong suggestive evidence that the concentration and use of patents, or intellectual property more broadly, have dramatically changed over time. Patent concentration has been trending up since the 1980s, and by 2000 those patents started to shift toward becoming more internal and narrower in scope, indicating that firms are filing patents for strategic rather than exploratory purposes. These observations are broadly consistent with declining knowledge diffusion from the technology leaders to their followers and have likely contributed to declining business dynamism through the lens of our model.

**Figure 9. 90-50 Differential in High-Tech Sector**




**Source:** Decker et al. (2016b).

**Note:** Similar patterns are documented for the 50-10 differential, for the balanced sample of continuers, and for gross job reallocation in the information sector.

### *2.f. Evidence from Data on Inventors*

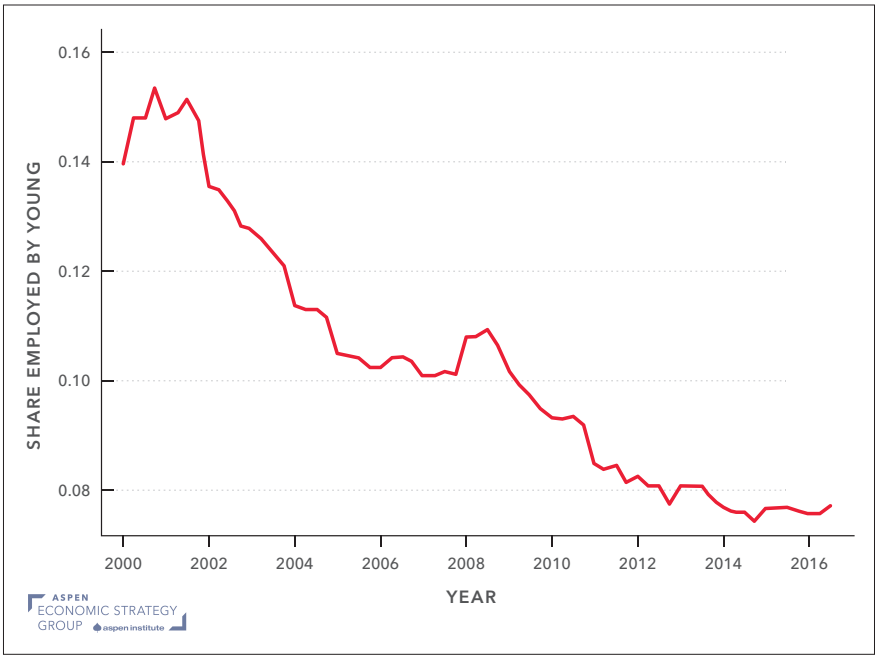
In this section, we explore how these patterns impact employment dynamics for inventors—the central agents for the generation and flow of ideas through the economy. In particular, we discuss the findings on inventor dynamics in a recent work by Akcigit and Goldschlag (2020), who build a novel data set that compiles detailed information on the population of inventors, linking patents to individuals, businesses, and employee-employer relationships. The results suggest a concentration of inventors in mature incumbent firms, with their innovative output and its quality decreasing.[15]

Figure 10 demonstrates the steady decline in the share of inventors working at young firms (defined as those in existence for five years or less) since the early 2000s. The consequent concentration of inventors at mature incumbent firms parallels our earlier results demonstrating a similar concentration for patents. This shift is not by itself concerning, so long as inventors maintain their productivity. However, Akcigit and Goldschlag (2020) find that inventors who join more established firms apply for fewer patents relative to comparable inventors who join young firms.[16] Moreover, the patents for which inventors apply after switching to a mature incumbent firm receive fewer citations relative to those filed by inventors at young firms, suggesting a deterioration in the quality of innovative output among inventors at incumbent firms. Meanwhile, inventors hired by mature incumbents see increases in their share of self-citations relative to inventors hired by young firms, implying that such patents have more internal and exploitative content, consistent with the theory that the patent plays a more protective role.

15 Mature incumbents refer to firms that employ more than 1,000 workers and that are older than 20 years.

16 The observation is consistent with the findings of Akcigit and Kerr (2018), that young firms are more R&D- and innovation-intensive than older firms.

**Figure 10. Share of Inventors Employed in Young Firms**




**Source:** Akcigit and Goldschlag (2020).

While inventors' outputs deteriorate after they accept positions at mature incumbent firms, they increase their earnings by 10 to 15 percent in their new roles (Akcigit and Goldschlag, 2020). That is, the private return for the inventors' activity increases while the public return decreases. Together with the increasing share of inventors at incumbent firms, this finding is concerning from the perspective of aggregate welfare.

Turning back to Figure 10, the falling share of inventors in young firms may be an artifact of the falling share of activity by young firms in the economy (as discussed in Section 2.a). However, the data reveal that US inventors themselves have also become less entrepreneurial over time. This result is particularly worrying for the future of new firms: start-ups founded by inventors exhibit faster employment growth over the first decade of their lives than do start-ups founded by non-inventor entrepreneurs. The reduced frequency of inventor entrepreneurs in the post-2000 era has therefore likely contributed to the declining prevalence of high-growth young firms and the concurrent decline in job reallocation rates.

Altogether, inventors' migration to mature firms, their decreasing innovation output, their increasing earnings in conflict with shrinking public returns, and their slowdown in entrepreneurship suggest a decline in knowledge diffusion and business

dynamism. Empirical evidence meanwhile indicates a growing technological disparity between the country's leading firms and their competitors, with inventors and patents concentrated among the former and the diffusion of knowledge to the latter weakening. These shifts distort the competitive race. Catching up with or overtaking established incumbents has become increasingly difficult for industry followers, thereby reducing all rivals' incentives to make productive investments and consequently causing overall dynamism to backslide.

The natural question becomes: what policies could help to reinvigorate competition, innovation, and dynamism in the US economy? In the absence of domestic solutions, policymakers could instead seek the benefits of trade openness; competitive pressures need not necessarily emerge domestically, and crucial support could potentially stem from overseas. Increased competition from foreign rivals could potentially incentivize US firms to invest in improving their products and processes in order to maintain their market shares (Bloom et al., 2016; Akcigit et al., 2018), boosting domestic productivity growth. The next section addresses the importance of analyzing competitive forces and firm dynamics in an economy open to international competition.

## 3. International Competition and Industrial Policy

Globalization and ever-expanding international trade routes stiffen the competition for leadership in global markets. Politicians around the world have increasingly shown their discontent with these dynamics, blaming globalization and increased foreign competition for causing various economic problems. Yet openness to trade and foreign competition, when managed by the appropriate institutions with appropriate policies, create incentives for domestic firms to improve their products and their efficiency; indeed, a large literature explores the effect of trade liberalization on innovation and productivity growth (Shu and Steinwender, 2019).[17]

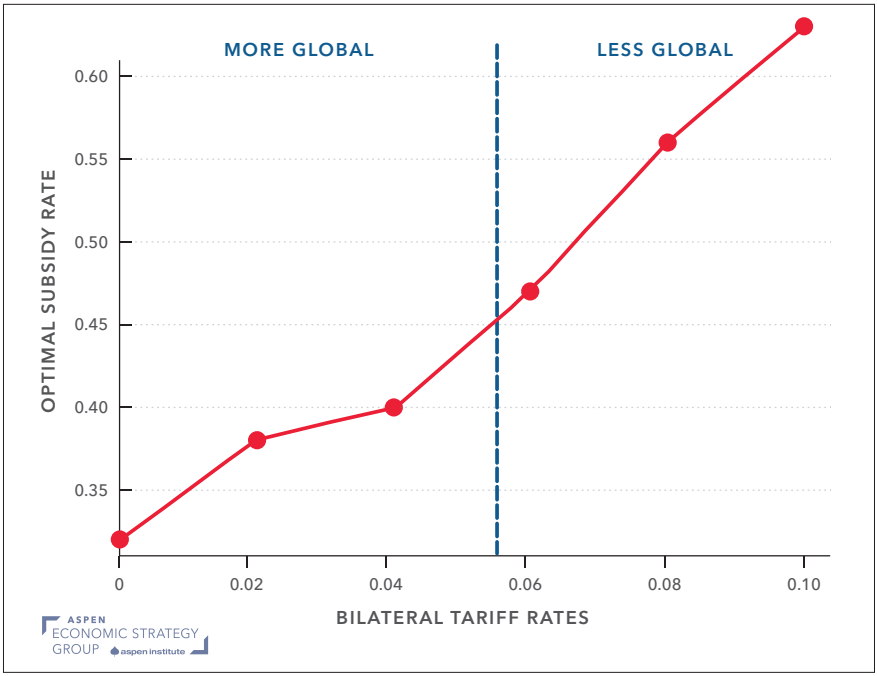
*"Lower trade costs produce stronger competitive threats for domestic firms, inducing them to innovate more intensively."*

Our previous work (Akcigit et al., 2018; Akcigit et al., 2022) explores in detail how foreign competition and innovation interact, and the implications for trade and innovation policy, aggregate innovation, business dynamism, and economic growth. We find that increased foreign competition *reduces* the need for R&D subsidies aimed at spurring innovation. In particular, as bilateral trade costs decline—that

17 Akcigit and Melitz (2021) and Melitz and Redding (2021) provide other extensive reviews of empirical work on the nexus of foreign competition, innovation, and economic growth.

is, the world becomes more open—the optimal R&D subsidy rates decrease as well (Figure 11). Lower trade costs produce stronger competitive threats for domestic firms, inducing them to innovate more intensively. The need for R&D subsidies to correct for deficient domestic innovative activity is reduced, as firms are naturally pushed toward optimal innovation effort.

**Figure 11. Optimal US R&D Subsidy Over Different Bilateral Tariff Rates**




**Source:** Reproduced from Akcigit et al. (2018).

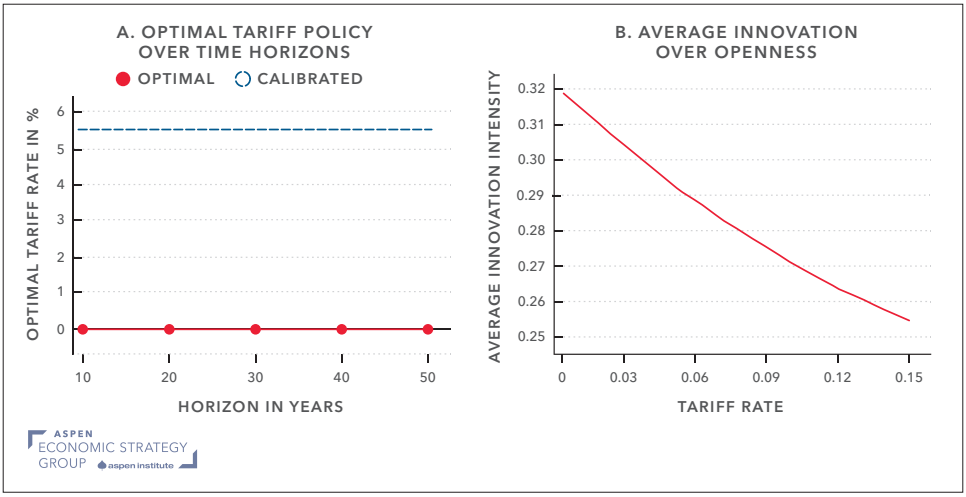
**Note:** Figure 11 exhibits optimal R&D policy rates for the United States over a fixed horizon of 35 years subject to varying degrees of globalization. The vertical line denotes the calibrated level of tariffs for either country.

Our work further implies that policymakers ought to slash trade barriers to zero, at all policy time horizons and even unilaterally (Figure 12a). The optimality of removing trade barriers unilaterally is a novel finding in the international trade literature and hinges crucially on the effect of protectionist policies on market competition and innovation incentives.[18] While trade barriers protect some firms

18 This effect is dominant especially in longer horizons. In the short term, higher trade barriers produce a positive effect on domestic wages, which in turn reduces an economy's competitiveness, proving the trade barriers suboptimal. Even when adjusted to exclude this margin, the model demonstrates that unilaterally removing trade barriers is still the optimal policy for relatively farsighted policymakers (see Akcigit et al., 2018).

in the short run, helping them to retain production and profits, protection from the competitive pressure that foreign rivals could exert reduces domestic firms' incentives to innovate and to improve their products' competitiveness (Figure 12b). Moreover, trade barriers deprive the economy of superior foreign products by creating distortions in relative prices. This negative dynamic effect on innovation incentives translates into lower productivity growth in the economy over time and becomes the dominant margin in policymakers' welfare calculations. Policymakers optimally should choose to curtail trade barriers even unilaterally.

**Figure 12. Optimal Tariff Policy and Innovation over Varying Levels of Trade Openness**




**Source:** Akcigit et al. (2021a).

**Note:** Panel A shows the optimal unilateral tariff policy for the United States over various policy horizons. Panel B shows the negative effect of unilaterally higher US tariff rates on US firms' average innovation intensity.

Finally, new findings from a recent complementary study (Akcigit et al., 2022) provide empirical support for the role that increased foreign competition can play in rejuvenating business dynamism. In addition to the well-known effects of foreign presence and market concentration on firm dynamics, we document that in more concentrated industries, higher foreign presence mitigates the negative effect of concentration on firm growth.[19] This result corroborates the insight that enabling more intense foreign competition can help to reinvigorate weakened business dynamism in the United States, complementing other standard innovation policy tools.

19 Precisely, the coefficient of the interaction term between foreign owned firms' sales share and the initial level of market concentration is positive, when regressing firm growth on these variables and other controls.

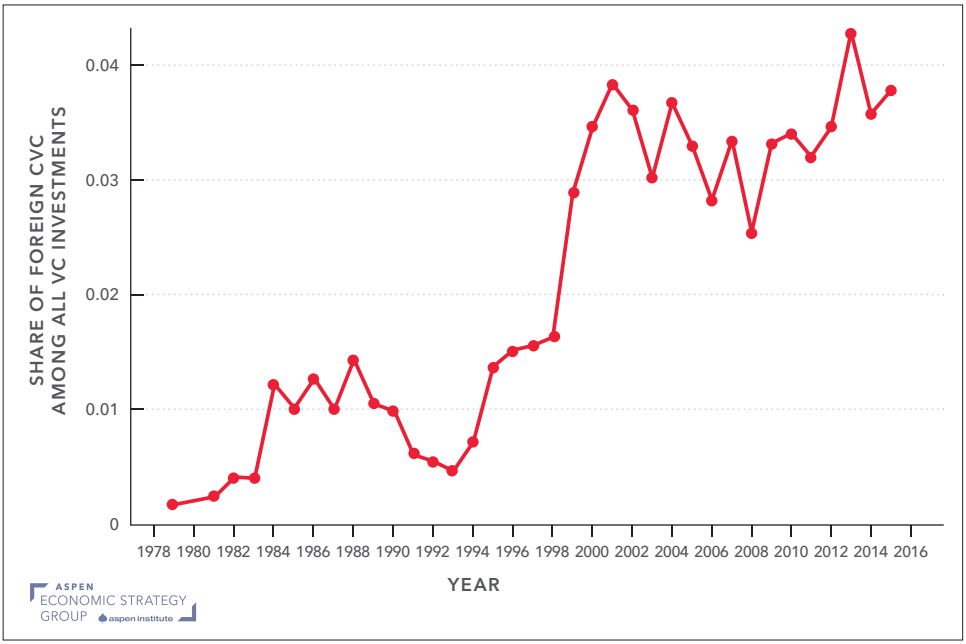
## 4. Foreign Investment and Technology Transfer

Enhanced integration with the global economy, which can help to spur overall innovation and business dynamism, often entails increased cross-border investments in domestic firms. But one of the most contentious issues in public policy debates over the past five years regarding US entrepreneurship has been the treatment of foreign investors. The military community in particular has highlighted the extent of foreign venture investments in Silicon Valley, especially from Chinese corporations, individuals, and financial institutions. These analysts have also emphasized that these investments are often in critical areas, such as artificial intelligence, fintech, robotics, and virtual reality, and have expressed concern that these activities may be leading to technology flows that, while legal, are nonetheless detrimental to US economic and military interests. Corporate venture investments pose a particular concern, since these investors are well-suited to gain insights from their interactions with the companies in their portfolios, and subsequently to exploit these discoveries. Brown and Singh (2018) highlight, for instance, Alibaba's and Enjoyor's investments in Magic Leap, Baidu's purchase of shares in Velodyne, and Lenovo and Tencent's investments in Meta; collectively these companies specialize in areas such as augmented reality, active remote sensing, and artificial intelligence.

The primary policy response by US authorities to these concerns has been to strengthen the mandate of the Committee on Foreign Investment in the United States (CFIUS), an inter-departmental task force that was first established in 1975. The Foreign Investment Risk Modernization Act of 2018 expanded the CFIUS' scope to include reviews of "non-controlling 'other investments' that afford a foreign person an equity in and specified access to information … [about] certain critical technologies." This legislation, and in particular the enabling regulations promulgated by the United States Treasury, Office of Investment Security (2019), raised substantial concerns among the US venture capital community (National Venture Capital Association, 2019). Anecdotal accounts suggest that in response to the new rules, Chinese-based entities' investments in new ventures have dropped sharply even before the pandemic. Similar controversies have played out contemporaneously in, among other nations, Australia, Canada, Germany, and especially Israel (Klein, 2018).

Despite the intense controversy and substantial stakes, economists have paid only modest attention to these issues, and the government's response has been limited. Our work, Akcigit et al. (2020a), seeks to address this gap, examining foreign corporate investment in Silicon Valley from a theoretical and empirical perspective. Our data set identifies transactions involving 344 companies from 32 distinct countries between 1976 and 2015. Figure 13 demonstrates the rapid increase in such transactions. We identify start-up firms' patents, as well as patenting by the corporate investors specifically and by residents of the countries in which they are based.

**Figure 13. Foreign Corporate Venture Capital as a Share of All US Venture Capital Investment**




**Source:** Reproduced from Akcigit et al. (2020a).

Our analysis measures patenting activity before and after foreign corporate investment in start-ups. Near the time of the foreign investment, patent applications in the relevant patent classes increased from entities located in the investor's home country (Figure 14A). Citation patterns tell a similar story. As illustrated in Figure 14B, foreign citations in the relevant patent classes increased after a foreign corporate investment. The results suggest that there are benefits from these investments in the form of knowledge spillovers.

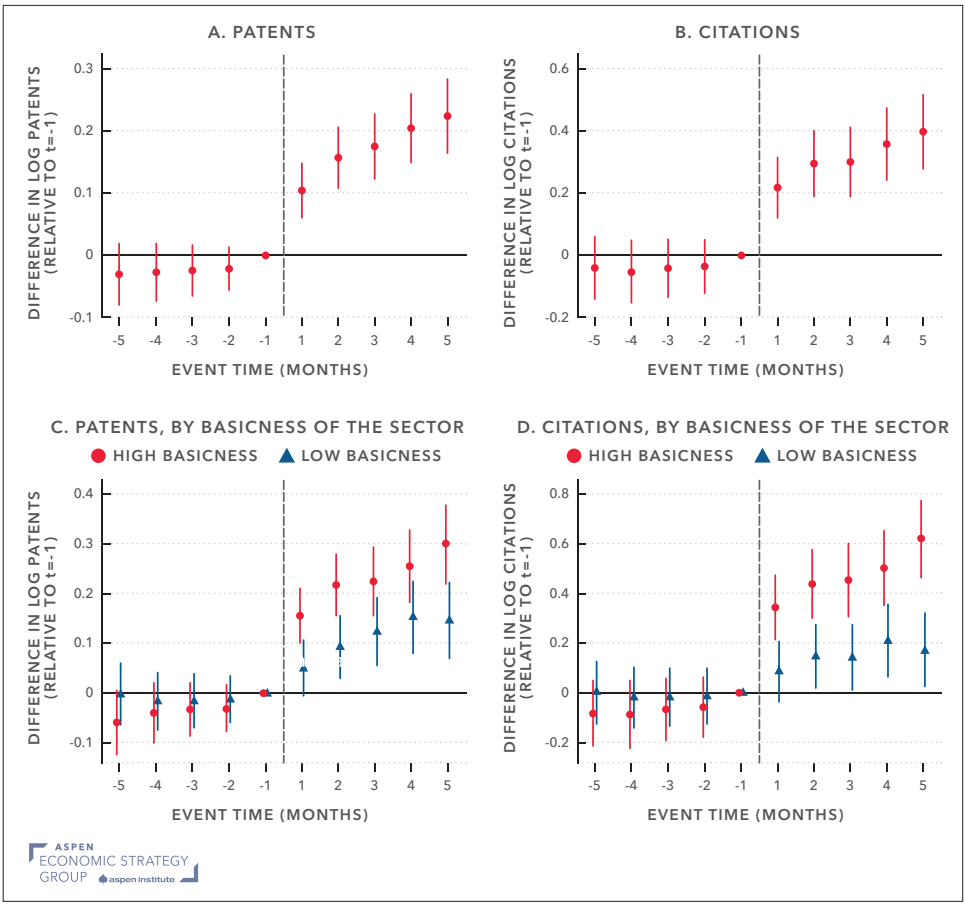
The spillover benefits from technologies that the National Science Foundation defines as more "basic"—including research on the atomic structure or the Genome Project and its exploration of human DNA—may be different than those in technology classes that rely more on applied research.[20] These frontiers present special challenges to firms playing catch-up; building capacity to compete with leading firms is notoriously difficult. As a result, the evidence indicates that foreign financing has even stronger effects on patenting patterns for research in these

20 The National Science Foundation (NSF) of the United States defines basic research as a "systematic study to gain more comprehensive knowledge or understanding of the subject under study without specific applications in mind." Conversely, applied research is defined as a "systematic study to gain knowledge or understanding to meet a specific, recognized need." See Akcigit et al. (2021b) for a thorough analysis of these different types of research.

more "basic" fields (Figures 14C and 14D), consistent with stronger spillovers to entities located in the investor's country in more basic technology classes. Similarly, knowledge flows appear to increase in classes that contain patents subject to a secrecy order from the federal government.

These patterns suggest that real knowledge is being transferred internationally, out of the United States and into foreign countries. And foreign investments in US technology firms are more common when the investor's home country lags further behind the United States in developing the relevant technology, as measured in various ways. The investments appear, at least partially, to be responses to address this technology gap.

**Figure 14. Impact of Foreign Investment on Firm Patents and Citations**




**Source:** Akcigit et al. (2020a).

**Note:** The figures show the effect of foreign investment on patenting activity of firms residing in the investing country. The left panels refer to patent counts, and the right panels refer to citations received by those patents. The bottom panels show the different patterns across sectors with low and high basicness levels.

While the evidence cannot demonstrate causality, more foreign investments in firms specializing in a technology class are associated with greater subsequent patenting by US start-ups in the same class (Akcigit et al., 2020a). These results are at least consistent with the hypothesized benefits of such investments in easing capital constraints.[21]

*"The empirical evidence suggests that US start-ups benefit from the funds enabled by foreign investment, but at the expense of knowledge transfers abroad."*

The empirical evidence suggests that US start-ups benefit from the funds enabled by foreign investment, but at the expense of knowledge transfers abroad. Akcigit et al. (2020a) explores optimal policies to manage foreign investment. The results show that decreasing the cost of foreign investment is optimal; the ensuing productivity growth caused by encouraging start-up formation through the increased availability of foreign funds more than offsets the associated costs. Even if national security concerns increase, we recommend that unless and until extreme national security threats arise, cost-raising interventions should not be undertaken lightly. The distortions these interventions exert on firm behavior and the ensuing productivity costs are likely to outweigh potential gains from higher barriers to foreign investment.

## 5. Inventors, Immigration, and Tax Policies

A particular group of inventors—migrant innovators—constitute an important part of the scientific workforce in several developed economies, including the United States, where they have been a major force behind productivity growth in the post-war period (Akcigit et al., 2017). What drives people to become inventors, and what incentivizes them to immigrate? Answers to these questions have become all the more important as the global talent pool grows while anti-immigration resistance enforces higher barriers against the movement of human capital.

There is strong complementarity between education and innovation in the United States as shown in Akcigit et al. (2017).[22] The likelihood of becoming an inventor rises dramatically with higher educational attainment. While the literature widely recognizes parental income as a determinant of a child's future in innovation, we find that the data presents a more complicated story. Figure 15 maps a child's probability of becoming an inventor against their parents' income. Strikingly, there is no discernible link between parental income and a child's probability of becoming

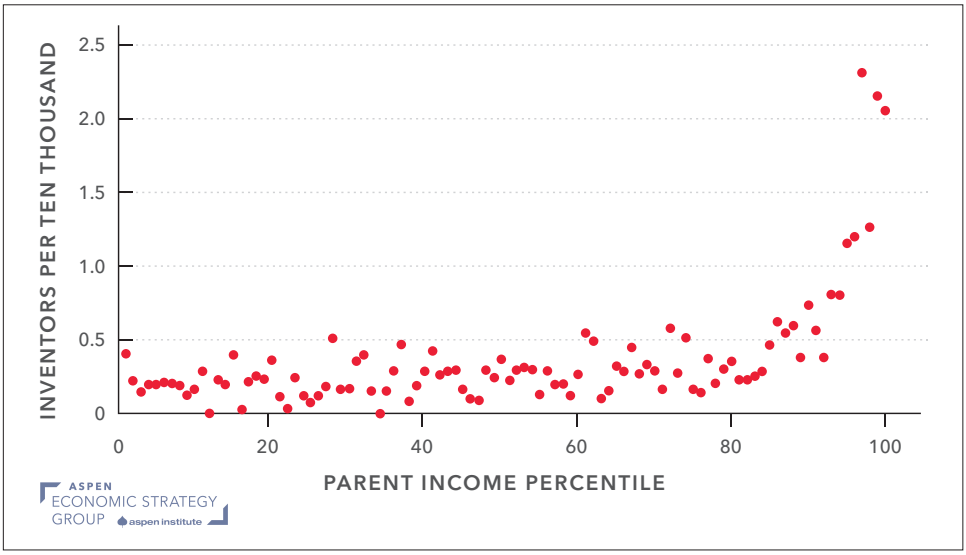
21 That the investments are coming from technologically laggard entities diminishes the possibility that the increase in US patenting stems from technology spillovers from abroad.

22 For international evidence, see Aghion et al. (2017).

an inventor throughout most of the income distribution. However, for the group at the top 5 percent, the correlation becomes extremely strong, indicating that innovation is indeed concentrated among those coming from rich families.

But a key related observation from Akcigit et al. (2016c) is that the strong positive impact of parental income on a child's potential to become an inventor vanishes once the child's education attainment is controlled for. That is, parental resources are an important determinant of their children's innovation chiefly through their influence on education. Providing equal educational opportunities for children outside the very top income percentiles could therefore be a powerful policy to increase innovation.

**Figure 15. Inventors and Parental Income**




**Source:** Akcigit et al. (2016c).

While education policy is fundamental for a country's economic growth, its effect on innovation is likely to encounter significant lag. Completing higher education and becoming a prolific inventor takes significant time, as would restructuring the country's education system to better support education for 95 percent of the population equal to what the very richest can afford. In addition, relying only on domestic talent can invite diminishing returns. For instance, Akcigit et al. (2020b) show that the increase in the number of PhD slots following policy changes in Denmark in 2002 produced a significant decline in the average IQ of PhD students.[23]

23 From 2002 onward, the universities in Denmark were required to increase the availability of PhD slots, as part of a broader initiative to enhance education and innovation.

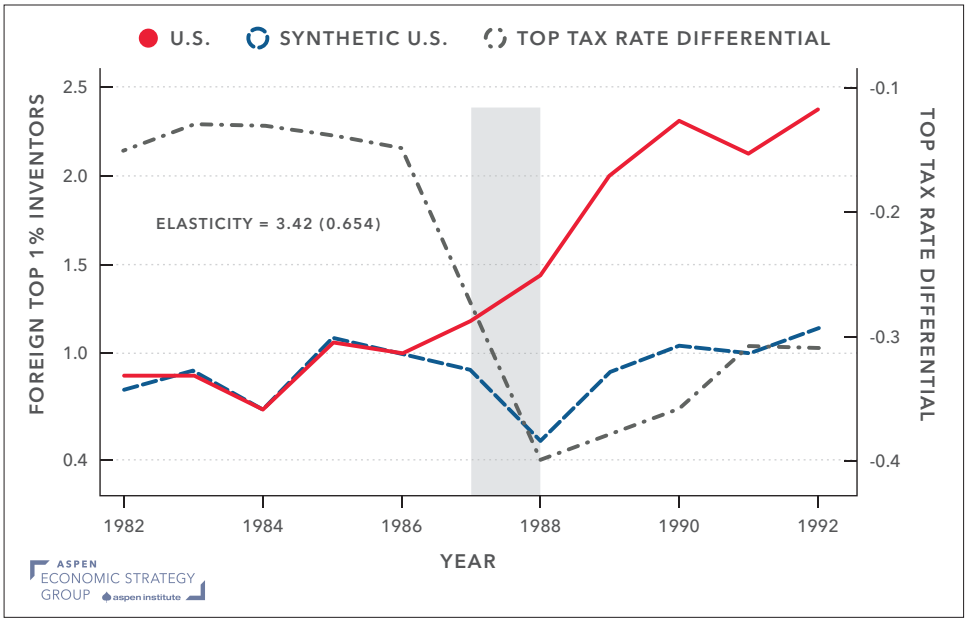
The result implies substantial heterogeneity in the quality of PhD student pool—as would be expected. The obvious trade-off between the supply of PhD slots and the average talent of the student pool attending these programs makes plain how vital it is for countries to tap the broader pool of international talent. Immigrant innovators must enter the successful economy's expansion plans.

Immigrants have made substantial contributions to US inventions over the past century (Akcigit et al., 2017). Patent records and federal Census data demonstrate broad evidence of the impact of immigrants on US innovation and labor market outcomes. For example, technological areas where immigrant inventors were more prevalent between 1880 and 1940 experienced faster growth over the following six decades—an effect that prevails even after controlling for various variables that could have contributed to economic growth in the latter period. Immigrant inventors were also more productive during their lifecycle than were native-born inventors, even though they received significantly lower wages than their native-born counterparts. Overall, these findings suggest a substantial contribution from foreign-born inventors to US innovation, despite the apparent assimilation frictions in the labor market.

What policies could help governments to take advantage of global worker mobility and to attract successful inventors from abroad? Many prolific inventors around the world are international migrants, and country-specific policies greatly affect their location choices (Kerr and Lincoln, 2010). Notably, high income taxes appear to have significant negative effects on inventor relocation.

In response to the 1986 reduction in the nation's top marginal tax rate, foreign "superstar" inventors—defined as those in the top 1 percent of quality distribution, with quality being measured by total citations received—flocked to the country, implying substantial elasticity in their location choices, as demonstrated in Figure 16. When the country lowered the top tax rate for high-income foreign researchers, the number of foreign inventors migrating into the country rose significantly. These findings, taken together with the results in the previous sections, suggest that ill-devised policies can impose significant costs on societies through their adverse effects on innovation incentives felt by both firms and individuals, hurting economic growth and development.

**Figure 16. United States Tax Reform Act of 1986 and Inventor Migration**

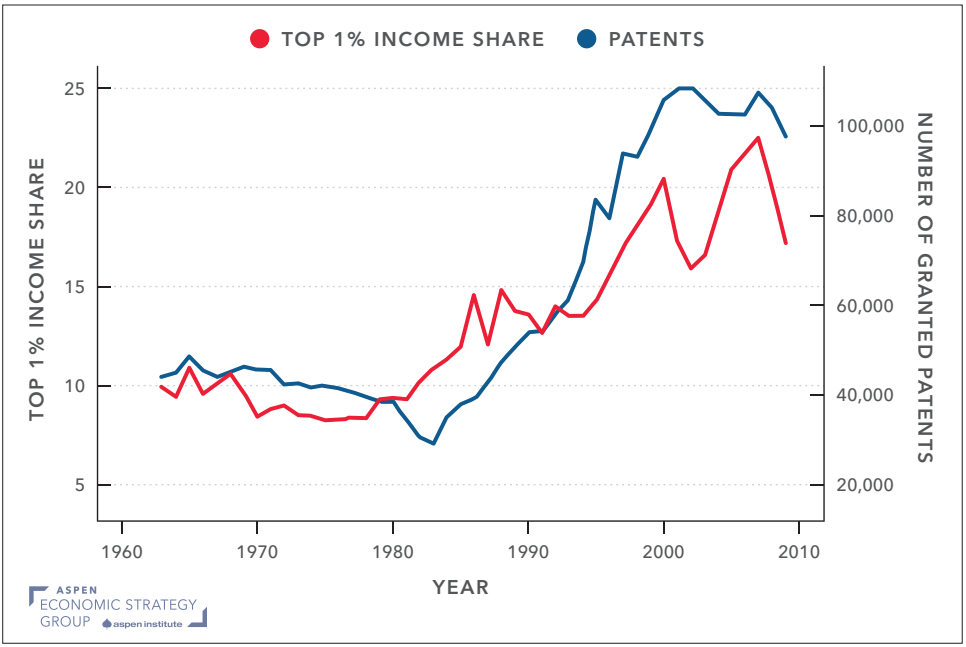



**Source:** Akcigit et al. (2016a).

## 6. Innovation and Top Income Inequality

Our analysis concludes with a discussion of innovation's effect on inequality and social mobility—aspects that are usually overlooked in the analysis of innovation and policies meant to encourage it. Aghion et al. (2019) document a strong association between innovation and top income inequality, with returns on innovations boosting the income share of the top 1 percent of income earners, and argue that this relationship is at least partially causal. As a demonstration, Figure 17 highlights the close relationship between the number of patents granted in a given year and the top 1 percent income share in that same year. The authors argue moreover that innovation, especially by entrants, supports social mobility.

**Figure 17. Patents and the Income Share of the Top 1 Percent**




**Source:** Aghion et al. (2019).

Policymakers therefore ought to be aware of the double-edged sword they potentially wield: policies that promote innovation can also lead to increased inequality. To the extent that increased inequality in turn raises barriers to prospective inventors and start-ups, these policies may have negative unintended consequences for social mobility and business dynamism.[24] Recall that this mechanism echoes our discussion in Section 2—previously successful incumbents can become entrenched in their industries and may find ways to preclude follower firms from competing, restraining innovation and dynamism.

Certain policy options discussed in this paper have less potential than others to produce adverse effects on inequality. First, R&D subsidies that target entrant firms or small and medium enterprises may be more supportive of social mobility than blanket R&D subsidies that are made available equally for all firms. Likewise, tapping into global talent expands the pool of skilled workers and mitigates the quest for scarce human capital, which can reduce inequality. Lastly, exposure to global competitors can dampen entrenched incumbents' advantageous positions

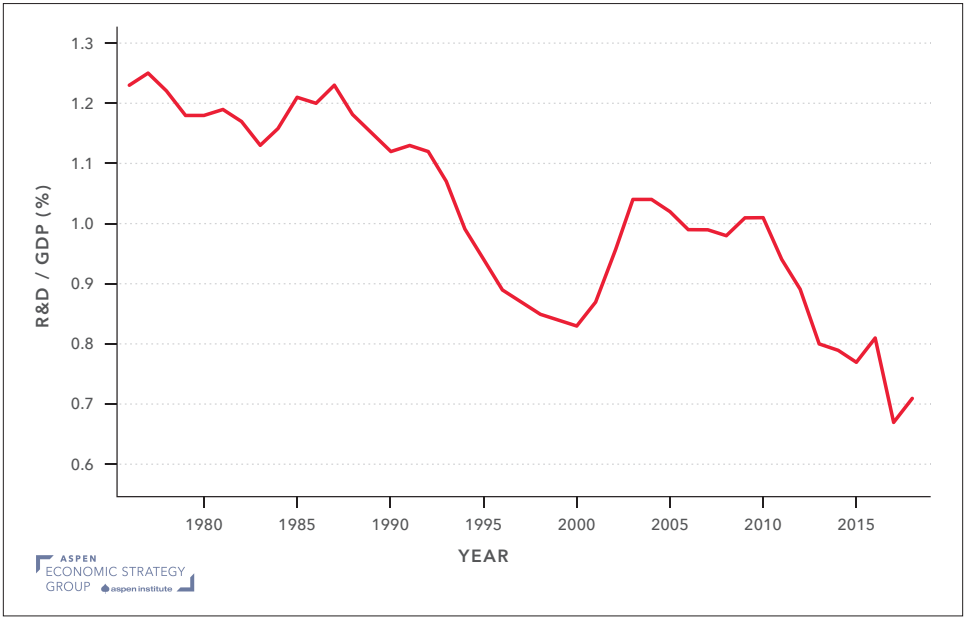
24 Recall that parental income, through expanding education opportunities for children, is an important determinant of who becomes an inventor (Figure 15).

and enhance the competitive environment, helping to level the field between leaders and followers. Altogether, taking inequality concerns and policies' longer-term implications into consideration will prove vital when crafting policy to promote sustained and inclusive growth.

## 7. Additional Policy Considerations

Although not at the forefront of our analysis here, some additional issues are worth considering for the design of an optimal innovation environment. First, government spending on R&D as a fraction of GDP has been steadily declining in the United States since the 1970s (Figure 18). This decline is still concerning even though private R&D has increased, since private and public R&D spending are not interchangeable. While government is able to undertake high-risk basic research projects, the private sector, driven by return on investment, predominantly focuses on applied research, and increasingly so (Bloom et al., 2019). Oftentimes major breakthroughs won through basic research clear a path for follow-on applied research, creating significant complementarities between the two (Akcigit et al., 2021b). Engaging the public sector in basic research should therefore be an important aspect of innovation policy; this essential function isn't easily replaced by private-sector spending.

**Figure 18. Public R&D Expenditure as a Fraction of GDP**




**Source:** Akcigit et al. (2021b).

Another aspect of the knowledge market for policymakers to consider is the secondary market for the exchange of patents and intellectual property more broadly. Akcigit et al. (2016b) emphasize the key role that the US patent market plays in ensuring the allocation of patents to their most productive users. In light of our discussion in Section 2 regarding the decline of knowledge diffusion in the US economy, enhancing this market should form a vital part of a national innovation policy. That same discussion also informs the need for dynamic, proactive competition agencies, particularly considering that new digital-intensive sectors such as e-commerce allow successful firms to quickly grow into dominant players.[25]

Finally, policymakers should be aware of how firms of different sizes use subsidies differently. Smaller firms, for instance, produce more radical innovations and generate more major innovations relative to their size (Akcigit and Kerr, 2018), providing further support for the importance of targeted measures, in addition to those related to inequality concerns. By contrast, blanket measures, including R&D subsidies available equally to all firms, may disproportionately help larger players. Such was the case, for example, when the United States introduced R&D tax credits during the 1980s. The notable pickup in R&D spending at publicly traded firms was not matched by the path of overall private R&D spending, suggesting that larger firms benefited most from these facially universal measures. Providing a level field conducive to the emergence of competitive, high-growth, small and young firms necessitates more nuanced and targeted approaches.

## 8. Conclusion

In recent decades the US economy has been suffering from low productivity growth, slower business dynamism, and weaker competition. The technological gap between the frontier firms and the laggards has been widening, with the former hoarding innovative resources and output while the latter face increasingly higher barriers to compete. In this environment, eliminating distortions to competition can foster innovation; renewed competition can provide the right incentives for firms to improve their products and their processes. Appropriate policy responses would remove barriers to competition and take advantage of complementarities between competition, innovation, and dynamism. To achieve those goals, policymakers can look to expand human capital in the economy, reaping benefits from foreign competition as well as the global talent pool. Certain of these policies can also alleviate the inequality concerns that prioritizing innovation might raise.

25 Digital and online technologies offer firms significant opportunities of scale economies; successful firms can quickly expand their customer base and scale and become a dominant firm in their respective sector.

To summarize the key takeaways for the appropriate innovation policies:

1. Enhanced competition reduces the need for government intervention via R&D subsidies. Lowering barriers to competition from foreign firms is helpful in this regard.
2. Foreign competition appears to be particularly helpful to reinvigorate dynamism in more concentrated sectors.
3. Foreign investment appears to benefit the domestic economy by funding start-ups and promoting increased competition over time, unless the security concerns associated with reverse technology transfer are monumental.
4. While improving the education system and providing equal opportunity to every student is vital for developing human capital in the longer term, policies to attract global inventors can provide a complementary solution, offering an option to expand the talent pool more immediately.
5. As compared to other policy approaches to increasing innovative activity, taking advantage of global forces either by lowering trade tariffs or by attracting human capital can be less prone to causing inequality. Key is to maintain a healthy degree of competition in the economy and to ensure a level field, precluding successful agents—be they firms or individual inventors—from raising barriers to potential competitors.
6. R&D subsidies are useful options to boost innovative investment, but are also prone to increasing top income inequality and are likely to benefit larger firms.
7. Targeted measures could more decisively reinforce laggard or small and young firms.
8. Promoting the exchange of patents in the secondary market would alleviate the problems with knowledge diffusion from which the US economy has particularly been suffering.
9. Ensuring a dynamic and proactive competition agency is key for accelerating competition and innovation, especially as newer, digital-intensive sectors achieve growing market share.
10. Spending on basic research is diminishing. Increasing public expenditure on basic research would likely have outsize ripple effects on the innovation landscape.

These considerations are certainly not all-encompassing, and recent proposals in the literature also consider various education policies as well as changes to the patent system to improve its efficiency (Ouellette and Williams, 2020). But our study emphasizes an important aspect of innovation policy that policymakers oftentimes neglect—that is, the need for a vigorous competitive environment.

## References

Aghion, P., U. Akcigit, A. Bergeaud, R. Blundell, and D. Hémous (2019): "Innovation and Top Income Inequality," The Review of Economic Studies, 86, 1–45.

Aghion, P., U. Akcigit, A. Hyytinen, and O. Toivanen (2017): "Social Origins and IQ of Inventors," National Bureau of Economic Research Working Paper 24110.

Ahmad, N., J. Ribarsky, and M. Reinsdorf (2017): "Can Potential Mismeasurement of the Digital Economy Explain the Post-crisis Slowdown in GDP and Productivity Growth?" OECD Statistics Working Papers, 2017/09.

Akcigit, U. and S. T. Ates (2021): "Ten Facts on Declining Business Dynamism and Lessons from Endogenous Growth Theory," American Economic Journal: Macroeconomics, 13, 257–98.

——— (2022): "What Happened to U.S. Business Dynamism?" Journal of Political Economy, forth- coming.

Akcigit, U., S. T. Ates, and G. Impullitti (2018): "Innovation and Trade Policy in a Globalized World," National Bureau of Economic Research Working Paper 24543.

——— (2021a): "Innovation and Trade Policy in a Globalized World," University of Chicago, mimeograph.

Akcigit, U., S. T. Ates, and S. Kalemli-Ozcan (2022): "Diverging Productivity of the Best and the Rest: The Role of Globalization," Mimeo.

Akcigit, U., S. T. Ates, J. Lerner, R. R. Townsend, and Y. Zhestkova (2020a): "Fencing Off Silicon Valley: Cross-Border Venture Capital and Technology Spillovers," National Bureau of Economic Research Working Paper 27828.

Akcigit, U., S. Baslandze, and S. Stantcheva (2016a): "Taxation and the International Migration of Inventors," American Economic Review, 106, 2930–2981.

Akcigit, U., M. A. Celik, and J. Greenwood (2016b): "Buy, Keep or Sell: Economic Growth and the Market for Ideas," Econometrica, 84, 943–984.

Akcigit, U. and N. Goldschlag (2020): "Measuring the Employment Dynamics of U.S. Inventors," Mimeo.

Akcigit, U., J. Grigsby, and T. Nicholas (2016c): "The Rise of American Ingenuity: Innovation and Inventors of the Golden Age," National Bureau of Economic Research Working Paper 23047.

——— (2017): "Immigration and the Rise of American Ingenuity," American Economic Review, Papers and Proceedings, 107, 327–31.

Akcigit, U., D. Hanley, and N. Serrano-Velarde (2021b): "Back to Basics: Basic Research Spillovers, Innovation Policy and Growth," The Review of Economic Studies, 88, 1–43.

Akcigit, U. and W. R. Kerr (2018): "Growth through Heterogeneous Innovations," Journal of Political Economy, 126, 1374–1443.

Akcigit, U. and M. J. Melitz (2021): "International Trade and Innovation," National Bureau of Economic Research Working Paper 29611.

Akcigit, U., J. G. Pearce, and M. Prato (2020b): "Tapping into Talent: Coupling Education and Innovation Policies for Economic Growth," National Bureau of Economic Research Working Paper 27862.

Andrews, D., C. Criscuolo, and P. N. Gal (2015): "Frontier Firms, Technology Diffusion and Public Policy," OECD Productivity Working Paper No. 2.

——— (2016): "The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy," OECD Productivity Working Paper 5/2016.

Argente, D., D. Hanley, S. Baslandze, and S. Moreira (2020): "Patents to Products: Innovation and Firm Performance," Federal Reserve Bank of Atlanta Working Paper 2020-4.

Autor, D., D. Dorn, L. F. Katz, C. Patterson, and J. Van Reenen (2017a): "Concentrating on the Fall of the Labor Share," American Economic Review, 107, 180–85.

——— (2017b): "The Fall of the Labor Share and the Rise of Superstar Firms," National Bureau of Economic Research Working Paper 23396.

Azar, J., I. Marinescu, and M. I. Steinbaum (2017): "Labor Market Concentration," National Bureau of Economic Research Working Paper 24147.

Barkai, S. (2017): "Declining Labor and Capital Shares," Mimeo.

Bijnens, G. and J. Konings (2018): "Declining Business Dynamism," CEPR Discussion Papers DP12165.

Bloom, N., M. Draca, and J. Van Reenen (2016): "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity," Review of Economic Studies, 83, 87–117.

Bloom, N., M. Schankerman, and J. Van Reenen (2013): "Identifying Technology Spillovers and Product Market Rivalry," Econometrica, 81, 1347–1393.

Bloom, N., J. van Reenen, and H. Williams (2019a): "A Toolkit of Policies to Promote Innovation," Journal of Economic Perspectives, 33, 163–184.

Bravo-Biosca, A., C. Criscuolo, and C. Menon (2013): "What Drives the Dynamics of Business Growth?" OECD Science, Technology and Industry Policy Papers No. 1.

Brown, M. and P. Singh (2018): "China's Technology Transfer Strategy: How Chinese Investments in Emerging Technology Enable A Strategic Competitor to Access the Crown Jewels of U.S. Innovation," Tech. rep., Defense Innovation Unit Experimental.

Brynjolfsson, E. and A. McAfee (2014): The Second Machine Age: Work, Progress, and Prosperity in A Time of Brilliant Technologies, WW Norton & Company.

Brynjolfsson, E., D. Rock, and C. Syverson (2017): "Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics," National Bureau of Economic Research Working Paper 24001.

Calligaris, S., C. Criscuolo, and L. Marcolin (2018): "Mark-ups in the Digital Era," OECD Working Paper 2018-10.

Council of Economic Advisors (2016): "Benefits of Competition and Indicators of Market Power," Issue brief.

Criscuolo, C., P. N. Gal, and C. Menon (2014): "The Dynamics of Employment Growth," OECD Science, Technology and Industry Policy Papers No. 14.

De Loecker, J. and J. Eeckhout (2018): "Global Market Power," National Bureau of Economic Research Working Paper 24768.

De Loecker, J., J. Eeckhout, and G. Unger (2017): "The Rise of Market Power and The Macroeconomic Implications," National Bureau of Economic Research Working Paper 23687.

Decker, R. A., J. Haltiwanger, R. S. Jarmin, and J. Miranda (2016a): "Declining Business Dynamism: What We Know and the Way Forward," American Economic Review: Papers & Pro- ceedings, 106, 203–07.

——— (2016b): "Where Has All The Skewness Gone? The Decline in High-Growth (Young) Firms in The US," European Economic Review, 86, 4–23.

Decker, R. A., J. C. Haltiwanger, R. S. Jarmin, and J. Miranda (2018): "Changing Business Dynamism and Productivity: Shocks vs. Responsiveness," National Bureau Economic Research Working Paper 24236.

Eggertsson, G. B., J. A. Robbins, and E. G. Wold (2018): "Kaldor and Piketty's Facts: The Rise of Monopoly Power in the United States," National Bureau of Economic Research Working Paper 24287.

Elsby, M., B. Hobijn, and A. Sahin (2013): "The Decline of the U.S. Labor Share," Federal Reserve Bank of San Francisco, Working Paper 2013-27.

Farhi, E. and F. Gourio (2018): "Accounting for Macro-Finance Trends: Market Power, Intangibles, and Risk Premia," National Bureau of Economic Research Working Paper 25282.

Fernald, J. (2014): "Productivity and Potential Output before, during, and after the Great Recession," National Bureau of Economic Research Working Paper 20248.

Fernald, J. G. and C. I. Jones (2014): "The Future of U.S. Economic Growth," American Economic Review, 104, 44–49.

Goldschlag, N. and J. Miranda (2016): "Business Dynamics Statistics of High Tech Industries," Working Papers 16-55, Center for Economic Studies, U.S. Census Bureau.

Gordon, R. J. (2012): "Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds," National Bureau of Economic Research Working Paper 18315.

——— (2016): The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War, Princeton University Press.

Gourio, F., T. Messer, and M. Siemer (2014): "What Is the Economic Impact of the Slowdown in New Business Formation?" Chicago Fed Letter.

——— (2016): "Firm Entry and Macroeconomic Dynamics: A State-Level Analysis," American Economic Review, 106, 214–18.

Grullon, G., Y. Larkin, and R. Michaely (2017): "Are U.S. Industries Becoming More Concentrated?" Mimeo.

Gutiérrez, G. and T. Philippon (2016): "Investment-less Growth: An Empirical Investigation," National Bureau of Economic Research Working Paper 22897.

——— (2017): "Declining Competition and Investment in the U.S." National Bureau of Economic Research Working Paper 23583.

Hall, R. E. (2018): "New Evidence on Market Power, Profit, Concentration, and the Role of Mega-Firms in the U.S. Economy," Stanford University, mimeo.

Haltiwanger, J., R. S. Jarmin, and J. Miranda (2013): "Who Creates Jobs? Small versus Large versus Young," The Review of Economics and Statistics, 95, 347–361.

Jones, Benjamin F., "Science and Innovation: The Under-Fueled Engine of Prosperity," in Rebuilding the Post-Pandemic Economy, ed. Melissa S. Kearney and Amy Ganz (Washington D.C.: Aspen Institute Press, 2021). Available at https://www.economicstrategygroup.org/publication/jones/

Karabarbounis, L. and B. Neiman (2013): "The Global Decline of the Labor Share," Quarterly Journal of Economics, 129, 61–103.

——— (2018): "Accounting for Factorless Income," National Bureau of Economic Research Working Paper 24404.

Karahan, F., B. Pugsley, and A. Sahin (2016): "Demographic Origins of the Startup Deficit," New York Fed, mimeo.

Kehrig, M. and N. Vincent (2018): "The Micro-Level Anatomy of the Labor Share Decline," National Bureau of Economic Research Working Paper 25275.

Kerr, William R., and W. F. Lincoln. (2010): "The Supply Side of Innovation: H-1B Visa Reforms and US Ethnic Invention," *Journal of Labor Economics*, 28 (3), 473-508.

Klein, J. X. (2018): "It's not just the US: Around the world, doors are shutting on Chinese investment," Southern China Morning Post, September 13.

Lawrence, R. Z. (2015): "Recent Declines in Labor's Share in U.S. Income: A Preliminary Neoclassical Account," National Bureau of Economic Research Working Paper 21296.

Lucking, B., N. Bloom, and J. Van Reenen (2019): "Have R&D Spillovers Declined in the 21st Century?" Fiscal Studies, 40, 561–590.

Melitz, M. J. and S. J. Redding (2021): "Trade and Innovation," National Bureau of Economic Research Working Paper 28945.

National Venture Capital Association (2019): "National Venture Capital Association Comments on Proposed Rule RIN 1505-AC64, Provisions Pertaining to Certain Investments in the United States by Foreign Persons (84 FR 50174) ('Part 800 Rules') and Proposed Rule RIN 1505- AC63, Provisions Pertaining to Certain Transactions by Foreign Persons Involving Real Estate in the United States (84 FR 50214) ('Part 802 Rules')," .

Nekarda, C. J. and V. A. Ramey (2013): "The Cyclical Behavior of the Price-Cost Markup," National Bureau of Economic Research Working Paper 19099.

Nordhaus, W. D. (2015): "Are We Approaching an Economic Singularity? Information Technology and the Future of Economic Growth," National Bureau of Economic Research Working Paper 21547.

OECD (2018a): "Market Concentration," Issues Paper by the Secretariat.

——— (2018b): "Market Concentration - Note by the BIAC," Hearing on Market Concentration.

——— (2018c): "Market Concentration - Note by the United States," Hearing on Market Concentration.

Ouellette, L. L. and H. Williams (2020): "Reforming the Patent System," Policy Proposal 2020-12, The Hamilton Project, Brookings Institution, Washington, DC.

Philippon, Thomas, "Causes, Consequences, and Policy Responses to Market Concentration," in Maintaining the Strength of American Capitalism, ed. Melissa S. Kearney and Amy Ganz (Washington D.C.: Aspen Institute Press, 2021). Available at https://www.economicstrategygroup.org/publication/causes-consequences-and-policy-responses-to-market-concentration/

Shapiro, C. (2001): "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting," in Innovation Policy and the Economy, Volume 1, National Bureau of Economic Research, Inc., NBER Chapters, 119–150.

Shu, P. and C. Steinwender (2019): "The Impact of Trade Liberalization on Firm Productivity and Innovation," Innovation Policy and the Economy, 19, 39–68.

Stiglitz, J. (2017): "Inequality, Stagnation, and Market Power," The Roosevelt Institute. Syverson, C. (2017): "Challenges to Mismeasurement Explanations for the U.S. Productivity

Slowdown," Journal of Economic Perspectives, 31, 165–86.

Traina, J. (2018): "Is Aggregate Market Power Increasing? Production Trends Using Financial Statements," Stigler Center New Working Paper Series No. 17, University of Chicago Booth School of Business.

United States Treasury, Office of Investment Security (2019): "Provisions Pertaining to Certain Investments in the United States by Foreign Persons."