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HOW ORGANIZATIONAL INEFFICIENCY ADVERSELY AFFECTS NUMBER-OF-EMPLOYEE BASED PRODUCTION OUTPUTS

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Abstract: This study uses an analytical approach to investigate the emerging disconnect between firm size and financial performance, as observed recently from a set of long-term data collected from U.S. public firms. By holding all organizational aspects of a firm constant, it confirms the validity of the old saying that the larger a firm is, the better chance it can secure advantages against rivals and the higher returns it can fetch. However, if the assumption about organizational aspects is removed, the present study shows that if a firm employs its assets to increase production output through hiring additional employees, then the consequently increased organizational inefficiency, as caused by interactions of the

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employees, will soon erase the expected increase in the output. Additionally, it is also shown, among other results, that when a firm hires additional human labor to meet the increasing market demand, the expected profit will decline after first reaching its maximum level. These results crystalize what has been speculated and what have been empirically observed. In the conclusion section, it is recommended that increasing a firm's size, in terms of the number of employees, is not a realistic, efficient solution to meeting the challenge of increasing market demand. Instead, any genuine solution must satisfy the condition that it does not increase the organization's inefficiency of the firm, such as increasing the magnitude of automation and/or digitization.

Keywords: asset size; capital market; firm size; mission; personnel; scale economy; values and beliefs.

JEL Codes: D02, D21.

1. Introduction

A recent empirical study reveals that between 1970 and 2013, the asset size of the U.S. public firms that operate in traditional industries has on average increased more than 20 times, while the revenue and net income increased merely 10 times and their profitability declined by half (Muthusamy & Kannan, 2023). By associating this discovery with a recent theoretical result (Forrest & Orvis, 2016) – inefficiency always exists in the organization of any firm that has at least one full-time employee whose personal system of values and beliefs is not in total agreement with the firm's mission, it is natural to question: Can the aforementioned disconnection between asset size and net income be caused at least partially by the firms' internal inefficiencies?

This study seeks to address this question from an analytical lens and provide a positive answer. The importance of addressing this question is of two folds, one for practical significance and the other for theoretical worthiness. For front-line managers, the answer to this question will provide them with real-life guidelines as for what within their jurisdiction they should pay attention to beyond what other possible issues outside the boundaries of individual firms, such as financial crises (Barton et al., 2017), increasingly volatile markets (Dobbs et al., 2015), frequent appearance of disruptive technologies and intensifying globalized competitions (Hitt et al., 2007; Rousseau, 2000). For scholars of the academia, the answer to the previous question will no doubt provide another meaningful organizational antecedent that can potentially help explain the association between a firm's management antecedents and financial performance.

In terms of what contributions this study makes to the relevant areas of knowledge, first, it certainly confirms an old saying that the larger a firm is, the better chance it can secure advantages against rivals and the higher returns it can fetch, which is also

empirically confirmed by various authors, for example, Adler (2012), Coase (1937), Josefy et al. (2015) and Mason (1939). However, the validity of this confirmation only holds true under the following caveat, as shown in this paper: assume that one merely considers the acquisition and sale of a product with all other organizational aspects of the firm held constant. Second, this study shows that if a firm employs its assets to increase production output through hiring additional employees, then the consequently increased organizational inefficiency will soon erase the expected increase in the output. Third, among other results, it is shown that when a firm hires additional labor to meet the market demand, the expected profit will decline after first reaching its maximum level. All these conclusions point to the following managerial recommendation: Increasing a firm's size, in terms of the number of employees, is not a realistic solution to meeting the challenge of increasing market demand. Instead, automation might be a potential alternative.

The rest of the study is organized as follows. Section 2 provides a brief literature review and compares what are established here with what are already known. Section 3 demonstrates the development of all our mean conclusions, while positioning them within the relevant literature. Section 4 visits related empirical studies, while showing how this work helps carry these known data-based conjectures onto the height of analytical abstraction. Section 5 concludes the presentation while providing a few relevant managerial recommendations.

2. Literature review

This work touches on two areas of the literature, one about the decoupling between firm size and profitability and the other on organizational efficiency (and inefficiency). Regarding the former area of the literature, it has been long believed that the larger a firm is, the better chance it can secure advantages against rivals and the higher returns it can fetch. In particular, from the dawn of the Industrial Revolution to the days of the mass-production economy, integrating and mobilizing more and more assets have been a principal strategy to build a larger enterprise in order to realize greater productivity and more production outputs, apprehend better economies of scale, and develop innovation and knowledge-based capabilities (Adler, 2012; Buzzell, 1983; Chandler, 1990). And, in the modern era of business, to successfully meet the challenge of the globalizing economy and markets, assimilating forever swelling number of assets and growing firm size still represent a critical strategy (Josefy et al., 2015; Muthusamy & Kannan, 2023). Accordingly, in academia, it has been a well-established fact (Adler, 2012) that the asset size of a firm is positively correlated with the firm's market share, economies of scale, profits, return on assets, market capitalization, competitive advantage, and innovation capabilities. That is, firm size is closely and positively associated to the firm's profitability.

However, in reality, the larger a firm becomes, the more it suffers from organizational inefficiencies and the more it experiences organizational inertia (Lin, 2009), defined as the inertia about how much the firm would operate within and along the existing routine or form of operation. When a firm is trapped in its organizational inertia of the past, it will be difficult for the firm to adapt to the accelerated changes of the business environment. As a matter of fact, since the start of the new millennium, many firms within the industries of the traditional scale-economy across the developed economies, such as metals, transportation, construction, electrical & electronics, appliances, machine tools & industrial goods, automobiles, and durables, have witnessed a decoupling between firm size and profitability (Autio et al., 2021; Cutcher-Gershenfeld et al., 2015; Lincicome, 2021; Pieri & Verruso, 2019; Warrian, 2016). For instance, many U.S. manufacturing firms, considering their large sizes, have not been able to maintain their market dominance or their profitability since the start of the new millennium, even though they enjoyed great successes from the 1940s through the 1980s (The Economist, 2017; Vermeulen, 2017). And, more noticeable have been corporate failures among the large firms operating in the afore-described industries. For example, 52% of the firms that were ranked in the 1990 Fortune 500 list, have either gone bankrupt, been rescued through acquisition, or ceased to exist completely since the year 2000 (Autio et al., 2021; Dobbs et al., 2015; Vermeulen, 2017; Watts, 2009).

Many extensive works, such as Goddard et al. (2009), Rumelt (1991), Schmalensee (1985) and Schumacher and Boland (2005), have traced the exogenous and endogenous reasons for the decoupling between firm size and profitability. However, other than attributing the phenomenon to such exogenous reasons as the emergent new state of demand, cost, competition, and profit conditions, and such endogenous causes as outdated governance and inflexible strategies (Muthusamy and Kannan, 2023), there does not seem to be any study on the organizational characteristics that underly the steady erosion of profitability, as firms keep growing in their size. Targeting at filling this gap in the literature, the present work attempts to unveil one such organizational essence that can naturally and fully explain the growing attrition of firm performance in the face of increasing firm size.

As for the area of literature regarding organizational efficiency and inefficiency, there is a huge amount of studies addressing various issues related to the former. Due to what this study evaluates, this review will focus mainly on the latter – organizational inefficiency. Roughly, this area of literature can be divided into two classes, one on improving inefficiencies in individually different particular areas of the economy, while the other on what characteristics the general organizational inefficiency possesses. For example, along with the intensifying competition of the globalizing economy, customers become increasingly uncertain about what they need due to the mounting complexity of their needs. Such demand-side uncertainty

has directly led to organizational inefficiency in terms of how to satisfy customer demand. Hence, it is very important for managers to understand when their organizations should involve an uncertain customer in the production process and in which organizational form such involvement can be effectively managed (Blandi, 2018). When business scholars and managers focus on optimizing decision making, as a way to define organizational efficiency, the management of sports teams provides a good source of examples, showing how firms can exist for different purposes beyond those whose sole purpose is to increase the economic value of stakeholders (Altman & Altman, 2021). Different from the inefficiencies of sports teams is a similar situation with donations to U.S. nonprofit organizations. Various models are developed to examine how the price of giving is affected by organizational size. It turns out that different definitions of organizational size lead to different results (Marudas & Jacobs, 2008).

When looking at the US life insurance industry, whose profitability is mainly driven by cost efficiency, Greene and Segal (2004) find that the industry's cost inefficiency is substantial relative to earnings, that inefficiency is negatively associated with profitability measures, such as the return on equity, and that shareholder-owned companies are as efficient and profitable as policyholder-owned ones. Similarly, the medical industry is intrinsically interconnected within this framework. What is interesting with this industry is that the enormous, widely existing inefficiencies did not successfully incite entrepreneurs to enter the business domain to help make relevant operations more efficient (Cutler, 2011). When looking at how organizational inefficiencies can be induced by legislation, the question of how Federal agencies are able to regulate the economy in general and to utilize financial regulations in particular arises. In this regard, Johnson (2015) examines challenges associated with the uncertainty of the administrative environment in which Federal agencies drafted regulations in response to Dodd-Frank.

In terms of how to diagnose organizational inefficiency and how to identify possible solutions, Vining and Weimer (1999) examine public organizations by employing theories of market and government failure so that the leaders can improve their organizational efficiencies. Moreover, Lewis and Sexton (2004) show how to use data envelopment analysis to look inside a *decision-making unit (DMU) so that* greater insights can be obtained regarding the sources of organizational inefficiencies within that unit.

As for the second area of the literature related to this work, regarding the characteristics of the general organizational inefficiency, the effect of organizational slack has been found to be inconsistently and impacts firm performance positively (Hatch, 2018); it breeds inefficiency and constrains performance (Delbufalo, 2018). Corresponding to the inconclusive empirical evidence regarding this concept, Tan and Peng (2003) employ a survey and archival data from China to conclude that

organization theory generates stronger predictions (positive impacts) when dealing with unabsorbed slack, while agency theory yields stronger validity (negative impacts) when focusing on absorbed slack. In terms of why resources are continuously mobilized to support permanently failing organizations, such as those that provide help to battered women and those that employ the handicapped, in competitive markets, Seibel (1996) argues that each permanent organizational failure requires those, which contribute resources, to be interested in both failure and ignorance about failure. As for such issues as why X-inefficiency persists in many organizations, when its existence, nature and causes will be known, when everyone stands to gain from correcting the errors that cause it, Leibenstein and Maital (1994) argue that when a *critical mass* of individuals is willing to admit and correct errors, organizations will succeed in eliminating their X-inefficiencies. Different from these studies on general organizational inefficiencies, Forrest and Orvis (2016) establish the principle of management efficiency and that of organizational inefficiency regarding the structure of employees' efforts and devotion toward realizing the mission of their organization. The former principle tells how management efficiency can be achieved by appropriately entertaining employees with inconsistent personal values and beliefs. And the second principle states that organizational inefficiency always exists in any organization due to the inconsistencies that exist among the systems of values and beliefs of involved parties.

In terms of the relationship between organizational efficiency and size of assets, the works of Arrow (1983), Blau and Meyer (1987), Child (1973), Riordan and Williamson (1985) and Williamson (1975) indirectly suggest that there are limits over how much efficiency can be gained from larger asset bases. For large firms with increasing asset bases, employee alienation, coordination lapses, information delays, compounding of errors, and bottlenecks can cause diseconomies of scale; the rising number of bureaucratic layers, compounding information processing errors and delays, and enlarging power distance between organization layers can all make organizational inefficiency worse. For example, managers in large firms are often entangled in fights for the control of greater turfs, the attainment of more powers, and the development of political coalitions, all of which deteriorate the existing synergy, if there is any, among management layers and divisions (Riordan & Williamson, 1985; Williamson, 1975).

In comparison to the aforementioned studies on general organizational inefficiency, this study examines how an increasing number of employees, a reflection of an enlarging asset basis, can naturally worsen the organizational inefficiency, as reflected in the production output due to the existing disagreement among individual systems of values and beliefs. Other than theoretically confirming some of the statistically tested hypotheses, conclusions developed herein also refine some of the previously conjectured results.

The firm of focus, considered in the rest of the paper, is assumed to conduct its business in one of the traditional, scale-economy industries. It has the structure and scope needed to implement such strategies that are predominantly driven by the conventional temperament of scale economies. To make the situation under consideration more readily imaginable, we can think of the focal firm as being one founded long before the arrival of information and internet technologies, and the essence of adopted strategies is around how to boost its production output.

3. Main Results

This section develops our main results regarding how for any firm, its organizational inefficiency can adversely eat into its desired amount of production output. It consists of three subsections with the first one looking at an unrealistic situation regarding what could happen if no organizational inefficiency existed. The second subsection models the effect of organizational inefficiency on a firm's profit. Then, the third subsection develops analytical results on how the said inefficiency can materially impact the profits of the firm.

3.1. When no organizational inefficiency exists

This study based the empirical modeling on Mincer's theoretical framework to investigate gender earnings disparities. The Mincer theory suggests that variations in earning profiles among individuals can be attributed to differences in human capital, such as labor market experience, innate abilities, and education (Mincer, 1974). To identify the factors that have a significant effect on earnings, the augmented version of the traditional human capital semi-logarithmic earnings equation was applied, which is as follows:

$$max^{F}_{p^p}\pi^p = m_p(p^p)(p^p - c^p). \qquad (1)$$

That is, the firm chooses such a selling price p^p so that it can maximize the total profit π^p, where the superscript F stands for the firm's specific order of real numbers. In other words, max^F stands for how the firm maximizes the realization of its mission (Forrest, Wu et al., 2022).

If the firm orders real numbers in the conventional fashion, then we write $max^F = max$ and the first-order condition of the unconstrained maximization problem in equation (1) is

$$m_p^{'}(p^p) = -\frac{m_p(p^p)}{p^p - c^p}$$

from which we obtain

$$m_p(p^p) = \frac{C}{p^p - c^p} \qquad (2)$$

where C is the integration constant. This unconstrained maximization implicitly implies that the firm is able to finance its operation without suffering from any monetary limitation. In other words, we assumed that the financial market is perfect for the firm.

If the initial market demand for the product is $m(p_0^p)$ at the product's launch price p_0^p, we have

$$C = m_p(p_0^p)(p_0^p - c^p) \qquad (3)$$

Hence, we have

$$\pi^p = m_p(p_0^p)(p_0^p - c^p) \quad \text{(from equations (1), (3))} \qquad (4)$$

and

$$m_p(p^p) = m_p(p_0^p)\frac{p_0^p - c^p}{p^p - c^p} \quad \text{(from equations (2), (3))}$$

If the firm needs to make profit from the said product, then equation (2) implies that on the average, the firm needs to sell each unit of the product at a price that is more than the cost. That is, $p^p > c^p$, and so, $C > 0$. In this case, the market demand $m_p(p^p)$ for the product rises indefinitely, as the unit profit $p^p - c^p \to 0$. This end reflects the idea of selling for less while the volume is huge. At the same time, equation (2) indicates that the lower the initial selling price p_0^p is, the greater the initial market demand $m_p(p_0^p)$; and equation (4) implies that the initial unit profit $(p_0^p - c^p)$ stays constant, the lower the initial selling price p_0^p is, the greater the total profit π^p. In other words, for the firm to generate an as high level of profit as possible, it needs to keep its per-unit cost c^p as low as possible. So, an effective strategy for the firm to considerably lower its cost basis c^p is to collaborate with such suppliers that offer competitive supplies due to the firm's ability to indefinitely increase its sales.

Next, let us consider the case that the firm of our concern is constrained by the total amount T of funds it can invest in the acquiring and selling of the product. In this case, the firm solves the optimization problem in equation (1) subject to the constraint below:

$$m_p(p^p)c^p = T \tag{5}$$

For this maximization problem of equations (1) and (5), the first-order conditions are

$$\frac{\partial \pi^p}{\partial p^p} = m_p'(p^p)(p^p - c^p) + m_p(p^p) = \lambda m_p'(p^p)c^p \tag{6}$$

and

$$\begin{aligned} \frac{\partial \pi^p}{\partial c^p} = & \quad m_p'(p^p)\frac{dp^p}{dc^p}(p^p - c^p) + m_p(p^p)\left(\frac{dp^p}{dc^p} - 1\right) \\ = & \quad \lambda\left[m_p'(p^p)\frac{dp^p}{dc^p}c^p + m(p^p)\right] \end{aligned} \tag{7}$$

where λ is the Lagrange multiplier. By inserting equation (6) into equation (7), we have

$$(1 + \lambda)m_p(p^p) = 0$$

which implies $\lambda = -1$, because $m_p(p^p) \neq 0$ due to equation (5). So, from equation (6), the market demand and the firm's profit from the product can be obtained as follows:

$$m_p(p_s^p) = \frac{m_p(p_0^p)p_0^p}{p^p} \tag{8}$$

and

$$\begin{aligned} \pi^p & = \frac{m_p(p_0^p)p_0^p}{p^p}(p^p - c^p) \\ & = m_p(p_0^p)p_0^p\left(1 - \frac{c^p}{p^p}\right) \end{aligned} \tag{9}$$

Equation (8) indicates that to swell the demand for the product, the firm needs to reduce the selling price p^p. That is different from what equation (9) implies: When p^p lowers towards c^p, the profit π^p also drops, because the firm's ability to raise funds is difficult, making it tough for the firm to also lower the cost c^p so that c^p/p^p stays roughly constant. Speaking differently, when a firm is constrained financially, it is not able to compete with any firm that has sufficient investment capital.

By combining the discussions above, can we conclude, as a long-held belief goes, that the larger a firm's asset size is, the better chance the firm can secure advantages against rivals and the higher returns it can fetch? To this end, Forrest and Orvis (2016) established the following

Theorem 1. Inefficiency always exists in the organizational system of any firm that has at least one full-time employee whose personal system of values and beliefs is not in total agreement with the organization's mission, where the concept of organizational efficiency is defined as if its employees help reach the defined mission of the organization.

Even with this result known regarding organizational inefficiency, the previous discussion still confirms the following:

Theorem 2. In terms of acquiring and selling a product without considering other organizational aspects of a firm, it is true that the larger the firm's asset size is, the better chance the firm can secure advantages against rivals and the higher returns it can fetch. QED

3.2. Modeling organizational inefficiency

To continue our discussion, let us first make sense out of Theorem 1 by examining three related concepts: personal system of values and beliefs, the mission statements of a firm, and organizational efficiency. It is argued that each individual takes actions and reacts to stimulations according to his system of values and beliefs (Forrest & Liu, 2022, Chapter 10; Lin & Forrest, 2012, Part IV). The system consists of such codes regarding what is considered as right or wrong, and how the world functions. Such concept of value-belief systems that underly individuals' decision making enriches and generalizes what Mises (1949, p. 244) stated that "the value judgements a man pronounces about another man's satisfaction do not assert anything about this other man's satisfaction. They only assert what condition of this other man better satisfies the man who pronounces the judgement."

In mathematical terms, what the concept of value-belief systems implies is that even when the starting point of optimization, such as an objective function, might appear the same in formality, the specifically employed criteria or methods of optimization can be different from one person to another. The concept of value-belief systems is also different of that of Stigler and Becker's (1977) tastes, which is defined (p. 76) as that they "neither change capriciously nor differ importantly between people." However, systems of values and beliefs can change drastically from one person to another, leading to, among other situations, different orderings of real numbers. For example, due to differences in their systems of values and beliefs, some individuals

may easily see $2 million as greater than $60 K, while some others would see $60 K as greater than $2 million, if these millions were the gains from robbing a bank.

When each and every business firm is seen as a form of life with its particular reason for existence, the concept of value-belief systems can be generalized (Forrest, Shao et al., 2023) from the level of individuals to that of business firms. In this generalization, each firm's system of values and beliefs is outlined in its mission statements, which clearly spell out whom the firm is, what values it stands for, and what it believes it can deliver. At the same time, because different persons have dissimilar value-belief systems (Forrest, Nicholls et al., 2020, Proposition 8.1), and because philosophical and value-based differences exist within any organization that has at least two employees (Forrest & Orvis, 2016), it is necessary for a functional business organization to clearly state its missions. Otherwise, its daily operations would be torn apart by the inconsistent individuals' philosophical assumptions and value-belief systems. In other words, if a firm desire to exist and last for a reasonable length of time, then it needs to have a clearly stated and strictly practiced mission. Additionally, if a firm wishes to be a leader in the present business world, it has to be able to successfully ride waves of transient competitive advantages (McGrath, 2013). In this case, the firm has to have such a mission that clearly establishes a long-term, unwavering public commitment to the ambition of becoming a leader. In practice, such ambition needs to be proactively supported by the firm's management through setting the bar high while having a clear sense of strategic direction in every endeavor, and through promoting common key themes. In this vein, Forrest, Shao et al. (2023, Proposition 15) shows that when a firm faces a decision-making situation, it optimizes the potential subject to the given constraints by using its particular set of criteria formulated consistently with its value-and-belief system.

With this discussion on how a firm bases the optimization of its potential on its particularly defined rules of priority in place, one may naturally ask: are the maximizations in the previous symbolic analysis still valid in general? The reason why this question arises is because it has been shown (Forrest, Hafezalkotob et al., 2021) that out of the same objective function and set of constraints, different rules of priority can indeed lead to different solutions. The answer to this question is: Yes, the previous symbolic discussions are valid in general no matter what system of values and beliefs is considered. This affirmative answer follows directly from the fact that the relevant discussions merely focused on the portion of selling a product without touching on any other aspects of business; and, it is the other aspects of business that need to consider related details of the firm's underlying system of values and beliefs, such as green production, corporate social responsibilities, etc.

It is argued (Lin, 2009) that when a firm has sufficient funds to acquire and to sell its product, it also creates profits from the personnel dimension, because, intuitively,

the firm can employ as many employees as needed to meet the demand for its product.

Similar to the setup of the previous subsection, assume that each employee hired by the firm, in theory, can create on the average the revenue of $\$p^W$, while costing $\$c^W$. Let the corresponding staffing need be $m_W = m_W(p^W)$ and the profit from the personnel dimension be π^W. So, Theorem 1 indicates that the more employees a firm hire, the more likely that the firm will experience organizational inefficiency. To this end, the profit from the personnel dimension is modelled as follows:

$$\pi^W = \text{profit from peronnel} = m_W(p^W)(p^W - c^W) - O_I m_W^r(p^W) \qquad (10)$$

where O_I (≥ 0) is referred to as the organizational inefficiency coefficient or simply inefficiency coefficient, and r (> 0) represents the order on how the staffing need of the company makes the organizational inefficiency worse. Evidently, if $O_I = 0$, it means that the firm does not suffer from any organizational inefficiency. According to Theorem 1, $O_I = 0$ is impossible in real life. So, assume $O_I > 0$. The second term on the left-hand side of equation (10) describes the phenomenon that the more employees a firm has, the more likely its organizational inefficiency eats into its expected profits.

3.3. The existence of a cap over the number of employees hired

By assuming that the capital markets are perfect for the firm, the first-order condition of the problem of maximizing π^W is,

$$\frac{\partial \pi^W}{\partial p^W} = \frac{dm_W(p^W)}{dp^W}(p^W - c^W) + m_W(p^W) - rO_I m_W^{r-1}(p^W)\frac{dm_W(p^W)}{dp^W} = 0$$

So, we have

$$\frac{dm_W(p^W)}{dp^W} = \frac{-m_W(p^W)}{p^W - c^W - rO_I m_W^{r-1}(p^W)} \qquad (11)$$

Because rO_I is a constant, regrouping relevant variables together can help rewrite equation (11) as follows:

$$\frac{d[rO_I m_W(p^W)]}{dp^W} = \frac{-rO_I m_W(p^W)}{p^W - c^W - (rO_I)^{2-r}[rO_I m_W(p^W)]^{r-1}}$$

Therefore, by letting $x = p^W - c^W$ and $y = rO_I n_W(x - p^W)$, equation (11) becomes

$$\frac{dy}{dx} = \frac{-y}{x - \alpha y^{r-1}}$$

where $\alpha = (rO_I)^{2-r}$. Solving this exact ordinary differential equation produces

$$xy - \frac{\alpha y^r}{r} = C$$

where C is the integration constant. Hence, the solution to equation (11) is

$$(p^W - c^W) r O_I m_W(p^W) - \frac{(rO_I)^2 m_W^r(p^W)}{r} = C$$

or

$$(p^W - c^W) m(p^W) - O_I m_W^r(p^W) = C \tag{12}$$

So, we have

$$m_W(p^W) = \frac{[C + O_I m_W^r(p^W)]}{p^W - c^W} \tag{13}$$

Substituting equation (12) into equation (10) provides

$$\pi^W = \text{profit from peronnel} = C \tag{14}$$

This symbolic analysis indicates that when $p^W - c^W \to 0^+$, meaning that the profit each employee is expected to generate for the firm is approaching zero, the staffing need $m_W(p^W) \to 0$. Hence, equations (10) and (14) imply that $\pi^W = \text{profit from peronnel} \to 0$. That is, $C = 0$.
What is discussed above provides an answer to the question that was raised earlier: Is it true that the larger a firm's asset size is, the better chance the firm can secure advantages against rivals and the higher returns it can fetch? That is, we have

Theorem 3. If a firm applies its assets to hire additional employees for the purpose of increasing production output, then the organizational inefficiency created by the newly hired employees will sooner or later erase the expected increase in the output. QED

From equation (13) and the fact that $C = 0$, it follows that

$$\frac{1}{O_I m_W^{r-1}(p^W)} = \frac{1}{p^W - c^W} \to +\infty, \text{as } p^W \to (c^W)^+$$

which implies that $m_W(p^W) \to +\infty$, as $p^W \to (c^W)^+$ and $r > 1$. Therefore, we have

Theorem 4. For any chosen firm, its organizational inefficiency is of an order higher than one in terms of the number of employees hired, while its expected profit is of order one in the number of employees working for the firm.

Proof. Let the firm's profit from its personnel be given in equation (10). Then, the expected profit from personnel is solely generated by the first term on the right-hand side, which is of order one in $m_W(p^W)$. On the other hand, the firm's inefficiency is described by the second term, which is of order r. Hence, the previous discussion shows that $r > 1$. QED.

In terms of the literature, this theorem analytically confirms what has been gradually guessed that there are limits to firm size, which can offset returns to scale and trigger the diseconomies of scale, as caused by such issues as employee alienation, dysfunctional employee relations, coordination lapses, information delays, compounding of errors, and bottlenecks (Arrow, 1983; Blau & Meyer,1987; Canbäck, 2004; Child, 1973; Riordan & Williamson, 1985; Williamson, 1975). It also partially supports the growing disconnect between antecedents (such as firm asset size, growth, etc.) and financial performance of the large firms operating in the scale-economy industries (Autio et al., 2021; Cutcher-Gershenfeld et al., 2015; Lincicome, 2021; Pieri & Verruso, 2019; Warrian, 2016). In particular, it explains at least in part why the association between firm assets and profitability/performance ratios has been declining for U.S. public companies operating in two different scale-economy industries: Electrical and Electronics manufacturing (SIC 36), and Steel, Aluminum, and Metal Production (SIC 33), as discovered by Muthusamy and Kannan (2023).

Corollary 1. For the firm of concern, each of its product lines needs to cap the total number of employees involved in the production and sale before the involved organizational inefficiency starts to diminish the profit that is expectedly generated from the personnel.

Proof. This conclusion follows directly from Theorem 4 by noticing that the argument for that result is based on a single product. QED

Compared to the existent studies, this conclusion enriches the literature magnificently. In particular, during the days from the time of the Industrial Revolution to the economy of the mass production, a core strategy, for reaching greater production output, actualizing much improved economies of scale and scope, and developing innovation-based capabilities, has always been the integration of as many assets as possible (Adler, 1995, 2012; Buzzell, 1983; Chandler, 1962, 1977, 1990). Even in the modern world of business, which is characterized by globalization and where once sustainable competitive advantages had become transient, assimilating more assets and expanding firm size are still considered a critical strategy (Josefy et al., 2015). Opposite to such backdrops of knowledge, Corollary 1 looks at a firm inwardly and shows that firm size can surely backfire on the managerial desire for achieving better financial performance.

Theorem 5. When the firm hires $m_W(p^W)$ employees, its profit from personnel reaches the maximum, when

$$m_W(p^W) = \sqrt[r-1]{(p^W - c^W)/O_I} \tag{15}$$

where O_I is the organizational inefficiency coefficient of the firm.

Proof. Differentiating the profit π^W, generated from the firm's personnel, with respect to the staffing need $m_W(p^W)$ in equation (10) produces

$$\frac{d\pi^W}{dm_W(p^W)} = (p^W - c^W) - rO_I m_W^{r-1}(p^W)$$

So, when $m_W(p^W) < \sqrt[r-1]{(p^W - c^W)/O_I}$, $d\pi^W/dm_W(p^W) > 0$; and $m_W(p^W) > \sqrt[r-1]{(p^W - c^W)/O_I}$, $d\pi^W/dm_W(p^W) < 0$. Therefore, the profit π^W from personnel reaches its maximum at the $m_W(p^W)$-value given in equation (15). QED

In terms of the literature, Tan and Peng (2003) empirically find that the impact of organizational slack on performance is curvilinear, resembling inverse U-shaped curves, where from the point of view of agency theory the slack breeds inefficiency and constrains performance (Delbufalo, 2018). In the study of how collaboration impacts organizational outputs, Park et al. (2019) evaluate the efficiency of US cities' use of energy efficiency conservation block grant. They find that collaboration's efficiency-improving effects are not linear; its marginal effects diminish as cities approach the highest level of collaboration. Comparing to these findings, Theorem 5 not only theoretically confirms these data-based conjectures,

but also provides a formula for computing where the peak of the inverse U-shaped curve is located.

4. Empirical confirmations

What is analytically developed above actually answers the following question by Canbäck et al. (2006): Why don't the largest business organizations have ten, twenty or a hundred million employees rather than a few hundred thousand? The answer lies with the phenomenon of organizational inefficiency, which is also known as diminishing returns to management or diseconomies of scale. As a matter of fact, if there were no diminishing returns to management, there would be inexorable concentration of industries and economies with only one global firm standing. However, the reality is the opposite, as observed by, for example, Coase (1937, p.394) and Stigler (1974, p.8). As a firm grows larger by internalizing additional environmental factors, such as transaction costs (Riordan & Williamson, 1985), it experiences more diseconomies of scale due to bureaucratic failures (Allison, 2001; Taylor et al., 2009; Williamson, 1975) or organizational inefficiency, as discussed here in this paper.

The relevant literature confirms the existence of diseconomies of scale and various kinds of bureaucratic failures, where a commonly used measure of scale is the number of employees a firm has (Amis & Slack, 1996; Slack, 1997). For example, Pugh et al. (1969) and Child (1973) document that increasing size does lead to additional bureaucracy – the larger a firm is, the more highly bureaucratized it becomes, while the increasing levels of formalization and rigidity, as parts of the increasing bureaucracy, in turn breed diseconomies. And "almost surely," as noted by Williamson (1996, p. 266), "the added costs of bureaucracy are responsible for limitations in firm size." Speaking differently, it is the added policies and procedures of bureaucracy that restrain the flexibility of the firm.

To see more closely how scholars have empirically confirmed our theorems developed in the previous sections, let us quickly glance through two empirical studies.

Empirical Case Study 1. Wicker et al. (2014) look at the effect of the number of employees on the severity of organizational problems. To achieve this goal, two nationwide surveys of nonprofit sport clubs, consisting of the same core questionnaire, in Germany (n = 19,345) and in Switzerland (n = 6,221) are analyzed by using regression analysis to increase the external validity and generalizability of their findings. Two cost measures – LN(cost/member) and LN(cost/sport) – for organizational efficiency are calculated. All other variables are summarized in the following table:

Table 1 All other variables

Recruitment/retention of volunteers	1 = no problem, 5 = a very big problem
Financial situation of club	1 = no problem, 5 = a very big problem
Availability of sport facilities	1 = no problem, 5 = a very big problem
Number of laws, orders, directives	1 = no problem, 5 = a very big problem
Number of members	count
Number of sports provided by the club	count
LN(rev)	Log of the club's total revenue
Percentage of voluntary core positions	= (# of core volunteers/total # of members)*100
Percentage of secondary volunteers	Share of such volunteers who work sporadically
Own facilities	1 = yes, 0 = no
Use of public facilities	1 = yes, 0 = no
Have a strategic policy	1 = do not agree, 5 = totally agree
Give value on tradition	1 = do not agree, 5 = totally agree
Set value on companionship & conviviality	1 = do not agree, 5 = totally agree
Promote young talents	1 = do not agree, 5 = totally agree

Source: Own processing

After employing descriptive statistics to provide an overview of the two samples, one for Germany and the other for Switzerland, six regression models are estimated. The first two models have LN(cost/member) and LN(cost/sport) as dependent variables, while the other four models demonstrate how the organization-problem variables – the first four variables in Table 1 – depend on other predictor variables. Among a hole list of various important observations, this regression analysis statistically confirms the following:

- The economies of scope (that is, the number of sports) have a significant negative impact on costs per member. That is, efficiency losses may exist due to the reason that club size cannot be adjusted for each sport individually (Brueckner & Lee, 1991).
- The higher the total revenues, the higher the severity of the club's financial situation. That is, the financial situation worsens with increasing revenue.
- Any increasing number of employees is associated with rising levels of bureaucracy so that the more the club grows, the higher level of bureaucracy. This is especially true for large clubs. See Sandler and Tschirhart (1997) for possible explanations.

Empirical Case Study 2. Based on a careful literature review, Canbäck et al. (2006) derive a list of nine hypotheses, three of which are:

H_1: Bureaucratic failure increases with firm size.
H_2: Large firms exhibit economies of scale.
H_3: Diseconomies of scale from bureaucratic failure have a negative impact on firm performance.

In relation to our current work, H_2 is closely related to Theorem 2, H_1 and H_3 jointly to Theorem 3, and H_3 to Theorem 4.

To statistically confirm their hypotheses, Canbäck et al. collected data of publicly traded manufacturing firms from different sources that are headquartered in the US with sales ≥ $500 million and 1998 as the benchmark year for the period 1961-2000. After cleaning the raw data, the records of 784 firms are used in their hypothesis testing by using two structural equation models. One model tests the relationship between firm size and diseconomies of scale and economies of scale, and the other the relationship between firm performance and diseconomies of scale, economics of scale and moderating factors.

Collectively, these models statistically confirm H_1 with a significance better than the 5% level and H_2 with a significance better than 0.1%. As for H_3, if diseconomies of scale are seen as caused by bureaucratic insularity, then H_3 is statistically confirmed with a significance better than 0.1%. And, if diseconomies of scale are seen as consequences of incentive limits, H_3 is confirmed with a significance better than 1%. In summary, Canbäck et al.'s work empirically suggests that diseconomies of scale seem to exist in real life and vary in magnitude and impact, and that economies of scale increase the relative profitability of large firms over small firms.

Other than these two studies visited above, there are also many on how increased firm size negatively impacts the efficiency of a firm. For example, Afinindy et al. (2021) examine how firm size and sales growth do not increase the capital structure and the value of a firm. Diaz and (2008) and Hanousek et al. (2015) empirically confirm that small and medium-sized firms tend to be less inefficient than the large firms are. Dhawan (2001) confirms that small firms are significantly more productive but also much riskier than their large counterparts. The author's estimates imply that each tradeoff between flexibility and efficiency should be adjusted for the dimension of risk – small firms face market uncertainties, capital constraints and other challenges that force them to be more efficient than large firms, while the increased efficiency is achieved at the cost of increasing levels of riskiness.

Similarly, to scrutinize the correlation between enterprises' numbers of employee and the firms' efficiencies, Zheng et al. (2011) analyze the 94 Real Estate Companies (LRECs) that are listed in the Chinese stock markets by utilizing techniques of data envelopment. Their outcomes reveal that the employees' slack is prevalent at 18.96% for the inefficient LRECs. In a similar vein, Li et al. (2019) delve into the operational efficiency of 37 banks in Taiwan for the period from 2012 to 2016 by employing a min/max slacks-based measurement data envelopment analysis. As expected, their

the findings also ascertain that the most inefficient aspect of operations pertains to the magnitude of personnel.

5. Conclusions

This study addresses the question raised in the beginning of this paper: are internal inefficiencies the cause or causes that make a firm's asset size and net income increasingly more disconnect from each other than before? By considering how a firm employs assets to hire additional labor, and by associating the question of concern with the Principle of Organizational Inefficiency (Forrest & Orvis, 2016), that is Theorem 1, this study is able to derive the following main conclusions:

- The following old saying is true, if one focuses on acquiring and selling a product without considering other organizational aspects of the firm: the larger the firm's asset size is, the better chance the firm can secure advantages against rivals and the higher returns it can fetch (Theorem 2).
- The more employees are hired for the purpose of increasing production output, the more organizational inefficiency will be naturally created. Furthermore, the magnitude of the inefficiency that appears is faster than the speed of increase in production output (Theorems 3 and 4).
- The expected profit from the personnel dimension of the hiring firm is nonlinear in the number of additional employees hired, and can be shown as an inverse U-shaped curve (Theorem 5 and Corollary 1).

What is significant about these conclusions is that they explain at least in part why a disconnect between firm assets and profitability (or performance) has appeared since around the start of this new millennium for many public companies operating in scale-economy industries (Autio et al., 2021; Cutcher-Gershenfeld et al., 2015; Josefy et al., 2015; Lincicome, 2021; Muthusamy & Kannan, 2023; Pieri & Verruso, 2019; Warrian, 2016). These results jointly show that the conventionally successful strategy for reaching greater production output by improving economies of scale and scope and by developing innovation-based capabilities through integrating assets (Adler, 1995, 2012; Buzzell, 1983; Chandler, 1962, 1977, 1990) need to be updated in order to deal with the phenomenon of transient competitive advantages within the modern world of business (McGrath, 2013).

As for the practical usefulness, all the conclusions derived in this study collectively lead to the following recommendations for decision-making managers and entrepreneurs.

- As a firm's asset size increases, it needs to tap into the production of different products, while keeping the number of employees on each individual production line limited (Corollary 1; Theorem 5).

- As a firm's asset size increases significantly, the firm needs to produce goods for different markets in order to maximally reduce the severity of number-of-employee based inefficiencies.
- To meet the challenge of increasing market demand of a single product, instead of hiring more workers, the firm needs to increase its level of automation and/or digitization of the related production (Liu et al., 2020).

Potential future research, building on what has been achieved in the current study, can examine, for example, in what forms the derived theorems in this study will take when the firm of concern is not established for making the maximum profit. For such firms, all the arguments in the previous sections that are based on the maximization of profits will no longer be valid. The firm types that can be usefully considered, for instance, may include the following: (i) a government agency; (ii) a subordinate unit of a large organization, where the unit functions for a defined purpose, such as the development of public relations, providing help to battered women, creating opportunities for the handicapped; (iii) a community-own business entity; (iv) one of those recognized as permanently failing organizations (Seibel, 1996).

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Jeffrey Yi-Lin Forrest and Orhan Kara conceived the main idea behind this research, while Jeffrey drafted the first version of the report and Orhan provided related references. Both Lua A. Augustin and Gizem Uzuner conducted literature review; and Jun Liu, Lua A. Augustin and Orhan Kara suggested the empirical case studies cited in the paper. And each coauthor carefully and critically went through the paper to ensure the validity of the logical reasoning and articulations of the main results.

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