MAGKS

Joint Discussion Paper
Series in Economics

by the Universities of

Aachen · Gießen · Göttingen
Kassel · Marburg · Siegen

ISSN 1867-3678

No. 29-2010

Matthias Göcke

Layoffs in a Recession and Temporary Employment Subsidies when a Recovery is Expected

Coordination: Bernd Hayo • Philipps-University Marburg
Faculty of Business Administration and Economics • Universitätsstraße 24, D-35032 Marburg
Tel: +49-6421-2823091, Fax: +49-6421-2823088, e-mail: hayo@wiwi.uni-marburg.de

Layoffs in a Recession and Temporary Employment Subsidies when a Recovery is Expected

Author / corresponding author: Matthias Göcke

Affiliation / institution:
University of Giessen, Department of Business Administration and Economics

Abstract: *Sunk firing costs shelter employment – and this effect is typically amplified by uncertainty due to an option value of waiting. Thus, if sunk firing costs are high, e.g. due to a employment protection legislation, and if recession related losses are with a high probability expected to be only transitory and not permanent, a relatively small employment subsidy will be sufficient to avoid layoffs by firms operating with current losses. Depending on the size of sunk hiring costs cyclical layoffs or even permanent job destruction can be avoided by short run subsidies during the beginning of a recession.*

Keywords*: recession; employment; sunk firing costs; uncertainty; employment subsidy*

JEL-Code: *J63, J68, D81*

Contact information:
Dr. Matthias Göcke
University of Giessen, Department of Economics – VWL IV, Licher Str. 62
D-39394 Gießen / Germany
Tel.: (+49)641/99-22241 / Fax: (+49)641/99-22249
e-mail: Matthias.Goecke@wirtschaft.uni-giessen.de

Layoffs in a Recession and Temporary Employment Subsidies when a Recovery is Expected

1. Introduction

If a firm operates at losses during a recession, this may be an incentive to stop activities and to fire staff. However, firing and (re-)hiring costs may shelter employment even when continuing employment causes losses, if firing and eventually re-hiring is more costly than continuing employment. In a stochastic environment, this employment protection effect of sunk firing/hiring costs is amplified by uncertainty due to an option value of waiting. If there is a chance of recovery with positive future profits, in case of this recovery a continuation of employment will later turn out to be better. Thus, if a firm has the option to postpone layoffs, it may prefer to wait for a while to become sure about future profits (Bentolila and Bertola, 1990, Bentolila and Saint-Paul, 1999, Chen and Zoega, 1999, Belke and Göcke, 1999).

The ECB addresses the surprisingly low employment losses in the euro area during the 2008-2009 recession compared to the United States (Monthly Bulletin, July 2010, p. 42): *"Part of this divergence can be understood in terms of the heavier reliance on reductions in working hours as the main means for adjusting employment in many euro area countries. In several euro area countries, these measures were also supported by government subsidies. Such policies were broadly welcomed by firms anxious to retain skilled workers – particularly in those countries where skills shortages had been observed in the years preceding the recession. Finally, the stronger employment protection legislation in the euro area is also likely to have played an important role in delaying the labour market adjustment to what was initially perceived in many euro area economies as being to some extent a temporary disruption to demand."*

This paper wants to formalize several aspects of this ECB-statement with a simple model. If a recession is perceived to be only temporary, a firm operating with current losses during a recession has to decide about layoffs. However, under employment protection legislation layoffs result in sunk firing costs, and maybe later on, induce re-hiring costs (e.g. due to skill shortages). Furthermore, the firm has to consider whether layoffs will be only temporary or are expected to be even permanent. Thus, the firm has two options, the option to wait with firing versus firing immediately, and the option to re-hire or not, in case that a recovery will actually take place later on. Moreover, in order to give an incentive to continue employment, the government can interfere the firm's decisions by temporarily subsidising employment in a situation of under-utilised capacities (as e.g. done by the German "Kurzarbeitergeld", i.e. a reduced hours compensation). Based on a simple option model, the trigger levels of recession related losses, that are inducing immediate firing, instead of waiting with firing, can be calculated. Furthermore, the size and duration of a temporary subsidy which effectively protects employment can be determined for different situations concerning the size of the current losses, the level of sunk firing costs (i.e. of the employment protection legislation), the expected duration of the recession, the probability of a potential recovery, the costs of re-hiring, and the expected profits during a potential future boom.

2. A simple model

2.1 Assumptions, time structure of payments and optional strategies

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, due to the current recession, suffers a loss v (≥ 0), i.e. a negative profit of $(-v \leq 0)$. The firm has to decide about a market exit, which is associated with firing the staff. Layoffs can only be done if sunk firing costs F (≥ 0), e.g. severance pay, are paid.

However, there is a chance of recovery after period $t=n$ (≥ 1), with probability B $(0 \leq B \leq 1)$. Potential recovery is expected to last for b (≥ 0) periods, thus, the entire planning horizon is $(n+b)$ periods. In case of a recovery, in each of the b boom periods an expected gain of g (≥ 0) is earned, instead of the recession related loss v. Interest rate is i (≥ 0). If the firm is firing staff now and wants to re-hire in case of a recovery, sunk hiring costs H must be paid. During the recession the firm may receive an employment subsidy s (≥ 0), e.g. like German “Kurzarbeitergeld”, for the next m $(\leq n)$ periods.

Tab. 1: Time distribution of payments in a recession with or without recovery
for different strategies of the firm

			recession (of n periods)				**potential recovery** (b periods)
			now	with subsidy	without subsidy	potential end	
	Case	period	$t=0$	$t=1$ ... $t=m$	$t=m+1$ ... $t=n-1$	$t=n$	$t=m+1$ ... $t=n+b$
if **no** recovery with prob. (1–B)	**(A)**	payments if **never exit**, **if no** recovery after $t=n$		$-v+s$	$-v$	$-v$	$-v$
	(E1)	payments if **immediate exit**, **no re-entry** in $t=n$	$-F$				
	(W1)	payments, if **wait** and **late exit** in $t=n$ (if no recovery)		$-v+s$	$-v$	$-v$ $-F$	
if recovery, with prob. B	**(W2)**	payments, if **wait** and **no exit** in $t=n$ (if recovery)		$-v+s$	$-v$	$-v$	g
	(E2)	payments, if **immediate exit** and **re-entry** in $t=n$	$-F$			$-H$	g

The expected present value (EPV) of continuing employment without considering an option to fire later, even if no recovery takes place after $t=n$, can be calculated based on two present values (PV), the PV of case (A) in Tab. 1, weighted with the probability (1–B) of no recovery, and of case (W2), weighted with the probability B of a recovery:

$$(1) \qquad EPV_A = \frac{-v+s}{i} - \frac{s}{i\cdot(1+i)^m} + \frac{B\cdot(v+g)}{i\cdot(1+i)^n} + \frac{(1-B)\cdot v - B\cdot g}{i\cdot(1+i)^{n+b}}$$

For the very simple case of a zero interest rate, the expected present value of an employment continuation strategy EPV_A converges to:

(2) $\lim_{i \to 0}(EPV_A) \equiv EPV_A(i{=}0) = s \cdot m - v \cdot n - (1-B) \cdot v \cdot b + B \cdot g \cdot b$

The EPV_W of waiting with the firing decision until the chance of recovery is either realised or not is calculated based on probability weighted cases (W2) and (W1). If, fortunately, the recovery actually happens in $t = n$, the firm will continue activity and earn g in the following b periods. The PV in this case (W2) is:

(2) $$PV_{(W2)} = \frac{-v+s}{i} - \frac{s}{i \cdot (1+i)^m} + \frac{v+g}{i \cdot (1+i)^n} - \frac{g}{i \cdot (1+i)^{n+b}}$$

In the unfavourable case of no recovery, the firm will use the option to fire in $t = n$ (paying the firing costs F) in order to avoid future losses (i.e. W1, with an exit in $t = n$):

(3) $$PV_{(W1)} = \frac{-v+s}{i} - \frac{s}{i \cdot (1+i)^m} + \frac{v}{i \cdot (1+i)^n} - \frac{F}{(1+i)^n}$$

The recovery has probability B; the probability of a continued recession is $(1-B)$. Thus, the EPV of waiting is:

(4) $EPV_W = B \cdot PV_{(W2)} + (1-B) \cdot PV_{(W1)}$

$$\Rightarrow \quad EPV_W = \frac{-v+s}{i} - \frac{s}{i \cdot (1+i)^m} + \frac{v - (1-B) \cdot i \cdot F + B \cdot g}{i \cdot (1+i)^n} - \frac{B \cdot g}{i \cdot (1+i)^{n+b}}$$

$$\Rightarrow \quad \lim_{i \to 0}(EPV_W) \equiv EPV_W(i{=}0) = s \cdot m - v \cdot n - (1-B) \cdot F + B \cdot g \cdot b$$

Notice, we assume the absence of moral hazard effects; i.e. the firm('s owner) is able and is forced to finance F. A late exit/firing in $t = n$ is only executed if the PV of expected losses of activity/employment in the last b periods exceeds the firing costs:

(5) $$\text{Exit/firing in } t = n \text{ only if:} \quad \frac{v}{i} - \frac{v}{i \cdot (1+i)^b} > F \quad \Leftrightarrow \quad v > v_{t=n}^{exit} \equiv \frac{i \cdot F \cdot (1+i)^b}{1 + (1+i)^b}$$

$$\Rightarrow \quad \text{for } i = 0: \quad v > v_{t=n}^{exit}(i{=}0) = \frac{F}{b}$$

Since exit/firing in $t = n$ is optimal in the unfortunate case of a continued recession only if the loss exceeds $v_{t=n}^{exit}$, the EPV_W of the "wait-and-see-with firing" strategy dominates the EPV_A of the employment continuation strategy if the losses v are high:

(6) $v > v_{t=n}^{exit} \quad \Rightarrow \quad EPV_W > EPV_A$

The PV of an immediate exit in $t = 0$ without considering re-entry (case E1) is determined by just the negative firing costs $(-F)$. If the option to re-hire (E2) in case of a recovery after $t = n$ is included, the corresponding EPW_R of an immediate exit/firing with an option to re-hire is:

(7) $$EPW_R = (-F) + B\cdot\left(\frac{g - i\cdot H}{i\cdot(1+i)^{n}} - \frac{g}{i\cdot(1+i)^{n+b}}\right)$$

$$\Rightarrow \lim_{i\to 0}(EPV_R) \equiv EPV_R(i{=}0) = -F + B\cdot(g\cdot b - H)$$

Re-entry/hiring in $t=n$ is optimal in case of a recovery, only if the PV of the gains exceeds hiring costs H:

(8) $$\text{Re-entry in } t=n \text{ only if: } \frac{g}{i} - \frac{g}{i\cdot(1+i)^{b}} > H \quad\Leftrightarrow\quad g > g^{entry}_{t=n} \equiv \frac{i\cdot H\cdot(1+i)^{b}}{(1+i)^{b}-1}$$

$$\Rightarrow \text{ for } i=0:\quad g > g^{entry}_{t=n}(i{=}0) = \frac{H}{b}$$

In this case ($g > g^{entry}_{t=n}$) a "fire and wait-and-see with re-hiring" strategy EPV_R dominates the pure exit (case E1) with an PV of $(-F)$

(9) $$\text{If } g > g^{entry}_{t=n} \;\Rightarrow\; EPV_R > (-F)$$

2.2 Optimal reaction for different situations

Based on the EPV of the different strategies, the optimal reaction of the firm can be derived for four different situations [1] to [4].

Situation [1]: For a firm being active in an industry which suffers under *serious business cycles* (like e.g. production of investment goods) severe losses during a recession ($v > v^{exit}_{t=n}$) and high expected future profits in case of a recovery ($g > g^{entry}_{t=n}$) are typical. The corresponding option-based EPW_W (of "wait with firing with an option to fire later") and EPW_R ("fire and with an option to re-hiring") must in this situation be compared as the relevant alternative reactions. "Waiting with firing" dominates "immediate firing" if:

(10) For ($v > v^{exit}_{t=n} \wedge g > g^{entry}_{t=n}$) ***no layoff*** in $t=0$ if:

$$EPV_W > EPV_R \;\Leftrightarrow\; v < v^W_R = \frac{s\cdot[(1+i)^{n} - (1+i)^{n-m}] - [(1-B) - (1+i)^{n}]\cdot i\cdot F + B\cdot i\cdot H}{(1+i)^{n}-1}$$

$$\Rightarrow \text{ for } i=0:\quad v < v^W_R(i{=}0) = \frac{s\cdot m + B\cdot(F+H)}{n}$$

Note that, as the critical re-hiring level of expected future gains is exceeded ($g > g^{entry}_{t=n}$), the size of g as well as the duration of the future boom b are both not relevant for the optimality of the strategy at the margin any more. If the current losses are below v^W_R, the firm will wait with layoffs and continue employment. The corresponding employment subsidy s^W_R that ensures employment in firms suffering under severe cycles can be derived from the condition ($v < v^W_R \Leftrightarrow s > s^W_R$):

(11) $s > s_R^W = \frac{v\cdot[(1+i)^m-(1+i)^{m-n}]+[(1+i)^{m-n}\cdot(1-B)-(1+i)^m]\cdot i\cdot F-(1+i)^{m-n}\cdot B\cdot i\cdot H}{(1+i)^m-1}$

$\Rightarrow$ for $i=0$: $s > s_R^W(i{=}0) = \frac{v\cdot n - F - B\cdot H + (1-B)\cdot F}{m}$

$\Rightarrow$ $s_R^W(i{=}0) > 0$ if $v > \frac{B}{n}\cdot(F+H)$

Employment can be protected in a severe-cycle situation by moderate subsidies, if the firing and hiring costs F and H are high, and if a future recovery is expected with a high probability B. Furthermore, the size of a subsidy which is effectively protecting employment is the lower, the lower are the losses v, the less long-lasting the recession is expected (small n), and the longer the subsidy is paid (high m). In order to avoid layoffs a positive payment of a subsidy s is only necessary if the current loss v exceeds $(B/n)\cdot(F+H)$. Thus, a subsidy s_R^W of a relatively small size can avoid *cyclical* unemployment during the recession for the employees of these firms.

Situation [2] of a "weak" firm: If the current losses are severe, but potential future profits are only moderate, the relevant alternatives are waiting with firing (EPV_W) or an immediate exit/firing ($-F$) without considering a re-entry. In the simple case of no interest payments (i=0), the results are:

(12) For $(v > v_{t=n}^{exit} \wedge g < g_{t=n}^{entry})$ ***no layoff*** in $t=0$ if:

$EPV_W > (-F) \Leftrightarrow v < v_F^W = \frac{s\cdot[(1+i)^n-(1+i)^{n-m}]-[(1-B)-(1+i)^n]\cdot i\cdot F+B\cdot[1-(1+i)^{-b}]\cdot g}{(1+i)^n-1}$

$\Rightarrow$ for $i=0$: $v < v_F^W(i{=}0) = \frac{s\cdot m + B\cdot(F+g\cdot b)}{n}$

The corresponding employment subsidy which protects employment ($v < v_F^W \Leftrightarrow s > s_F^W$) in a "weak" firm for the simple case of neglecting interest payments (i=0) is:

(13) For $i=0$: $s > s_F^W(i{=}0) = \frac{v\cdot n - F - B\cdot g\cdot b + (1-B)\cdot F}{m}$

Since re-hiring is not relevant due to low potential future profits, employment in this situation is not protected by re-hiring costs H. However, firing costs F and the probability of a recovery B are effectively protecting employment. Note that, in contrast to situation [1], now the level of potential future gains g as well as the duration of a potential future boom b are both at the margin relevant for the firing decision. Since $(g < g_{t=n}^{entry})$ and $(H > g\cdot b)$, for (i=0) the subsidy which avoids layoffs is higher compared to situation [1]: $s_F^W > s_R^W$. However, the subsidy for a "weak" firm avoids a *permanent* exit, i.e. it prevents a permanent job destruction, and not only cyclical inactivity/unemployment as in situation [1].

Situation [3]: For industries/firms with a *moderate business cycle*, low losses in a recession $(v < v_{t=n}^{exit})$ are combined with moderate future profits expected in case of a recovery $(g < g_{t=n}^{entry})$. In this situation the EPV_A (of permanently continuing activity/employment) must be compared to the alternative of immediate firing (–F). Continuation of employment dominates if:

(14) For $(v < v^{exit}_{t=n} \wedge g < g^{entry}_{t=n})$ ***no layoff*** in t = 0 if:

$$EPV_A > (-F) \Leftrightarrow v < v^A_F = \frac{s \cdot [(1+i)^n - (1+i)^{n-m}] + (1+i)^n \cdot i \cdot F + B \cdot [1-(1+i)^{(-b)}] \cdot g}{(1+i)^n - B - (1-B) \cdot (1+i)^{(-b)}}$$

$$\Rightarrow \text{ for } i = 0: \quad v < v^A_F(i{=}0) = \frac{s \cdot m + B \cdot g \cdot b + F}{n + (1-B) \cdot b}$$

The corresponding employment subsidy which, since no re-hiring is considered, avoids *permanent* layoffs $(v < v^A_F \Leftrightarrow s > s^A_F)$ in firms with mild cycles in the simple (i=0)-case is:

(15) $$\text{For } i = 0: \quad s > s^A_F(i{=}0) = \frac{v \cdot n - F - B \cdot b \cdot g + (1-B) \cdot v \cdot b}{m}$$

Situation [4] of a "*potentially strong*" firm: if the current loss is moderate, but potential future profits are high, a permanent continuation of employment (EPV_A) and firing with a re-hiring option (EPV_R) are compared:

(16) For $(v < v^{exit}_{t=n} \wedge g > g^{entry}_{t=n})$ ***no layoff*** in t = 0 if:

$$EPV_A > EPV_R \Leftrightarrow v < v^A_R \Leftrightarrow s > s^A_R$$

$$\Rightarrow \text{ for } i = 0: \quad v < v^A_R(i{=}0) = \frac{s \cdot m + F + B \cdot H}{n + (1-B) \cdot b}$$

$$\Leftrightarrow \quad s > s^A_R(i{=}0) = \frac{v \cdot n - F - B \cdot H + (1-B) \cdot v \cdot b}{m}$$

Comparing situations [3] and [4], the employment protection subsidy for a "mild cycle firm" (sit. [3]) is higher than for a "strong firm" (sit. [4]). However, as in the "weak" firm situation [2], this higher subsidy avoids a *permanent* destruction of jobs in sit. [3], and not only cyclical inactivity/unemployment as in sit. [4].

Summarising all four situations, the minimum subsidy s_{min} which protects employment, i.e. avoids layoffs, for the simple case of not considering interest payments (i=0) can be stated as:

(17) ***No layoff*** in t = 0 (for i=0) if:

$$s > s_{min}(i{=}0) = \frac{v \cdot n - F - B \cdot \min(H, g \cdot b) + (1-B) \cdot \min(F, v \cdot b)}{m}$$

$$\Leftrightarrow \; s_{min}(i{=}0) = \min[\, \max(s^W_R, s^W_F) \,,\, \max(s^A_R, s^A_F) \,] \; = \; \max[\, \min(s^W_R, s^A_R) \,,\, \min(s^W_F, s^A_F) \,]$$

The terms in the numerator of s_{min} can be interpreted directly. The minimum employment protecting subsidy s_{min} must first cover the difference of accumulated losses during the recession minus firing costs $(v \cdot n - F)$. Sunk firing cost F reduce s_{min} and shelter employment. s_{min} is reduced by the probability weighted costs of a re-entry in t=n $(B \cdot H)$ or, if cheaper, by the opportunity costs of no-re-entry $(B \cdot g \cdot b)$. Furthermore, since avoiding layoffs in t=0 is, in the unfortunate case of no recovery, associated with the potential necessity of layoffs in t=n, s_{min} must cover the probability-weighted firing cost in t=n $[(1-B)\cdot F]$ or, if cheaper, the opportunity costs of no firing/continuation $[(1-B)\cdot v \cdot b]$.

Tab. 2: Overview of the relevant alternatives in situations [1] to [4]

<table>
<tr><td colspan="2" rowspan="2">Overview of
no-layoff conditions</td><td colspan="2">Valuable option to wait with firing (to fire later in t=n)</td></tr>
<tr><td>Option to wait with firing:
$v > v^{exit}_{t=n}$</td><td>Fire now or never:
$v < v^{exit}_{t=n}$</td></tr>
<tr><td rowspan="2">Valuable option
to re-enter / re-hire</td><td>Option to
re-enter/hire
$g > g^{entry}_{t=n}$
(s_{min} avoids *cyclical* unemployment)</td><td>[1] severe cycles
(wait with firing instead exit & re-entry):
$EPV_W > EPV_R$
$\Leftrightarrow\ v < v^W_R \ \Leftrightarrow\ s > s^W_R$
$s^W_R(i=0) = \frac{v \cdot n - F - B \cdot H + (1-B) \cdot F}{m}$</td><td>[4] “pot. strong” firm
(continuation instead exit & re-entry):
$EPV_A > EPV_R$
$\Leftrightarrow\ v < v^A_R \ \Leftrightarrow\ s > s^A_R$
$s^A_R(i=0) = \frac{v \cdot n - F - B \cdot H + (1-B) \cdot v \cdot b}{m}$</td></tr>
<tr><td>No re-entry:
$g < g^{entry}_{t=n}$
(s_{min} avoids *permanent* job destruction)</td><td>[2] “weak firm”
(wait with firing instead exit/firing forever):
$EPV_W > (-F)$
$\Leftrightarrow\ v < v^W_F \ \Leftrightarrow\ s > s^W_F$
$s^W_F(i=0) = \frac{v \cdot n - F - B \cdot g \cdot b + (1-B) \cdot F}{m}$</td><td>[3] moderate cycles
(continuation instead firing forever):
$EPV_A > (-F)$
$\Leftrightarrow\ v < v^A_F \ \Leftrightarrow\ s > s^A_F$
$s^A_F(i=0) = \frac{v \cdot n - F - B \cdot b \cdot g + (1-B) \cdot v \cdot b}{m}$</td></tr>
</table>

2.3 The effect of a positive interest rate – a simple 2 period version

The effects of a positive interest rate $(i \geq 0)$ on the investment calculus of the firm is explicitly calculated for the simple 2-period parameterisation of the model (i.e. n=1, m=1, b=1). For a severe business cycle situation [1] the employment protecting subsidy $s^W_R(n,m,b=1)$ and the effect of interest rate changes on this subsidy are:

$$(18) \quad \text{situation [1]:} \ s^W_R(n,m,b=1) = v - i \cdot F - B \cdot F - B \cdot H \qquad \Rightarrow \quad \frac{\partial s^W_R}{\partial i} = (-F) < 0$$

Thus, the higher the imputed interest rate i, the lower is the subsidy which is sufficient to protect employment in a severe business cycle situation [1], since the interest costs of immediately (in t=0) financing the firing costs F are more important compared to later payment flows, the higher the interest rate is. In reverse, very low interest rates during a recession are c.p. increasing the size of the subsidy which is protecting employment.

(19) situation [2]: $s_F^W(n,m,b{=}1) = \frac{(1+i)\cdot v - F - (1+i)\cdot i\cdot F - B\cdot(g + i\cdot F) + (1-B)\cdot F}{1+i}$

$$\Rightarrow \quad s_F^W(n,m,b{=}1) = v - i\cdot F - B\cdot F - B\cdot\frac{g}{1+i} \qquad \Rightarrow \quad \frac{\partial s_F^W}{\partial i} = (-F) + \frac{B\cdot g}{(1+i)^2}$$

with $g < g_{t=n}^{entry} = H\cdot(1+i)$

In a "weak firm" situation [2] the interest rate effect on financing F is still working. However, this effect may be compensated (partly) via a discounting effect, which reduces the present value of potential future profits. However, since future profits are low [$g < g_{t=n}^{entry} = H\cdot(1+i)$] in situation [2] and since potential future profits are probability weighted by ($0 \le B \le 1$) the overall effect of increased interest on s_F^W should still be negative.

(20) situation [3]: $s_F^A(n,m,b{=}1) = \frac{(1+i)\cdot v - (1+i)^2\cdot F - B\cdot g + (1-B)\cdot v}{1+i}$

$$\Rightarrow \quad s_F^A(n,m,b{=}1) = v - (1+i)\cdot F - B\cdot\frac{g}{1+i} + \frac{(1-B)\cdot v}{1+i}$$

$$\Rightarrow \frac{\partial s_F^A}{\partial i} = (-F) + \frac{B\cdot g}{(1+i)^2} - \frac{(1-B)\cdot v}{(1+i)^2}$$

with $g < g_{t=n}^{entry} = (1+i)\cdot H$ and $v < v_{t=n}^{exit} = (1+i)\cdot F$

In a moderate cycle situation [3], an additional discounting effect on potential future losses (in case of no recovery) is ceteris paribus reducing the subsidy as imputed interest rates are increasing.

(21) situation [4]: $s_R^A(n,m,b{=}1) = \frac{(1+i)\cdot v - (1+i)^2\cdot F - B\cdot(1+i)\cdot H + (1-B)\cdot v}{1+i}$

$$\Rightarrow \quad s_R^A(n,m,b{=}1) = v - (1+i)\cdot F - B\cdot H + \frac{(1-B)\cdot v}{1+i}$$

$$\Rightarrow \frac{\partial s_R^A}{\partial i} = (-F) - \frac{(1-B)\cdot v}{(1+i)^2} < 0$$

For a potentially strong firm (sit. [4]), there is no interest effect on discounting future profits, since the level of g in this situation is not relevant at the margin, since a re-entry will be executed anyway in case of a recovery. Thus, the interest rate effect on the subsidy is definitely negative in this situation.

Summarising, in our net present value based model, a very low interest rate during a recession surprisingly has c.p. a negative effect on employment, since low interest rates are resulting in cheaper financing costs to be paid on the firing costs F. Correspondingly, the size of a subsidy which protects employment is increasing ceteris paribus if the interest rate is decreasing during a recession.

4. Conclusion

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. This reluctance is the more pronounced, the higher sunk firing and hiring costs are. This motivation can be a reason for the differences in unemployment dynamics during the 2008/2009 recession when comparing the United States to the euro area. Due to stronger employment protection legislation, sunk firing costs are more serious in Europe. Based on option-based reluctance to fire a well trained staff, this paper shows how a relatively moderate temporary subsidisation can result in changing a firm's optimal decision away from firing towards the continuation of employment. Depending on the expectations of the firm in a situation with sunk hiring costs, the subsidy can avoid temporary unemployment or even permanent job destruction. The results of our simple model reflect the reasoning behind the astonishing success of only temporary employment subsidies by European governments, like the German "Kurzarbeitergeld".

References

Belke, A., Göcke, M., 1999, A Simple Model of Hysteresis in Employment under Exchange Rate Uncertainty, Scottish Journal of Political Economy 46, 260-286.

Bentolila, S. and G. Bertola, 1990, Firing Costs and Labour Demand: How Bad is Eurosclerosis?, Review of Economic Studies 57, 381-402.

Bentolila, S. and G. Saint-Paul, 1994, A Model of Labor Demand with Linear Adjustment Costs, Labour Economics 1, 303–326.

Chen, Y.-F. and G. Zoega, 1999, On the Effectiveness of Firing Costs, Labour Economics 6, 335-354.

ECB (European Central Bank), Monthly bulletin, July 2010, p 42.