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Economies of Resource Accumulation

Karel COOL
Ingemar DIERICKX
Luis ALMEIDA COSTA
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Karel Cool*

Ingemar Dierickx**

Luis Almeida Costa***

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* BP Chaired Professor of European Competitiveness, Professor of Strategic Management at INSEAD, Boulevard de Constance 77305 Fontainebleau Cedex, France. Email: karel.cool@insead.edu

** I. D. Consulting Limited, New Zealand GST No.: 105-822-70 Registered Office: C/- Duncan Cotterill, 1 Sir William Pickering Drive Burnside, 8053 Christchurch, New Zealand. Email: id@ingemar-dierickx.com

*** Associate Professor at Nova School of Business and Economics, Universidade Nova de Lisboa, Campus de Campolide 1099-032 Lisboa, Portugal and Adjunct Professor of Strategy at INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, France. Email: luis.almeidacosta@insead.edu

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Abstract

This paper discusses when firms may expect economies in the accumulation of resources (asset mass efficiencies). Specifically, we describe situations in which the accumulation of a resource benefits from a “success breeds success” dynamic that creates an exponentially growing gap between resource levels of early movers and imitators. Early movers can expect such an advantage where products or services have high evaluation costs, durability, trial costs, network value and cost, impulse characteristics, and dependence on complementary products. Where the accumulation of one resource depends on the level of another resource, accumulation economies may also be expected. The mechanisms are illustrated using stylized stocks-flows simulations with the iThink software.

**Key words:** resource accumulation, competitive advantage, asset mass efficiency, resource imitation, resource complementarity, success-breeds-success, exponential advantage, word-of-mouth
Resources as asset stocks

Most resources are the cumulative result of a series of investments over a period of time. For example, a firm’s reputation for quality is the result of a consistent set of policies on production and quality control, a consistent investment in communication with customers, etc. Similarly, a business school's key resource, its reputation for excellence in teaching and research, reflects its past investments in faculty, the faculty’s investment in research and teaching, “word of mouth” advertising of its alumni base, etc. Likewise, the cost per unit of making a product is related to the cumulative experience in making this product (i.e. the experience curve). More generally, we can state that resources are stocks, which are accumulated over time by a stream of investments or flows.\(^1\)

It may be useful to provide an intuitive anchor for the view of resources as asset stocks. A resource may be pictured as the amount of water in a “bathtub.” This is the cumulative result of flows of water into the tub through the tap and out of it through a hole. Similarly, the “level” of an asset stock is the cumulative result of investment flows, which build the asset, and outflows that erode the asset over time. In the example of R&D, the amount of water in the tub represents the stock of know-how at a particular moment in time. The fact that know-how depreciates or that private knowledge becomes common knowledge is represented by the flow of water leaking through the hole in the tub.

The fact that stocks do not adjust as quickly as flows lies at the heart of the sustainability of competitive advantage. If competitors have different asset stock levels, the stock-flow dynamics imply that it will take time for them to catch up with the firm that has a higher asset stock level. The time it will take to catch up and the cost of this effort depends on the difference in the asset stock levels and the difference in the net investments (inflows) among competitors. Moreover, not all stocks are built in exactly the same way. Several characteristics of stock accumulation processes influence the time and cost of imitation. Some relate to *economies of resource accumulation* where “(initial) success breeds (further) success,” helping first movers to sustain their lead. A second set of processes relate to *diseconomies of time compression*, i.e. the time-cost trade offs in the accumulation and imitation of resources.

\(^1\) Respectively Insead; ID Consulting Ltd; Universidade Nova de Lisboa
This paper focuses on economies of resource accumulation and first describes the concept and its importance to the sustainability of competitive advantage. It then focuses on the drivers of economies of resources accumulation. The mechanism is illustrated using stylized stocks-flows simulations with the iThink software.

The exponential “success breeds success” mechanism

When Facebook became the social network of choice at Harvard, it soon found that students at several other Ivy League schools were eager to be part of the network. And as these students adopted Facebook, students from colleges all over the US clamored to become part of the network, which drove high school students in huge masses to the network, etc. Similarly, when the iPhone became the smart phone of choice among the early adopters, Apple soon found that it was easier to motivate writers of Apps to bring these out for the iPhone, which compelled even more customers to buy the popular phone, which motivated even more suppliers of Apps to join the Apple eco-systems, etc.

The above examples point to the presence of economies of accumulation in the creation of the resources: businesses that develop a high level of an asset stock (e.g. user base, brand awareness, applications) before competitors, achieve an increase in the asset stock at a lower effort or cost than competitors. As the difficulties of Motorola, Sony, RIM and Nokia illustrate, building an asset base once a competitor benefits from economies of resource accumulation, becomes increasingly difficult, enhancing the advantage of the first mover.

The phenomenon that is at work in the Facebook and iPhone examples is the exponential growth process of asset stocks. It operates in a similar way to the accumulation of financial capital in a fixed rate investment where interest is compounded. Left to its own, a starting capital will grow exponentially since each year interest is obtained on a larger capital base. In the case of Facebook, there was an exponential growth of the social network’s user base due to a “word-of-mouth” capitalization effect. The rate at which users encourage others to join the network may be compared to the interest rate. The number of users that at a given stage are part of the network may be considered the starting capital of the social network service. The multiplication of the word-of-mouth rate with the starting capital gives an indication of the number of new people per period (month, year, etc.) that become member of the network. That is, the inflow at any time is proportional to the size of the asset stock. The higher the stock, the higher is its growth, leading to a higher stock, and so on.

The success-breeds-success growth process is illustrated in Figure 1. It traces an initial customer base (for convenience set at 100) in which each month the word-of-mouth effect brings an additional 5% (line 1), 10% (line 2) or 15% (line 3)
customers. The graph shows the exponential growth of the customer base. It also shows that the higher the rate at which customers talk, the higher the growth of the customer base and the higher the resulting brand awareness or user base.

**Figure 1: Positive word of mouth effects**

The exponential accumulation process has direct implications for the competitive position of businesses. If customers talk about competing brands *at the same rate*, then the gap between the firm that was early to start a word-of-mouth campaign and a follower grows with time. Figure 2 shows the evolution of a customer base of 100 (line 1) and 300 (line 2). The relative size of the two bases stays the same because they grow at the same rate. However, the gap in numbers of customers steadily increases because of the difference in the initial base. Firm 2 would have to mount an effort several times its flow to overcome the shortfall of its asset stock with Firm 1. For example, at the end of the 12th month, Firm 1 would have to obtain an inflow of new customers that is more than twenty times the size of the inflow of the 12th month to catch up with Firm 2. While possible, the cost may be prohibitive.

**Figure 2: Word-of-mouth effects with a different initial base**
Drivers of economies of resource accumulation

In what situations do success-breeds-success processes in the creation of asset stocks occur? In what situations do firms that build high resource levels before the competitors benefit from a compounding process shown above?

**Evaluation of the product before the purchase.** Many products can be assessed only after they have been paid for. For example, the choice of a life insurance, restaurant, travel tour package, business school, consultant, investment banker, etc. can be judged only after the fact. Consumers with limited experience therefore tend to seek advice or rely on the word-of-mouth information on the various options. Products and services that were first to build a large word-of-mouth capital have a head start that results in an increasing gap with followers. This gap will become even bigger if early movers succeed in achieving a higher "capitalization rate."

These experience effects are frequently found in the services sector. Since every “product” is made on the spot, is affected by conditions at the time of the consumption, and may need the active involvement of the customer (e.g. travel, implementation of consulting recommendations), there potentially is a high variance in the quality of the outcome. The medical profession illustrates this very well. Doctors often need the compliance of the patient to achieve a satisfactory medical result of a treatment. Since, in addition, many drugs have (benign) side effects and often are taken in combination with other drugs, serious side effects may unexpectedly develop in some patients. This produces risk-averse prescription behavior, well known in the medical sector. Pharmaceutical companies, recognizing the critical role of “word-of-mouth” effects, try to beat competitors to the market with
a new drug. Once a new drug has obtained the endorsement of leading physicians in prestigious teaching hospitals the medical profession tends to quickly converge on the new leader and only reluctantly considers latecomers.

**Product durability.** Experience effects are also found in markets where products are durable and where operating failure heavily disrupts ongoing operations (e.g. aircraft, house construction, paper-making machinery, major home appliances). Since the customers may have to live with the consequences of their choice for a considerable period of time, risk-averse behavior is observed: many customers buy what others say is best. One of the major difficulties of the European Airbus consortium in taking off was its lack of credible proof of the longevity of its aircraft and the resale value of the aircraft after a period of use. Similarly, entry into the aero-engine business is virtually blocked because of the extreme degree of risk-averse behavior on the part of the aircraft manufacturers and airlines. The engine manufacturers are further helped by the need to have a worldwide repair and spare-parts network that needs to be ready to service planes on very short notice. A similar stability is found in the market for paper making equipment. Since this equipment may last over forty years, customers want to be well informed about the potential choices: they visit competitors’ plants, exchange information, etc. This, again, produces conservative buying behavior.

**Trial costs** also substantially affect the degree to which customers are risk-averse. Food products have an experience component since they can be assessed only after their purchase. However, their trial cost often is too low to protect established brands. Too high a price difference between well-known brands and follower brands frequently induces switching. The success of distributors’ brands in retail shows that a (minimal) re-assurance leads to significant switching by the customer. In contrast, reputation is very important for exclusive restaurants because their trial cost often is considered substantial for many customers.

**Dependence on a network.** Success-breeds-success dynamics are frequently observed when products have network characteristics, i.e. when the value a customer derives from a product or service is dependent on the size of the network that is being accessed. Social networks, search engines and open networks such as Android are prime example of this. Similarly, renting cars or moving equipment is most convenient from rental firms that have developed a large number of rental points. Likewise, advertisers want to advertise in media that have the highest penetration in a target market. In all of the above situations, firms that are first to build a large stock of users are able to grow their stock with less investment than competitors with a smaller base since most customers seek to be part of the larger network.

**Transportation cost to serve a network.** Cost advantages to firms with a large installed base naturally occur when there are transportation costs to serve the base.
For example, express delivery services such as UPS, Federal Express or DHL can substantially reduce the delivery cost per customer in a given area if they achieve a high market penetration. Similar economies are observed in the soft drinks and cigarette businesses where a key element is the achievement of local distribution in vending machines. A high penetration of machines boosts sales and reduces distribution costs. Unilever has built a very strong position in the impulse ice cream market in Europe in a comparable manner. To quickly develop a vast base of outlets, it provided ice cream cabinets for free to large numbers of corner shops in return for exclusive supply. The high density of ice cream cabinets in a given area enabled Unilever to replenish the cabinets in a very cost efficient way. In addition, it made media advertising cost effective. Latecomers like Mars found it impossible to close the gap with Unilever’s installed base.

**Impulse characteristics of products.** Network effects may also be found in products or services with impulse characteristics (e.g. fast food, impulse ice cream, video rental). In these products, sales are triggered by the local availability of the product, but are strongly determined by a customer’s previous experience with the product, possibly in other locations. Chains like McDonald's, Burger King or Starbucks attempt to have many locations per area. In addition to possible transportation cost advantages, having many locations enables them to capture the wandering customers when these feel like having a burger or coffee.

**Host-complement interactions.** When a "complementary" product is needed to add functionality to a "host" product, the firm that succeeds in building a large stock of either product is likely to stimulate the demand of the other product, which in turn stimulates the demand for the complement, etc. Thus, initial success breeds further success and latecomers have to incur an increasingly larger cost to convince reluctant customers to join the smaller network. This has been observed, among others, in the computer industry (software & hardware), consumer electronics (cameras & lenses), the car industry (sales network & service network), video consoles and games, smart phones, etc.

More generally, the presence of complementarities between the host and the complement implies that the size of the stock of the host products drives the increase (inflow) of the stock of complements while the size of the stock of complementary products drives the increase in the stock of the host products. A numerical example may illustrate these host-complement interactions. Consider two firms A and B that compete in the markets of the host and the complementary products. A has a stock of host products of 70 and a stock of complements of 7. B has stocks of host and complements of 30 and 3 respectively. To track the evolution of the stocks over time, we need to know at what rate the stocks of hosts and complements capitalize. If this rate would be 0.10 for firm A, the increase in the stock of host products for A in the first year would be 0.7 (i.e. 7 times 0.1). That is, roughly one unit would be added to
the stock of host products because of the availability of its stock of complementary products. For simplicity let us assume that the capitalization rate is the same for the stocks of host and complement. In this case, the increase of the stock of complements for A in the first year would be 7 (i.e. 70 time 0.1).

Figure 3 shows the ratio of the stock of host products A and B if the capitalization rate for A is 5% (line 1), 10% (line 2), 15% (line 3) and 20% (line 4). In each case, the capitalization rate for B is maintained at 5% in view of its smaller stock of host and complementary products. Figure 3 shows the success-breeds-success dynamics of the host-complement interaction. It demonstrates how quickly a firm that was first to build an installed base increases its lead and the predicament of a follower whose rate of growth of its stocks falls behind that of its competitor. While the initial differences were not dramatic (70/30), firm B quickly falls behind, and more so when firm A can capitalize its lead at a higher rate.

**Figure 3**: Ratio of the stock of rival host products

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**Complementarity of resources.** Success-breeds-success dynamics may also unfold when complementary resources affected by economies of accumulation are needed in the production of a product. Consider the market for credit cards. Only a handful of cards (Visa, Mastercard, American Express, Diners) have dominated credit card use during the past forty years. This is not for a lack of entrants; a host of large companies in retail, oil, travel, etc. entered only to find out how difficult it is to keep clients. Why are the positions of the entrenched players in the credit card market so stable?

Each credit card network needs at least two stocks, a stock of customers and a stock of businesses that accept the credit cards. Customers deciding which credit card to ask typically will take a card they think will be accepted in the largest number of
businesses. Shop owners, restaurants, hotels, etc. typically accept the credit cards they think are held by most customers. Otherwise, they would be turning away business. As new shops follow the lead of existing shops, the stock of businesses that accept these cards increases with time, which grows the stock of customers with the credit card, etc. The well-known credit cards have attempted to consolidate their lead over other cards by providing customers access to stocks of complementary products. For example, American Express has associated itself with frequent flier programs, car rental, etc. When its card is used in booking these services, American Express provides extra “free miles”, car up-grades, etc. The combined effect of complementary products and resources produces a very strong success-breeds-success dynamic.

Conclusion

This article examined resource sustainability from an imitation angle. Specifically, we described situations in which the accumulation of a resource benefits from a “success breeds success” dynamic that creates an exponentially growing gap between resource levels of early movers and imitators. Early movers can expect such an advantage where products or services have high evaluation costs, durability, trial costs, network value and cost, impulse characteristics, and dependence on complementary products. Where the accumulation of one resource depends on the level of another resource, accumulation economies may also be expected.

For example, NovoNordisk has created in the insulin market an increasing gap with followers both in R&D and installed base when it changed insulin from a commodity product into a host-complement system with its set of Novopens and other delivery mechanisms. Similarly, Monsanto with the “Roundup-ready” family of seeds has left many other herbicide and seed companies in the dust as it pursued its host-complement strategy. In a similar vein, S&P Capital IQ has constructed a fully integrated system of financial and market databases that allow analysts to obtain more value out of the integrated use than a separate use of the individual components.

Thus, when the accumulation processes for key resources are characterized by economies of resource accumulation, firms that already have important resource stocks may be able to leverage this advantage to increase their lead over rivals lacking comparable resource endowments.
Relevant literature


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The reader may recognize the familiar framework from Optimal Control Theory. See also Winter (1987) who similarly conceptualizes assets as state variables. His discussion but does not analyze the resource accumulation process, however.
Europe Campus
Boulevard de Constance
77305 Fontainebleau Cedex, France
Tel: +33 (0)1 60 72 40 00
Fax: +33 (0)1 60 72 55 00/01

Asia Campus
1 Ayer Rajah Avenue, Singapore 138676
Tel: +65 67 99 53 88
Fax: +65 67 99 53 99

Abu Dhabi Campus
Muroor Road - Street No 4
P.O. Box 48049
Abu Dhabi, United Arab Emirates
Tel: +971 2 651 5200
Fax: +971 2 443 9461

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