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Increasing Returns, Productive Specialization, and the Theory of the Firm

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Abstract: Theorizing on increasing returns is both a promise and a paradox. Positive feedback may drive explosive dynamics, while a focus on decreasing returns excludes coherent accounts of innovation. This article examines how increasing-returns processes shape firm organization and the competitive process, integrating insights from complexity and Austrian economics. Firms and entrepreneurs emerge as key generators of returns, since "islands of specialization" internalize specific, complementary tasks that spot markets cannot coordinate. By capturing productive specialization, firms drive intra-firm growth, reshaping their competitive environment. Nevertheless, beyond a certain scale, they face calculational limits from the absence of external price signals for economic goods. Thus, external benchmarks impose a ceiling on expansion, introducing stabilizing feedback. Our analysis explains why firms arise, grow, and confront limits, enriching both traditions and offering a coherent view of organizational boundaries.

Keywords: Theory of the Firm, Entrepreneurship, Complexity Theory, Capital Theory.

Retornos Crescentes, Especialização Produtiva e a Teoria da Firma

Resumo: Teorizar sobre retornos crescentes é, ao mesmo tempo, promessa e paradoxo. A retroalimentação positiva pode gerar dinâmicas explosivas, enquanto o foco em retornos decrescentes exclui explicações coerentes para a inovação. Este artigo examina como processos de retornos crescentes moldam a organização das firmas e seu processo competitivo, integrando insights da complexidade e da economia austríaca. Firmas e empreendedores emergem como geradores centrais de retornos, pois "ilhas de especialização" internalizam tarefas específicas e complementares que os mercados "spot" não conseguem coordenar. Ao capturar a especialização produtiva, as firmas impulsionam o crescimento intraorganizacional e reconfiguram seu ambiente competitivo. Contudo, além de certa escala, elas enfrentam limites de cálculo decorrentes da ausência de sinais de preços externos para os bens econômicos. Assim, referências externas impõem um teto à expansão, introduzindo uma retroalimentação estabilizadora. Nossa análise explica por que as firmas surgem, crescem e enfrentam limites, enriquecendo ambas as tradições e oferecendo uma visão coerente das fronteiras organizacionais.

Palavras-chave: Teoria da Firma, Empreendedorismo, Teoria da Complexidade, Teoria do Capital.

Retornos crecientes, especialización productiva y la teoría de la firma

Resumen: Teorizar sobre los rendimientos crecientes es, a la vez, promesa y paradoja. La retroalimentación positiva puede impulsar dinámicas explosivas, mientras que el enfoque en los rendimientos decrecientes excluye explicaciones coherentes de la innovación. Este artículo examina cómo los procesos de rendimientos crecientes dan forma a la organización de la empresa y del proceso competitivo, integrando aportes de la complejidad y de la economía austríaca. Las empresas y los emprendedores emergen como generadores clave de rendimientos, ya que las "islas de especialización" internalizan tareas específicas y complementarias que los mercados "spot" no pueden coordinar. Al capturar la especialización productiva, las empresas impulsan el crecimiento intraorganizacional y reconfiguran su entorno competitivo. Sin embargo, más allá de cierta escala, enfrentan límites de cálculo derivados de la ausencia de señales de precios externas para los bienes económicos. Así, las referencias externas imponen un techo a la expansión e introducen una retroalimentación estabilizadora. Nuestro análisis explica por qué surgen las empresas, cómo crecen y por qué enfrentan límites, enriqueciendo ambas tradiciones y ofreciendo una visión coherente de las fronteras organizacionales.

Palavras clave: Teoría de la Empresa, Emprendimiento, Teoría de la Complejidad, Teoría del Capital.

INTRODUCTION

The theory of the firm has advanced important explanations of why firms exist and how they are organized. Nevertheless, the dynamics of increasing returns remain insufficiently integrated into this literature, although they are directly related to issues of firm size, diversification, and growth (Penrose, 1959; Arthur, 1994a; 1994b; 1994c). While complexity economics highlights positive feedback (Arthur, 1999, 2015), Austrian economics emphasizes how specialization and entrepreneurial judgment create self-reinforcing productivity gains (Menger, 1871/1970; Mises, 1949/1998; Hayek, 1945). However, these insights have not been systematically connected to the theory of the firm.

Building on Bylund's (2011; 2015; 2016) notion of the firm as an "island of specialization," in this article, we argue that firms capture increasing returns by internalizing highly specific and complementary activities that cannot be coordinated by market exchange alone. Bylund (2016) establishes why firms emerge, namely, to encapsulate specialized tasks that exceed the coordination capacity of spot markets, but does not systematically analyze increasing returns as the positive-feedback mechanism that drives intra-firm growth once the firm is established, nor does he derive from specialization the calculational ceiling that bounds firm expansion.

With that background, we extend Austrian contributions by showing how the firm is not merely a substitute for markets, but a mechanism for deepening the division of labor and generating dynamic efficiency (Foss, K, Foss, N. J., & Klein, 2007; Huerta de Soto, 2010), and as we shall demonstrate below, a vehicle for capturing the increasing returns that productive specialization generates. At the same time, Austrian theory also points to inherent limits to the growth of the firm. Even if internalization increases physical productivity and decreases coordination costs, without external price signals, firms face calculational constraints that bound their expansion (Mises, 1949/1998; Rothbard, 1963/2009).

Our contribution is thus twofold. First, we provide a positive theory of increasing returns rooted in Austrian economics, complementing complexity economics while offering distinctive insights into the firm. Specifically, we show that increasing returns are not merely a byproduct of productive specialization, but the positive-feedback mechanism through which the firm deepens the division of labor and generates dynamic efficiency, a dimension absent from Bylund's (2016) original account. Second, we identify the dual role of increasing returns as both a driver of intra-firm growth and a source of natural boundaries. Our claim is that these two facts, that firms capture increasing returns the market cannot and that firms face a calculational limit to their scale, are aspects of one another that clarify the conditions under which firms emerge, expand, and stabilize. The specificity of the complementary factors a firm internalizes is what places their joint returns beyond the reach of market contracting; and it is the same specificity, the same want of an external price, that ultimately bounds the firm's rational expansion. This article integrates insights from Austrian and complexity economics, developing the logic of specialization and firm boundaries, discussing implications for the theory of the firm.

1. INCREASING RETURNS AND THE MARKET PROCESS.

Long before increasing returns acquired a formal vocabulary, Austrian economists were describing the phenomena that vocabulary names. The deepening division of labor, the entrepreneurial discovery of new combinations, and competition understood as a process rather than a state are all accounts of self-reinforcing productivity, of small advantages that compound into aggregates irreducible to their parts. What complexity economics, as developed by William Brian Arthur (1994a, 1994b, 1994c, 1999, 2015), supplies is a precise language for those phenomena: positive feedback, path dependence, and emergence. We therefore treat complexity as a formalization of dynamics the Austrians had already located in the market process, and use the pair to ask how increasing returns shape the firm (Koppl, 2006).

Both traditions begin by refusing the Newtonian–Walrasian image of a market converging smoothly to a single equilibrium. Prigogine and Stengers (1984) describe such systems as "open" and "indeterminate," exchanging information with their environment and admitting no future state uniquely deducible from present conditions; Buchanan and Vanberg (1991) liken forecasting economic evolution to reading a book whose closing chapters are unwritten. This is the same indeterminacy Mises (1949/1998) and Hayek (1937, 1945) insisted upon against the notion that all contingencies are folded into today's prices (Glasner, 2022). The future does not unfold from data already given; it emerges through trial, error, and revision (Barbieri, 2013)[3], which is to say, through entrepreneurial discovery under dispersed knowledge (Kirzner, 1973, 1997) and the continual remaking of production plans (Lachmann, 1956/1978). Some entrepreneurial experiments succeed and are imitated, while others fail and are abandoned and from these decentralized trials, coordination patterns form that may hold or may shift abruptly.

Seen this way, actors survey a multi-peaked landscape in which different combinations of resources interact in unique and path-dependent ways (Foss & Ishikawa, 2007). Once a particular pattern of coordination takes hold, displacing it may require a substantial disturbance or a deliberately engineered innovation. The resulting phenomena are features of concrete markets and the firms competing within them: lock-in, the persistence of configurations that no longer exhaust available opportunities, and the self-reinforcement of small initial asymmetries in technique or organization.

Arthur (1999) identifies four hallmarks of such systems in variation, selection, retention, and emergence, and the Austrian reader will recognize each: the entrepreneurial introduction of novel practices, the competitive and consumer selection among them, the retention of what proves viable through imitation and routine, and the emergence of higher-level patterns such as the internal structure of firms and the organization of an industry. Within this sche-

[3] As put by Barbieri (2013, p. 49): "The complexity approach in economics […] models markets as adaptive systems in which, over time (not statically), coordination patterns (not necessarily equilibria) emerge (not assumed) that show continuous adaptation to change (not optimality). These patterns are obtained by decentralized interaction (not coordinated by a Walrasian auctioneer) between heterogeneous agents (not representative agents), with partial (not perfect) knowledge, as the result of a learning process from which unanticipated results or novelty frequently arises. Additionally, agents act according to a set of rules (rather than maximizing known functions)."

me positive and negative feedback coexist. Negative feedback, the analogue of diminishing returns, holds a relationship near a familiar state while positive feedback, the analogue of increasing returns, amplifies small advantages until offset by countervailing forces. As Arthur (2015, p. 17) puts it:

> "Positive feedbacks in fact are very much a defining property of complex systems (…) With a mixture of both it shows 'interesting' or 'complex' behavior. With positive feedback, interactions add to each other and cause structure, in time to be offset by negative forces and dissipate. Structures then come and go, some stay to be further built on and some lead to further structures. The system is 'alive.'"

Pure negative feedback yields a dead equilibrium without growth or innovation, while pure positive feedback yields runaway instability. Only their mixture produces the ordered change that characterizes a competitive process, the same insight Schumpeter (1911) expressed as creative destruction and that the Austrians locate in entrepreneurship as the perturbing, restructuring force within markets (Vaughn, 1999).

The two literatures differ in method more than in substance: Austrian analysis proceeds verbally and conceptually, stressing the irreducible subjectivity of value, while complexity economics leans on agent-based models and computational experiment. But both hold that coordination is not imposed from above as it arises endogenously from the decentralized interaction of individuals pursuing local ends under uncertainty. The productive place to press this convergence is the firm, which has been relatively mute in complexity theory but which has been of increasing importance in Austrian theorizing (Bylund, 2016; Machaj, 2021). As we argue below, increasing returns are realized in organizational form: in the boundaries an entrepreneur draws around a set of complementary activities, and it is there, rather than in any economy-wide trajectory, that we can show how positive feedback generates the structures Austrians call firms, and how it is eventually checked.

2. THE ECONOMICS OF INCREASING RETURNS

The existence of increasing returns, and therefore of positive feedback, gives the market process multiple equilibria rather than a single focal point. Were diminishing returns the only force at work, negative feedback would prevail and prices, market shares, and resource allocations would settle into determinate, stable values. Marshall (1890) supplied the classic case: when a firm's unit costs fall as its market share rises, the producer that reaches sufficient scale tends to prevail over its rivals and to capture the resulting gains. Arthur (1994a, 1994b, 1994c) generalizes the point. Increasing returns are common wherever a large initial investment functions as a barrier to entry and continued operation then yields gains through low ongoing costs, as with a new technology whose principal expense is incurred once, at creation.

Continuous production deepens the effect. Intangible assets such as accumulated knowledge, experience, and the working relationships of a managerial team (Penrose, 1959; Barney, 1991; Teece, Pisano & Shuen, 1997) generate increasing returns of their own, so that

a firm's growth comes from its developing capacity to identify productive opportunities, organize resources around their complementarities, and realize gains from scale through successive investment. Increasing returns are in this sense nonlinear: small present events produce aggregate outcomes that cannot be read off the current state, but emerge from the interaction of market participants over time (Arthur, 1994a, p. 5).

These dynamics shape which products and technologies come to prevail. An early lead, sometimes won by little more than chance, lets one technology exploit the increasing returns from its own adoption and steer the market toward lock-in (David, 1985). Arthur (1994b, p. 13) shows that increasing returns introduce non-convexities, and with them multiple equilibria and corner solutions in which a single good or firm comes to dominate. Which one prevails is not settled in advance, and rising switching costs then entrench whatever position emerges. Such non-ergodic processes display unpredictability, potential non-superiority, since an inferior technique may be selected, and structural rigidity, since the cost of abandoning an entrenched technology obstructs the adoption of a better one (Arthur, Ermoliev & Kaniovski, 1994). The deeper a coordination becomes entrenched, the higher the repositioning costs required to leave it (Arthur, 1994c, p. 118).

What complexity economics describes formally as increasing returns, the Austrian tradition has long traced to a concrete cause: the division of labor. Mises (1949/1998), echoing Adam Smith, treats specialized cooperation as the source of the productivity gains that make ever more roundabout production structures worthwhile (Loasby, 1976; Lachmann, 1956/1978). Subdividing a task lets each producer work within the bounds of his localized knowledge (Hayek, 1937, 1945; Lavoie, 1985), while prices carry the dispersed information that allows the resulting activities to be recoordinated as conditions change (Kirzner, 1973, 1997). Increasing returns, on this reading, are the productivity yield of a deepening division of labor, and the engine that drives them is specialization itself.

This is also where the division of labor meets its classical limit. Smith's theorem, that the division of labor is limited by the extent of the market, states the constraint, and Young (1928) draws out its dynamic corollary: a finer division of labor itself widens the market that sustains further subdivision, so that specialization and the returns it yields reinforce one another over time. Stigler (1951) carries the logic to the firm, observing that where the market for a specialized activity is too thin to support an independent supplier, the activity is performed within a firm instead. The extent of the market thus sets a moving frontier of specialization, and the returns available beyond that frontier go unrealized for want of any market to coordinate or price them.

3. BEYOND THE EXTENT OF THE MARKET

The firm is the institutional response to this frontier. By internalizing successive stages of production and capturing the increasing returns of organizational integration, firms realize what the market leaves unrealized. When an entrepreneur conceives a subdivision of

tasks finer than existing markets can support, no market exists in which the new specialized inputs can be bought, sold, or priced, and the increasing returns such specialization would yield, though real, cannot be appropriated through arm's-length exchange. The firm forms to break this deadlock, internalizing the subdivided activities so their complementary services can be coordinated under a single judgment (Coase, 1937; Bylund, 2011).

As a factor specializes more intensively its productivity rises, the increasing returns to specialization that Young (1928) identified, while its output grows less compatible with the surrounding market, since a more narrowly defined task yields an intermediate product for which no established demand exists. Past the market's prevailing degree of specialization the two move in opposite directions: productivity climbs while marketability falls toward zero. A factor that specialized this far on its own would produce something more valuable in principle and unsalable in practice. The gains are real yet unappropriable by any factor acting alone, because realizing them requires the complementary specialization of every other task in the chain, and no market coordinates or prices those tasks (Bylund, 2015).

This is what the firm resolves. By bringing the complementary tasks under unified ownership and a single entrepreneurial judgment, it encapsulates the subdivided chain, coordinating internally what no market could coordinate externally and capturing the increasing returns that would otherwise go unrealized. The endpoints of the process remain market interfaces, since the firm still buys its inputs and sells its output at prices the market provides, while the intermediate links are internal and unpriced[4] (Piano & Rouanet, 2020). That same absence of a price for the intermediate stages, which is what lets the firm appropriate the returns, later proves to be the source of its limit (Section 4). By bundling assets under a unified governance structure, the firm realizes efficiencies through shared routines and the direct supervision of interdependent tasks (Foss, K, Foss, N. J. & Klein, 2007). What Bylund (2016, p. 27) calls an "island of specialization" is therefore a space in which the entrepreneur orchestrates a deeper division of labor than spot markets permit.

In this vein, the notion of "capital specialization" extends the logic of the division of labor to the deployment of capital goods as embodied knowledge (Lewin, 2011). Machinery, software platforms, and even organizational routines possess perceived attributes that make them uniquely suited to certain production processes. Nevertheless, these same assets often exhibit complementarities: one specialized machine only realizes its full productivity when paired with another, or when supervised by a manager with matching expertise. These complementarities and the possibility of recombination are what Edith Penrose[5] (1959) labeled the "services" of capital: the firm-specific uses and attributes of resources that cannot be fully

[4] The price system and firms are not mutually exclusive. Rather, they represent different kinds of what Hayek (1964, 1973, e.g.) classifies as orders. There are three main characteristics between designed and organic orders (in this specific case, between the firm and the market process). First, the degree of complexity involved in the order. Second, the capacity to plan the order. And third, the mode of its emergence (Hayek, 1964, 1973).

[5] Although Penrose is not labeled as an "Austrian economist", Langlois (2013) considers that her work has similarities with the Austrian School of Economics, both grounding their understandings of the firm within resource heterogeneity and entrepreneurship.

specified or priced in advance, but that entrepreneurs learn to harness through trial, error, and experience. Ludwig Lachmann underscores the subjectivity of these capital-good services:

> "Beer barrels and blast furnaces, harbor installations and hotel-room furniture are capital not by virtue of their physical properties but by virtue of their economic functions. Something is capital because the market, the consensus of entrepreneurial minds, regards it as capable of yielding an income" (Lachmann, 1956/1978, p. 17).

Capital goods (and capital) do not have intrinsic value, but otherwise are the result of individual meaning and appraisement in the market process. Entrepreneurs continually organize different resources of their property, and these resources acquire the significance of capital goods when they are involved in intermediate processes of production (Huerta de Soto, 2006, pp. 272-284). In practice, this means that what counts as a "complement" to one process may be irrelevant in another. From a subjectivist standpoint, the place occupied by a resource in a production structure is dictated by the entrepreneur's judgment (Foss, K., Foss, N. J., Klein, 2008). To the extent that a resource has a specified function, it is a direct consequence of the place it occupies in an entrepreneurial plan (Foss et al., 2007).

Only within the firm can an entrepreneur coordinate these ambiguous, context-dependent assets, aligning their imagined services into a coherent production plan. When resource attributes are uncertain, and uses are subjectively evaluated, decentralized markets cannot convey sufficiently precise signals to guide allocation. The role of entrepreneurs in the organization of production is a relevant aspect of Austrian theory. Menger (1871/1970, p. 161) explains that entrepreneurs determine the role of economic goods in production, assigning their place in a specific production process. Also, they are responsible for the continued supervision of the execution of tasks, to make their performance as economically efficient as possible.

Lachmann emphasized the role of production plans, which define the purposes of the capital goods that will be put into practice. He noted that every capital good functions as part of a plan (Lachmann, 1956/1978, p. 8). Furthermore, he believed that the theory of capital must delineate how capital goods are arranged within a production plan and how they are rearranged and recombined over time as plans are revised. Production, therefore, requires a plan (Lachmann, 1956/1978, p. 35). Entrepreneurs must therefore assert ownership and governance rights over critical assets, organizing them under contract and command structures that reflect their unique vision of how those assets will be combined (Foss & Klein, 2005; 2012). The firm's boundaries (what it chooses to produce in-house versus buy on the market) emerge from these entrepreneurial assessments of where the specialization deadlock bites hardest.

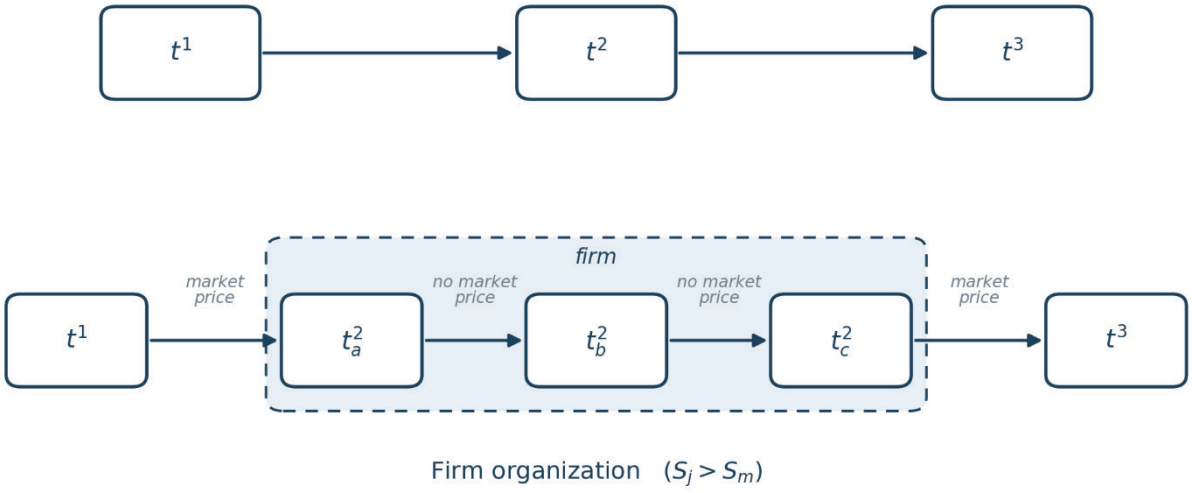
The firm exists because these conditions cannot be settled by price. If every potential use of a capital good were common knowledge, markets would price its services accurately and no firm would need to internalize them; the firm arises in the interstices of dispersed knowledge and uncertainty, coordinating what the market leaves unpriced through an

organization built to a preconceived plan[6] (Hayek, 1973, pp. 36–37). An entrepreneur who conceives a finer subdivision of tasks confronts what we might call productive incompleteness: no single supplier holds the information or contractual reach to orchestrate the new interdependencies, and no market trades the unique intermediate outputs. Within the firm those tasks can be subdivided beyond what spot markets allow, each specialized activity meeting its complement at the next stage, so that what would otherwise stall at the market's fringes becomes a coherent process.

Bylund (2015) formalizes this insight with a stylized model. Suppose a good a is produced through a three-stage process $t^1 \rightarrow t^2 \rightarrow t^3$, where each stage is a layer of productive activity coordinated through market transactions. The market's prevailing degree of specialization, S_m, corresponds to the finest separation at which those transactions reliably occur. If an entrepreneur identifies three new, mutually complementary factors J_4, J_5, J_6, each able to execute a substage of t^2 (namely t^2a, t^2b, t^2c), the result is a more roundabout process $t^1 \rightarrow [t^2a \rightarrow t^2b \rightarrow t^2c] \rightarrow t^3$, whose specialization degree S_j exceeds the market's S_m. The input to this subdivided process remains the output of t^1, and its output still feeds t^3, both traded at market prices, while the internal links among t^2a, t^2b, and t^2c have no market price at all. Because no market exists for these intermediate subtasks, the entrepreneur internalizes the whole chain, extending the division of labor beyond S_m into S_j (Figure 1).

Figure 1

Market organization ($S_j = S_m$)



Note. Synthetic representation of the specialization deadlock, theoretically drawn from Bylund (2015; 2016). Figures were drawn by the authors and were plotted in MatLab with the assistance of Claude's Opus 5 for coding.

[6] For the importance of incomplete markets as an explanation for integrating decisions, see not only Coase (1937) but also Barney (1986), Dierickx & Cool (1989) and Denrell & Winter (2003).

Market Specialization vs. Firm Specialization

Once the firm encapsulates this process it gains two advantages the market could not deliver. It guarantees compatibility between t^1 and t^3 through intermediate outputs cut to exact specification, which separate market contracts could not cheaply negotiate; and it captures the increasing returns to specialization internally, since each repetition of the subdivided process embeds deeper learning, tighter coordination, and more refined use of the specialized assets.

Once established, the firm continuously refines its internal structures to extend the frontier of productive specialization. Departments likely emerge to handle specialized tasks, R&D labs experiment with prototypes, marketing teams tailor messages to niche segments, and logistics units optimize complex supply chains. In effect, the firm creates an internal network of complementary factors whose joint productivity exceeds what could be achieved by arm's-length exchanges. Over time, as the firm exploits its internal positive feedback loops, it may push the boundaries of specialization even further, spawning new divisions or spinning off specialized subsidiaries[7]. Nevertheless, this expansion remains tethered to the market: the firm tests its innovations through competitive sales, adapts to consumer feedback, and reinvests profits to explore new combinations of labor and capital. Moreover, the firm's initial innovation triggers positive-feedback loops in the wider market.

Competitors observe the superior performance of the subdivided process, prompting them to mimic the organizational structure or to coalesce around similar internal integrations (Stigler, 1951). As more firms narrow the gap between S_j and S_m, market specialization gradually converges toward the firm's internal standard. This diffusion of specialization entails its own increasing returns: complementary industries (such as specialized parts suppliers or training institutions) emerge to support the new production paradigm. Thus, firms are both islands of specialization and bridges back to the market, embodying the entrepreneurial function that drives productive specialization.

This dynamic exemplifies the core principle of complex systems theory: changes in the structure of production arise from self-reinforcing innovations that reconfigure existing patterns of coordination. Entrepreneurs, acting on visions of novel resource configurations, create positive feedback mechanisms that not only generate firm-level growth but also reshape the coordination structure of the specific markets in which they operate. The deepening of internal specialization within successful firms and the subsequent reorganization of their supplier networks and adjacent competitors reflect this interplay of intra-firm specialization and market adaptation (Langlois, 2023). In sum, the firm's role in overcoming the specialization deadlock illuminates how entrepreneurial action and organizational integration function as engines of productive specialization and organizational change. By internalizing finely subdivided tasks and the complementary capital goods they require, firms capture increasing returns that markets alone cannot realize. Through iterative innovation and the diffusion of

[7] Mises (1944, p. 32-33) conceives that the economic calculation of monetary profits allows the decentralization of the firm. Entrepreneurs use the profit and loss calculation to analyze the skills of their employees.

specialized practices, these positive-feedback processes reshape the competitive structure, driving continual change and the emergence of ever more complex production structures.

A scope condition is in order. The increasing-returns logic developed here describes the efficiency-oriented dimension of entrepreneurship, in which the entrepreneur captures the productivity gains of a deeper division of labor. Not every entrepreneur is so oriented. Bylund (2020) identifies the promoter-entrepreneur, whose concern is the creation of value for consumers and whose judgment is directed at subjective value rather than efficiency alone (Bylund & Packard, 2022). For such entrepreneurs the rationale for internalization may lie in a perceived opportunity to deliver greater efficacy, a value configuration consumers had not thought possible, rather than in cost savings from specialization (Mises, 1998; D'Andrea, 2025; D'Andrea & Mazzoni, 2019). Both orientations are at home in the Austrian framework. We bracket the value-creating dimension here and return to it as a direction for further work, since the increasing-returns mechanism, though it does not exhaust entrepreneurial motivation, accounts for a large and theoretically tractable part of why firms emerge and grow.

4. A LIMIT TO FIRM SIZE

In the example above, the economic function of the firm emerges directly from the entrepreneurial impulse to exploit gains from deeper productive specialization in markets. By creating an "island of specialization," the entrepreneur integrates multiple stages of production, each of which might previously have been handled by distinct market actors, into a coherent, internally coordinated process[8]. This integration displaces the older, more rudimentary mode of production by encapsulating interdependent tasks and assets within a single organizational boundary. The firm thereby becomes both a repository and a catalyst for complex combinations of labor and capital that would otherwise remain fragmented or misaligned when left to arm's-length market exchanges[9].

The increasing returns that drive the firm to break the specialization deadlock do not stop there; they fuel its subsequent growth, as deeper internal specialization, accumulating managerial knowledge, and tighter coordination lower unit costs and let the firm expand. But the forces that propel this expansion eventually turn against it. Nonetheless, the same forces that drive growth can also give rise to diseconomies of scale if taken too far (Bylund, 2016; Penrose, 1959). As entrepreneurs continue to acquire and integrate additional factors of production, their very success pushes up the market price of these inputs. Mises (1949/1998,

[8] Here the theory of the firm can gain from Hayek (1964, 1973), which explains that organizations (taxis) are controlled through commands (direct deliberations about the organization of assets and division of labor) and rules (developed to give guidelines for task-performance for subordinates).

[9] It must be emphasized that much of this firm-level growth rests on genuine efficiency gains rather than rent extraction alone. Disruptive innovations are here understood as innovations that initially target overlooked market segments and subsequently reshape the competitive structure of an entire industry (Christensen, 1997). From the perspective of complexity economics, disruptive innovation is precisely the mechanism by which new positive-feedback loops emerge to challenge existing lock-ins (Arthur, 1994a). When they introduce new products or open up new markets, they upset existing market coordination and force rival entrepreneurs to respond. In the Austrian framework, this process is driven by the promoter-entrepreneur who perceives new value configurations before rivals do, exploiting increasing returns from specialization to establish a new island of productive organization (Bylund, 2020; D'Andrea, 2025).

p. 340) observed that when a firm diverts resources from other productive processes into its own expansion, the increased demand bids up factor prices, eroding the cost advantages that spurred growth in the first place. Moreover, coordinating an ever-larger array of tasks under one roof introduces managerial complexity: information bottlenecks, communication breakdowns, and bureaucratic inertia can offset the earlier gains from specialization[10].

It must be stressed that, unlike the perfectly competitive model, where each firm is assumed to be infinitesimally small and incapable of influencing market price, the real-world firm always possesses some market power simply by virtue of its non-zero scale. When a single producer commands enough capacity to meaningfully affect total supply, its choices about output and input usage will necessarily feed back into the price it receives. This is not an exceptional anomaly but rather the norm once we recognize that productive resources are often lumpy, discrete, and cannot be scaled down to arbitrarily small increments.

These same forces leave a signature in the shape of the firm's cost curve. The textbook draws that curve as a smooth U, with average cost falling and then rising as perfectly divisible factors are added in ever finer increments. Austrian capital theory rejects the premise. Capital goods are heterogeneous and lumpy, acquired and installed in whole units rather than infinitesimal doses, so the firm's costs do not vary smoothly with output (Rothbard, 1963/2009; Lewin, 2011). What replaces the U is a discontinuous, stepped curve, and its structure shows the two forces of our argument operating in the firm's own accounts: increasing returns appear as the stretches over which average cost falls, and the indivisibility of specialized capital appears as the jumps that interrupt them. Rothbard (1963/2009, p. 593) emphasizes that a firm's cost curve in such circumstances is largely composed of discrete steps rather than a smooth, continuous function. This "step-wise" structure arises because many capital goods (machinery, specialized tools, assembly lines) come in indivisible units. You either install the entire machine, or you do not; partial installation is impossible[11]. Consequently, the relationship between inputs and output features has abrupt jumps at certain scales of operation.

For an example, suppose that producing a good Z requires an indivisible capital good, a specialized machine, alongside variable inputs that scale with output. One machine costs 12 and can produce up to three units of Z; any higher output requires a second machine. Variable inputs cost 2 per unit of Z. Total cost is then $C(Q) = 12\lceil Q/3 \rceil + 2Q$, where $\lceil Q/3 \rceil$ counts the machines the output requires, one up to three units and two from there to six. Within the capacity of a single machine, cost rises only with variable inputs: 14 at one unit, 16 at two, 18 at three. Crossing three units requires a second machine, and because a machine is bought whole, total cost jumps by its full price of 12 the moment capacity is exceeded,

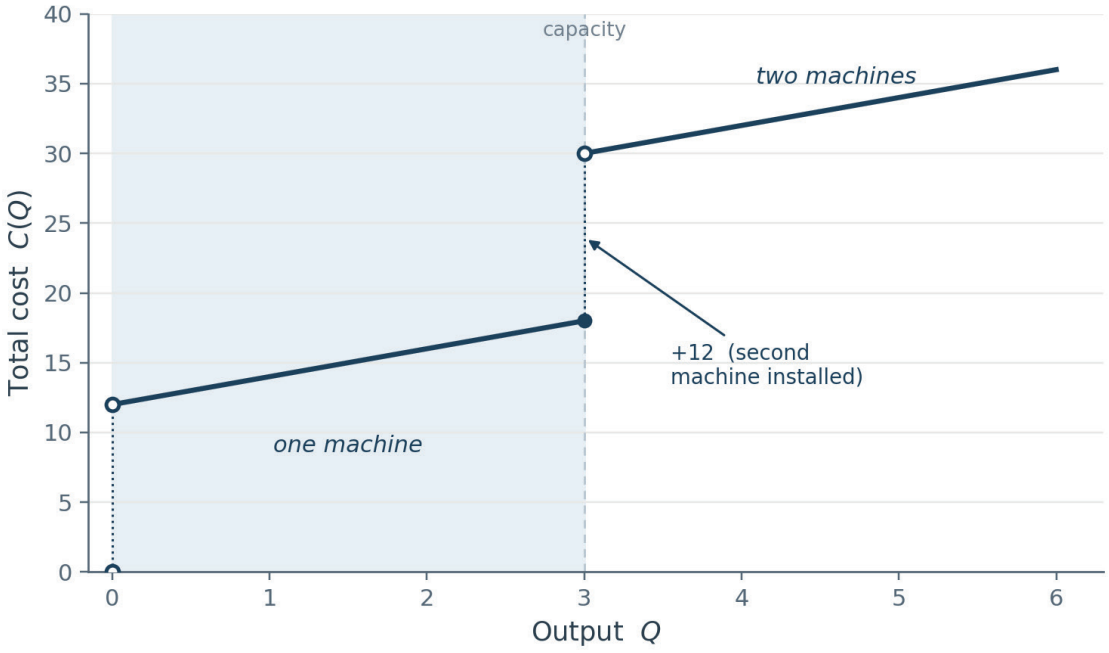
[10] Derived judgment can be productive or destructive (Foss & Klein, 2012, pp. 197-198). When employees focus on activities that reduce firm value, their entrepreneurship is destructive. For example, when they discover new forms of moral hazard or develop new rent-seeking strategies. Conversely, when their actions increase firm value, they exercise productive entrepreneurship, such as finding better uses for resources in a productive process.

[11] Capital, for Rothbard (1963/2009), is not a homogeneous mass which entrepreneurs deploy and recombine in production, but a structure of different capital goods, combined in a cohesive sense by the capitalist-entrepreneur.

from 18 to 30, before the additional output is even made. Cost then climbs gently again with variable inputs, reaching 36 when the second machine is itself filled at six units (Figure 2).

Figure 2[12]

Total cost with indivisible capital



Source. Figures were drawn by the authors and were plotted in MatLab with the assistance of Claude's Opus 5 for coding.

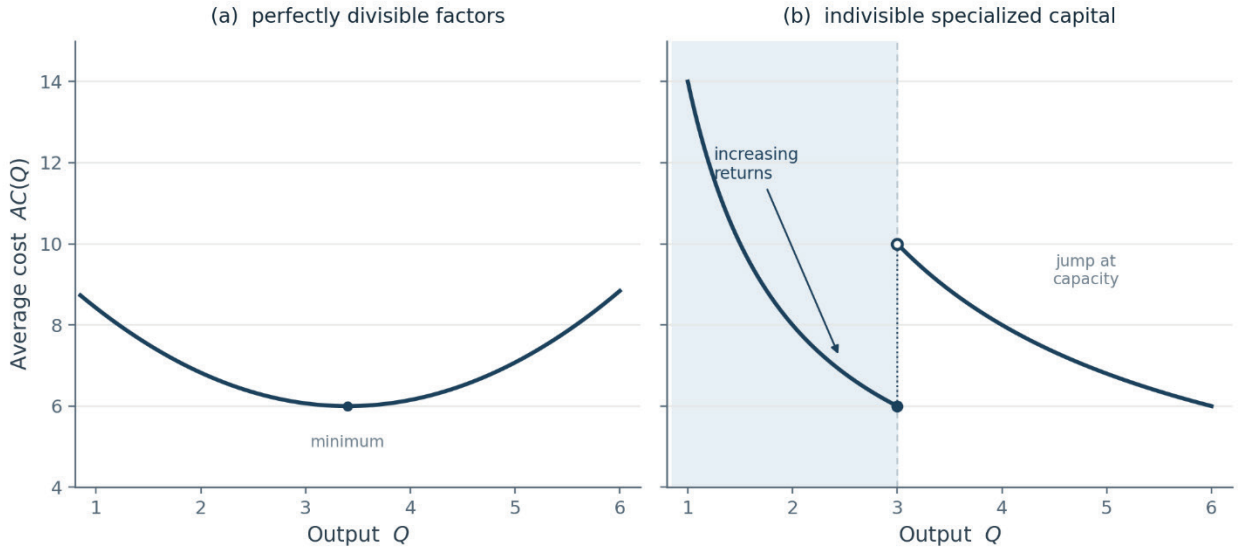
Dividing by output gives average cost, $AC(Q) = 12\lceil Q/3\rceil/Q + 2$, and the increasing returns now become visible. While one machine is in use, its fixed cost of 12 is spread over a rising output, so average cost falls from 14 at one unit to 8 at two and 6 at three; each additional unit adds only its variable cost of 2, leaving marginal cost low and average cost in steady decline. When capacity binds, the arithmetic reverses. The next unit carries with it the entire cost of a second machine, average cost springs back to 10, and the decline resumes, returning to 6 only once that machine is fully used at six units (Figure 3). Each downward run is a pocket of increasing returns, produced by spreading an indivisible cost across more output; each jump records the indivisibility of the specialized capital that yields them. The firm is therefore drawn toward the next whole block of capacity and penalized for halting between blocks,

[12] With a machine costing F and producing up to k units, variable inputs at v per unit, and $\lceil\cdot\rceil$ the ceiling function, total cost is $C(Q) = F\lceil Q/k\rceil + vQ$. On each interval $((n-1)k, nk]$ the machine count $\lceil Q/k\rceil$ equals n and is constant, so C is linear in Q with slope v, the marginal (variable) cost. At every capacity threshold $Q = nk$ the count rises by one and C jumps upward by F, the price of one machine, independently of Q. The curve is therefore a sequence of parallel segments of slope v, each displaced above the previous one by the constant F, with the first jump occurring at $Q = 0^+$, since a machine is required before any output is produced. The figure sets $F = 12$, $k = 3$, $v = 2$, giving $C = 12 + 2Q$ on $(0, 3]$ and $C = 24 + 2Q$ on $(3, 6]$, so $C(3) = 18$ and $C(3^+) = 30$.

and it retains some influence over price at every output for the simple reason that it cannot adjust its capital in infinitesimal steps.

Figure 3.[13]

Divisible Factors Versus Specialized Capital Arrangements



Source. Figures were drawn by the authors and were plotted in MatLab with the assistance of Claude's Opus 5 for coding.

Setting the two curves side by side makes the difference plain (Figure 3). Panel (a) is the textbook cost curve, drawn on the assumption that capital, like every other factor, can be varied in arbitrarily small amounts: average cost descends to a single minimum and climbs back as diminishing returns take hold, one smooth bowl. Panel (b) is the same firm once its capital must be acquired in whole machines. The single minimum disappears. Average cost falls in runs and resets upward at each capacity threshold, a saw-edged descent in place of a bowl, the deepest point of each run no lower than the last. The textbook curve is smooth because it presumes capital can be varied without limit; once capital is lumpy, that smooth-

[13] Dividing by output, AC(Q) = $F\lceil Q/k \rfloor/Q + v$. Within block n, for $(n-1)k < Q \le nk$, the machine count is constant, so $AC = nF/Q + v$ is a rectangular hyperbola decreasing in Q. It reaches its block minimum $v + F/k$ at the top of capacity Q = nk, the same floor in every block, and is highest just past a threshold. At Q = nk the function jumps from that floor to $v + (n+1)F/(nk) = v + (F/k)(1 + 1/n)$, so successive jumps shrink as n grows and each block becomes large relative to a single machine. With $F = 12$, $k = 3$, $v = 2$ the floor is 6, attained at $Q = 3$ and $Q = 6$, and the jump at $Q = 3$ runs from 6 to 10. Panel (a) is the conventional construct, in which a smoothly spread fixed cost (a declining F/Q term) combines with marginal cost rising under diminishing returns to give a single interior minimum; panel (b) holds marginal cost constant within a block and makes the fixed factor indivisible, so the smooth bowl is replaced by discrete resets.

ness gives way to the stepped pattern of panel (b), the cost-level expression of the increasing returns and indivisibility that together drive the firm's growth and bound its scale.

Rather than producing the smooth, continuously diminishing returns assumed by the neoclassical U-shaped cost curve, the indivisibility of capital goods generates alternating regimes of increasing and constant returns separated by discrete jumps. These non-linearities thus stand in stark contrast with the textbook U-shaped cost curves. Instead of a smooth, convex relationship driven by continuously diminishing returns at high output, we observe alternating regimes of constant average cost and sudden efficiency gains. The result is a cost structure that both encourages firms to expand to the next indivisible scale, discourages them from lingering in the "gaps", and grants them discrete bouts of market power as they leap to larger production blocks.

In practice, these indivisibilities manifest in myriad ways: a car factory cannot produce 37.5% of its maximum annual output; a data center cannot spin up half a rack of servers; a logistics firm cannot operate 3.2 delivery trucks. Each addition of a whole unit of capital often requires complementary investments in training, maintenance, and supporting infrastructure that themselves come in chunks rather than drips. All of this means that real-world cost curves are inherently "lumpy" and that firms confront step-function incentives when deciding to expand or contract. Except in the world of perfect competition, where the infinitesimal size has welfare implications in the form of negative feedback that prevents firm growth, a world of increasing returns implies, according to Rothbard (1963/2009, p. 598):

> "What any given firm's size and output will be is therefore subject to a host of conflicting determinants, some impelling a limitation, some an expansion, of size. At what point any firm will settle depends on the concrete data of the actual case and cannot be decided by economic analysis. Only the actual entrepreneur, through the give and take of the market, can decide where the maximum-profit size is and can set the firm at that point. This is the task of the businessman and not of the economist."

It is important to underscore that the rising costs associated with internalizing capital assets within the firm owe directly to the very characteristics that made those assets valuable in the first place: their multiple, context-dependent specificities. When a piece of capital is tailored to a particular production process, it acquires a bundle of "imagined services" that only the entrepreneur can fully foresee and coordinate. Nevertheless, these idiosyncratic attributes also create a dilemma: if an asset truly had no conceivable alternative application beyond a single specialized task, it would, in theory, command no observable market price at all, since buyers would have no comparative basis for valuation. In such an extreme case of absolute specificity, the firm would be blind to whether the cost of deploying the asset was rising or falling over time, and it would lack any benchmark against which to judge the efficiency of its use.

The rising cost of internalization therefore traces to the very specificity that made the assets valuable. An asset with no conceivable alternative use would carry no market price at all, leaving the firm without a benchmark against which to judge its deployment. Assets

of multiple specificity, by contrast, retain a residual value in their alternative applications, and that value, the present discounted value the asset would command if sold or leased, becomes the yardstick of efficient use[14]. When the returns a firm earns from holding an asset in-house fall below this benchmark, it has integrated past the point worth doing so, and the benchmark thereby sets a ceiling on the firm's scale. This is Mises's calculation problem at the level of the firm. Without genuine market prices for the competing uses of capital, no rational comparison among them is possible (Mises, 1949/1998; Klein, 1996, 1999). A capital market in which multi-purpose assets are bought and sold supplies precisely those prices; they anchor entrepreneurial decisions and curb over-integration. As Huerta de Soto (2010, p. 118) observes, beyond a critical size the firm can no longer coordinate the dispersed entrepreneurial knowledge held within it, and losses follow.

Vertical integration makes the difficulty concrete. A multidivisional firm assigns transfer prices to the goods its divisions exchange, but those prices are artificial unless pegged to an external benchmark. Where no external market for an intermediate good exists, the firm cannot tell whether a stage is over- or under-used, and its calculus becomes guesswork. Rothbard (1963/2009, pp. 613–614) draws the limit sharply: every capital good requires a market in which it is bought and sold, and "as the area of incalculability increases, the degrees of irrationality, misallocation, loss" grow with it. Because the bound depends on the particular assets and the markets around them, theory names no universal optimum in physical terms. It names an economic one: the firm reaches its limit at the scale where an external market for one or more of its critical factors ceases to exist, removing the reference prices that rational allocation requires. Past that point, further integration only deepens the firm's incalculability.

Because the precise point of this upper bound depends on the particular capital goods in question and the institutional context of their markets, theory cannot specify a universal optimal firm size in physical terms. Nevertheless, by recognizing that a firm grows only until its internal valuation methods become too detached from market-based PDVs, economic analysis can identify a clear economic limit: the firm's maximum scale is the scale at which there ceases to be an external market for one or more of its critical factors, thereby removing the reference prices necessary for rational allocation. In other words, while sophisticated machines or proprietary software can deliver steep cost curves and steep learning-by-doing gains, their benefits can be neutralized if the firm cannot determine the opportunity cost of locking capital into one stage rather than leasing it to an outside producer. As technological productivity pushes for ever-greater scale and complexity, the calculational boundary set by the availability of external price signals pushes back, creating a negative-feedback mechanism that limits the unchecked expansion of vertical integration.

[14] In strictly Austrian terms, the PDV yardstick is conceptually defined as the discounted marginal revenue product, to reflect the interest-rate discounted unit price of the produced consumer or capital good. For our purposes, both concepts can be thought of as talking about the same thing: the current worth of a future sum of money or stream of cash flows that reflects the monetary opportunity cost of the use of a resource, proxied by its purchase price in a market for which there is an agreed upon valuation of its future services. For more on this, see Lewin & Cachanosky (2020).

The argument to this point has treated the firm's capacity to capture increasing returns and its eventual calculational limit as if they were two distinct forces, one propelling growth and the other arresting it. They are better understood as a single property of specific, complementary capital seen from two sides. What allows the entrepreneur to appropriate the increasing returns of a deeper division of labor is precisely that the finely subdivided tasks, and the assets that perform them, have no external market: because t^2_a, t^2_b, and t^2_c cannot be traded in isolation, no outside party can bid for the complementarities among them, and the returns to their joint organization accrue to the firm that encapsulates them. Yet the same absence of an external market that renders these returns appropriable also withholds the price signal by which the entrepreneur might gauge their continued worth. The factor that no one else prices is the factor the entrepreneur, too, cannot price. Increasing returns and the calculational ceiling are therefore not opposing mechanisms joined after the fact as much as they are the upside and the downside of one condition, the firm's removal of its critical factors from the market's valuation. The firm grows by moving those factors beyond the reach of market pricing, and it is bounded at the point where that same remove deprives it of the means to calculate.

CONCLUDING NOTES

The existence of increasing returns is one of the principal elements behind the emergence of complexity in the market process. The positive feedback they engender leads to the existence of multiple patterns of coordination, the absence of a determined end state, the formation of productive structures, and the breakdown of the perfect competition model due to the lack of negative feedback mechanisms required to uphold its assumptions.

One of the schools of economic thought that most fully recognized the existence of increasing returns, allowing its well-known convergence with the complexity approach, was the Austrian School of economics. Beyond the need for restrictive assumptions to ensure allocative efficiency in markets, its theories largely took into account the role played by positive feedback in shaping market outcomes, prominent examples being the theory of the origin of money and the theory of institutions.

In addition to these familiar connections, this paper sought to investigate the dynamics of increasing returns within Austrian economics at the level of the firm organization and market coordination by exploring the theory of the firm as an "island of specialization" developed by Bylund (2015; 2016). In this theory, the rationale for establishing a firm lies in the very need to encapsulate stages in order to push the degree of productive specialization in the relevant market beyond the limits imposed by the specialization deadlock. Building on subsequent developments in the Austrian literature, particularly Bylund's (2020) account of the promoter-entrepreneur and Bylund and Packard's (2022) analysis of subjective value in entrepreneurship, the paper further recognizes that the increasing-returns logic of specialization operates alongside, but does not exhaust, the full range of entrepreneurial motivations that drive firm formation and growth.

Conversely, a contribution was also offered regarding the negative-feedback mechanisms that constrain firm scope. Beyond continuous productive integration, the necessity of a market that can determine the value of a production factor for its efficient use demonstrates that firms, far from growing indefinitely toward a size that encapsulates all production stages, will halt at the point where the increasing returns from specialization confront the diminishing returns arising from the inability to determine a factor's contribution to the production process.

It should be noted, however, that this particular framework captures the efficiency-oriented dimension of entrepreneurship. For promoter-entrepreneurs, their primary goal is value creation rather than efficiency; the calculus of internalization is governed by the pursuit of greater efficacy in answering consumer demand, instead of just productive efficiencies (Bylund, 2020; Bylund & Packard, 2022). Integrating this dimension into the analysis of increasing returns and firm boundaries represents a promising avenue for future research, as an open question remains in the extent to which productive internalization and increasing returns may correlate with novel consumer offerings, in which case both efficacy and efficiency are met.

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