Kill Zone

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Raghuram Rajan     Luigi Zingales
Motivation

• **Kill Zone**: Venture capitalists are reluctant to fund investments in a space that is proximate to large digital platforms.

• “The Kill Zone is a real thing. The scale of these companies [digital platforms] and their impact on what can be funded, and what can succeed, is massive”: Albert Wenger, VC

• “Venture capitalists are now hesitant to fund new startups to compete with these big tech companies because it’s so easy for the big companies to either snap up growing competitors or drive them out of business.” : Senator Elizabeth Warren.
• **Wait a minute!** The prospect of being acquired should spur, not stifle, innovation and investment.
• What do the data say?
VC Early Stage Investments in social media space: Number of Deals
VC Early Stage Investments in social media space: Dollar amounts invested
Nature of the Test

• Ideally, we would like to study the impact on start-up investments of a decision by antitrust authorities to strike down a big acquisition by a major digital platform.

• Unfortunately, we have not observed any such decision

• Therefore, we resort to a different strategy

• We consider the announcements of major acquisitions by platforms as a signal that the FTC and DoJ will let these, and similar, acquisitions go through.

• We then examined the impact on investment decisions by related companies.
Empirical Strategy

Identify which acquisitions are big enough to matter

- All Google and Facebook acquisitions > $ 500 million in the period 2006-2016
## Events

All software companies acquired by Facebook or Google for more than 500 M between the beginning of 2006 and the end of 2018.

<table>
<thead>
<tr>
<th>Year</th>
<th>Acquirer</th>
<th>Target</th>
<th>Price</th>
<th>Software Sector</th>
<th>Complementarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Google</td>
<td>Youtube</td>
<td>1,650</td>
<td>Multimedia and Design</td>
<td>Substitute</td>
</tr>
<tr>
<td>2007</td>
<td>Google</td>
<td>DoubleClick</td>
<td>3,100</td>
<td>Internet</td>
<td>Complement</td>
</tr>
<tr>
<td>2009</td>
<td>Google</td>
<td>AdMob</td>
<td>750</td>
<td>Vertical Market</td>
<td>Complement</td>
</tr>
<tr>
<td>2009</td>
<td>Google</td>
<td>Postini</td>
<td>625</td>
<td>Network Management</td>
<td>Complement</td>
</tr>
<tr>
<td>2011</td>
<td>Google</td>
<td>ITA Software</td>
<td>676</td>
<td>Vertical Market</td>
<td>Substitute</td>
</tr>
<tr>
<td>2012</td>
<td>Facebook</td>
<td>Instagram</td>
<td>1,000</td>
<td>Social Platform</td>
<td>Substitute</td>
</tr>
<tr>
<td>2013</td>
<td>Google</td>
<td>Waze</td>
<td>966</td>
<td>Communication</td>
<td>Substitute</td>
</tr>
<tr>
<td>2014</td>
<td>Facebook</td>
<td>WhatsApp</td>
<td>19,000</td>
<td>Communication</td>
<td>Substitute</td>
</tr>
<tr>
<td>2016</td>
<td>Google</td>
<td>Apigee</td>
<td>625</td>
<td>Development Applications</td>
<td>Complement</td>
</tr>
</tbody>
</table>
Strategy

- Identify a set of “treated firms”
  - Similar to the one acquired (possibly not too similar)

- Define a “cycle-adjusted” measure of investments
  - We standardize the amount by all the amount VCs invest in all software companies (all early deals) from Pitchbook.
  - We normalize by this ratio in the year of the acquisition.

- Compute this cycle-adjusted normalized measure around the year of acquisition (+/- 3 years)

- Aggregate them in an event study across acquisitions
Normalized relative investment before and after an acquisition
Normalized relative number of deals before and after an acquisition
Pitchbook-based measure of similarity (Table 3 a)

<table>
<thead>
<tr>
<th></th>
<th>Relative Investment</th>
<th>Relative # of deals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Post acquisition dummy</td>
<td>-0.967**</td>
<td>-0.927***</td>
</tr>
<tr>
<td></td>
<td>(-2.22)</td>
<td>(-3.06)</td>
</tr>
<tr>
<td>Constant</td>
<td>2.521***</td>
<td>2.504***</td>
</tr>
<tr>
<td></td>
<td>(6.61)</td>
<td>(11.04)</td>
</tr>
<tr>
<td>Acquisition fixed effects</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>N</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>R^2</td>
<td>0.067</td>
<td>0.646</td>
</tr>
</tbody>
</table>
Table 4: Varying degree of similarity

<table>
<thead>
<tr>
<th>Pitchbook measure of similarity &gt;</th>
<th>75%</th>
<th>85%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post acquisition (dummy)</td>
<td>-1.947***</td>
<td>-0.565***</td>
<td>-0.436**</td>
</tr>
<tr>
<td></td>
<td>(-3.86)</td>
<td>(-3.05)</td>
<td>(-2.10)</td>
</tr>
<tr>
<td>Constant</td>
<td>5.357***</td>
<td>1.146***</td>
<td>0.736***</td>
</tr>
<tr>
<td></td>
<td>(15.19)</td>
<td>(7.75)</td>
<td>(4.26)</td>
</tr>
<tr>
<td>Acquisition Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>63</td>
<td>54</td>
<td>43</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.808</td>
<td>0.347</td>
<td>0.275</td>
</tr>
</tbody>
</table>
Table 5: Restricting to start ups that are not too similar.

<table>
<thead>
<tr>
<th></th>
<th>Relative Investment (1)</th>
<th>Relative # of Deals (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post acquisition (dummy)</td>
<td>-1.748***</td>
<td>-1.563***</td>
</tr>
<tr>
<td></td>
<td>(-3.69)</td>
<td>(-4.76)</td>
</tr>
<tr>
<td>Constant</td>
<td>5.103***</td>
<td>4.830***</td>
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<tr>
<td></td>
<td>(14.16)</td>
<td>(19.87)</td>
</tr>
<tr>
<td>Acquisition Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.828</td>
<td>0.897</td>
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</table>
Table 6: New deals

<table>
<thead>
<tr>
<th></th>
<th>Relative Investment (1)</th>
<th>Relative # of Deals (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post acquisition (dummy)</td>
<td>-0.376***</td>
<td>-0.534***</td>
</tr>
<tr>
<td></td>
<td>(-3.34)</td>
<td>(-4.67)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.978***</td>
<td>1.415***</td>
</tr>
<tr>
<td></td>
<td>(10.35)</td>
<td>(15.88)</td>
</tr>
<tr>
<td>Acquisition Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>58</td>
<td>58</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.658</td>
<td>0.797</td>
</tr>
</tbody>
</table>
Table 7: All Software Acquisitions

<table>
<thead>
<tr>
<th></th>
<th>Relative Investment (1)</th>
<th>Relative # of Deals (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post acquisition indicator *</td>
<td>-0.649**</td>
<td>-0.689***</td>
</tr>
<tr>
<td>Facebook/Google indicator</td>
<td>(-2.07)</td>
<td>(-3.22)</td>
</tr>
<tr>
<td>Post acquisition indicator</td>
<td>-0.322***</td>
<td>-0.148**</td>
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<tr>
<td></td>
<td>(-3.51)</td>
<td>(-2.30)</td>
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<tr>
<td>Constant</td>
<td>4.288***</td>
<td>3.341***</td>
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<tr>
<td></td>
<td>(70.00)</td>
<td>(90.77)</td>
</tr>
<tr>
<td>Acquisition Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1285</td>
<td>1285</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.892</td>
<td>0.926</td>
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</tbody>
</table>
### Table 8: Substitutes and Complements

<table>
<thead>
<tr>
<th></th>
<th>Relative Investment</th>
<th>Relative # of Deals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Substitute</td>
<td>Complement</td>
</tr>
<tr>
<td>Post acquisition (dummy)</td>
<td>-0.350***</td>
<td>-0.404*</td>
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<tr>
<td></td>
<td>(-3.92)</td>
<td>(-1.89)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.628***</td>
<td>1.352***</td>
</tr>
<tr>
<td></td>
<td>(8.80)</td>
<td>(7.58)</td>
</tr>
<tr>
<td>Acquisition Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.741</td>
<td>0.468</td>
</tr>
</tbody>
</table>
Do acquisitions encourage entry in a digital platform world?

- A world characterized by:
  - One (or a few) gigantic incumbents
  - Network externalities: the more the apps/customers on a platform, the more each customer benefits
  - Switching costs for some (no costless multi-homing)
  - Multi sided platforms
    - The price charged on the customer side of the platform equals zero

- Perhaps not!
Intuition

• In any acquisition, the price the entrant gets depends upon
  • Competition among bidders
  • Entrant’s outside option to go it alone (even if mergers are always efficient)

• If only one large incumbent platform, there is no competition

• Go-it-alone value depends upon
  • the entrant’s quality
  • the number of customers the new entrant can attract: network effects
• Customer decisions swayed by decisions of app designers who choose the entrant platform.
• In a world where app designers have switching costs
  • Entrant is already at a disadvantage
    • App designers start with incumbent.
Intuition contd.

• Disadvantage potentially exacerbated if the authorities permit easy acquisitions
  • Acquirer is expected to make seamless the adaptation of apps to the merged platform.
  • Anticipating this, few app designers will switch to entrant.
  • Seeing few app designers switch, few customers will switch.
  • This depresses stand-alone valuations, hence acquisition prices.
  • Depresses investments in potential entrants.
• No overt anti-competitive behavior!
Model Setup
Problem in modeling

- Network externalities lead to multiple equilibria
  - If I think many customers will switch, I too will switch, while if I think no one will switch, I will not switch.
  - No relationship to fundamentals (sun spots)
  - Similar to the modeling of bank runs
- Technique of global games helps us get a unique equilibrium.
  - Equilibrium related to fundamentals.
  - Allows us to do comparative statics.
Model

• Consider an incumbent platform I, which is threatened by a new entrant platform E.

• Without loss of generality, we will assume the quality of the incumbent is normalized to zero.

• The quality increment of the new entrant is $\theta$

• There are two sets of agents:
  • App designers with measure $\lambda$
  • Ordinary customers with measure 1.
App designers: Early adopters

- At date 0 (the beginning of the first period), app designers observe a common signal such that their posterior on $\theta$ is distributed $\mathcal{N}(q, \frac{1}{\alpha})$.

- Having observed the signal, the app designers decide whether to switch incurring switching cost $s_i \sim U[0, \bar{s}]$.

- App designers get a per period incremental expected utility of $E(\theta)$.
  - No network externalities for now.
Ordinary Customers

• Ordinary customers need to pay attention to the switching decision.
  • They do so when there is a serious entrant.
  • Otherwise, they stay with their current choice.

• Ordinary customers do enjoy network externalities.

• Their value of being on a platform is:
  • expected platform quality +
    total measure of app designers and ordinary customers who opt for it.
Ordinary Customers -2

• At date \( \frac{1}{2} \), ordinary customers have two pieces of information in making their switching decision:
  • they observe how many app designers switched (and thus how many stayed)
  • they also see a private signal of incremental entrant quality:

\[
x_i = \theta + \eta_i
\]

where \( \eta \sim N\left(0, \frac{1}{\beta}\right) \)

• They have no switching costs.
• No switching back – light attachment.
Value of platform revenues (from advertisers)

• A platform’s profits derive from the revenues a platform can get on the advertising side.

• The value of a platform to advertisers depends on the number of customers a platform has:
  • more customers on the platform means more eyeballs that will see the advertisement
  • more customers also mean more platform data and thus better targeted advertising.

• Let $V^E(p)$ be the value of the entrant platform to advertisers. Then $\frac{dV^E(p)}{dp} > 0$
The Merger Game

• At date 1+m, the two companies get to merge (or not).
• The share of the merged value each party gets is determined through bargaining
• If they do merge, the superior technology will be adopted by the merged entity and all the customers will enjoy it.
• If the two companies do not merge, they will survive \( n-(1+m) \) more periods independently.
• The shorter is \( m \), the more liberal the merger regime.
Timeline

**Period 1**

- **Date 0**: App designers see the common signal and decide whether to adapt based on their own adaptation cost.
- **Date ½**: Ordinary customers see app designer adapting and their own private signal, and decide whether to switch.

**Period 2 and after**

- **Date 1+m**: Incumbent and entrant decide whether to merge and the terms thereof. If merger does take place, superior technology adopted. If not, platforms continue separately.
- **Date n**: Technology is imitated or becomes obsolete.
Solving for app designer and customer decisions
Analysis of app designer behavior

• App designers know that if they switch they expect to gain $q$ for $(1+m)$ periods, where
  • $m=0$ if the merger takes place at date 1
    • liberal antitrust regime
  • $m=n-1$ if it never takes place
    • Tough antitrust regime
Analysis of app designer behavior

• As a result, each app designer $i$ will decide to adapt iff

\[ (1 + m)q > s_i \]

• Measure of app designers who switch at date 0 is given by

\[ \lambda \frac{(1 + m)q}{s} \quad \text{if} \quad 0 \leq \frac{(1 + m)q}{s} \leq 1 \]
Analysis of Ordinary Customers

• Ordinary customers observe how many app designers have switched.
• Since they know $m$, they can back out $q$, the app designers’ expectation of $\theta$.
• Combining with the private signal they observe at the beginning of period 2, each ordinary customer will have a posterior belief of the quality differential

$$\rho_i = \frac{\alpha q + \beta x_i}{\alpha + \beta}$$

with a precision $\alpha + \beta$
• An ordinary customer will switch if and only if the network-externality-adjusted quality of the entrant is superior, that is, iff

\[ \rho_i + p(\rho_i) + (1+m)\lambda q \geq (1-p(\rho_i)) + \lambda \]

where \( p \) is the fraction of customers who switch.

• On LHS
  • Customer’s perception of the quality differential,
  • Measure of ordinary customers he believes will switch to the entrant
  • Measure of app designers who adapted.

• On RHS
  • Measure of ordinary customers he believes will not switch,
  • Measure of all app designers (multi-homing).
Switching Game

• Typical global game (see, for example, Morris and Shin, 2000, 2003).

• To solve it, we first conjecture that ordinary customers will follow a switching strategy where they switch if their prior of quality exceeds a threshold.

• When a customer is the marginal switcher, he has to believe that a fraction $p$ of customers will switch as well.

• Thus, a fraction $p$ should have a posterior at least as high as his.

• So calculation $p$ at the switching point $\rho^*$, and substituting
• At the switching point we must have

\[
\rho^* + 2p(\rho^*) + \frac{(1+m)\lambda q}{s} - (1 + \lambda) = 0
\]

• Let

\[
S(\rho) = \rho + 2 + \frac{(1+m)\lambda q}{s} - (1 + \lambda) - 2\Phi\left(\gamma(\rho - q)\right)
\]

**Theorem 1:** For \(\gamma < \sqrt{\frac{\pi}{2}}\) the function \(S()\) is always increasing in rho given \((m,\rho)\) and there is a unique switching equilibrium.
Corollary 1:
The optimal switching point decreases and the fraction of ordinary customers switching to the entrant increases in the number of periods \((1+m)\) that the app designer expects the entrant to remain independent.

Intuition:
• The longer the expected period of independence, the more app designers will switch to the entrant for a given positive expectation of the quality differential \(q\),
• This will increase the network externalities to an ordinary customer joining the entrant
• In turn, this will reduce the quality threshold at which ordinary customers will switch to the entrant
• This enhances the expected value of the entrant as a stand-alone entity.
• Note – price not a factor: platforms price services at zero on one side.
$p(\rho^*)$ for $\lambda = 0.4$
Merger Game
Mergers will always take place if allowed

• Let \( V(1) \) be the discounted sum of profits that a merged platform with all the customers and the superior technology extract in the advertising market after a merger at date 1.

• Let \( p \) be the proportion of ordinary customers who switch to E at time \( \frac{1}{2} \).

• Let \( V^I(1-p) \) and \( V^E(p) \) be the value respectively of the incumbent and of the entrant, operating for the remaining n-1 periods as stand-alone platforms.

• Since a monopolist’s profit is greater, \( V(1) > V^I(1-p) + V^E(p) \)

• With bargaining under symmetric information, the merger will always take place if allowed. The only question is at what price.
Transaction price

• If a merger takes place, we assume that with probability $\mu$ the incumbent makes a take-it-or-leave-it offer to the entrant.
• With probability $1 - \mu$ the entrant does so.
• The entrant gets

$$\Pi^E(p^M) = \mu V^E(p^M) + (1 - \mu) [V(1) - V^I(1 - p^M)]$$

• If mergers are prohibited, she gets

$$\Pi^E(p^{NM}) = V^E(p^{NM})$$
• But \[ E_0 \left[ V^E(p^{NM}) \right] \geq E_0 \left[ V^E(p^M) \right] \]

• Hence if mergers are prohibited, and the entrant’s bargaining power is small (e.g., \( \mu = 1 \)), she gets more ex post when mergers are prohibited.

• This depends critically on the stand alone value
  • The stand-alone value increases in the number of customers the entrant has attracted.
  • The number of customers it attracts, ceteris paribus, increases in the expected time before a merger.
Theorem 2: So long as the expected measure of app designers switching with a prohibition on mergers is positive, there is a $\hat{\mu} \in [0, 1]$ such that for incumbent bargaining power $\mu > \hat{\mu}$, the probability a new platform enters the market is higher when mergers are prohibited than when they are not.
Implications

• Importance of incumbent’s bargaining power. Why likely to be high?
  • Lower cost of capital, lower impatience.
  • Incumbent ownership structure less concentrated, less risk averse.
  • Incumbent can replicate entrant’s technology over time, shortens latter’s horizon.

• Importance of entrant’s outside option or stand alone valuation.
  • Rent-seeking behavior

• Ex ante versus ex post
Ex ante investment by potential entrant
Ex ante investment

• Potential entrant faces a cost of R&D, $C^E$

• On paying this cost, she can draw a technology of quality $\theta$

• Before she decides whether to invest, E will compare her expected profit with her known cost of R&D and invest if and only if

$$E_{\theta}[\Pi^E(\theta)] > C^E$$

• Prohibiting acquisitions by incumbent platforms can have the effect of increasing the expected profit of new entrants

• This will increase the range of $C^E$ that are viable, and increase the probability of investment in R&D and thus entry.
Critical assumptions

• Network externalities associated with early adopters – app designers
• Information content of app designer adaptation?
• App designers motivated by attracting customers and not just platform quality?
• App designers can only single-home?
• Limited attention of ordinary customers?
• Platform can pay to attract designers/customers?
Implications
• What Wenger and Warren say is not inconsistent with theory
• The data suggest it might even be plausible
• Different history of digital platforms in the United States, China, and the EU.
  • EU entrants had to contend from the beginning with US incumbents, who built extensive networks in Europe early on.
  • By contrast, Chinese entrants did not have the same problem.
• India and TikTok
Prohibiting mergers has problems both in theory and in practice

- **Theory**: it prevents the industry from realizing ex post efficiencies.
- **Practice**: how you define the boundaries of the prohibition
  - A case-by-case approach will inevitably lead to approving all acquisitions

However, the regulatory authorities can affect switching costs.

- Mandate a common standard and interoperability.
- All competitors realize common network externalities.

Data should not be the sole privilege of incumbents.
Conclusions

• We construct a simple model that rationalizes the existence of “kill zones” without obvious anti-competitive actions by the incumbent.
• It depends upon the interaction of 3 frictions
  • network externalities
  • switching costs
  • lack of price competition (zero lower bound)
• Mandated interoperability could help alleviate the problem.