



## On platforms, incomplete contracts, and open source software<sup>☆</sup>



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### ABSTRACT

We analyze investment incentives for a firm A owning a software platform and an application and a firm B deciding whether to develop a new application for the platform. While B's entry helps the success of the platform, B fears ex post expropriation by A and is hence reluctant to enter and invest. We show that different platform governance structures prevalent in the Information and Communication Technology industry (integrated, proprietary, standardized, open source platform) serve to balance investment incentives for the platform and for the applications.

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“... If you look at history ... rumor has it that IBM spent a billion dollars on applications for [their operating system] OS2 but they bought people, they said ‘here, do this for me.’ And at the end, the companies turned around and said ‘here, it’s done’ – and IBM said ‘well, aren’t you going to sell it, market it?’ They said ‘well no, our deal was to develop it: you’ve got it, now good luck.’”<sup>1</sup>

### 1. Introduction

The availability of complementary products is crucial for the success of platforms in the Information and Communication Technology industry. A prominent example is the smartphone market, in which the

availability of applications and hardware has played an important role for smartphone operating systems such as Apple’s iOS, Google’s Android, and Microsoft’s Windows Phone. Other examples are the markets for (personal) computer operating systems, microprocessors, and middleware platforms such as Java and .NET. Firms developing platforms typically provide some of the complementary products themselves. However, as the quote at the beginning exemplifies, this is often not enough. Employees or firms that are simply paid to finish a product (e.g. a piece of software or a hardware peripheral) do not have the incentive to work as hard for the success of the product as an owner of the product would. Therefore, the platform owner needs independent firms to create a complementary product. But this raises problems of its own. After an independent firm has created the product and made the platform successful, the platform owner has the stronger position and ex post every incentive to expropriate the rents. An independent firm anticipating this may not be willing to create the product ex ante.

The key insight of this article is that the different licensing schemes of platforms (proprietary, standardized, and open source) and the different ownership structures (vertical integration, independent firms, initially independent start-ups being bought up later) are commitment devices to reduce the inefficiencies created by this hold-up problem and to improve incentives to invest in innovation.

In particular, we link the licensing schemes of platforms and the ownership structures to the incomplete contracts and property rights literature à la Grossman and Hart (1986) and Hart and Moore (1990). If a firm’s specific investment is more important, it should be assigned stronger property rights ex ante to have a stronger bargaining position

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<sup>1</sup> Claude Leglise, director of Intel Developer Relations Group, explaining why Intel wants independent firms to invest in products complementary to the Intel platform by themselves. Quote taken from Gawer and Henderson (2007, p. 20).

ex post and hence higher investment incentives. However, some of the observations cannot be explained by the standard Grossman–Hart–Moore framework. In the standard framework joint ownership and ownership by none can never be optimal. We will argue that a standardized platform is analogous to joint ownership (all parties in the standardization committee have veto powers<sup>2</sup>) and that open source is analogous to ownership by none (no one has veto power). A further point where our analysis departs from the standard framework is the consideration of the asset creation phase. It is a recurring pattern that a start-up develops a first version or prototype of a product (e.g. piece of software) and then it is bought up by a large platform firm.

We explain the ownership structure with a model with two software developers, A and B, and three stages, 0, 1, and 2. For the sake of simplicity, it is useful to think of A and B as two individuals that are all-rounders and do software development, research and development, management, marketing etc. In reality, one would think of A and B being two groups or teams.<sup>3</sup> At stage 0, A owns a platform and a complementary product. For the sake of simplicity, we will refer to the complementary product as application, but one can also think of consulting services or a hardware device. B considers developing a first version or a prototype of a new application *b*. B is the only person with the expertise to produce *b*. B also decides whether he<sup>4</sup> wants to do this as an independent developer or whether he wants to negotiate with A about being hired.<sup>5</sup> At stage 1, if B is independent, A and B will decide whether B should be acquired by A or stay independent. After deciding on ownership structure, A and B make non-verifiable investments in the further development of the platform and the applications. At stage 2, A and B renegotiate their contracts. If A acquired B's firm, she has all the bargaining power and can therefore appropriate the whole rent. If A's platform is proprietary and B is independent, A can threaten B to use her strong position to reduce B's application profits. Such an action has been referred to as an “ex post squeeze” of B's profits. If the platform is standardized both A and B can threaten to veto mutually beneficial changes to the platform. If the platform is open source, no one has a threat. Stronger property rights result in a better bargaining position at renegotiations. The main statement of the model is that the more important B's specific investment, the stronger his bargaining position should be. Bargaining power is the lowest if B has been acquired, higher if he is an independent developer for a proprietary platform, again higher for a standardized platform, and highest for an open source platform. In contrast to this, if the development of the platform or A's application is important, she should be given stronger bargaining power. Further, if specific investment in the first version of B's application is important, but further development is not, then it is optimal that B develops a first version as an independent firm and is acquired by A afterwards.

1.1. Related literature

This paper is clearly related to the property rights and incomplete contracts literature (as in Grossman and Hart (1986), Hart and Moore (1990), and Hart (1995)). We differ from the Grossman–Hart–Moore framework, by having the additional ownership/governance structures standardization and open source and an additional stage 0. The main difference in results is that joint ownership and ownership by none can be optimal in our setup. In contrast to Rosenkranz and Schmitz's

(1999) analysis of joint ownership, we have three assets and only one party investing in the potentially joint asset (here: the platform).

We focus on the optimal allocation of property rights as a means to mitigate inefficiencies due to insufficient incentives to invest. This focus is the main difference to the literature on open source software (Bessen, 2005; Economides and Katsamakos, 2006; Lerner and Tirole, 2005; Maurer and Scotchmer, 2006; Polanski, 2007), on appropriation of profits in complementary markets (Choi and Stefanadis, 2001; Eisenmann et al., 2008; Farrell and Katz, 2000; Heeb, 2003; Miller, 2008; Parker and Van Alstyne, 2008), on platforms and standardization (Bresnahan and Yin, 2007; Casadesus-Masanell and Yoffie, 2007), and on two-sided markets (Caillaud and Jullien, 2003; Nocke et al., 2007; Rochet and Tirole, 2003).

The paper is structured as follows. Section 2 introduces the basic setup. Section 3 describes ownership structures that can be agreed on at stage 1. Section 4 describes firms' investment choices between stages 1 and 2 and the properties of different ownership structures at stage 1. Section 5 describes stage 0 of the model when assets are created. Section 6 illustrates results with the example of the smartphone industry. Section 7 concludes.

2. Basic setup

A manager of a firm (or software developer) A owns a platform *p* and an application *a* that is complementary to the platform. Another manager (or software developer) B considers developing a further application *b* that increases the popularity of the platform. The platform is a joint, complementary input which is essential for the application to be useful to consumers. The platform is a bottleneck in the system, whoever controls the platform can threaten to (partially) “block” the system. Therefore, the platform can be seen as conferring veto right to whoever controls it. One can think of firm A developing a baseline platform with sufficient functions (application *a*) to deliver value to the final customer. A then considers opening the platform to firm B.

The timing is as follows. There are three stages. At stage 0, A has already developed a platform *p* and an application *a*. A commits to a software development model (open-source, standardized, non-standardized). After observing the software development model, B decides whether to create application *b*. Most of our analysis focuses on the case in which B chooses to create application *b*. In this case, B chooses the amount  $\gamma$  of how much he invests in the creation of the application. At stage 1, A and B decide on the ownership structure of the assets *p*, *a*, and *b*. Next, A and B choose how much to invest in improving the quality of the platform (investment  $\pi$  by A), application *a* (investment  $\alpha$  by A), and application *b* (investment  $\beta$  by B). At stage 2, there are renegotiations between A and B about how to split the revenues generated and demand and profits are realized. The timing is illustrated in Fig. 1.

Investments  $\gamma, \pi, \alpha, \beta \geq 0$  are non-verifiable by courts, that is, it is not possible to write contracts that are contingent on investment levels. Investment is specific investment in physical capital, that is, the owner of the asset can fully expropriate the revenues generated by the asset. Investment in the platform benefits both applications.

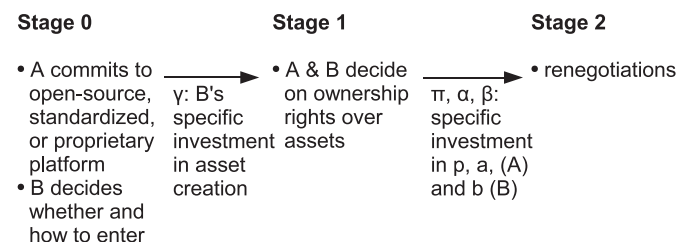


Fig. 1. Timing of the model.

<sup>2</sup> Of course this is a strong simplification as other decision rules than unanimous vote can be agreed on for a committee. However, decisions made by a committee are in any case more complicated than those by a single party.

<sup>3</sup> Our analysis is about conflicts of interest between the two teams, abstracting away from conflicts of interest within a team.

<sup>4</sup> In the following we will refer to A as “she” and to B as “he”.

<sup>5</sup> This can be viewed as the negotiations between A and B being about “make” or “buy”: A can either hire B and make the product in-house or buy the product from an independent firm run by B.

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