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Laying Off Versus Training Workers: How Can Saudi Entrepreneurs Manage the COVID-19 Crisis?*

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Abstract

This study aims to determine theoretically the best workers layoff/training strategy that entrepreneurs should apply to manage the COVID-19 crisis successfully. It also examines the impacts of the Saudi government's emergency measures on firm performance. The paper develops a theoretical framework in which the optimal control technics is applied to model the entrepreneur's hiring, layoff, and training behaviors. The results show that, during the current COVID-19 pandemic, the entrepreneur should first lay off the less productive workers to reduce labor costs. As more and more inefficient workers quit and profit increases, the entrepreneur starts expanding his activity and training workers. In the long run, only the training activity allows the firm efficiency to grow at a constant rate. This finding suggests that the key to long-run economic recovery in Saudi Arabia will rely on training, innovation, and adaptability to the new digital environment. The paper also shows that the Saudi government initiative of covering 60% of salaries for the small- and medium-sized entrepreneurs during the COVID-19 pandemic will enhance training activities in small- and medium-sized enterprises and improve their efficiency in both the short and long run. This policy will also prevent Saudi entrepreneurs from laying off half of their staff.

Keyword: Layoff, Training, Firm's efficiency, Saudi entrepreneurs, COVID-19

JEL Classification Code: D21, J24, L20, L25, L26

1. Introduction

The COVID-19 outbreak has severely restricted economic activity around the world. Many sectors are hurt badly by the lockdown. Entrepreneurs respond to the COVID-19 by laying off their employees and/or training and equipping them with work-from-home tools (Zoom, Webex, Skype, etc.) and adopting new ways to interact with customers, partners, and suppliers to continue operating. In Saudi Arabia, the General Authority for SMEs (Monshaat) has surveyed 918 Saudi entrepreneurs from different Kingdom regions through its website, e-mails, and social media channels. Alhawal et al. (2020) showed that 34% of entrepreneurs are from food service and residential activities, 22% from wholesale and retail, 11%, from manufacturing, and 9% from construction. The majority of them are micro (47%) and small businesses (47%). Only 6% are medium-sized businesses. The questionnaire was about the measures undertaken by these entrepreneurs and how they implemented these procedures in reducing the harmful effects of the crisis on their businesses. The results show that 99.5% of Saudi entrepreneurs of all sizes were negatively affected by the COVID-19 crisis, and over 65% of them were highly affected by this pandemic. Indeed, 46.7% of micro-, 30% of small-, and 30.6% of medium-sized enterprises have closed at least one of their branches.

Consequently, to the question: How many workers did you temporarily lay off due to the COVID-19?, 36.4% of medium-, 23% of small-, and 3.5% of micro-businesses answered that they laid off more than ten workers since the beginning of the crisis. Also, 49.1% of medium-, 27.6%

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of small-, and 10.6% of micro-enterprises laid off all of their workers due to the COVID-19 crisis. To support entrepreneurs, the Saudi government has introduced a wide range of emergency measures such as exempting small entrepreneurs from paying many fees and covering 60% of private-sector salaries to prevent them from laying off their workers. The Saudi Financial Support Services Company “SANID” covers 100% of Saudi workers in micro-businesses (less than five workers) and covers up to 70% of Saudi workers in small businesses (more than five workers). Also, the Saudi HR Development Fund (HADAF) has allocated SR5.3 billion to provide employment support.

The questions about the Saudi government support to reduce the burden on staff salaries revealed that small entrepreneurs are the major beneficiaries from the Saudi government initiatives. Indeed, 22% of them benefited from the recovery program, 24.3% from the SANID initiative, and 53.7% benefited from other initiatives. 18.2% of micro-businesses benefited from SANID initiatives, and 17.2% of them from the recovery program. The Saudi government allocated SAR800 million to around 100,000 businesses to provide more training opportunities, such as participation in seminars and workshops and training programs from national and international training institutes. The Technical & Vocational Training Corporation (TVTC) allowed the private sector’s training facilities to freely provide training courses. However, to the questions about training, most of the entrepreneurs answered that they did not participate to training activities to transfer their traditional activities to electronic ones. 15% of entrepreneurs have attended these training courses without benefiting from them. Only 8% answered yes and benefited from it. Also, 51% of Saudi entrepreneurs did not consult any specialist to move from a traditional activity to an electronic one. The majority (more than 60%) of those who did said that their workers had not been trained on the new business model. Finally, 75% of Saudi entrepreneurs believe that they need more government support than the current one to overcome the COVID-19 crisis.

In the midst of this turbulent environment and building on labor turnover (exits and replacements of workers) and learning theories, this article develops a model to study how layoff and worker training simultaneously affect the firm performance. It also proposes for Saudi entrepreneurs the optimal layoff/training strategy to benefit from the Saudi government measures, handle the economic effects of Covid-19 in the short run, and achieve long-run sustainable efficiency growth.

The paper combines two strands of literature. The first one focuses on the relationship between turnover (exits and replacements of workers) and firm performance. The theory and evidence show a negative relation between turnover and many performance indicators, such as value-added, productivity, profit, and customer satisfaction. Krackhardt and Porter (1986) argued that turnover results in decreased trust, lower worker morale, and increased coordination costs. Similarly, McEvoy and Cascio (1987) found a negative effect of both quits and dismissals on the firm performance (Shaw, 2011; Heavey et al., 2013; Hancock et al., 2013; Nyberg & Ployhart, 2013; Hom et al., 2013; Lee et al., 2017). The turnover effects on firm performance vary by the entrepreneur’s values or strategy (Baron et al., 1996) and industry/market conditions (Abelson & Baysinger, 1984). It is shown that turnover reduces the performance of firms competing on service quality or customer loyalty. According to Batt and Colvin (2011), firms with higher dismissal and quit rates have lower customer service. This result may be the consequence of the firm-specific skills (McElroy et al., 2001; Batt, 2002; Kacmar et al., 2006) or worker motivation (Schlesinger & Heskett, 1991).

Some other studies have shown an inverted-U-shaped relationship implying that firms benefit from low turnover because of the low labor costs. Beyond a critical turnover level, turnover costs outweigh its benefits, leading performance to decline (Shaw et al., 2005; Glebbeek & Bax, 2004; Meier & Hicklin, 2007). Using longitudinal data of Belgian firms over the 1999–2008 period, De Winne *et al.* (2019) show that, for low turnover levels, labor productivity rises, reaches a peak, and then decreases afterward. Many other studies focused separately on “voluntary turnover” (voluntary quits) and/or “involuntary turnover” in the form of layoffs. For example, Koys (2001) argued that dismissals positively affect performance while quits have a negative effect. Other studies (Dalton et al., 1981; Jacofsky, 1984; Sturman et al., 2003) distinguish between “functional” turnover (when inefficient workers quit) and “dysfunctional” turnover (when efficient workers quit). Wells and Muchinsky (1985), Price (1977), Tang and Frost (1999) and Shaw (2011) equated dismissals with dysfunctional turnover since individuals who leave voluntarily are the most efficient who can easily find a job elsewhere.

Shaw et al. (2005) argued that workers exiting generate social capital losses that harm firm productivity. According to Park and Shaw (2013), exiting workers leave communication network gaps, which are hardly filled by new workers. Other studies found that involuntary turnover (layoffs/dismissals) improves firm productivity. For example, Bishop (1990), and Elvira and Zatzick (2002) showed that firms layoff less productive workers leading to average productivity gains. However, by lowering worker trust and morale, layoffs may raise the remaining workers’ voluntary turnover (Trevor & Nyberg, 2008), which, in turn, will outweigh the benefits of removing inefficient workers. Also, short-term firm performance may be lower until the new workers become efficient (Batt, 2002). Even in the long run, it is not certain that the new workers are more performing than the dismissed ones (Hausknecht et al., 2009). Indeed, McElroy et al. (2001) found that high dismissal rates in bank branches negatively affect customer satisfaction. Stefano et al. (2019) find an inverted U-shaped relation between temporary worker turnover and Italian firm performance during 2007–2014. It showed that beyond a certain level of turnover, the costs of disruption outweigh flexibility benefits. More recently, the study of Rahaman et al. (2020) shows that job certainty is the most crucial factor for firm performance in Bangladesh as it is the most motivating factor for employees.

The second strand of literature focuses on the effects of worker training on firm performance. Since Arrow (1962), the "learning by doing" theory postulates how productivity at the firm level grows according to the practical experience acquired during the production process. Improving this productivity depends on the firm's efforts in worker training (Audretsch, 1995; Lucas, 1993; Hewitt & Wield, 1992; Cohen & Levinthal, 1989). Research has shown that training positively affects firm performance. (e.g., Bartel, 2000 and Sepúlveda, 2010). In the electronics industry, Bee Yan et al. (2007) argued that Taiwanese exporters who invest in worker training are significantly more productive than firms that only export. Mano et al. (2012) found that 12 months after the completion of training, the likelihood of firm survival increases by 9%. McKenzie and Woodruff (2013) showed that worker training helps entrepreneurs launch new businesses more rapidly.

More recently, Qing and Ruosi (2016) showed that training helped boost manufacturing Chinese firm productivity and wages during the period 2003–2007. Jadhav et al. (2017) conclude that Singaporean firms should enhance training to generate innovative behaviors amongst their workers and improve their performances. Similarly, Qing et al. (2017) showed that trade liberalization improves Chinese firm productivity, especially for those with more training investment. Using the Compete Caribbean's Productivity Technology Innovation Survey of 2014 and the World Bank Enterprise Survey of 2010, Mohan et al. (2018) suggest that training may not matter for firm performance and has a low incidence in the region maybe because of the barriers to in-firm training. However, the study of Chioma and Nelson (2019) revealed a strong relation between worker training and organizational performances of the Federal Ministry of Labour and Productivity Port Harcourt.

Similarly, Rodríguez-Moreno and Rochina-Barrachina (2019), found that worker's training investment affects positively Ecuadorian manufacturing firms' productivity and markups. Recently, Kusumaningrum et al. (2020) show that training is the most significant positive factor affecting the Indonesian hospital staff performance. Muttakin et al. (2020) suggest that to improve their performance during the COVID-19 crisis, Indonesian startup companies should change work patterns and train their employees on working from home. Similarly, the empirical study of Wolor et al. (2020) suggests that during the COVID-19 crisis, Indonesian companies must focus on e-training to improve worker performance.

The two branches of literature above focused on either the role of workers turnover or worker training in increasing firm performance, while other studies have focused on both of them simultaneously. Staw (1980) showed that high turnover might raise costs by shifting experienced workers and other resources away from daily work to train new workers. Several studies argued that the turnover slows down learning and destabilizes routines (Argote & Epple, 1990; Dess & Shaw, 2001; Staw, 1980; Watrous et al., 2006; Kacmar et al., 2006). Other researchers suggest that firms incur replacement costs in selecting, hiring, and training new workers (Hausknecht et al., 2009; Hancock et al., 2013), which draws time and work focus from existing workers. More recently, Da Rocha et al. (2019), showed the importance of Brazilian firm-specific learning for obtaining productivity gains between 1996 and 2013. Contrarily, turnover results in a loss of human capital and harms firm efficiency.

More recently, Nguyen (2020) shows that to improve performance, the textile and garment companies in Binh Duong Province should focus on talent retention, which is mainly influenced by training and promotion opportunities. Finally, all the above studies focus on how turnover affects organizational performance without investigating the reverse relationship between performance and turnover. Using data from public elementary and middle schools in New York City over three years, Weijie and Rusi (2020) show that organizational performance negatively affects employee turnover.

In sum, the relation linking turnover, learning, and firm efficiency seems to be a complex result of multiple contingencies. To our knowledge, none of the existing researches models these complicated interactions simultaneously to determine the contribution of turnover and training to the firm's efficiency growth. The current literature, therefore, suggests that other studies may help explain these interactions and answer these crucial questions:

1. How do turnover and training interact and contribute simultaneously to a firm's efficiency growth.
2. Which optimal training/layoff strategy should entrepreneurs follow to achieve sustainable efficiency growth?
3. Which optimal strategy should entrepreneurs apply to manage the current COVID-19 economic crisis successfully?

Finally, the existing theoretical research focuses on the effects of turnover and/or learning on firm performance only in the short and long-term. However, no one studies the convergence toward the long-term equilibrium. This paper, by modeling the firm's transition dynamics, will enable the author to study the firm's optimal transition path and answer all the above questions.

The first section introduces the model in which Optimal control theory is applied to the entrepreneur's hiring/layoff behavior and training workers. The model identifies the best strategy by determining the optimal allocation of workers to training and production activities and the optimal recruitment/layoff rate of workers. Entrepreneurs that apply this strategy will successfully handle the economic effects of COVID-19 by achieving a high-efficiency level in the short term and will converge to a long-term sustainable efficiency growth. The second section focuses on the steady-state equilibrium and the properties of transitional dynamics of the model. The comparative dynamics in the third section discuss the effects of Saudi economic measures theoretically, and the numerical simulations in the last section support the theoretical results.

2. The Model

The theoretical framework considers n firms in a closed economy. Each firm produces one variety of the differentiated product. The inter-temporal utility function below describes the preference ordering of identical consumers:

$$U = \int_0^{+\infty} e^{-rt}\left(x_0(t) + Y_t\right) d_t \tag{1a}$$

$x_0(t)$ is the consumption of the numeraire in time t

Y_t is the Dixit-Stiglitz consumption index of varieties:

$$Y_t = \left(\int_0^{n_t} (y_{j,t})^{\alpha}\, d_j\right)^{1/\alpha} \tag{1b}$$

$y_{j,t}$ is the quantity of variety j demanded by a consumer and $P_{j,t}$ is its price at time t.

The total expenditure on differentiated products, E is given by:

$$E = \int_0^{n_t} p_{j,t} y_{j,t}\, d_j \tag{2}$$

By maximizing Y_t subject to (2) we obtain the demand $y_{j,t}$ of firm j, which is isoelastic with the elasticity of demand $\sigma = 1/(1-\alpha)$.

$$y_{j,t} = \frac{p_{j,t}^{1/(\alpha-1)}}{\int_0^{n_t} p_{i,t}^{\alpha/(\alpha-1)}\, d_i} E \tag{3}$$

2.1. Firms

The representative firm j is endowed with an amount $L_{j,t}$ of labor devoted between training and production activities. The firm decides the amount of labor $(L^T_{j,t})$ devoted to worker training. So the amount of labor devoted to production is $L^p_{j,t} = L_{j,t} - L^T_{j,t}$. The production technology of firm j is:

$$L^p_{j,t} = c^m_{j,t} y_{j,t} \tag{4}$$

So the average labor productivity of the firm j is given by, $1/c^m_{j,t}$. Let w^p and w^T the wages in the production and training activities, respectively. So $w^T L^T_{j,t}$ is the training expenditure and $w^p L^p_{j,t}$ is the total cost of production. Thus, the firm j's profit is:

$$\pi_{j,t} = \left(p_{j,t} - w^p c^m_{j,t}\right) y_{j,t} - w^T L^T_{j,t} \tag{5}$$

Let r the exogenous interest rate. The net cash flow present value of the firm j is:

$$V_{j,t} = \int_t^{\infty} e^{-r(\tau-1)} \pi_{j,\tau}\, d_\tau \tag{6}$$

Each firm maximizes its present value (6) subject to its demand schedule (3) and its production technology (4) and decides its optimal price strategy as follows:

$$p_{j,t} = \frac{c^m_{j,t}}{\alpha} \tag{7}$$

Eq. (7) gives, the firm j's profit:

$$\pi_{j,t} = \frac{\left(1 - \alpha\, w^p\right) E\, \hat{c}^m_{j,t}}{\hat{C}_t} - w^T L^T_{j,t} \tag{8}$$

where $\hat{c}^m_{j,t} = \left(c^m_{j,t}\right)^{-\alpha/(1-\alpha)}$.

We call $\hat{c}^m_{j,t}$ "the average efficiency of the representative firm j" and $\hat{C}_t = \int_0^{n_t} \hat{c}^m_{j,t}\, dj = n\, \hat{c}^m_{j,t}$ "the total efficiency of the sector". Thus $\hat{c}^m_{j,t} = \dfrac{\hat{C}}{n}$.

The firm j may layoff a number $L^l_{j,t}$ of employees. By doing it must pay a layoff cost, ϕ. It may also hire a number $L^h_{j,t}$ of workers and receives the same amount, ϕ, as a subsidy from the government. The hired (laid off) worker has an efficiency level $\hat{c}^{h/l}_{j,t} = \theta\, \hat{c}^m_{j,t}$ which may be higher or lower than the firm's average efficiency (i.e. $\theta \geq 1$ or $\theta \leq 1$).

The firm j's profit given in (8) becomes:

$$\pi_{j,t} = \frac{\left(1-\alpha\, w^{p}\right) E\, \hat{c}^{m}_{j,t}}{\hat{C}_{t}} - w^{T} L^{T}_{j,t} + \phi\left(L^{h}_{j,t} - L^{l}_{j,t}\right) \quad (9)$$

The firm may respond to the COVID-19 crisis by equipping its workers with work-from-home tools (Zoom, Webex, Skype, etc.), adopting new ways to interact with customers, partners, and suppliers to continue operating, and establishing in-house training facilities to increase its employees' efficiency according to the dynamic equation (10):

$$L_{j,t}\, \dot{\hat{c}}^{i}_{j,t} = \mu\, \hat{C}_{t}\, L^{T}_{j,t} \quad (10)$$

Where $L_{j}\, \dot{\hat{c}}^{i}_{j,t}$ is the flow of workers' efficiency generated by the training activities using a number $L^{T}_{j,t}$ of workers for an interval of time dt. $\mu > 0$ is an exogenous parameter. The aggregate efficiency of the sector, $\hat{C}_{t}$ represents the stock of total knowledge and captures spillover effects, which increase the productivity of labor in the trainingactivity, $\mu\hat{C}_{t}$.

2.2. The Average Efficiency Growth of the Firm

Let $\hat{c}^{T}_{j,t} = \int_{0}^{L_{j,t}} \hat{c}^{T}_{j,t}\, d_{j}$, the total efficiency of the firm j. An increase in $\hat{c}^{T}_{j,t}$ may result from laying off inefficient employees or from hiring new efficient ones as well as from training existing workers, according to the following dynamic relation:

$$\dot{\hat{c}}^{T}_{j,t} = L_{j,t}\, \dot{\hat{c}}^{i}_{j,t} + (L^{h}_{j,t} - L^{l}_{j,t})\, \hat{c}^{h/l}_{j,t} \quad (11)$$

$L^{h}_{j,t} - L^{l}_{j,t} = L^{n}_{j,t} = \dot{L}_{j,t}$ is the net recruitment, which may be positive or negative, thus

$$\dot{\hat{c}}^{T}_{j,t} = Lj,t\, \dot{\hat{c}}^{i}_{j,t} + L^{n}_{j,t}\theta\, \hat{c}^{m}_{j,t} \quad (12)$$

The growth rate of $\hat{c}^{T}_{j,t}$ is:

$$\frac{\dot{\hat{c}}_{j,t}}{\hat{c}^{T}_{j,t}} = \frac{L_{j,t}\, \dot{\hat{c}}_{j,t} + L^{n}_{j,t}\, \theta\, \hat{c}_{j,t}}{\hat{c}^{T}_{j,t}} \quad (13)$$

As $L_{j,t}\, \dot{\hat{c}}^{i}_{j,t} = \mu\, \hat{C}_{t}\, L^{T}_{j,t}$, the equation (13) becomes:

$$\frac{\dot{\hat{c}}^{T}_{j,t}}{\hat{c}^{T}_{j,t}} = \frac{\mu\, \hat{C}_{t}\, L^{T}_{j,t} + L^{n}_{j,t}\, \theta\, \hat{c}^{m}_{j,t}}{\hat{c}^{T}_{j,t}} \quad (14)$$

replacing $\hat{c}^{m}_{j,t} = \hat{c}^{m}_{j,t} / L_{j,t}$ in equation (14) gives:

$$\frac{\dot{\hat{c}}^{T}_{j,t}}{\hat{c}^{T}_{j,t}} = \frac{\mu\, C\, L^{T}_{j,t}}{\hat{c}^{T}_{j,t}\, L_{j,t}} + \theta\, \frac{L^{n}_{j,t}}{L_{j,t}} \quad (15)$$

Let $l^{T}_{j,t} = \dfrac{L^{T}_{j,t}}{L_{j,t}}$, the investment rate in the training activity and $l^{n}_{j,t} = \dfrac{L^{n}_{j,t}}{L_{j,t}}$, the net recruiting rate. Then (15) becomes:

$$\frac{\dot{\hat{c}}^{T}_{j,t}}{\hat{c}^{T}_{j,t}} = \frac{\mu\, \hat{C}\, l^{T}_{j,t}}{\hat{c}^{m}_{j,t}} + \theta\, l^{n}_{j,t} \quad (16)$$

Let $\hat{g}_{j,t} = \dot{\hat{c}}^{m}_{j,t} / \hat{c}^{m}_{j,t}$, be the average efficiency growth rate. Which is the difference between the total efficiency growth rate $\dot{\hat{c}}^{T}_{j,t} / \hat{L}^{T}_{j,t}$ and the growth rate of the number of employees $(\dot{L}_{j,t} / L_{j,t})$ which is equal to the net recruitment rate, $l^{n}{}_{j,t}$.

$$\dot{\hat{g}}_{j,t} = \frac{\dot{\hat{C}}^{m}_{j,t}}{\hat{C}^{m}_{j,t}} = \frac{\dot{\hat{C}}^{T}_{j,t}}{\hat{C}^{T}_{j,t}} - l^{n}_{j,t} \quad (17)$$

By replacing equation (16) in (17) we obtain:

$$\dot{\hat{g}}_{j,t} = \frac{\dot{\hat{C}}^{m}_{j,t}}{\hat{C}^{m}_{j,t}} = \frac{\mu\, C\hat{l}^{T}_{j,t}}{\hat{C}^{m}_{j,t}} + (\theta - 1) l^{n}_{j,t} \quad (18)$$

2.3. The Firm's Training Behavior

The intertemporal program of the firm j is maximizing the present value of the firm j's net cash flow given by Eq. (6), subject to its training technology (10).

$$\underset{L^{T}_{j,t}}{Max}\, V_{j,t} = \int_{t}^{\infty} e^{-r(\tau - t)} \pi_{j,\tau}\; d\tau$$

$$\begin{aligned}
&\text{Subject to } \dot{\hat{C}}^{m}_{j,t} = \mu\, \hat{C}_{t}\, l^{T}_{j,t} + (\theta - 1)\, \hat{C}^{m}_{j,t}\, l^{n}_{j,t} \\
&\text{and } \dot{L}_{j,t} = L^{n}_{j,t} = l^{n}_{j,t} L_{j,t} \\
&\text{with } \pi_{j,\tau} = \frac{(1 - \alpha w^{p})\, \hat{C}^{m}_{j,\tau}\, E}{\hat{C}_{\tau}} - w^{T} l^{T}_{j,\tau} L_{j,t} + \varphi l^{n}_{j,t} L_{j,t}
\end{aligned}$$

The Hamiltonian is:

$$H_{j,\tau} = \frac{(1-\alpha w^p)\hat{C}^m_{j,\tau} E}{\hat{C}_\tau} - w^T L_{j,t} l^T_{j,\tau} + \varphi L_{j,t} l^n_{j,t}$$

$$+\lambda^T_{j,t}(\mu \hat{C}_t l^n_{j,t} + (\theta-1)\hat{C}^m_{j,t} l^n_t) + \lambda^n_{j,t} L_{j,t} l^n_t$$

$\lambda^n_{j,t}$ and $\lambda^T_{j,t}$ are the costate variables. The state variables are the total number of workers, $L_{j,t}$ the firm's efficiency level, $\hat{C}^m_{j,t}$. The control variables are the investment rate in training, $l^T_{j,t}$ and the net recruitment rate, $l^n_{j,t}$.

By maximizing the Hamiltonian with respect to $l^T_{j,t}$ we obtain:

$$\frac{\partial H_{j,t}}{\partial l^T_{j,t}} = -w^T L_{j,t} + \lambda^T_{j,t} \mu \hat{C}_t = 0$$

Thus

$$\lambda^T_{j,t} = \frac{w^T L_{j,t}}{\mu \hat{C}_t} \tag{19}$$

$$\frac{\dot{\lambda}^T_{j,t}}{\lambda^T_{j,t}} = \frac{\dot{L}_{j,t}}{L_{j,t}} - \frac{\dot{\hat{C}}}{\hat{C}} = l^n_{j,t} - \frac{\dot{\hat{C}}_t}{\hat{C}_t} \tag{20}$$

as $\hat{C}^m_{j,t} = \frac{\hat{C}_t}{n}$ so $\frac{\dot{\hat{C}}_t}{\hat{C}_t} = \frac{\dot{\hat{C}}^m_{j,t}}{\hat{C}^m_{j,t}} = \hat{g}_{j,t}$

Equation (18) re-writes:

$$\hat{g}_{j,t} = \mu n l^T_{j,t} + (\theta-1) l^n_{j,t} \tag{21}$$

and $\frac{\dot{\hat{C}}_t}{\hat{C}_t} = \frac{\dot{\hat{C}}^m_{j,t}}{\hat{C}^m_{j,t}} = \hat{g}_{j,t}$ thus (20) becomes:

$$\frac{\dot{\lambda}^T_{j,t}}{\lambda^T_{j,t}} = (2-\theta) l^n_{j,t} - \mu n l^T_{j,t} \tag{22}$$

The derivative $H_{j,t}$ with respect to $l^n_{j,t}$:

$$\frac{\partial H}{\partial l^n_{j,t}} = \lambda^T_{j,t}(\theta-1)\hat{C}^m_{j,t} + (\lambda^n_{j,t} + \varphi) L_{j,t} = 0 \tag{23}$$

By replacing $\lambda^T_{j,t}$ by (19) and $\hat{C}_t = n\hat{C}^m_t$ we obtain:

$$\frac{\partial H_{j,t}}{\partial l^n_{j,t}} = w^T \frac{(\theta-1)}{\mu n} + \lambda^n_{j,t} + \varphi = 0 \tag{24}$$

This implies:

$$\lambda^n_{j,t} = \frac{w^T(1-\theta)}{\mu n} - h \Rightarrow \dot{\lambda}^n_{j,t} = 0 \tag{25}$$

The derivative of $H_{j,t}$ with respect to $L_{j,t}$ is:

$$\frac{\partial H_{j,t}}{\partial L_{j,t}} = -w^T l^T_{j,t} + (\lambda^n_{j,t} + \varphi) l^T_t = r\lambda^n_{j,t} - \dot{\lambda}^n_{j,t} \tag{26}$$

By replacing $\lambda^n_{j,t}$ and $\dot{\lambda}^n_{j,t}$ in (26) we obtain:

$$l^n_t = r + \frac{\varphi r \mu n}{w^T(1-\theta)} + \frac{\mu n}{(1-\theta)} l^T_{j,t} \tag{27}$$

$$\Rightarrow \dot{l}^n_t = \frac{\mu n}{(1-\theta)} \dot{l}^T_{j,t} \tag{28}$$

According to equations (27) and (28) there is a positive relation between training, $l^T_{j,t}$ and net recruitment, $l^n_{j,t}$. Which means a negative relation between the training, $l^T_{j,t}$ and layoff ($-l^n_{j,t}$). This may be explained by the *cost effect* (or also *substitution effect*) since an increase in the ratio φ / w^T rises the cost of layoff relatively to the cost of training and enhances firms to switch to training (i.e., to increase $l^T_{j,t}$) and to reduce the layoff rate (i.e., increase $l^n_{j,t}$).

The derivative of $H_{j,t}$ with respect to $\hat{C}^m_{j,t}$:

$$\frac{\partial H_{j,t}}{\partial \hat{C}^m_{j,t}} = \frac{(1-\alpha w^p)E}{\hat{C}_t} + \lambda^T_{j,t}(\theta-1) l^n_{j,t} = r\lambda^T_{j,t} - \dot{\lambda}^T_{j,t} \tag{29}$$

$$l^n_{j,t} = r + \mu n l^T_{j,t} - \frac{\mu(1-\alpha w^p)E}{L_{j,t} w^T} \tag{30}$$

$$\dot{l}^n_{j,t} = \mu n \dot{l}^n_{j,t} + \frac{\mu(1-\alpha w^p)E}{w^T L_{j,t}} l^n_{j,t} \tag{31}$$

According to Eq. (30) and Eq. (31) there is a *complementarity effect* generating two other negative relations between worker layoff and worker training. Indeed, on the one hand, an increase in the layoff rate (i.e., a decrease in the net recruitment rate $l^n_{j,t}$) lowers the number of employees the firm should train decreasing the training rate, $l^T_{j,t}$. On the other hand, by devoting more employees to training, an increase in $l^T_{j,t}$ creates a shortage of employees in the daily production activity, leading firms to decrease the layoff rate (rise the net recruitment rate $l^n_{j,t}$).

2.4. Short-Term Equilibrium

By solving the expressions (28) and (31) with respect to $\dot{l}^T_{j,t}$ and $\dot{l}^n_{j,t}$ we obtain the dynamic system of equations (32) and (33), which determines, for a given initial values l^n_0 and l^T_0, the evolution path of $l^n_{j,t}$ and $l^T_{j,t}$.

$$\dot{l}^T_{j,t} = -\frac{(1-\theta)(1-\alpha w^p)E}{w^T \theta n L_{j,t}} l^n_{j,t} \tag{32}$$

$$\dot{l}^n_{j,t} = -\frac{(1-\alpha w^p)\mu E}{w^T \theta L_{j,t}} l^n_{j,t} \tag{33}$$

3. The Steady State

In the steady state the training and turnover rates are constant (i.e. $\dot{l}^n_{j,t}* = \dot{l}^T_{j,t}* = 0$). Consequently, Equations (32) and (33) imply that $l^n_{j,t}* = 0$ (this means that the number of employees is constant in the steady-state). By setting the expressions (27) and (30) to zero, we determine the following values of $l^T_{j,t}$ and $L_{j,t}$:

$$l^T_j* = r\frac{\varphi\mu n - w^T(1-\theta)}{\mu n w^T} \tag{34}$$

and

$$L^*_j = \frac{\mu(1-\alpha w^p)E}{r(w^T\theta + \varphi\mu n)} \tag{35}$$

Thus

$$L^T_j* = L*l^T* = \frac{E(1-\alpha w^p)\left(\varphi\mu n - w^T(1-\theta)\right)}{nw^T(w^T\theta + \varphi\mu n)} \tag{36}$$

and

$$L^{p*}_j = L* - L^{T*} = \frac{\dfrac{\mu n w^T - r\left(\varphi\mu n - w^T(1-\theta)\right)}{nw^T}}{\dfrac{(1-\alpha w^p)E}{(w^T\theta + \varphi\mu n)}} \tag{37}$$

Replacing Eqs. (34) in Eqs. (18) gives the steady state efficiency growth rate:

$$\begin{aligned} g_j* &= \mu n l^T_j* \\ &= \frac{r\phi\mu n}{w^T} - r(1-\theta) \end{aligned} \tag{39}$$

To determine the nature of the steady state, we study the system of differential equations approximating (32) and (33) at l^T* and l^n*. We calculate the eigenvalues of the Jacobian matrix of this system to determine its local stability properties. Appendix1 proves that the two eigenvalues of the Jacobian matrix are real numbers with one positive $(\lambda_1 > 0)$ and one nil $(\lambda_2 > 0)$. This means that the system converges monotonically to the steady-state equilibrium, which is a stable saddle-point.

3.1. Transitional Dynamics

For a given initial values l^n_0 and l^T_0, Eq. (32) and Eq. (33) allow to study the transition path of $l^n_{j,t}$ and $l^T_{j,t}$, using the phase diagram in Figure 1 in which the horizontal axis corresponds to $l^T_{j,t} = l^T_j*$ and satisfies $\dot{l}^T_{j,t} = 0$ in (32). Here one has to distinguish two situations:

The first one is the case of economic expansion when the firm's HR strategy is recruiting efficient workers whose productivities are higher than the average productivity of the firm. So, this is the case where $l^n_{j,t} \geq 0$ and $\theta > 1$.

The second one is the case of economic recession, such as the COVID-19 crisis leading firms to lay off inefficient workers whose productivities are lower than the average productivity. i.e $l^n_{j,t} \leq 0$ and $\theta < 1$. A conventional phase diagram is drawn in the $(l^n_{j,t}, l^T_{j,t})$ space (The first case of economic expansion is briefly discussed in the appendix (see phase diagram in Figure 3). The analysis in this paper is then confined to the regions where $l^n_{j,t} \leq 0$ and $0 \leq l^T_{j,t} \leq 1$. The equation (32) implies that $l^T_{j,t}$ is increasing for $l^n_{j,t} \leq 0$. The vertical axis $l^n_j* = 0$ satisfies $\dot{l}^n_{j,t} = 0$ in (33), which means that, $l^n_{j,t}$ is increasing for $l^n_{j,t} < 0$. According to the phase diagram, the lines $l^T_{j,t} = l^T_j*$ and $l^n_{j,t} = 0$ intersect at $S(0, l^T_j*)$, which is the stationary equilibrium. Arrows on Figure1 indicate the directions in which the processes evolve over time. They show that only firms starting in region *A* can converge to the stationary equilibrium and only if they are initially situated on the optimal and unique transition pattern. As indicated in figure1, all other firms in region *A* will move either to region *B* or to the irrelevant region.

Along the transition path both the training rate, $l^T_{j,t}$ and the net recruitment rate $l^n_{j,t}$ rises monotonically toward the stationary equilibrium. The transitional dynamics can be described as follows: in the situation of economic recession, for example, the current COVID-19 crisis, the firm should start out in the region where it focuses more on layoff the less productive workers (negative recruitment rate $l^n_{j,t} < 0$) to reduce its labor costs, rather than training workers to improve its productivity ($l^T_{j,t}$ low). As more and more inefficient workers quit and the profit increases, the firm starts expanding its activity and retaining and developing its workers (both $l^n_{j,t}$ and $l^T_{j,t}$ increase) to become more efficient. The firm then converges to a steady state where the number of workers is constant and the efficiency level of the firm grows at a constant rate as a result of the training activity only. This means that the key to long-run economic recovery in Saudi Arabia will rely on training, innovation, and adaptability to the new digital environment as well as creating an economic framework that is more resilient to future crises.

Now, what about the transition dynamics of the firm's efficiency growth rate, $\hat{g}_{j,t}$ during this recovery path? By replacing $l^n_{j,t}$ given by (30) in Equation (21) we obtain the transitional growth rate:

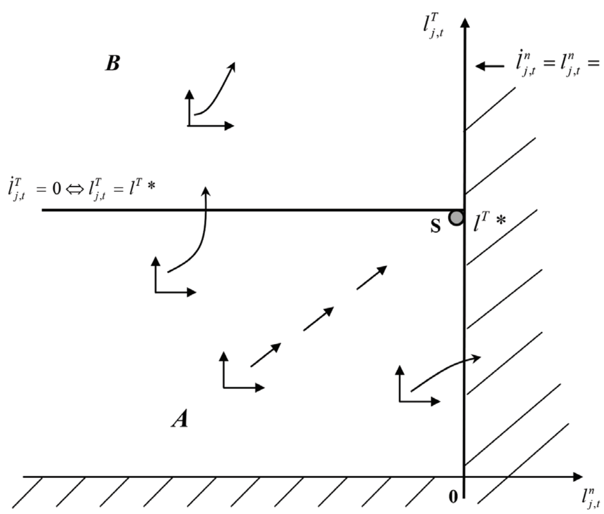

Figure 1: The Phase Diagram in the Case of Economic Crisis (θ < 1)

$$\hat{g}_{j,t} = \theta\mu n l^T_{j,t} - r(1-\theta) + \frac{(1-\theta)\mu(1-\alpha w^P)E}{L_{j,t} w^T} \tag{40}$$

The interaction between the *Substitution* and the *complementarity* effects discussed above will determine the behavior of the growth rate. Eq. (40) shows that the growth rate is increasing in the training rate, $l^T_{j,t}$ which rises along the transition path. According to the same equation, the growth rate is decreasing in the number of workers, $L_{j,t}$ which decreases along with the transition ($l^n_{j,t} < 0$). This means that $\hat{g}_{j,t}$ rises and approaches the stationary equilibrium value from below. This result confirms the positive (negative) contribution of worker training (layoff) to the firm efficiency growth, suggested by the empirical literature.

4. Comparative Dynamics

As mentioned in the introduction, the Saudi government has approved, in March 2020, quick initiatives to support the small- and medium-sized enterprises that have been significantly impacted by COVID-19. This section attempts to analyze the impact of the main Saudi policy, namely, covering 60% of private-sector salaries in both production and training activities (reducing w^p and w^T by 60%) to prevent entrepreneurs from laying off their workers and support worker training and development.

4.1. The Effects of Covering Training Costs (Reducing Trainers' Wages w^T)

The phase diagram in Figure 2 shows that reducing the trainer's wage w^T, shifts up the dashed horizontal axis (locus $\dot{l}^T_{j,t} = 0$) and increases $l^T_j *$ (since $\partial l^T_j * / \partial w^T = \frac{r\phi}{(w^T)^2} < 0$). The solid horizontal axis represents the new locus $\dot{l}^T_{j,t}{}' = 0$). The new stationary equilibrium $S'(0, l^T_j *')$ results from the new intersection, showing a higher training rate ($l^T_j *' > l^T_j *'$) and a higher growth rate ($g*' > g*$).

We can conclude that reducing training costs through subsidizing trainers' wages, w^T, should raise the firm's incentives to develop more its employees and to train and adapt them to new technologies and work-from-home tools (Zoom, Webex, Skype, etc.) to improve its average efficiency and handle the COVID-19 crisis effects.

We can also see that the number of workers at the steady state, $L_j *$ given by equation (35) is decreasing in the trainer's wage, w^T (since $\partial L_j * / \partial w^T < 0$). Thus, subsidizing trainers' wages by the Saudi government (i.e., reducing, w^T) will prevent Saudi entrepreneurs from laying off their workers and increase the number of workers at the steady state.

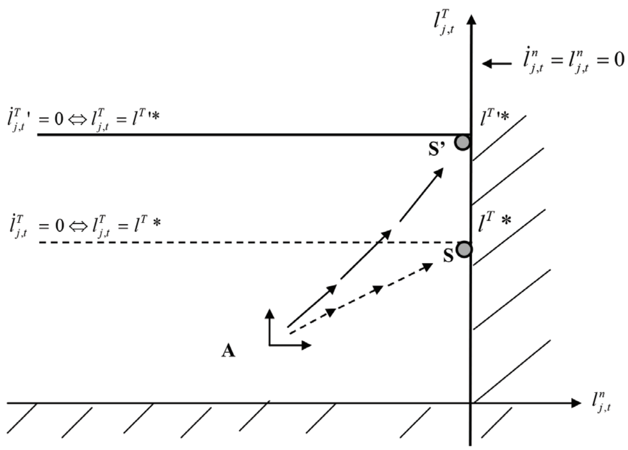

Figure 2: The Impact of Covering Workers' Wages (Reducing w^p and w^T)

4.2. The Effects of Covering Production Costs (Reducing Workers' Wage w^p)

Reducing the firm's production costs through subsidizing worker's wage, w^p, has no effect either on l_j^T* or on $g*$ ($\partial l_j^T*/\partial w^p = \partial g*/\partial w^p = 0$) and should not improve the efficiency growth of the firms. However, such a policy will prevent workers layoff and increase the number of workers, $L*$ at the stationary equilibrium. $\left(L_j* = \dfrac{\mu\left(1-\alpha w^p\right)E}{r\left(w^T\theta + \phi\mu n\right)} \right)$

5. Numerical Simulations

We first define a benchmark situation by fixing a number of parameters. Then, we determine the impacts of varying the trainers' and the workers' wages (w^T and w^p respectively) on the long-run number of workers L_j* and the efficiency growth rate $g*$.

The number of firms in the sector, n is normalized to unity, i.e., $n = 1$. The total expenditure is fixed at $E = 10$, the layoff cost $\phi = 1$, the interest rate, r, is 10%, the labor productivity parameter is $\mu = 0.2$ and the parameter $0 < \alpha < 1$ is fixed at $\alpha = 0, 7$. The efficiency level of the laid-off workers is lower than the average efficiency. i. $\theta = 0.8$.

5.1. The Effects of Covering Training Costs (Reducing Trainers' Wages w^T)

By setting $w^p = 1$, Table 1 displays the corresponding number of workers and the growth rate of the firm efficiency for each level of w^T, in the stationary equilibrium. The table shows that when w^T decreases from 1 to 0.1, the long run number of workers, $L*$, rises monotonically from 6 (in the case of $w^T = 1$) to 21.4 (in the case of $w^T = 0.1$). This higher number of workers will be associated, in the long run with a higher efficiency growth increasing from 0% to 18%.

Table 1: The Long Run Effects of Decreasing the Trainers' Wage, w^T

Number of workers growth rate		
Trainers' wage (w^T)	**$L*$**	**$g*$ (in %)**
1	6.0	0.00
0.9	6.5	0.22
0.8	7.1	0.50
0.7	7.9	0.85
0.6	8.8	1.33
0.5	10	2.00
0.4	11.5	3.00
0.3	13.6	4.66
0.2	16.6	8.00
0.1	21.4	18.0

Source: Author's calculations based on equations (35) and (39) using the benchmark parameter values and varying w^T from 1 to 0,1.

This result implies that the Saudi economic policy of covering 60% of the trainers' salaries (i.e., the firm pay only 40% of w^T), will improve the firm efficiency growth rate, $g*$ from zero (for $w^T = 1$) to 3% (for $w^T = 0.4$). This policy will also prevent firms from laying off half of their staff since the number of workers, $L*$ in the steady stated will be 11 instead of 6.

5.2. The effects of Covering Production Costs (Reducing Workers' Wage w^p)

By setting $w^T = 1$, Table 2 below shows the corresponding number of workers for each level of, w^p, in the stationary equilibrium. According to the table when w^p decreases from 1 to 0.1, the long-run number of workers, $L*$, rises monotonically from 6 (in the case of $w^T = 1$) to 18.6 (in the case of $w^T = 0.1$). This result implies that the Saudi economic policy of covering 60% of the workers' salaries (i.e., the firm pays only 40% of..), will increase the number of workers, $L*$ from 6 to 14.4 at the steady state, and prevent the firm from laying off 8 employees. Finally, these numerical results are robust with regard to parameter changes and support the theoretical results of the comparative dynamics section.

Table 2: The Long-Run Effects of Decreasing the Workers' Wage, w^P

Number of workers	
workers' wage (w^P)	L^*
1	6.0
0.9	7.4
0.8	8.8
0.7	10.2
0.6	11.6
0.5	13
0.4	14.4
0.3	15.8
0.2	17.2
0.1	18.6

Source: Author's calculations based on equations (35) using the benchmark parameter values and varying w^P from 1 to 0.1.

6. Conclusion

65% of Saudi entrepreneurs are highly affected by the COVID-19 pandemic. Indeed, 46.7% of micro-, 30% of small-, and 30.6% of medium-sized enterprises have closed at least one of their branches. Consequently, 49.1% of medium-, 27.6% of small- and, 10.6% of micro-enterprises laid off all their workers due to the COVID-19 pandemic. To support these entrepreneurs, the Saudi government has introduced a wide range of emergency measures to prevent them from laying off their workers. In the midst of this turbulent environment, this paper developed a model to study how layoff and training simultaneously affect the firm performance. We also propose for Saudi entrepreneurs the optimal layoff/training strategy to benefit from the Saudi government measures, handle the negative economic effects of Covid-19 in the short-run and achieve long-run sustainable efficiency growth.

The theoretical framework involves many feedback mechanisms. Indeed an increase in the layoff cost encourages firms to switch to training (*substitution effect*). Also, an increase in the layoff rate lowers the number of employees the firm should train and consequently decreases the training rate. Finally, an increase in the training rate by reallocating employees to training generates a shortage of employees in the daily production activity leading firms to decrease the layoff rate (*complementary effect*). The model allows studying the firm's optimal transition path. It shows that in the economic recession situation, for example, the current COVID-19 crisis, the Saudi entrepreneur should start in the region where it focuses more on laying off the less productive workers to reduce labor costs rather than training workers to improve productivity. As more and more inefficient workers quit and profit increases, the entrepreneur starts expanding his activity and retaining and developing workers to improve aggregate productivity. In the steady state, worker layoff peters out. Then, the entrepreneur settles into a stable steady state where the workers training activity allows the average business efficiency to grow at a constant rate. This means that the key to long-run economic recovery in Saudi Arabia will rely on training, innovation, and adaptability to the new digital environment and creating an economic framework that is more resilient to future crises. The numerical simulations, as well as the comparative dynamics section, prove theoretically and numerically the significant positive effects of covering 60% of salaries for the SMEs by the Saudi government during the COVID-19 crisis. They show that such a qualitative measure will enhance training activities by small- and medium-sized entrepreneurs and improve their business efficiency in both the short and the long run. This policy will also increase the number of workers in the steady state and prevent Saudi entrepreneurs from laying off half of their staff. This theoretical result suggests that the Saudi government's strategic initiatives for supporting small and medium entrepreneurs will certainly help Saudi entrepreneurs survive and should be renewed when needed. Finally, testing empirically this theoretical model will certainly contribute significantly to the empirical literature.

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Appendix

This appendix studies the stability of the non-linear system of equations (26) and (27). It calculates the Jacobian matrix of the system and evaluates it at the stationary equilibrium.

$$\begin{bmatrix} \dot{l}_n^T \\ \dot{l}_t^n \end{bmatrix} = \begin{bmatrix} \Omega_{l^T} & \Omega_{l^n} \\ \psi_{l^t} & \psi_{l^n} \end{bmatrix} \begin{bmatrix} l_t^T - l^T * \\ l_t^n - l^n * \end{bmatrix}$$

Where $\dot{l}_{j,t}^T$ and $\dot{l}_{j,t}^n$ are given respectively by expressions (26) and (27):

$$\dot{l}_{j,t}^T = \frac{(\theta - 1)(1 - \alpha\ w^p)\,E\ l_{j,t}^n}{w^T \theta\, n\ L_{j,t}} \tag{32}$$

$$\dot{l}_{j,t}^n = -\frac{(1 - \alpha\ w^p)\,\mu\,E}{w^T \theta\, L_{j,t}}\ l_{j,t}^n \tag{33}$$

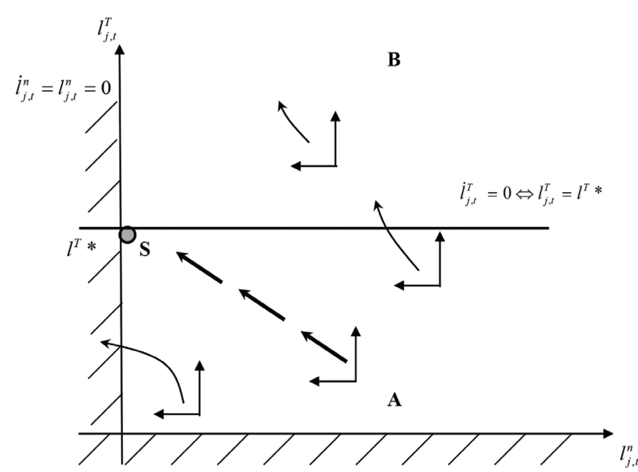

Figure 3: The Phase Diagram in Economic Expansion, $\theta > 1$

Evaluating the elements of the Jacobian matrix at the stationary equilibrium gives:

$$\Omega_{l^T} = \frac{\partial \dot{l}^T}{\partial l^T} = 0\,;$$

$$\Omega_{l^n} = \frac{\partial \dot{l}^T}{\partial l^n} = \frac{(\theta - 1)(1 - \alpha\ w^p)\,E}{w^T \theta\, n\, L_{j,t}} > 0 \text{ or } < 0$$

$$\Psi_{l^T} = \frac{\partial \dot{l}^T}{\partial l^T} = 0$$

$$\Psi_{l^n} = \frac{\partial \dot{l}^n}{\partial l^n} = -\frac{(1 - \alpha\ w^p)\,\mu\, E}{w^T \theta\, L_{j,t}} < 0$$

The eigenvalues of the Jacobian matrix are the roots of the determinant of the matrix $(\lambda I - J) = 0$ $\left(d_{et}\,(\lambda I - J) = 0\right)$, with J is the Jacobian matrix and λ is an eigenvalue. We write this equation at the stationary equilibrium as follows:

$$\lambda \left(\lambda + \frac{(1 - \alpha\ w^p)\,\mu\, E}{w^T \theta\, L_{j,t}} \right) = 0$$

Which has the following roots:

$$\lambda_1 = -\frac{(1 - \alpha\ w^p)\,\mu\, E}{w^T \theta\, L_{j,t}} < 0 \text{ and } \lambda_2 = 0$$

The two eigenvalues are real numbers. One is negative ($\lambda_1 < 0$) the other is nil ($\lambda_2 < 0$). Thus the system converges monotonically to the long-run equilibrium. This equilibrium is a saddle-point.