The Welfare Impact of New Firm Acquisitions

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Abstract

Despite a large volume of studies examining the welfare impact of acquisitions, there are not many studies that model the welfare impact of acquiring new firms. This study offers a review of the literature and presents a framework for evaluating the welfare impact of the acquisition of new firms. Our results suggest that the acquisition of new firms is not necessarily welfare reducing as long as (1) the number of new firm entry is within a given range (i.e., not too many and not too few), (2) sufficient oligopolistic interdependence is present (output response from firms not involved in the acquisition or outsider firms), and (3) there are cost symmetries. The key factor that makes the privately beneficial acquisition welfare enhancing is the profit opportunity for outsider firms and oligopolistic interdependence, given the restriction on the number of new firms. Our findings imply that, under the given conditions, start-up acquisitions may not need to be restricted by merger control policies. Our literature review and model highlight the need for regulators to pay attention to the specific number of new firms that enter a given market when there are no cost synergies.

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1 Introduction

In the past two decades, several horizontal merger and acquisition (M&A) deals which involve the purchase of new businesses by relatively larger firms have taken place. For example, in 2016, Hormel Foods Corporation, a multi-plant food processor, announced its acquisition of Justin's LLC, a start-up snack food producer. Another example is large high tech firms that have frequently acquired start-up businesses (Bryan and Hovenkamp, 2020). While this has raised concerns over the elimination of competition and market power in certain industries, there are not many studies that model the welfare impacts of the acquisition of new or start-up firms. It is not clear under what conditions such acquisitions improve or reduce economic welfare and which sectors are likely to harness welfare gains or losses, if any. It is also not entirely clear how and whether merger control policies ought to be used to regulate firms engaged in such deals.

Previous studies have used different methodologies and frameworks with varying assumptions on market and technology parameters to examine the welfare impact of plant-ownership structures, including M&As, yielding different results and implications (Bayes et al., 1996). This provides an excellent benchmark through which the impact of start-up acquisitions could be evaluated. In this paper we provide a comprehensive review of studies on the welfare impact of M&A deals and propose an extension, not yet adopted in the literature, to re-examine the merger-welfare relationship when new firms are acquired. While other studies look at new firm entry after acquisitions or merger induced firm entries (e.g., Davidson and Mukerjee, 2007), we look at entry of new firms followed by the acquisition of some or all. Thus, the unique aspect of our model is that it captures the acquisition of new firms that enter a market.

Our framework allows us to address the following research question in Cournot markets with the entry of new firms: Under what conditions does the acquisition of new firms by an incumbent multi-plant firm enhance welfare? Overall, our results suggest that the

profitable acquisition of new firms is not necessarily harmful for welfare as long as (1) the number of new firm entry is within a given range (i.e., not too many and not too few), (2) sufficient oligopolistic interdependence is present (output response from firms not involved in the acquisition deal or outsider firms), and (3) there are cost symmetries. The key factor that makes the privately beneficial acquisition of new firms welfare enhancing is the profit opportunity for outsider firms and oligopolistic interdependence, given the restriction on the number of new firm entry. Our findings imply that, under the given conditions, such acquisition deals may not necessarily need to trigger a scrutiny from merger control policies. Our model also highlights the importance for merger control policies to pay attention to the specific number of new firms that enter a given market when there are no cost synergies.

In Section 2 we present a review of the literature on the welfare impacts of M&As, including the relatively more recent literature of new firm or start-up acquisitions. In Section 3 we present the model, assumptions, and derive conditions under which the profitable acquisition of new firms affects economic welfare. We also present a discussion of results and implications for policy. Section 4 presents concluding remarks.

2 Welfare Impact of Horizontal Mergers: A Review

The literature review focuses on studies that examine the welfare impact of horizontal M&As in an oligopoly market with quantity competition (i.e., Cournot markets).[1] The seminal paper in the literature is by Oliver Williamson in 1968. Williamson (1968) presents a trade-off model which highlights the need to balance efficiency gains and the degree of market power facilitated by mergers. The theoretical argument is that mergers have two broad impacts which affect economic welfare in the opposite direction. On one hand, mergers facilitate reduction in average costs while on the other hand market power leads to higher

[1]There are several other studies modeling merger decisions and examining profitability without studying welfare impacts. We excluded these because our interest is to examine welfare impacts of horizontal mergers to document lessons for policy-making.

prices for consumers. If cost savings and efficiency gains are sufficiently higher, they could offset any merger induced price hikes. The Williamson (1968) model considers a competitive pre-merger market, and subsequent studies consider pre-merger markets with some market power (Williamson, 1969, 1977). These subsequent studies show that as long as the pre-merger market exhibits market power, the cost savings needed to offset loss in consumer surplus due to a merger restricting output is very large.

Until 1984, the US Horizontal Merger Guidelines assumed that mergers resulted in a modest amount of cost savings so that only extraordinary efficiency gains would be evaluated in the merger approval process. In 1984, the Guidelines included some language that would encourage merger participants to focus on the cost saving impacts of their proposed deals. In 1997, the Guidelines clarified the efficiency defense of mergers - cost savings arguments must verify that consumers are benefited from efficiency gains in the form of either lowering prices or preventing price increases in the defined market (Kwoka, 2014). This would mean that if a merger generates cost savings such that there is no loss in consumer surplus, the merger would not be challenged for market power.

A key principle used by Williamson (1968) and subsequent studies is the use of a welfare function as a primary tool to evaluate merger proposals. The decision rule can be summarized as follows: allowing mergers that do not result in net welfare losses. However, currently most nations, including the US, rely mostly on using the consumer surplus as a decision-making tool (Pitman, 2007). This is because in competition law, a small but significant and non-transitory increase in price in the relevant market could increase profits at the expense of consumer surplus, and hence bring a challenge by anti-trust agencies. For example, in 2019 the proposal to acquire Pacific Biosciences (an innovative DNA sequencing startup) by Illumina (incumbent firm with 90% market share of sequencing technologies) was blocked by the Federal Trade Commission (FTC) on the basis that the acquisition would eliminate a nascent competitive threat, lessen competition, and solidify monopoly market power for the incumbent, without creating substantial merger-specific efficiencies

(Pike, 2020a,b).

Since Williamson (1968) several studies have re-examined the welfare impacts of horizontal M&As under different scenarios/conditions, modeling approaches, and considering a variety of industry specific attributes. Game theory has been the dominant methodology in the theoretical literature. These studies show that the welfare impact of horizontal mergers is moderated by a myriad of factors the presence/absence of which has several implications for cost savings and market power. In what follows we summarize findings from the literature with respect to their findings on such factors that have implications on the welfare impacts of mergers irrespective of or with respect to the role of cost savings and price effects. Table 1 presents a summary of the literature which can be categorized into five broad types depending on the additional parameters/variables explicitly modeled with implications on the welfare impacts of mergers. We limit our literature review to studies that use an oligopoly model where firms compete in terms of quantity (Cournot model) and where economic welfare includes industry profits and consumer surplus.

2.1 The role of market share on welfare analysis

Earlier in the 1980s and 1990s, the literature was dominated by the Cournot-Nash model, non-decreasing marginal costs, a homogeneous good, and free-market (no government policy) assumptions. Under such assumptions, studies established that the pre-merger market shares of merging and non-merging firms (that is, insiders and outsiders respectively) are critical for welfare implications. Salant et al. (1983) is one of the most cited works that applies a Cournot framework with homogeneous goods and constant costs to show that mergers do not benefit their participants (profit losses) because outsider firms respond by increasing output which ultimately reduces market prices and makes the merger unprofitable. Later studies in the 2000s relaxed some of these assumptions (e.g., homogeneous goods, no firm entry) to include product differentiation (Gelves, 2014) and entry of new firms to re-examine the welfare impact of M&As.

Table 1: Summary of studies

What matters for understanding the welfare impact of M&As?	**Example of key studies**
Pre-merger market share of participating and non-participating firms	Farrell and Shapiro (1990); Levin (1990); McAfee and Williams (1992)
Extent of product differentiation and product variety offered	Shapiro (1995); Norman et al. (2005); Mazzeo et al. (2018)
New firm entry	Werden and Froeb (1998); Davidson and Mukerjee (2007); Spector (2003); Cabral (2003)
Strategic policy and policy changes post-merger	Huck and Konrad (2004); Collie (2003); Fikru (2013); Creti and Sanin (2017)
Industry specific parameters	a) Pollution intensity (Fikru and Gautier, 2020; Choi et al., 2021) b) Type of firm/industry (Canton et al., 2008; Bryan and Hovenkamp, 2019) c) Demand uncertainty (Qiu and Zhou, 2006)

Using a Cournot oligopoly model with homogeneous goods Farrell and Shapiro (1990) provide a necessary and sufficient condition for a profitable horizontal merger between a subset of firms (more than two firms) to raise welfare. They find that the modeled merger has a net positive impact on welfare if and only if the initial market share of outsiders exceeds the market share of insiders in the pre-merger market. This is because the merger reduces insider outputs but raises outsider output by so much more that both consumers and outsiders are benefited. Likewise, McAfee and Williams (1992) examine the welfare implications of horizontal mergers using a Cournot Nash model and find that such mergers are welfare increasing if the non-merging firms are large enough to have higher market power. Levin

(1990) examines the welfare implications of horizontal mergers where a subset of firms with no more than 50% of the pre-merger market share merge for cost-saving purposes (reallocation of output). The study finds that as long as the proposed merger is profitable it is welfare enhancing. While subsequent studies solidify insights on the role of market shares (e.g., Cheung, 1992), Farrell and Shapiro (1990) remains one of the most highly cited on the topic of merger-welfare relationships (e.g., as of July 4, 2022, Farrell and Shapiro (1990) has 634 citations on the Web of Science Core Collection while Williamson (1968) has 525).

Following this line of studies, market concentration has been widely used as a primary metric to evaluate merger deals. For example, mergers that lead to increased market concentration are likely to be challenged on grounds of anti-competitive effects (Kwoka, 2014). The proposed deal between Illumina and Pacific Biosciences provides an example of rejected merger deals on grounds of enhanced market power in the defined market. Another example is the acquisition of College Park (an incumbent with $613 million in sales) by Ossur (a start-up with $22 million annual sales) in the prosthetic devices market which was challenged by the FTC on grounds of reducing competition in a market which is already concentrated. The deal was later allowed on the condition that the incumbent divests assets to maintain future competition (Pike, 2020a,b).

Subsequent lines of literature introduce other parameters and assumptions in the Cournot model to examine the merger-welfare relationship. For example, some studies consider new firm entry, others introduce product differentiation, while even others consider both variables (entry and product differentiation) to examine welfare impacts with or without cost savings. Allowing for additional parameters aligned with real-world merger deals provides a much deeper analysis that is helpful for merger control policies.

2.2 The role of product differentiation on welfare analysis

Unilateral effects are the tendency of a merger to lead to a higher price due to eliminating a competitor firm and can arise in markets with product differentiation. When firms producing differentiated goods merge, the competition between the two brands may disappear and the price of one or more of the merging brands may increase post-merger. In 1992, the US Horizontal Merger Guidelines were revised to address competition in differentiated product markets.

Shapiro (1995) discusses the importance of re-evaluating merger deals involving differentiated products because such deals have a different implication for market definition, competition, consumer choice, and welfare. For example, if the merged entity increases the price of one brand without changing the price of the other brand, consumers will start buying the latter brand, but revenues will not be lost due to the merger. Shapiro (1995) highlighted the importance of such unilateral effects of mergers in differentiated markets and argued that the merged entity will benefit from price increases.

A few years later, Calem et al. (1999) adopted the Cournot model to derive conditions under which hospital mergers could increase welfare. Their result suggests that a merger could increase net social welfare if firms (i.e., hospitals) are highly differentiated or when the marginal cost of quality-adjusted services is high - both of which imply a higher pre-merger price, and a smaller gap between pre- and post-merger prices. Using a market with product differentiation, Norman et al. (2005) present an argument that mergers could lead to reductions in product variety such that a two-firm merger leads to higher prices and lower consumer surplus even with mergers inducing cost-savings. Similarly, Mazzeo et al. (2018) argue that once firms merge, their incentives could change and they may limit their product offerings which affect the impact of the merger on welfare.

Kao and Menezes (2010) examine the merger-welfare relationship under product differentiation and find that, when cost asymmetry is high, the range for welfare enhancing

mergers is greater if products are closer substitutes. This is because when products are similar, the merger leads to the allocation of production to the more efficient firm but when products are more differentiated, the merger leads to the shut down of production in one market creating consumer surplus losses. Using a Cournot model, Gelves (2014) find that with product differentiation and cost asymmetry, merger participants gain more profits than outsider firms. The study shows that as long as cost asymmetry between the merging firms is large enough, a two-firm merger will increase welfare.

2.3 The role of firm entry on welfare analysis

The role of entry conditions was addressed in the 1992 revisions of the US Horizontal Merger Guidelines and accordingly mergers that induce firm entry would be viewed favorably because of the potential to restore competition. The argument is that if a merger induces entry, this will undo any anti-competitive effects.

Studies by Werden and Froeb (1998), Spector (2003), Cabral (2003), Davidson and Mukherjee (2007), and Erkal and Piccinin (2010) include the possibility of new firm entry in the market and generally find that cost synergies are important for the welfare impact of mergers in the presence of entry. For example, Spector (2003) introduces firm entry and shows that a profitable merger that fails to generate technological synergies reduces consumer surplus irrespective of entry conditions in the industry. In the presence of free entry and exit and homogeneous goods, Davidson and Mukerjee (2007) compare pre- and post-merger welfare and show that welfare increases in the presence of cost savings generated by a horizontal merger among a small number of industry participants. This is because of the free entry/exit assumption which allows for welfare gains. Cabral (2003) considers a spatially differentiated oligopoly model with free entry and shows possibilities where post-merger entry of firms improves the effect of a merger on consumer welfare. In contrast, Erkal and Piccinin (2010) show that in a Cournot market with product differentiation, all

entry inducing mergers harm consumer welfare because firm entry occurs as long as merger-generated efficient gains are not large enough. The study shows that if a merger results in significant cost savings, it will induce firm exit which always improves consumer welfare.

2.4 The role of strategic policies on welfare analysis

While several studies continued to incorporate entry and product differentiation, a few other studies started introducing policies and hence moving away from the free-market unregulated industry assumption (Neven and Röller, 2005). Some studies model markets regulated by trade policies (Collie, 2003; Huck and Konard, 2004), others model markets regulated for pollution (Fikru and Gautier, 2017, 2020), while others consider anti-trust intervention or competition laws in the form of regulatory requirements to get the merger deal a regulatory approval (Vergé, 2010).

For example, Huck and Konrad (2004) incorporate trade policies in markets where local firms merge to derive conditions under which mergers could enhance welfare. Using a two-country model, they illustrate that strategic trade policies such as subsidies can be used to induce mergers that are both profit and welfare enhancing for the host country. Similarly, Collie (2003) uses a two-country model to show that in the presence of optimal trade policies a merger that takes place in a foreign country reduces welfare in a home country. This is because a foreign merger reduces competition, increases the foreign firm's margins and worsens the domestic country's terms of trade.

Fikru (2013) shows that if environmental policymakers adjust an emission tax when the market structure changes due to a merger deal, then such flexibility might reverse the negative welfare impact of mergers. Another closely related example is the study by Creti and Sanin (2017) which highlights how the welfare impact of horizontal mergers in a Cournot model depends on the presence of environmental policies and the extent of efficiency gains generated by mergers.

There are also studies that examine the role of competition and anti-trust laws on challenging welfare-reducing merger deals. For example, when a prospective merger raises concerns about reducing competition, anti-trust agencies may propose structural remedies such as divestiture of assets or licensing agreements to maintain competition. Vergé (2010) argues that if there are no technological synergies, mergers are likely to harm consumers even if firms divest some assets to rivals to allow them to gain merger approval.

2.5 The role of industry specific parameters on welfare analysis

More recent studies argue for customizing modeling approaches to account for industry and firm specific parameters. For instance, Canton et al. (2008) find that a merger among environmental service providers could reduce environmental quality which may in turn reduce social welfare. In a similar fashion, Fikru and Gautier (2020) introduce the possibility that pollution intensity of firms could affect the relationship between mergers and welfare. Choi et al. (2021) allow for product differentiation, cost asymmetry, and pollution intensities and show that in the presence of environmental regulations, a welfare-reducing merger may be allowed if pollution damages are not considered in the social welfare function; and a welfare-enhancing merger could be rejected because of ignoring improvements in environmental quality.

Qiu and Zhou (2006) further modify the assumption on the demand function to reflect markets with demand uncertainty. Qiu and Zhou (2006) argue that welfare increases when firms merge for sharing private information even in the absence of cost savings, and recommend mergers to be encouraged if demand uncertainty is high and market competition is intense.

Tao et al. (2021) model a merger between a public and private firm in a mixed oligopoly model and show that such mergers increase social welfare as long as the market is dominated by public firms. This is because of efficiency improvement opportunities to

reduce overcapacity. Their model features three firms producing a homogeneous good and they consider scenarios where the market is either mostly private or mostly public firms. They calculate welfare in both scenarios and illustrate welfare gains from a merger deal that is made of mostly public firms. Bryan and Hovenkamp (2019) consider a differentiated Cournot model where a start-up firm is acquired by an incumbent firm for an exclusive right on its innovative technology and shows that such acquisitions would lower consumer surplus unless regulated by anti-trust intervention. This is because such acquisitions may keep other firms from catching up on technological innovation.

2.6 The empirical evidence on welfare impact of M&As

Several empirical works examine the impact of mergers on welfare, in most cases the impact on prices as a proxy for consumer surplus, in different industries where results are mixed. For example, Jeziorski (2014) studies cost efficiency gains of mergers that took place between 1996 and 2006 in the US radio market.

Using data from US hospital mergers, Town et al. (2006) quantify the price impact to understand how consumers are impacted by hospital consolidations (consumer welfare). The study estimates a 3.2% increase in average premiums with consolidations than without any merger activity during the 1990s resulting in a significant loss in consumer surplus. In a related paper, Town (2001) argues that loss in consumer surplus could be offset by large efficiency gains induced by mergers.

Hüschelrath and Müller (2014) examine the impact of US airlines mergers on prices and find that the merger led to a 6.4% increase in price compared to prices offered by non-merging airlines serving the same route over the same period. Brueckner and Pels (2005) evaluate a European airline merger and found evidence that even if the merger increased company profits, consumer surplus and total welfare declined due to the merger. The authors argue that the merger was anti-competitive in affected markets.

On the contrary, Mishra and Kumar (2011) do not find evidence to support that M&As in the Indian manufacturing sector had any significant impact on consumer welfare. Rather their evidence shows that M&A deals helped firms consolidate businesses, increase competitiveness, and efficiency which may in the long-term benefit consumers in the form of lower prices.

2.7 Start-up acquisitions

The technology industry represents the highest number of start-ups being acquired by bigger incumbent firms (Onetti and Teare, 2017) and examples include Apple's purchase of Beddit, SensoMotoric Instruments, and Shazam in 2017. In the food processing industry, Nestle's purchase of Sweet Earth, Hormel Foods Corp's purchase of Justin's LLC, and PepsiCo's purchase of KeVita are examples of the 'from start-up to bought-up' strategy (FoodDive, 2017). M&As are also becoming a more frequent strategy among firms in industries with low barriers to entry such as real estate, construction, restaurants, finance, etc. (Kim et al., 2018; Covarrubias et al., 2020).

Recent evidence indicates that acquisition of new or start-up firms is less likely to be challenged by merger control policies because of several reasons (Bryan and Hovenkamp, 2020). First, current merger guidelines heavily rely on the theory of competitive harm where market share and concentration criteria are used to allow versus challenge merger proposals. Since start-ups typically have small current and uncertain future market shares, their acquisition is less likely to trigger a policy scrutiny. For instance, merger deals which are of smaller sizes and involve smaller firms are not always subject to merger control policy (Kwoka, 2015; Bryan and Hovenkamp, 2020; Onetti and Teare, 2017; Garcia et al., 2014). Furthermore, although merger control policies have some language on whether the proposed merger would eliminate or restrict new entry, such conditions are difficult to quantify and establish.

When it comes to start-up acquisitions, it is not clear whether the current non-intervention policy, that potentially allows the acquisition of all or most start-ups by dominant firms, results in welfare losses and to what extent. Bryan and Hovenkamp (2020) present some arguments for moving away from no-enforcement to having a limited merger control policy for start-up acquisitions. Bryan and Hovenkamp (2020) recommend that such a move is especially warranted if the buyer is very large, the deal price is high, and depending on the buyer's history, if any, of start-up acquisitions. However, it is not clear under what scenarios and conditions such a reform would enhance welfare. This is because the merger theory literature has yet to develop a model specific to start-up acquisitions as profitable firm strategy. In addition, the literature has not modeled a distinct merger control policy specific to regulating start-up acquisitions. Given the rise in acquisitions of new firms in several industries, it is important to develop frameworks that accommodate for new firm acquisitions (Bryan and Hovenkamp, 2019; Bryan and Hovenkamp, 2020) and examine conditions under which (profitable) acquisition of new firms would enhance welfare.

In this study we present a framework to re-examine the merger-welfare relationship by modeling the acquisition of new firms by an incumbent firm. By drawing largely from the modeling approaches of existing studies we re-examine the impact of acquisitions on welfare when there are no cost savings. Following previous studies we adopt, (1) a general demand function with product differentiation (e.g., Qiu and Zhou, 2006), (2) a multi-plant acquisition strategy where an incumbent firm could buy out several firms (e.g., Farrell and Shapiro, 1990), and (3) acquisition of new or start-up firms (e.g., Bryan and Hovenkamp, 2020). Like Fikru and Gautier (2020) we evaluate the post-merger market once some of the new firms are acquired by the incumbent firm, where the incumbent or parent firm maximizes joint profit to determine how many new firms to acquire. We examine whether such a strategy (profitable acquisition of new firms) is consistent with welfare-maximization.

Our model contributes to the literature on the welfare impact of horizontal mergers in at least two important ways. First, we examine merger incentives and welfare impacts in the

absence of traditional arguments of cost synergies and innovation (Farrell and Shapiro, 1990; Norman et al., 2005; Davidson and Mukerjee, 2007; Stennek, 2003). The general argument in the literature is that mergers do not enhance welfare unless there are sufficient cost synergies (Davis and Wilson, 2000). Overall, we find that the profitable acquisition of new firms do not necessarily reduce welfare and our main result holds when there are no cost synergies, that is, there is cost symmetry or marginal costs are constant.

Second, we make contributions to the limited literature on horizontal mergers when new firms are allowed to entry and exit. The papers by Werden and Froeb (1998), Spector (2003), Cabral (2003), Davidson and Mukherjee (2007), Kao and Menezes (2010), Erkal and Piccinin (2010), and Gama et al. (2020) propose merger models in the presence of free entry and exit. While these studies evaluate the welfare consequences of a merger in a market where new firms enter, they do not allow for some of these new firms to be acquired. Furthermore, the role of cost synergy is central in determining the welfare effects of mergers under free entry and exit by comparing markets with and without mergers. The general consensus is that cost synergies are crucial for welfare gains (Davidson and Mukherjee, 2007; Erkal and Piccinin, 2010). We present a cost-neutral framework where cost synergy plays no role in facilitating merger incentives nor welfare impacts. Rather we highlight the importance of oligopolistic interdependence and number of new firms in facilitating welfare impacts.

3 New Firm Acquisitions

3.1 Model and assumptions

We model an industry where there is a fixed number of $N+1$ plants (insiders) owned by an incumbent multi-plant firm and M independent firms (outsiders), where $N \geq 1$, $M \geq 2$. A total of m number of new firms enter the market. A share k of these new firms end up as insiders when acquired by the incumbent, whereas a share $1-k$ remain independent as outsiders, where $\forall m \in \mathbb{N}$, $k \in [0,1]$ s.t. $km \in \mathbb{N}$. This means some of the new firms, km,

end up as insiders while $(1-k)m$ firms as outsiders. All insiders are owned by one entity which we refer to as the merged entity. All outsiders are independent firms (Salant et al., 1983). The total number of firms operating as insiders and outsiders in the post-acquisition market is, respectively, $N+1+km$ and $M+(1-k)m$.

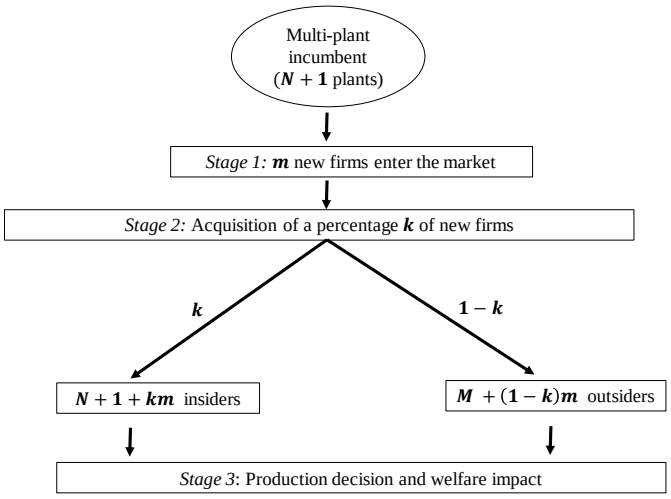
The literature on horizontal mergers and acquisitions has focused on the acquisition of a fixed number of existing firms (Salant et al., 1983; Farrell and Shapiro, 1990; Shapiro, 1996; Blair and Haynes, 2011; Fikru and Gautier, 2017). However, evidence indicates that corporate managers no more view M&A deals as a one-time combination of two or more otherwise independent firms. Rather they view M&A deals as part of their continuous restructuring strategy, where businesses come and go, in response to changes in market conditions and the regulatory framework. For instance, when new firms enter the market, they are in direct competition with incumbent firms, where some may end up being acquired while others succeed to operate independently. The variable k captures the strategy of a multi-plant incumbent to buy some of the new firms that enter a market.

There are two product varieties, one produced by insiders and the other by outsiders. Output levels for each insider and outsider are denoted by q and q^o, respectively. The demand function faced by each insider and outsider is given by $P_j = P_j\left(\sum q_j, \sum q_i^o\right)$ and $P_i^o = P_i^o\left(\sum q_i^o, \sum q_j\right)$, respectively, where $i = 1, 2, \ldots, M+(1-k)m$ and $j = 1, 2, \ldots, N+1+km$. The term $\sum q_j$ denotes total output of the merged entity and the term $\sum q_i^o$ denotes total output of outsiders. Further properties of the demand function are spelt out later on. Each insider's and outsider's costs are given by a function $C_j(q_j)$ and $C_i^o(q_i^o)$, where costs are increasing and convex in output, and $C_j(0) \neq 0$ and $C_i^o(0) \neq 0$.

The merged entity's joint profit function is given by $\sum \pi_j = \sum P_j q_j - \sum C_j(q_j)$ where $j = 1, \ldots, N+1+km$. The outsider's individual profit function is given by $\pi_i^o = P_i^o q_i^o - C_i^o(q_i^o)$ where $i = 1, \ldots, M+(1-k)m$.

We consider a 3-stage game. Similar to Davidson and Mukherjee (2007) in stage 1,

Figure 1: Conceptual framework



m number of new firms enter the market. In stage 2, the merged entity purchases a share, k, of new entrants. In stage 3 all firms compete in a Cournot-Nash fashion by choosing the level of output. The model is solved by backward induction. Figure 1 sketches the model setup.

We first characterize the merged entity's maximization problem which yields $j = 1, \ldots, N+1+km$ first-order conditions. That is,

$$\begin{aligned}
\frac{\partial \sum_{j=1}^{N+1+km} \pi_j}{\partial q_1} &= P_1 + q_1 \frac{\partial P_1}{\partial q_1} - \frac{\partial C_1}{\partial q_1} + q_2 \frac{\partial P_2}{\partial q_1} + \ldots + q_{N+1+km} \frac{\partial P^{N+1+km}}{\partial q_1} = 0 \\
&\vdots \\
\frac{\partial \sum_{j=1}^{N+1+km} \pi_j}{\partial q_{N+1+km}} &= P_{N+1+km} + q_{N+1+km} \frac{\partial P_{N+1+km}}{\partial q_{N+1+km}} - \frac{\partial C_{N+1+km}}{\partial q_{N+1+km}} \\
&\quad + q_1 \frac{\partial P_1}{\partial q_{N+1+km}} + \ldots + q_{N+1} \frac{\partial P_{N+1}}{\partial q_{N+1+km}} = 0
\end{aligned}$$

Assumption 3.1. *(i)*$\partial P_z/\partial q_l < 0, \forall z = l$*; (ii)* $\partial P_l/\partial q_z < 0$*,* $\forall z \neq l$*; and (iii)* $\partial P_z/\partial q_l = \partial P_l/\partial q_z, \forall z, l$*.*

This assumption says that for insiders the effects on demand are identical thus ruling

out product differentiation within the merged entity. But this assumption does not restrict the possibility of having product differentiation between insiders and outsiders.

Hence, under symmetry ($q_1 = q_2 = \ldots = q_{N+1+km}$) the first-order condition for the merged entity is given by

$$P_j + q_j(N + 1 + km)\frac{\partial P_j}{\partial q_j} - \frac{\partial C_j}{\partial q_j} = 0 \tag{1}$$

where $P_1 = P_2 = \ldots = P_{N+1+km}$.

Each outsider maximizes individual profit $\pi_i^o = P_i^o q_i^o - C_i^o(q_i^o)$, where $i = 1, \ldots, M + (1-k)m$. Under symmetry ($q_1^o = q_2^o \ldots = q_{M+(1-k)m}^o$) first-order condition for the profit maximization problem of each outsider is:

$$P_i^o + q_i^o\frac{\partial P_i^o}{\partial q_i^o} - \frac{\partial C_i^o}{\partial q_i^o} = 0 \tag{2}$$

where $P_1^o = P_2^o = \ldots = P_{M+(1-k)m}^o$. Equations (1) and (2) yield level of output of each insider and outsider as a function of k; that is, $q_j(k)$, $q_i^o(k)$. We find $\partial q_j/\partial k < 0$, $\partial q_i^o/\partial k > 0$ (see Appendix A). In words, as the share of new firms acquired by the merged entity increases each insider (outsider) reduces (raises) output. This is because now the merged entity consists of a larger number of insiders or plants, which translates into lower per-plant output, and at the same time the outsiders group now consists of fewer firms which prompts each outsider to produce more through the oligopolistic interdependence.

Assumption 3.2. *Let* $Q = \sum q_j = (N + 1 + km)q$, $Q^o = \sum q_i^o = (M + (1-k)m)q^o$. *Consider* $P = P(Q, Q^o)$. $\partial P/\partial Q \leq \partial P/\partial Q^o < 0$.

Assumption 3.2 says that the price is negatively-sloped for usual (i.e., non-Giffen) goods, both within-group and across-group, and that the own effect on demand is larger than the cross effect.

3.2 Profitable acquisition of new firms

The merged entity chooses a k so as to maximize joint profits. Imposing symmetry from the previous stage gives:

$$\sum \pi_j = (N + 1 + km)\,(Pq - C(q)) = (N + 1 + km)\pi$$

where differentiation with respect to k and imposing the first-order condition (Equation 1) gives:

$$\frac{\partial \sum \pi_j}{\partial k} \quad = \quad m\pi + (N + 1 + km)q\left[-(N + 1 + km)\frac{\partial P}{\partial q}\frac{\partial q}{\partial k} + \frac{\partial P}{\partial k}\right] = 0 \tag{3}$$

where $\partial q/\partial k < 0$, $\partial P/\partial q < 0$. Equation (3) points to two general opposing effects. On the one hand, an increase in joint profits from an increase in the share of new firms acquired, k, arises from the increase in the number of insider firms, which translates into higher profits for the merged entity. The merged entity is now larger due to the acquisition. This is the first term in Equation (3). On the other hand, with the acquisition of a higher share of new firms marginal profits of each insider fall, thereby lowering joint profits. This is captured by the second term in Equation (3). If the former effect is large enough, then there is a $\hat{k}$ such that joint profits are maximized.

Corollary 3.3. *There is a $\hat{k} \in (0, 1)$ which satisfies $\partial \sum \pi_j / \partial k = 0$, where $j = 1, \ldots, N + 1 + km$ if and only if the increase in joint profits from an increase in the share of new firms acquired is sufficiently large.*

Proof. See Appendix B □

The incumbent firm purchases a share of new firms, $\hat{k}$, based on joint or gross profit-maximizing incentives and the deal is referred to as a *privately beneficial acquisition*. In what follows we characterize a welfare-maximizing k^* and make comparisons with the $\hat{k}$ that maximizes joint profits.

3.3 Welfare impacts of new firm acquisition

Consider a welfare function which depends on industry profits and consumer surplus. That is,

$$W = CS\left(\sum q_j, \sum q_i^o\right) + \sum \pi_j + \sum \pi_i^o \tag{4}$$

Differentiation of Equation (4) and imposing the first-order conditions from Equations (1) and (2) gives:

$$\frac{\partial W}{\partial k} = \left[\pi m - (N+1+km)^2 q \frac{\partial P}{\partial q}\frac{\partial q}{\partial k}\right] - \left[(M+(1-k)m)q^o \frac{\partial P^o}{\partial q^o}\frac{\partial q^o}{\partial k} + \pi^o m\right] \tag{5}$$

where $\partial q/\partial k < 0$, $\partial P/\partial q < 0$, $\partial q^o/\partial k > 0$, $\partial P^o/\partial q^o < 0$.

Setting Equation (5) equal to zero characterizes the share of new firms acquired, k^*, which yields a maximum value for welfare.Equation (5) points to two broad effects. First, from the insiders' standpoint an increase in k results in higher profits for the insiders as the merged entity becomes larger, which prompts the policymaker to allow for a larger share of new firms to be acquired by the merged entity. But at the same time the policymaker restricts k because by allowing a higher share of acquisition it lowers the marginal profitability of each insider, thereby lowering the merged entity's profits. Second, from the outsiders' perspective an increase in k results in lower profits for the outsiders as there are fewer outsider firms due to the acquisition by the merged entity. This prompts the policymaker to restrict acquisitions of new firms. But with fewer outsider firms the marginal profitability of each outsider increases, thereby increasing the total profits of the outsiders. This prompts the policymaker to allow for more new firm acquisitions.

To analyze these effects we point to the role of the number of new firms, m. If the number of new firms lies within a certain range then there is a $k^* \in (0,1)$. Specifically, if m is large enough, then the acquisition of a small share by the merged entity raises total insiders' profits. This is because the acquisition raises the total number of insider firms

which are part of the merged entity thereby raising profits of the merged entity. But at the same time m cannot be too large. This is because new firm acquisition reduces the number of firms which are outsiders thereby lowering total profits for the outsiders. From these two effects we define a range for the number of new firms, $m \in (m^l, m^h)$, which is consistent with welfare maximization.

There are two important aspects for the characterization of k^*. First, the effect of new firm acquisition, k, on per-firm output q, q^o are assumed to be small enough. A small effect on per-firm output allows us to point to the role of the number of new firms, m. Second, we assume costs to be symmetric across outsiders and insiders. This symmetry assumption on the cost structure allows us to focus on new firm acquisition incentives absent any cost synergies.

Definition 3.4. *The effects of new firm acquisition on per-firm output are small enough, if* $\epsilon_{qk} > -1$ *and* $\epsilon_{q^o k}(1/k - 1) < 1$, *where* $\epsilon_{qk} = (k/q)(\partial q/\partial k) < 0$, $\epsilon_{q^o k} = (k/q^o)(\partial q^o/\partial k) > 0$.

Proposition 3.5. *Let the effects of new firm acquisition on per-firm output be small enough. There is a welfare-maximizing,* $k^* \in (0, 1)$, *for* $m \in (m^l, m^h)$, *if costs are symmetric across outsiders and insiders (i.e.,* $C(q) = C^o(q^o)$*).*

Proof. See Appendix C □

For the more general case where costs are not symmetric refer to Appendix D.

Next, to compare the welfare-maximizing k^* to the share which maximizes joint profits, we evaluate $\partial W/\partial k$ at $\hat{k}$ and analyze its sign. If positive (negative) then $k^* > (<)\hat{k}$. We argue that under the characterization in Proposition 3.5, $k^* > \hat{k}$. The intuition for this result is as follows. First, for $m > m^l$ an additional acquisition raises profits of the merged entity simply because the merged entity consists of a large enough number of insiders after the acquisition. And for $m < m^h$ an additional acquisition does not hurt profits of the outsiders too much. As a result, within this range of $m \in (m^l, m^h)$ there is room for higher k to increase

overall profits. That is, the presence of the outsiders and the oligopolistic interdependence open the possibility for higher welfare via a higher share of new firm acquisitions.

To see these results we evaluate Equation (5) at $\partial \sum \pi_j / \partial k = 0$, where its sign is positive for $m \in (m^l, m^h)$ if firms are symmetric in their cost structure.

Proposition 3.6. *Let $m \in (m^l, m^h)$. The welfare-maximizing share of new firm acquisitions exceeds the share that maximizes joint profits of the merged entity, if firms have symmetric costs.*

Proof. Consider Equation (5) evaluated at $\partial \sum \pi_j / \partial k = 0$ for $m \in (m^l, m^h)$. For given range of m the first two terms in Equation (5) are positive and the cost functions are symmetric across insiders and outsiders. □

The intuition behind Proposition 3.6 is that the merged entity takes over some of the new firms in a profit-maximizing way ($\hat{k}$) and while acquiring some more would reduce the merged entity's profits it would allow the outsiders to increase production, profits and improve consumer surplus. The increase in output from outsiders could be sufficient to raise aggregate output (or offset any reductions in aggregate output when the acquisition restricts each insider's output). This in turn could benefit consumers (or offset the reduction in consumer surplus that may have resulted post-acquisition). Overall, the increase in outsider production and outsider profits could offset (1) losses in the insiders' profits, and (2) any losses in consumer surplus such that $k^* > \hat{k}$ holds.

Finally, we highlight the role of product differentiation in mediating the relationship between $\hat{k}$ and k^*. The model is general enough to allow for product differentiation across the two group of firms (insiders versus outsiders) while assuming homogeneous products within the same group. When products are close substitutes (less differentiated), then the two group of firms are more interdependent. This implies that outsiders are able to increase production by a higher extent in response to the acquisition (i.e, $\partial q^o / \partial k > 0$ is larger) and

there is a stronger strategic substitutes effect. The higher increase in outsider production allows consumers to benefit (or lose less surplus) ultimately allowing a larger gap between $\hat{k}$ and k^*. On the other hand, if products are highly differentiated, there is a weaker strategic substitute effect (i.e, $\partial q^o/\partial k > 0$ is smaller) which could lead to $\hat{k}$ being closer to k^*.

3.4 Discussion and policy implications

In what follows we compare and contrast our results with previous studies and discuss implications for policy. Since the literature compares welfare pre- and post-acquisition to determine whether the proposed deal results in welfare loss, our pre-acquisition scenario can be captured by the case where $m \in (m^l, m^h)$ and $k = 0$, that is within the given range of entry of new firms the incumbent has not purchased any new firms. Within this context the profitable acquisition of $\hat{k}$ share of new firms is welfare enhancing given the three conditions are fulfilled: (1) the given range of m, that is, $m \in (m^l, m^h)$, (2) oligopolistic interdependence is present (output response from outsiders), and (3) cost symmetry or constant marginal costs. This result holds irrespective of the extent of product differentiation and irrespective of the size of the outsider group (e.g., even when outsiders as a group have a lower market share than all insiders). The key factor that prevents the privately beneficial acquisition, $\hat{k}$, from becoming welfare reducing is the profit opportunity for outsider firms and oligopolistic interdependence, given the restriction on the number of new firms m, $m \in (m^l, m^h)$.

Furthermore, our model shows that the multi-plant incumbent firm does not have as high of an incentive to buy more of the new firms compared to what maximizes welfare as long as the given conditions are fulfilled. This implies that, under the given conditions, merger control may not be needed to prevent such acquisition deals in the particular market structure captured by the model. This scenario is consistent with the one discussed in Bryan and Hovenkamp (2020) where current merger control policies in the United States do not restrict or prevent profitable start-up acquisitions. Bryan and Hovenkamp (2020) refer to this as a policy inaction or little anti-trust enforcement. While Bryan and Hovenkamp

(2020) recommend an expanded anti-trust intervention in start-up acquisitions, our model suggests that such regulations may not be needed, as long as the the given conditions hold, because the market incentive mechanism is sufficient to prevent acquisitions that would have been large enough to justify regulatory approval. Our model implies that if oligopolistic interdependence were absent then the privately beneficial acquisition could be too large and hence justifying merger control policy as in Bryan and Hovenkamp (2020).

Our results can be compared and contrasted with Davidson and Mukerjee (2007) who argue that privately-beneficial mergers are always welfare enhancing in a free entry market due to cost savings. In their analysis they compare pre - and post-merger welfare and argue welfare enhancements via the cost savings mergers generate. To directly compare our results with Davidson and Mukerjee (2007) we consider $k = 0$ as the pre-acquisition scenario and $\hat{k}$ as the privately beneficial acquisition. We find that without any cost savings the acquisition increases welfare as long as the given conditions on m and oligopolistic interdependence are fulfilled. However, the condition on m precludes a free entry market which is modeled in Davidson and Mukerjee (2007). With free entry of new firms, m is likely to be larger than m^h and so the results presented in Proposition 3.5 will not hold. That is, if $m > m^h$ then under the given assumption of no cost savings the merger is not necessarily welfare-enhancing which is consistent with Davidson and Mukerjee (2007). If cost is the same throughout the industry (no cost saving), we need a cap on m to ensure welfare-enhancing acquisition of new firms. The cap ensures welfare increases through oligopolistic interdependence.Thus, under the model assumptions presented in this study there may be some room for policymakers to use instruments to ensure entry neither exceeds the given threshold of m^h (e.g., licensing, entry fees) nor falls short of m^l (e.g., start-up loans).

The results of this model have some relevant policy implications. Currently the Biden Administration has directed the two merger control regulators, the US Federal Trade Commission (FTC) and Department of Justice (DOJ), to revise the horizontal merger guidelines. Among others, agencies are expected to use additional broader socio-economic criteria, such

as impacts on employment and small businesses, to evaluate merger proposals. Consistent with the literature, our model implies that the use of a net welfare approach in addition to a consumer surplus approach may provide additional insights. Net welfare can be defined in the most general way to include broader policy goals including the maximization of industry profits or efficiency, consumer surplus, government budget deficits/surplus, and environmental damages. We argue for additional research presenting alternative frameworks, methods, and assumptions to examine the net welfare impact of mergers, in particular when evaluating mergers with and acquisitions of new or start-up firms. For example, a weighted welfare function could be used when decision-makers give more value to gains/losses in consumer surplus than gains in efficiency.

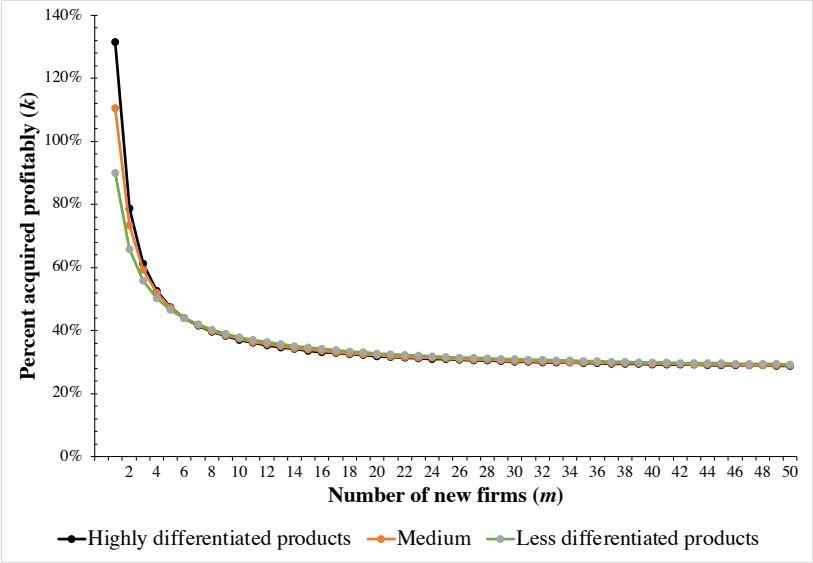
Our model also illustrates that customized models and sector-specific evaluation criteria may be required to capture the unique properties of certain markets (e.g., the electricity market) as well as define relevant markets because different industries have different objectives and constraints (including entry/exit conditions) that are likely to impact welfare changes due to mergers. For example, industries with frequent start-up activities are different from those with substantial barriers to entry and models should account for such differences. Hence, merger control policies that are used to evaluate the purchase of existing firms are likely to result in sub-optimal results when used to evaluate the acquisition of new firms.

3.5 Numerical illustrations

In this sub-section we illustrate some of the model's results by using a very simplified market scenario where $N = 1$ and $M = 1$. We assume a linear market demand line where $P = \alpha - \beta \sum q_j - \gamma \sum q_i^o$ for insiders and $P^o = \alpha - \beta^o \sum q_i^o - \gamma \sum q_j$ for outsiders. We consider $\beta = \beta^0 = 1 > \gamma > 0$.

We assume a constant and symmetric marginal cost, c, where $\alpha - c = 10$. We also assume that km is an integer. Under the given assumptions, we solve for the closed form

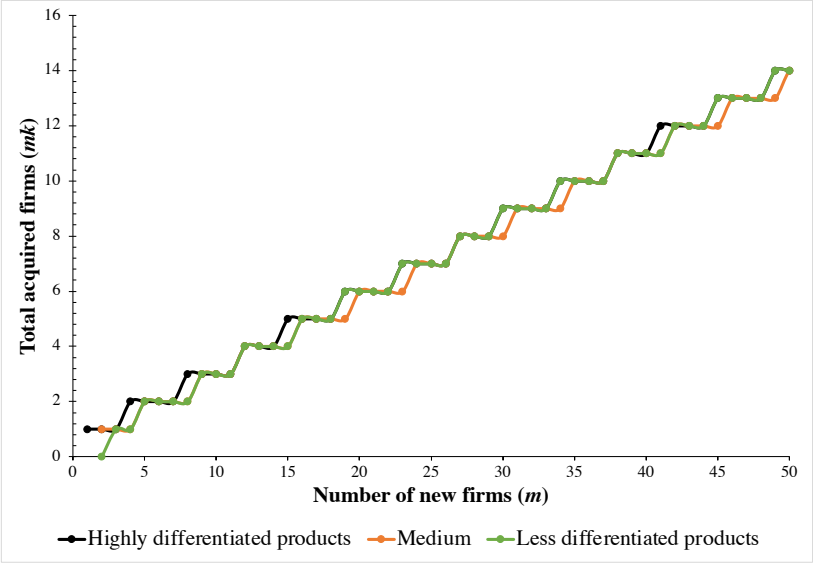
Figure 2: Number of new firms and percent acquired for different levels of product differentiation ($\gamma = 0.25, 0.50, 0.75$)



solution of the profit maximizing level of k given an exogenous number of new firm entry where m ranges from 1 to 50. Results are presented in Figures 2 and 3. Figure 2 illustrates that as m increases the percent of firms profitably acquired remains constant for all values of γ considered. Figure 3 shows that as m increases, the km also increases even if the profitable k percentage remains constant.

We then insert the calculated profit-maximizing percent (that is k values) into Equation (5) to evaluate the sign of $\partial W/\partial k$ at the privately beneficial percentage of acquisition of new firms. If the slope of the welfare function is positive, it implies that the welfare-maximizing percent of acquisition is higher than the profitable percent of new firm acquisitions. If the slope is negative, it implies that the privately beneficial acquisition is too high compared to what maximizes welfare. Results are summarized in Figure 4 and the figure shows that $\partial W/\partial k > 0$ holds only for $\gamma = 0.5$ and $\gamma = 0.75$, as long as $m > 12$. When $\gamma = 0.25$ (products are highly differentiated), we find that the profitable acquisition of new firms could reduce welfare for $m < 24$. When $\gamma = 0.25$, we find $\partial W/\partial k > 0$ only when

Figure 3: New firm entry and numbers acquired for different levels of product differentiation ($\gamma = 0.25, 0.5, 0.75$)



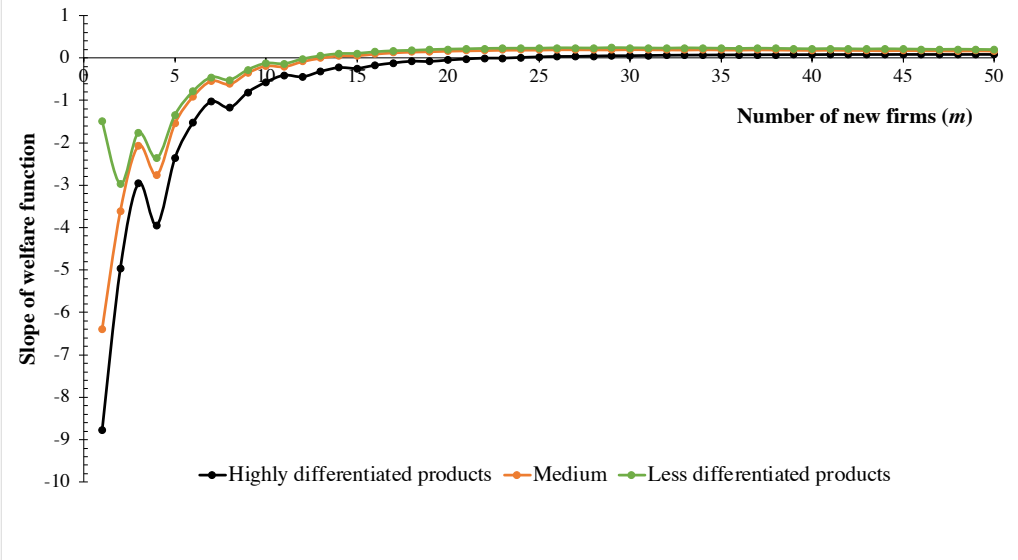
$m > 23$.

4 Conclusion

The literature on horizontal M&As has informed us in terms of lessons for merger control policies. Studies have examined the welfare impact of profitable horizontal merger deals among incumbent firms and whether such deals increase market power, reduce consumer surplus, increase operational efficiency, or prevent the entry of new firms (Farrell and Shapiro, 1990; Shapiro, 1996; Blair and Haynes, 2011; Nocke and Whinston, 2013; US Department of Justice, 2010; Department of Justice, 2014).

If the welfare criteria are to be used to evaluate the consequence of mergers by anti-trust agencies, the impact of mergers should be evaluated by looking at the several parameters identified in the literature (see Table 1 for a summary of parameters and factors most often modeled in the literature). For example, in 1984 the role of efficiency and cost savings was

Figure 4: Number of new firms m and slope of welfare ($\partial W/\partial k$) for different product differentiation levels ($\gamma = 0.25, 0.5, 0.75$)



explicitly included in the US Horizontal Merger guidelines. Since then, a clear evidence of cost savings or efficiency resulting from a merger would be viewed favorably by anti-trust agencies. This was a significant move from the market share criteria applied for merger control in previous years (pre-1984). In 1992, further modifications were made to the US Horizontal Merger guidelines to better evaluate mergers among firms producing differentiated products. In addition, entry conditions were made relevant because entry could allow for competition to be restored. In 2010, some specific language was added to evaluate whether prices would rise in differentiated products market, even after allowing for efficiency, and mergers that could eliminate potential new entrants were regulated.

However, less attention is given to the acquisition of new firms by multi-plant incumbent firms and whether policies are needed to regulate these (Bryan and Hovenkamp, 2020). There is a gap in the literature in modeling M&As deals involving new or start-up firms. In particular, there are very limited studies that model new firm acquisitions in markets with quantity competition (e.g., Bryan and Hovenkamp, 2019). The objective of this study is to

offer a review of the literature and examine the welfare impacts of a profitable acquisition of a share of new firms by an existing, relatively large incumbent firm.

Our results, based on model assumptions and conditions, indicate that as long as the number of new entering firms is within a given range there is no need to control or restrict the proposed acquisition strategy, even when cost synergies are absent. This is because of profit opportunities for outsider firms and the oligopolistic interdependence nature of the market. Our analysis and model framework can serve as a starting point that can be used to address contemporary and relevant policy questions. We showed that the profitable acquisition of new firms does not necessarily cause welfare losses under the given conditions. However, additional studies can further extend the model to incorporate other types of policies and merger incentives (e.g. technology sharing).

Furthermore, the model presented in this study illustrates that when an incumbent firm profitably purchases a new firm, welfare impacts primarily depend on the oligopolistic interactions of firms and number of new firms, given that there are no cost synergies. Thus policy-makers should pay attention to the specific number of new firms that enter an industry within a given period of time (e.g., a year) before or while some are acquired. A one-size-fits-all policy approach, such as a universal inaction or a universal control, is not appropriate when evaluating the acquisition of new firms. Industry specific barriers to entry (or lack of) and the resulting number of start-ups per period need to be included in the policy considerations.

The results of this model are specific to the model assumptions and apply for industries with a specific number of new firms where competition is Cournot. For example, if firms compete based on prices (strategic complements) rather than quantity the model results could change. Another limitation of the model is that we do not directly examine the impact of product differentiation (insider versus outsider brands) and the impact of consumer preference for one versus the other brand. We also assume a costless transition from the

outsider brand to the insider brand when acquisitions take place. In the future, studies can relax some of these assumptions and evaluate the welfare potential of new firm acquisitions.

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Appendices

A Comparative Statics

In this appendix we show the comparative statics results for $\partial q/\partial k < 0$, $\partial q^o/\partial k > 0$. Recall $P = P(Q, Q^o)$, $C = C(q)$,$C^o = C^o(q^o)$, $Q = (N+1+mk)q$, $Q^o = (M+(1-k)m)$. Consider equations (1) and (2) in symmetric equilibrium:

$$P + q(N+1+mk)P_q - C_q = 0 \tag{A.1}$$

$$P^o + q^o P^o_{q^o} - C^o_{q^o} = 0 \tag{A.2}$$

where subscripts denote partial derivatives. Total differentiation of (A.1) and (A.2), using the fact that $dQ = (N+1+km)dq + qmdk$, $dQ^o = (M+(1-k)m)dq^o - q^o mdk$, and collecting terms yields two equations in two unknowns dq, dq^o:

$$\left[\left(P_Q + QP_{qQ} + P_q\right)(N+1+km) - C_{qq}\right]dq + \left[\left(P_{Q^o} + QP_{qQ^o}\right)(M+(1-k)m)\right]dq^o$$
$$= \left[-qm\left(P_Q + QP_{qQ} + P_q\right) + q^o m\left(P_{Q^o} + QP_{qQ^o}\right)\right]dk \tag{A.3}$$

$$\left[\left(P^o_Q + q^o P^o_{q^oQ}\right)(N+1+km)\right]dq + \left[P^o_{Q^o} + q^o P^o_{q^oQ^o}(M+(1-k)m) - C^o_{q^oq^o}\right]dq^o$$
$$= \left[-qm\left(P^o_Q + q^o P^o_{q^oQ}\right) + q^o m\left(P^o_{Q^o} + q^o P^o_{q^oQ^o}\right)\right]dk \tag{A.4}$$

where "own" effects dominate "cross" effects. Solving for dq using Kramer's rule and simplifying gives, $\partial q/\partial k < 0$:

$$\begin{aligned} Ddq &= qm\left[\left(P^o_Q + q^o P^o_{q^oQ}\right)\left(P_{Q^o} + QP_{qQ^o}\right)\right. \\ &\quad \left. -\left(P_Q + QP_{qQ} + P_q\right)\left(P^o_{Q^o} + q^o P^o_{q^oQ^o}\right)\left(M + (1-k)m - C^o_{q^oq^o}\right)\right] \\ &\quad -mq^o C^o_{q^oq^o} < 0 \end{aligned} \tag{A.5}$$

where $P^o_{Q^o} + q^o P^o_{q^oQ^o} < P^o_Q + q^o P^o_{q^oQ} < 0$, $P_Q + QP_{qQ} + P_q < P_{Q^o} + QP_{qQ^o} < 0$, and the determinant of the coefficient matrix $D > 0$. An analogous expression for dq^o yields $\partial q^o/\partial k > 0$.

B Proof of Corollary 3.3

Consider $\sum \pi_j = (N + 1 + km)\pi$, whence first-order condition is given by $\partial \sum \pi_j/\partial k = (N + 1 + km)(\partial \pi/\partial k) + \pi m = 0$. Then, differentiation with respect to k gives

$$\frac{\partial^2 \sum \pi_j}{\partial k^2} = (N + 1 + km)\frac{\partial^2 \pi}{\partial k^2} + 2m\frac{\partial \pi}{\partial k} \tag{B.1}$$

Using first-order condition $\partial \sum \pi_j/\partial k = 0$ simplifies (B.1):

$$\frac{\partial^2 \sum \pi_j}{\partial k^2} = (N + 1 + km)\frac{\partial^2 \pi}{\partial k^2} + \frac{2m^2\pi}{N + 1 + km} \tag{B.2}$$

whence

$$\frac{\partial^2 \sum \pi_j}{\partial k^2} < 0 \Leftrightarrow \frac{(N + 1 + km)}{2m}\frac{\partial^2 \pi}{\partial k^2} < m\pi \tag{B.3}$$

Then,

$$\frac{\partial \sum \pi}{\partial k} = 0 \Leftrightarrow \hat{k} = \frac{-\pi}{\partial \pi/\partial k} - \frac{N + 1}{m} \tag{B.4}$$

whence, $\hat{k} < 1 \Leftrightarrow -\pi/(\partial \pi/\partial k) < (N + 1)/m$.

C Proof of Proposition 3.5

We want to show that for $m \in (m^l, m^h)$ there is a $k^* \in (0,1)$ such that $\partial W/\partial k = 0$ at k^* i.e., welfare is maximized.

The proof points to the existence of a share of new firm acquisitions, k, such that welfare is maximized for given $m \in (m^l, m^h)$. The welfare function is not smooth in k. But our analysis indicates that for given m within the defined range there is a corresponding $k \in (0,1)$ such that $km \in N$, which maximizes welfare. The strategy in our proof is to show that for given m, the expression in (5) is positive (negative) evaluated at $k = 0$ ($k = 1$). This means there exists one k (which is discrete, given finite m) which satisfies (5).

Assume (i) constant marginal costs (i.e., $\partial C/\partial q = C(q)/q$, $\partial C^o/\partial q^o = C^o(q^o)/q^o$) or sufficiently similar cost functions i.e., $C(q) \simeq C^o(q^o)$, (ii) the effects of new firm acquisition on per-firm output be small enough as in definition 3.4, and (iii) the welfare function is concave in k.

Consider the expression in (5) which we re-write here for completeness:

$$\frac{\partial W}{\partial k} = \left[\pi m - (N+1+km)^2 q \frac{\partial P}{\partial q}\frac{\partial q}{\partial k}\right] - \left[(M+(1-k)m)q^o \frac{\partial P^o}{\partial q^o}\frac{\partial q^o}{\partial k} + \pi^o m\right]$$

Substituting the first-order conditions (1) and (2), and imposing assumption (i) simplifies the above expression to

$$\begin{aligned}\frac{\partial W}{\partial k} = & -(N+1+km)q\frac{\partial P}{\partial q}\left[(N+1+km)\frac{\partial q}{\partial k} + qm\right] \\ & -q^o\frac{\partial P^o}{\partial q^o}\left[(M+(1-k)m)\frac{\partial q^o}{\partial k} - q^o m\right] \end{aligned} \tag{C.1}$$

where $\partial P/\partial q < 0$, $\partial P^o/\partial q^o < 0$. The sign of each term within squared brackets is ambiguous.

Consider the first term in squared brackets evaluated at $k = 0$:

$$(N+1+km)\frac{\partial q}{\partial k} + qm > 0 \Leftrightarrow m > m_1|_{k=0} = -(N+1)\frac{\partial q}{\partial k}q > 0 \tag{C.2}$$

Similarly, consider the second term in squared brackets evaluated at $k = 0$:

$$(M+m)\frac{\partial q^o}{\partial k} - q^o m > 0 \Leftrightarrow m < m_2|_{k=0} = \frac{M\frac{\partial q^o}{\partial k}}{-\frac{\partial q^o}{\partial k} + q^o} \tag{C.3}$$

where $m_2|_{k=0} > 0$ since $\partial q^o/\partial k > 0$ and by definition 3.4 $-\partial q^o/\partial k + q^o > 0$.

From (C.2) and (C.3), it follows that for $m \in (m_1|_{k=0}, m_2|_{k=0})$ at $k = 0$, $\partial W/\partial k > 0$.

Next, consider the first term in squared brackets evaluated at $k = 1$:

$$(N+1+m)\frac{\partial q}{\partial k} + qm < 0 \Leftrightarrow m < m_1|_{k=1} = \frac{-(N+1)\frac{\partial q}{\partial k}}{\frac{\partial q}{\partial k} + q} > 0 \tag{C.4}$$

where by definition 3.4 $\partial q/\partial k + q > 0$.

Similarly, consider the second term in squared brackets evaluated at $k = 1$:

$$M\frac{\partial q^o}{\partial k} - q^o m < 0 \Leftrightarrow m > m_2|_{k=1} = \frac{M\frac{\partial q^o}{\partial k}}{q^o} > 0 \tag{C.5}$$

From (C.4) and (C.5), it follows that for $m \in (m_2|_{k=1}, m_1|_{k=1})$ at $k = 1$, $\partial W/\partial k < 0$.

Because $m_2|_{k=1}$, $m_1|_{k=0}$, $m_1|_{k=1}$, $m_2|_{k=0}$ can relate in different ways we show that our results hold for an m satisfying $m_2|_{k=1} < m_1|_{k=0} < m < m_1|_{k=1} < m_2|_{k=0}$, where $m_1|_{k=0} < m_1|_{k=1}$ and $m_2|_{k=1} < m_2|_{k=0}$. Additionally,

$$\begin{aligned} m_1|_{k=1} < m_2|_{k=0} \quad &\Leftrightarrow \quad \frac{(N+1)}{M} < \eta_2 \\ m_2|_{k=1} < m_1|_{k=0} \quad &\Leftrightarrow \quad \frac{(N+1)}{M} > \eta_1 \end{aligned}$$

where $\eta_2 > 0$ by definition 3.4. Hence,

$$\eta_1 = \frac{\frac{1}{q^o}\frac{\partial q^o}{\partial k}}{-\frac{1}{q}\frac{\partial q}{\partial k}} < \frac{(N+1)}{M} < \frac{\frac{1}{q^o}\frac{\partial q^o}{\partial k}\left(1+\frac{1}{q}\frac{\partial q}{\partial k}\right)}{-\frac{1}{q}\frac{\partial q}{\partial k}\left(1-\frac{1}{q^o}\frac{\partial q^o}{\partial k}\right)} = \eta_2 \tag{C.6}$$

where using definition 3.4 the expression in (C.6) can be re-written in terms of elasticities:

$$\eta_1 = \frac{\epsilon_{q^o k}}{-\epsilon_{qk}} < \frac{(N+1)}{M} < \frac{\epsilon_{q^o k}}{-\epsilon_{qk}}\frac{\left(1+\frac{1}{k}\epsilon_{qk}\right)}{\left(1-\frac{1}{k}\epsilon_{q^o k}\right)} = \eta_2$$

That is, we have our range for m as long as (C.6) holds i.e., as long as the share of the original size of the merged entity relative to the original number of outsider firms is bounded. To complete the proof we define $m^l = max\{m_{2,k=1}, m_{1,k=0}\}$, and $m^h = min\{m_{1,k=1}, m_{2,k=0}\}$.

D Symmetric costs, range of m and k^*

In this appendix we present an analysis to illustrate the role of symmetric costs across insiders and outsiders, and the number of firms m in the characterization of k^* in proposition 3.5. The analysis is consistent with the literature and our results.

Consider the expression for $W_k = 0$ absent the assumption of symmetric costs (subscripts denote partial derivatives):

$$W_k = -(N+1+km)qP_qQ_k - q^oP^o_{q^o}Q^o_k + m\left(qC^{'} - C\right) - m\left(q^oC^{o\prime} - C^o\right) = 0 \tag{D.1}$$

where $Q_k = (N+1+km)(\partial q/\partial k) + mq$, $Q^o_k = (M+(1-k)m)(\partial q^o/\partial k) - mq^o$. Recall $Q_k > 0$ and $Q^o_k < 0$ from definition 3.4.

Set $C = C^o = \bar{C}$, $C^{'} = C^{o\prime} = \bar{C}^{'}$. Hence, (D.1) simplifies to

$$-(N+1+km)qP_qQ_k - q^oP^o_{q^o}Q^o_k + m\bar{C}^{'}(q-q^o) = 0 \tag{D.2}$$

where $q - q^o < 0$. Differentiation of (D.2) with respect to m and $\bar{C}^{'}$, and substituting (D.1) gives

$$\begin{aligned}\frac{d\bar{C}^{'}}{dm} = & \frac{-(N+1+km)qP_qQ_k\left(\frac{m}{Q_k}Q_{km} - 1\right) - q^oP^o_{q^o}Q^o_k\left(\frac{m}{Q_k}Q_{km} - 1\right)}{m\Phi} \\ & \frac{-Q_k(N+1+km)\eta_1 m - Q^o_k\eta_2 m + \bar{C}^{'}(q_m - q^o_m)m^2}{m\Phi}\end{aligned} \tag{D.3}$$

where

$$
\begin{aligned}
\eta_1 &= q_m(P_q + qP_{qq}) + (P_{q^o} + qP_{qq^o})\, q^o_m - P_{q^o} q^o_m \\
\eta_2 &= q^o_m(P^o_{q^o} + q^o P^o_{q^o q^o}) + \left(P^o_q + q^o P^o_{q^o q}\right) q_m - P^o_q q_m \\
\eta_3 &= q_{\bar{C}'}(P_q + qP_{qq}) + (P_{q^o} + qP_{qq^o})\, q^o_{\bar{C}'} - P_{q^o} q^o_{\bar{C}'} \\
\eta_4 &= q^o_{\bar{C}'}(P^o_{q^o} + q^o P^o_{q^o q^o}) + \left(P^o_q + q^o P^o_{q^o q}\right) q_{\bar{C}'} - P^o_q q_{\bar{C}'} \\
\Phi &= \frac{-(N+1+km)qP_qQ_k}{\bar{C}'}\left(\frac{\bar{C}'}{Q_k}Q_{k\bar{C}'} - 1\right) - \frac{q^o P^o_{q^o} Q^o_k}{\bar{C}'}\left(\frac{\bar{C}'}{Q_k}Q_{k\bar{C}'} - 1\right) - Q_k\eta_3 - Q^o_k\eta_4
\end{aligned}
$$

From (D.3), $m = 0$ is a vertical asymptote and from the numerator there are at least two m's which satisfy $d\bar{C}'/dm = 0$. We draw $W_k = 0$ in $(m, \bar{C}')$ space. For given m, at $\bar{C}'$ the profit-increasing effect of all insiders offsets the profit-decreasing effect of all outsiders by a change in k. Thus, for given m, $W_k > 0$ for $C' < \bar{C}'$, and $W_k < 0$ for $C' > \bar{C}'$. The vertical asymptote at $m = 0$ the function $\bar{C}'$ goes to infinity. This can be seen by setting $m = 0$ in the numerator: $(N+1)qP_qQ_k + q^oP^o_{q^o}Q^o_k \Leftrightarrow N + 1 < -q^oP^o_{q^o}Q^o_k/qP_qQ_k < 0$ since $Q_k > 0$, $Q^o_k < 0$ by definition 3.4. But this is a contradiction since $N + 1 > 0$ and so $(N+1)qP_qQ_k + q^oP^o_{q^o}Q^o_k$ is positive, which means that $d\bar{C}'/dm$ approaches infinity.

Figure 5 points to the existence of a range of (m^l, m^h) so that there is at least one $k \in (0, 1)$ which satisfies $W_k = 0$ (local maximum). That is, given symmetric costs, for $m \in (m^l, m^h)$ proposition 3.5 holds.

Figure 5: Symmetric costs, range of m and k^*