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Firing versus Continuing Employment if an Economic Setback is Expected

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Firing versus Continuing Employment if an Economic Setback is Expected

by Matthias Göcke

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Abstract: *A simple model evaluating a firm's optimal employment reaction to an imminent recession is presented. Firing costs shelter employment – and this effect is typically amplified by uncertainty due to an option value of waiting. However, this job protection effect is reduced if the expected probability of a setback increases, and if the expected duration and size of a recession grows. If a severe recession is expected with a high probability the option to wait with firing looses its value, thus, immediate layoffs and market exits become the optimal strategy even before the recession turns out to be actual.*

Keywords: Firing costs and uncertainty; probability, duration and size of recession

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Firing versus Continuing Employment if an Economic Setback is Expected

1. Introduction

Firing costs shelter employment even when continuing employment causes losses, because firing is more costly than continuing employment. In a stochastic environment this employment protection effect of sunk firing costs is amplified by uncertainty due to an option value of waiting (BENTOLILA & BERTOLA [1990], BENTOLILA & SAINT-PAUL [1999], CHEN & ZOEGA [1999]). Due to stochastic profit variations, in case of an unfavourable realisation future profits may turn out to be negative, which would make firing optimal. However, there is a chance that future profits may turn out to be more favourable – in that case continuing employment would be better. For that realisation of actual future profits a firm which has fired to early will regret to have paid the sunk firing costs. If a firm has the option to wait with firing and to postpone the layoffs, it will prefer to wait for a while to become sure about future profits. Thus, even sizeable current losses may not result in immediate layoffs. However, this employment protection is reduced if the chance of a favourable profit development decreases or, correspondingly, if the expected probability of an economic setback increases. Furthermore, waiting with a market exit in spite of current losses becomes more unattractive, if the expected duration and size of a probable setback increases. A severe looming recession which is expected with a high probability, devalues the option to wait with firing, and immediate layoffs and market exits become the optimal strategy even before the recession turns out to be actual. In this paper (in contrast to the literature cited above) a very *simple model* based on standard discrete financial mathematics is applied. The focus of this simple model is to formally describe the negative effects of changes in the expected probability of a severe imminent recession on the employment strategy of a firm.

2. A simple model

A risk-neutral firm is assumed, maximising the expected present value of its activities. If the firm in the present ($t=0$) is active and employs a staff it receives the profit e. If this current profit e is negative the firm has to decide about a market exit, which simultaneously is associated with firing the staff. If a recession actually takes place, the profit will even be lower during this setback: ($e-u$). A firm which fires its staff can avoid these high losses. The expectation of a recession can be the last straw that leads to a stop of unprofitable activities. However, there is a chance that no recession will occur; in this case the profit e remains unchanged. Moreover, layoffs can only be done if sunk firing costs F (e.g. severance pay) are paid. An overview of the time structure of the payments for different cases is given in Tab. 1.

Tab. 1: Time distribution of payments with or without an economic setback

	"now"	expected recession			expected recovery		
	present period	start of recession		end of recession			end of planning horizon
period	$t=0$	$t=1$	...	$t=n$	$t=n+1$	...	$t=N$
payments **without** recession (no exit)	e	e	...	e	e	...	e
payments if **immediate** exit	$-F$	-		-	-		-
payments if recession, but **no** exit in t=1	e	$e-u$	...	$e-u$	e	...	e
payments if recession, and **with** exit in t=1	e	$-F$		-	-		-

with e : firm's profit (without recession)
u : decline of profit during recession ($u \geq 0$)
F : sunk firing costs ($F \geq 0$)
n : duration of recession ($n \geq 1$)
N : total planning horizon ($N \geq n$)

C is the probability of a recession ("*c*risis", "*c*rash", "*c*ycle") in the next period $t=1$, thus, the probability of the non-appearance of a setback is $(1-C)$. The interest rate is i, and δ is the respective discount factor. The expected present value of continuing activity and employment without considering an option to exit/fire in next period ($t=1$), after the setback actually has begun, is:

$$(1) \quad EPV_0 = e + (1-C)\cdot\left(\frac{e}{i} - \frac{e}{i\cdot(1+i)^n}\right) + C\cdot\left(\frac{e-u}{i} - \frac{e-u}{i\cdot(1+i)^n}\right) + \frac{e}{i\cdot(1+i)^n} - \frac{e}{i\cdot(1+i)^N}$$

$$= \frac{(1+i)\cdot e}{i} - \frac{e}{i\cdot(1+i)^N} - C\cdot\left(\frac{u}{i} - \frac{u}{i\cdot(1+i)^n}\right)$$

$$= \frac{e\cdot[1-\delta^{(1+N)}] - C\cdot u\cdot[\delta-\delta^{(1+n)}]}{1-\delta}$$

with C : probability of a recession in next period $t=1$ $(0 \leq C \leq 1)$

i : interest rate $(i \geq 0)$ $\Leftrightarrow$ $\delta \equiv \frac{1}{1+i}$: discount factor $(\delta \leq 1)$

The expected present value of an immediate exit in $t=0$ is determined by the negative firing costs: $(-F)$. If no option to wait with firing is considered, a current profit e that triggers an immediate exit can be calculated by the indifference between immediate exit and permanently continuing activity:

$$(2) \quad EPV_0 = (-F) \quad \Leftrightarrow \quad e_{exit}^{no\text{-}opt} = \frac{C\cdot u\cdot[\delta-\delta^{(1+n)}] - (1-\delta)\cdot F}{1-\delta^{(1+N)}}$$

$$\Leftrightarrow \quad \text{exit in } t=0 \text{ if: } \quad e < e_{exit}^{no\text{-}opt} \leq 0$$

Notice that we assume the absence of moral hazard effects; i.e. the firm (or its owner) is able and is forced to finance the firing costs F.

The expected present value of waiting until the setback actually will take place – or not – is calculated: If a setback actually will happen in $t=1$, the firm will use the option to exit/fire and must bear the firing costs F. If no recession occurs the firm continues market activity and employment. The setback and exit has the probability C and, correspondingly, continuing activity and employment has the probability $(1-C)$. Waiting with the firing decision until the crash/crisis in $t=1$ will actually happen (or not) has a probability weighted expected present value EPV_{wait}.

(3) If recession, exit in $t=1$: $$PV_{(\text{exit in } t=1)} = e - \frac{F}{1+i} = e - \delta \cdot F$$

if no setback, no exit: $$PV_{(\text{no exit})} = \frac{(1+i)\cdot e}{i} - \frac{e}{i\cdot(1+i)^N} = \frac{e\cdot[1-\delta^{(1+N)}]}{1-\delta}$$

$$\Rightarrow \quad EPV_{wait} = C\cdot(e-\delta\cdot F) + (1-C)\cdot\frac{e\cdot[1-\delta^{(1+N)}]}{1-\delta}$$

Indifference between waiting and an immediate exit in $t=0$ with a present value of $(-F)$ results in an exit-threshold of the profit e if a waiting-strategy is feasible:

(4) $$EPV_{wait} = (-F) \quad \Leftrightarrow \quad e^{opt}_{exit} = \frac{-F\cdot(1-\delta)\cdot(1-C\cdot\delta)}{1-C\cdot\delta-(1-C)\cdot\delta^{(1+N)}} \le 0$$

$$\Leftrightarrow \quad \text{immediate exit in } t=0 \text{ if: } \quad e < e^{opt}_{exit} \le 0$$

Notice, the trigger-profit e^{opt}_{exit} does not rely on the absolute size u of the stochastic shock, but only on its probability C, because an exit avoids bearing these losses of $(u-e)$. However, as we will see below, the range of present profits e, where this waiting-trigger is relevant, depends on the size of u. The waiting-strategy is only relevant if in $t=1$ an exit will be an optimal reaction to the recession. Thus, in case of an actual setback firing must be cheaper than bearing expected transient losses during the recession with a length of n periods. Indifference between firing and employment in $t=1$ in case of a setback is given if:

(5) $$\frac{-F}{1+i} = \frac{e-u}{i} - \frac{e-u}{i\cdot(1+i)^n} + \frac{e}{i\cdot(1+i)^n} - \frac{e}{i\cdot(1+i)^N}$$

$$\Leftrightarrow \quad (-F) = \frac{(1-\delta^N)\cdot e-(1-\delta^n)\cdot u}{1-\delta}$$

$$\Leftrightarrow \quad e^{t=1}_{exit} = \frac{(1-\delta^n)\cdot u-(1-\delta)\cdot F}{1-\delta^N}$$

$$\Leftrightarrow \quad \text{exit in } t=1 \text{ in case of a setback if profit in } t=0\text{:} \quad e < e^{t=1}_{exit}$$

Thus, a waiting-strategy is optimal if the present profit e meets the following condition:

(6) Waiting in $t=0$ (with option to exit in $t=1$) if: $e < e^{t=1}_{exit} \ \wedge \ e > e^{opt}_{exit}$

$$\Leftrightarrow \quad \text{exit/firing in } t=0 \text{ if: } \quad e < e^{t=1}_{exit} \ \wedge \ e < e^{opt}_{exit}$$

If even in the case of a setback an exit in t=1 is not rational, the firm decides whether to withstand the whole recession period and to bear transient losses rather than to exit/fire:

(7) Endure the recession (no exit expected) if: $e > e_{exit}^{t=1} \wedge e > e_{exit}^{no\text{-}opt}$

$\Leftrightarrow$ immediate exit/firing in t=0 if: $e > e_{exit}^{t=1} \wedge e < e_{exit}^{no\text{-}opt}$

The intersection between these two different "non-firing"-cases is given by indifference between both expected present values, for the cases with and without the option to wait for a potential exit in t=1:

(8) $e_{exit}^{opt} = e_{exit}^{no\text{-}opt} \Leftrightarrow EPV_{wait} = EPV_0 \Leftrightarrow$ (solving for e) $e = e_{exit}^{t=1}$

Hence, the threshold $e_{exit}^{t=1}$ for a rational exit in the next period t=1 exactly represents the intersection resp. the borderline between the "waiting"- and the "enduring"-strategy. Thus, the firm will immediately exit/fire in t=0 if neither waiting nor enduring is reasonable:

(9) $e_{exit} = \min(e_{exit}^{opt}, e_{exit}^{no\text{-}opt}) \le 0$

$\Leftrightarrow$ immediate exit/firing in t=0 if: $e < e_{exit}$

In order to give an intuition of the "mechanics" of the model, some special cases are explicitly discussed. If, e.g., no recession is expected at all (C=0), both immediate-exit-triggers are the same:

(10) C=0: $e_{exit(C=0)} = e_{exit}^{opt} = e_{exit}^{no\text{-}opt} = \dfrac{-F\cdot(1-\delta)}{1-\delta^{(1+N)}} \le 0$

If, in contrast, the firm is sure that a setback will take place in the next period (C=1), the waiting/option-trigger e_{exit}^{opt} is determined by the interest payment on the firing costs. I.e. if the (negative) annuity due of the current profit e is below the negative firing costs (−F), the firm will prefer an immediate exit relative to the option to postpone exit until next period. However, the relevant alternatives may not be "immediate exit versus wait and see" but "immediate exit versus weather the market cycle", if the enduring-trigger is even lower than the waiting-trigger. This will be the case if the expected recession is not "severe" enough; i.e., if the absolute size of the shock u is small, or/and if the duration of the recession n is not too long. In such a situation, even if the recession will actually take place in the next period, an exit in t=1 will not be an optimal reaction.

(11) C=1: $e_{exit(C=1)}^{opt} = (1-\delta)\cdot(-F) = \dfrac{-i\cdot F}{1+i} = i\cdot\delta\cdot(-F) \le 0$

and $e_{exit(C=1)}^{no\text{-}opt} = \dfrac{u\cdot[\delta-\delta^{(1+n)}]-(1-\delta)\cdot F}{1-\delta^{(1+N)}}$

$\Rightarrow e_{exit(C=1)} = \min(e_{exit(C=1)}^{opt}, e_{exit(C=1)}^{no\text{-}opt})$

The firm considers an immediate exit, if the profit is negative (e≤0). If the planning horizon N is very long and the negative profit is expected for the very long future, and if these losses will be even higher during a recession, the enduring-strategy looses relevance. Thus, for a firm with an infinite planning horizon ($N \to \infty$), the waiting-trigger is the relevant one. Of course, if the firm expects a setback with an infinite duration ($n \to \infty$) the enduring-strategy is not relevant. In both cases the immediate exit trigger is determined by the interest payment on the firing costs F:

$$(12)\quad N \to \infty: \quad e^{opt}_{exit(N\to\infty)} = (1-\delta)\cdot(-F) \quad \text{and} \quad e^{no\text{-}opt}_{exit(N\to\infty)} = C\cdot u\cdot[\delta - \delta^{(1+n)}] - (1-\delta)\cdot F$$

$$\Rightarrow \quad e_{exit(N\to\infty)} = e^{opt}_{exit(N\to\infty)} = (\delta - 1)\cdot F \quad \le 0$$

$$(13)\quad n \to \infty: \quad e^{opt}_{exit(n\to\infty)} = (1-\delta)\cdot(-F) \quad \text{and} \quad e^{no\text{-}opt}_{exit(n\to\infty)} = C\cdot u\cdot \delta - (1-\delta)\cdot F$$

$$\Rightarrow \quad e_{exit(n\to\infty)} = e^{opt}_{exit} = (\delta - 1)\cdot F \quad \le 0$$

3. Simulation exercise

The following figures illustrate the effects of the absolute magnitude of the setback u, the duration n and the probability C of an expected recession on the current profit e_{exit} which triggers an immediate exit of a firm including firing of its employees. For the numerical calculations the firing costs F are normalized to $F=1$. The planning horizon of the firm is set to $N=4$ periods and the interest rate is $i=0.1$. The existence of firing costs safeguards the jobs. If, e.g., no recession is expected ($C=0$) the profit per period which triggers a market exit must be below $e=(-0.24)$, which is about a quarter of the total firing costs ($F=1$). However this sheltering effect is reduced, if a recession is expected with a higher probability (i.e. with a high C), if the recession is expected to be long (i.e. a large n), and if the negative shock is sizeable (i.e. a large u). These effects are graphically illustrated below.

Fig. 1: Immediate exit-triggers of the present profit e and the probability of a recession C for a different expected duration n of the recession; $n=1$, $n=2$, $n=3$, $n=4$ ($F=1$, $i=0.1$, $N=4$, $u=0.2$)

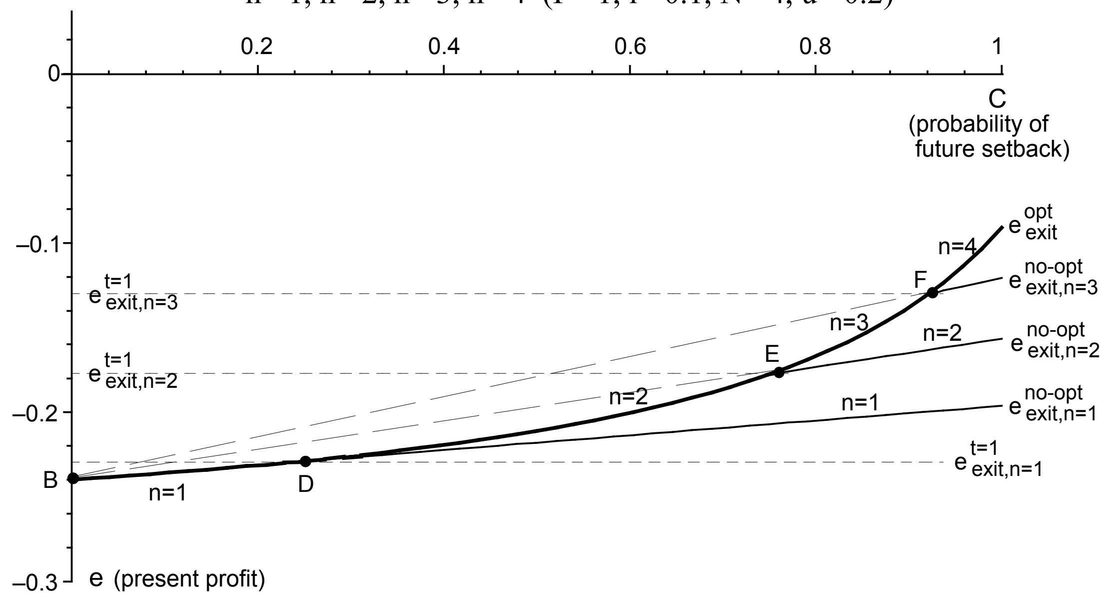

Fig. 1 shows the effects of an increase in the perceived probability of a future recession (with a magnitude of u = 0.2) on the willingness to fire immediately in the present period t = 0. The curve crossing the points B,D,E,F shows the waiting-threshold e_{exit}^{opt} (if the firm has a valuable option to fire in next period). However, this trigger is only relevant if firing in t = 1 is rational in case of an appearance of a recession; otherwise the enduring-trigger $e_{exit}^{no\text{-}opt}$ is relevant. For a very short one-period recession (n = 1), the waiting-trigger is relevant in the range of a very low crash-probability C between points B and D. For higher probabilities C the enduring-trigger $e_{exit,n=1}^{no\text{-}opt}$ determines the profit, below which an immediate exit is profitable for the firm and above which enduring this short (n = 1)-recession is the reasonable alternative. In contrast, for a setback which is expected to have a longer duration (n = 3), the waiting-trigger is relevant in the wider range between points B and F, and the enduring-trigger $e_{exit,n=3}^{no\text{-}opt}$ is only relevant for high crash-probabilities C (right hand side of point F, combined with low losses triggering an immediate exit). The positive slope of the (B,D,E,F)-curve for e_{exit}^{opt} indicates that the more probable the expected setback, the weaker is the safeguard effect against firing. Furthermore, the expected duration n has an effect on the range where this curve is relevant, since the longer the expected duration of the setback, the less attractive is the enduring-strategy. This is illustrated by the shift of the "kink" between both strategies from point D (for n = 1), to point E (for n = 2) and F (n = 3). For n = 4, the enduring-strategy is not relevant at all. The effect of an increase in the probability of a setback C is indicated by the positive slope of the e_{exit}^{opt}-curve. The convexity of this curve indicates that especially changes in the high C level area (i.e. if the expected crash-probability changes from "almost sure" to "absolutely sure") have the heaviest effect on weakening the job protection of the firing costs. This is because in this area the amplification effect of the firing payment F due to an option value of waiting diminishes vigorously.

Fig. 2: Immediate exit-triggers of the profit e and the probability of a recession C for a different absolute size u of the setback; u = 0, u = 0.1, u = 0.2, u = 0.3., u = 0.4 (F = 1, i = 0.1, N = 4, n = 2)

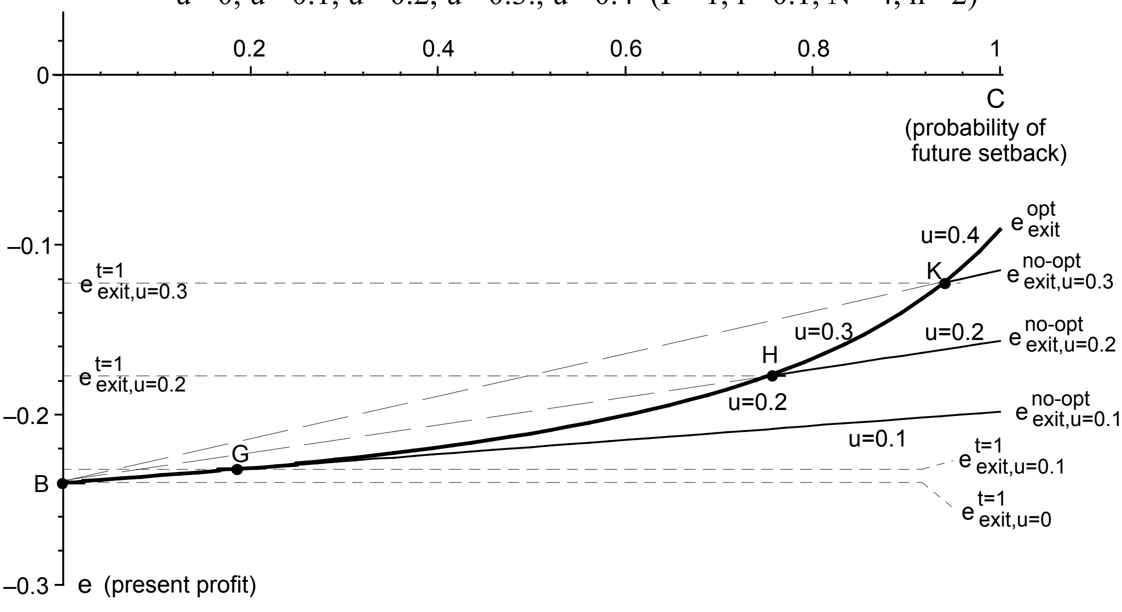

Fig. 2 shows a very similar pattern, though now not the duration n but the absolute size u of the setback is changed (while the duration of the recession is fixed n = 2). Again the waiting-strategy is illustrated by the e_{exit}^{opt}-curve (with points B,G,H,K). The position of the "kink"-

points indicating the switch to the enduring-strategy trigger $e_{exit}^{no\text{-}opt}$, depends on the size u of the setback. For u = 0 actually no setback is expected (independent from C), thus, $e_{exit,u=0}^{no\text{-}opt}$ (point B) is effective. If the expected size of the setback increases to u = 0.1, the waiting-trigger is valid in the range between points B and G. For a situation with a large expected size of the shock u = 0.3, the waiting trigger is effective in the range between points B and K. The "kink" in point K indicates the switch of the relevant strategy to enduring. Again, the more severe the expected setback (now in term of the absolute size u, in contrast to Fig. 1 where the duration n was addressed), the lower is the job sheltering effect of the firing costs. And again, due to the convex slope of the e_{exit}^{opt}-curve, especially changes to near certainty (with a high C) about the appearance of a recession in the next period have this weakening effect.

4. Conclusion

A very simple model based on standard mathematics of annuities was applied in order to illustrate the decision of a firm with respect to firing versus continuing employment. An option value of waiting based on sunk firing costs typically results in a firm's reluctance to fire workers. This reluctance is even strengthened by uncertainty, since in an uncertain situation there is a chance of a better future, when early firing may later on turn out to be the wrong decision. However, a rise in the expected probability of an economic setback devalues the option value of waiting. Moreover, two different cases of continuing employment were addressed. If only a weak recession with a low magnitude and/or a short duration is expected, "weathering the market cycle" is the relevant alternative to firing. In this "enduring-strategy" case even the actual future appearance of a weak recession will not result in layoffs. However, if the firm faces a severe imminent recession with a high expected magnitude and/or a long duration, continuing employment is merely based on a "waiting-strategy". Now firing will only be postponed and not abandoned if the recession will really start later on. The firing thresholds of the present profits are calculated for different expectations concerning the probability and the severity (magnitude and duration) of the economic crisis. Especially a rise in the probability that a looming severe recession really will come about, heavily weakens the employment protection effect of firing costs, and will induce immediate firing even before the recession becomes effective.

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