The Great Startup Sellout and the Rise of Oligopoly

By Florian Ederer and Bruno Pellegrino*

Acquisitions of startups by incumbent firms constitute a significant trend in recent years, with numerous high-profile examples making headlines. However, these acquisitions have also been the subject of much policy scrutiny and academic debate, with some authors arguing that they contribute to the entrenchment of dominant incumbent firms (Cunningham, Ederer and Ma, 2021). Rather than allowing for the creation of synergies acquisitions may serve to protect the dominant position of incumbent firms by limiting the ability of acquired startups to challenge their existing business models.

We extend the empirical findings of Pellegrino (2019) by presenting suggestive evidence that the progressive shift of VC-backed startups from initial public offerings (IPOs) to acquisitions has contributed to the aggregate increase in oligopoly power. Specifically, we first document that the number of IPOs declined dramatically compared to the number of acquisitions since the mid-1990s. Second, we show that new publicly-listed firms are significantly more productive than in the past relative to a minimum productivity threshold implied by a free entry condition which in turn suggests that they are facing increasingly high barriers to entry. Third, large technology companies which have employed particularly aggressive startup acquisition strategies, are measurably less exposed to product market competition than they were two decades ago.

I. Theory

We employ the general equilibrium model of Pellegrino (2019) in which n single-product granular firms produce differentiated products and compete in a network game of Cournot oligopoly. Each firm i produces a differentiated good consisting of a k-dimensional vector of common characteristics $\mathbf{a}_i$ and a single unit of an idiosyncratic characteristic. A representative agent with quadratic utility over product characteristics consumes all the goods produced in the economy, supplies labor as a production input, and receives income from owning shares of the firms in the economy. This setup yields the following linear demand system

$$\mathbf{p} = \mathbf{b} - (\mathbf{I} + \mathbf{\Sigma})\,\mathbf{q}. \tag{1}$$

$\mathbf{p}$ and $\mathbf{q}$ are the price and quantity vectors of all the products in the economy, $\mathbf{b}$ is the vector of demand intercepts b_i which can be interpreted as measures of product quality, and $\mathbf{\Sigma}$ is the $n \times n$ matrix of price-quantity derivatives for all pairs of products. $\mathbf{\Sigma}$ depends on α, the weight that the representative agent attaches to the common characteristics of products, and on the matrix $\mathbf{A}'\mathbf{A}$ containing the dot products (or cosine similarities) $\mathbf{a}_i'\mathbf{a}_j$ of the common characteristics of all firm pairs:

$$\mathbf{\Sigma} \equiv \alpha\,(\mathbf{A}'\mathbf{A} - \mathbf{I})\,. \tag{2}$$

Each firm i simultaneously produces output q_i at marginal cost c_i. The Cournot equilibrium output q_i of firm i can be written as

$$q_i^{\Phi} = \frac{1-\chi_i}{2}\,(b_i - c_i) \tag{3}$$

where b_i is the firm's demand intercept and χ_i is its product market centrality which is based on the economy's matrix of product market similarities.

The product market centrality χ_i determines how close the firm i's actual equilibrium markup μ_i is to the competitive markup which is equal to 1 and the mo-

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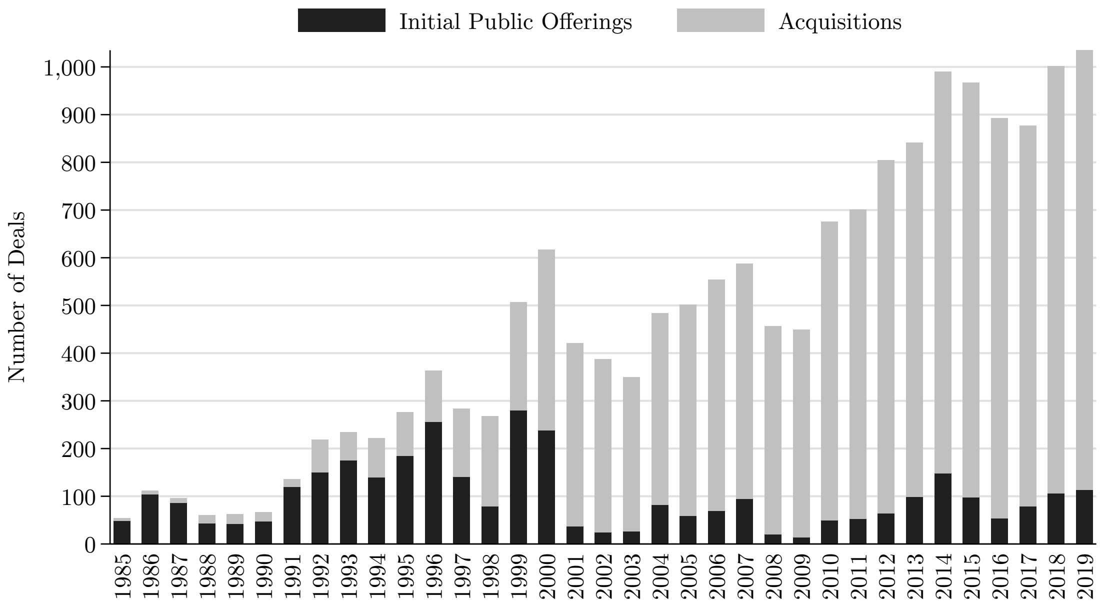

Figure 1. IPOs and Acquisitions of VC-backed Startups

Note: Number of VC-backed startups that exited via an initial public offering (black) or an acquisition (gray) by year.
Source: National Venture Capital Association.

nopolistic markup $\bar{\mu}_i$

$$\mu_i = \chi_i + (1 - \chi_i)\,\bar{\mu}_i. \tag{4}$$

This characterization of the markup μ_i, due to Pellegrino (2019), captures the link between the topology of the product market rivalry network given by $\mathbf{\Sigma}$ and firm i's ability to influence prices. When χ_i is close to 1, the firm is very central and has many rivals that supply products similar to its own. As a result, it behaves like an atomistic firm which cannot affect prices. In contrast, χ_i is close to 0, the firm is at the periphery of the product market rivalry network and supplies a product with characteristics that are not produced by other firms. Hence, it sets its production output like a monopolist. A lower centrality χ_i effectively insulates the firm from the competitive pressures of the product market.

In this model, the marginal surplus of the very first unit produced by firm i is given by $b_i - c_i$. This, in turn, can be interpreted as a measure of productivity. The minimum productivity level that allows an entering firm to be active (given the output of every other firm) while making weakly positive economic profits can easily be verified to be equal to $b_i - c_i - 2q_i^{\Phi}$.

We define the entrant productivity premium EPP_i as the difference between the actual and the minimum productivity level as a ratio of the latter:

$$\mathrm{EPP}_i = \frac{2q_i^{\Phi}}{b_i - c_i - 2q_i^{\Phi}}. \tag{5}$$

Suppose that there is a pool of potential entrants with pre-determined productivity levels of $b_i - c_i$ and some opportunity cost of entering. When this entry cost exogenously increases, a smaller subset of entrants will endogenously choose to enter and those entrants will have a higher entrant productivity premium. A higher entrant productivity premium thus provides suggestive evidence of barriers to entry.

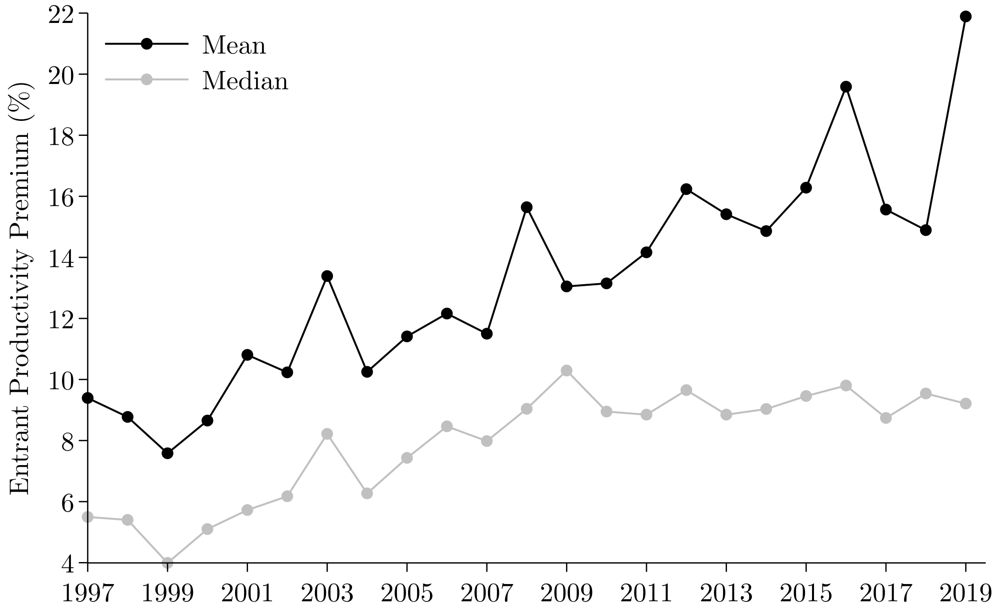

FIGURE 2. ENTRANT PRODUCTIVITY PREMIUM

Note: Mean (black) and median (gray) of the opportunity cost of entry as a percentage of the minimum productivity level by year.

II. Data

We use two data sources to estimate the markup, centrality, and productivity measures presented in Section I: firm financials and text-based product similarity.

We measure revenues, variable costs, and fixed costs in our model by using data from Compustat. These variables correspond to accounting revenues; costs of goods sold; and selling, general, and administrative costs, respectively.

Hoberg and Phillips (2016) provide a time-varying empirical estimate of the matrix of product-based cosine similarities $\mathbf{A}'\mathbf{A}$ between firms by text-mining the business description section of 10-K forms of all publicly-listed U.S. firms. Pellegrino (2019) shows how to identify the matrix $\mathbf{\Sigma}$ from the Hoberg and Phillips (2016) cosine similarity data.

III. Results

Figure 1 shows that initial public offerings (IPOs) have become a dwindlingly small share of venture capital (VC) exits compared to acquisitions. While IPOs greatly outnumbered acquisitions as the preferred exit for VC-backed startups in the late 1980s and early 1990s, this pattern has entirely reversed. By 2019 there were only just over 100 IPOs compared to over 900 acquisitions.[1] However, this relative decline of the importance of IPOs as an exit mechanism appears to be unrelated to the decline of the startup rate that has been measured in the broader economy (Decker et al., 2014). In fact, rather than declining, the number of startups that are backed by venture capital (which constitute the majority of startups that eventually go public) has radically increased over this period. Thus, the reason behind the decline in IPOs is not a dearth of startups, but rather the fact that most VC-backed startups nowadays choose to be acquired by incumbents instead.

Pellegrino (2019) documents that over the same time period the entire distribu-

[1] The patterns in Figure 1 are consistent with those reported in Gao, Ritter and Zhu (2013) for an earlier time period.

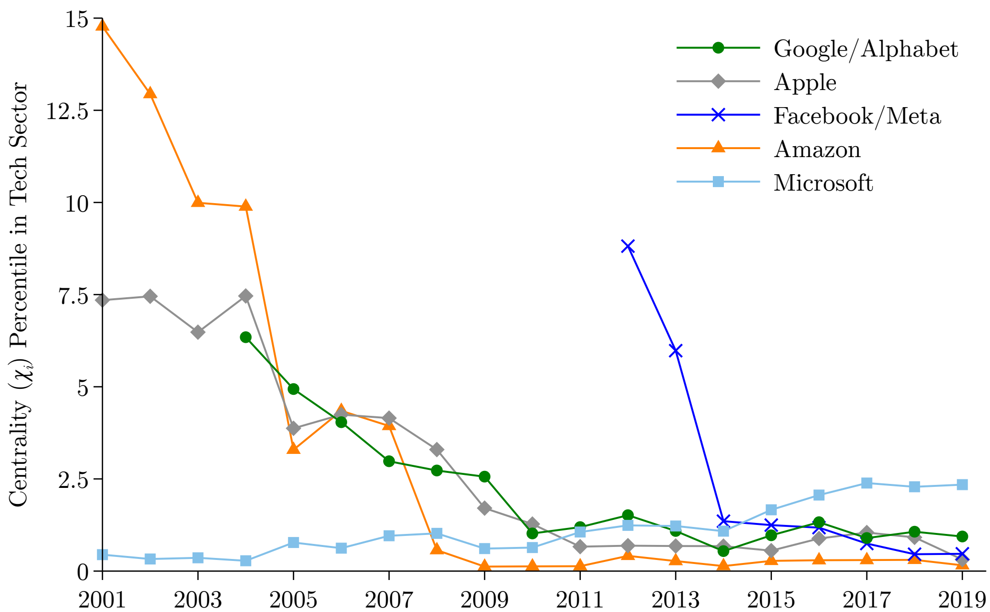

FIGURE 3. GAFAM PRODUCT MARKET CENTRALITY (χ_i)

Note: Percentile rank of product market centrality χ_i of Google/Alphabet (green), Apple (gray), Facebook/Meta (dark blue), Amazon (orange), and Microsoft (light blue) within the technology sector (GICS codes 45 and 50).

tion of firm product market centralities decreased suggesting that the typical public firm faces less competition from substitute products than it did in the past. While profits and value added increased with nominal GDP, economic activity is now concentrated among a much smaller number of firms. Kahle and Stulz (2017) argue that underlying this decrease in the overall number of firms is a secular decline in the rate of IPOs which has not been counterbalanced by a decrease in the rate of exit of incumbent firms.

Figure 2 reports the evolution of the entrant productivity premium EPP_i over time. The entrant productivity premium increased dramatically over the two decades. The mean entrant productivity premium doubled from around 10 percent at the beginning of our sample to over 20 percent at the end. This increase was not driven by outliers. The median entrant productivity premium experienced a similarly large increase, rising from around 5 percent in 1997 to over 8 percent in 2019. These developments suggest that over this time period the opportunity costs of entering and competing with incumbents have increased significantly throughout the entire distribution of firms.

A disproportionately large share of acquisitions of startups has occurred in the technology sector. Google/Alphabet, Apple, Facebook/Meta, Amazon, and Microsoft (GAFAM) have acquired hundreds of companies in the last twenty years and especially in the last decade, outpacing other groups of top acquirers (Jin, Leccese and Wagman, 2022). Many of these acquisitions also occurred without pre-closing antitrust review or antitrust challenge (Wollmann, 2019) prompting congressional and academic critics of past antitrust policy to suggest the companies' acquisition activity is competitively harmful because it eliminates future competitive threats and deters future entry into markets dominated by GAFAM (Hemphill and Wu, 2019).

Figure 3 analyzes how this acquisition spree has affected the product market centrality of GAFAM. All of these companies have an exceptionally low product market centrality χ_i placing them in the bottom percentiles of the distribution of χ_i among technology firms at the end of our sample period. This suggests that these companies supply products with exceptionally unique characteristics that provide them with tremendous insulation from competitive pressures. Moreover, with the exception of Microsoft, the product market centrality of GAFAM declined significantly over time all while their respective profitability increased. Because this percentile rank is computed *within* the technology sector, this result cannot be driven by a faster rate of productivity growth in the technology sector.

IV. Conclusion

In this paper we documented a secular shift from IPOs to acquisitions by VC-backed startups. We then presented suggestive evidence linking this dramatic shift and the aggregate increase in oligopoly power estimated by Pellegrino (2019). First, the gap between the productivity level of entrants and the counterfactual productivity level that would be implied by free entry suggests that firms face an increasingly high (opportunity) cost of going public. Second, dominant companies that are disproportionately active in the corporate control market for startups (such as GAFAM) appear to have become more insulated from the product market competition over the same period. These facts are consistent with the hypothesis that startup acquisitions have contributed to rising oligopoly power in high-tech sectors, although more research is needed in order to establish a causal nexus.

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