# Temporary Unemployment Regulations

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**Abstract**

In this paper we want to analyze the economic impact of the temporary unemployment regulations that a lot of governments of European countries have created during the last credit crunch recession. First we analyze when a representitive firm should exit the market if there is not such regulation. Second we study the effect of such regulation by deriving the optimal exit point for firm that uses the regulation. Third we take the government view on the topic and determine when it is optimal time from a welfare perspective to introduce such regulation.

## 1 Introduction

In this paper we want to analyze the economic impact of the temporary unemployment regulations (e.g. *Deeltijd WW* in the Netherlands, *Kurzarbeit* in Germany, *Tijdelijke werkloosheid* in Belgium, *Chômage partiel* in France) that a lot of governments of European countries have created during the last credit crunch recession. First we analyze when a representitive firm should exit the market if there is not such regulation. Second we study the effect of such regulation by deriving the optimal exit point for firm that uses the regulation. Third we take the government view on the topic and determine when it is optimal time from a welfare perspective to introduce such regulation.

## 2 No regulation

We study a firm that has a cash inflow that is defined by $D_0Y$, where $Y$ follows a geometric Brownian motion

$$dY_t = \alpha_S Y_t dt + \sigma Y_t d\omega_t.$$

The drift $\alpha_S$ depends on the economic situation, it is $\alpha_R < 0$ in the recession and $\alpha_N > 0$ when the recession is over. Every period the firm has a cash outflow that is equal to $c_0 > 0$. The firm can exit the market by paying a sunk cost $E > 0$. The value of the firm is denoted by $V_S$ where $S \in \{R, N\}$ denotes the state of the economy.

## 2.1 After the recession

The following Bellman equation for the value function of the firm should hold

$$rV_N = D_0 Y - c_0 + \lim_{dt \downarrow 0} \frac{1}{dt} E\left[dV_N\right].$$

Using Ito's lemma we get

$$E\left[dV_N\right] = \alpha_N Y \frac{\partial V_N}{\partial Y} dt + \frac{1}{2}\sigma^2 Y^2 \frac{\partial^2 V_N}{\partial Y^2} dt + o\left(dt\right).$$

Substitution and rearranging gives

$$rV_N = D_0 Y - c_0 + \alpha_N Y \frac{\partial V_N}{\partial Y} + \frac{1}{2}\sigma^2 Y^2 \frac{\partial^2 V_N}{\partial Y^2}.$$

The solution is given by

$$V_N\left(Y\right) = \frac{D_0 Y}{r - \alpha_N} - \frac{c_0}{r} + B_N Y^{\beta_2}.$$

The optimal moment to exit is equal to

$$Y_N^* = \frac{\beta_2}{\beta_2 - 1} \frac{\left(r - \alpha_N\right)\left(\frac{c_0}{r} - E\right)}{D_0}.$$

Furthermore, we have that

$$B_N = -\frac{1}{\beta_2} \frac{D_0}{r - \alpha_N} (Y_N^*)^{1-\beta_2}.$$

## 2.2 In the recession

The following Bellman equation for the value function of the firm should hold

$$rV_R = D_0 Y - c_0 + \lim_{dt \downarrow 0} \frac{1}{dt} E\left[dV_R\right].$$

Using Ito's lemma we get

$$E\left[dV_R\right] = \alpha_R Y \frac{\partial V_R}{\partial Y} dt + \frac{1}{2}\sigma^2 Y^2 \frac{\partial^2 V_R}{\partial Y^2} dt + \lambda\left(V_N - V_R\right) dt + o\left(dt\right).$$

Substitution and rearranging gives

$$rV_R = D_0 Y - c_0 + \alpha_R Y \frac{\partial V_R}{\partial Y} + \frac{1}{2}\sigma^2 Y^2 \frac{\partial^2 V_R}{\partial Y^2} + \lambda\left(V_N - V_R\right).$$

The solution is given by

$$V_R\left(Y\right) = \frac{D_0 Y}{r - \alpha_N} \frac{r + \lambda - \alpha_N}{r + \lambda - \alpha_R} - \frac{c_0}{r} + \frac{\lambda}{\lambda + \beta_2\left(\alpha_N - \alpha_R\right)} B_N Y^{\beta_2} + B_R Y^{\beta_2^R}.$$

The optimal moment to exit $Y_R^*$ is implicitly defined by

$$\left(1 - \frac{1}{\beta_2^R}\right) \frac{r + \lambda - \alpha_N}{r + \lambda - \alpha_R} Y_R^* - \frac{1}{\beta_2}\left(1 - \frac{\beta_2}{\beta_2^R}\right) \frac{\lambda}{\lambda + \beta_2\left(\alpha_N - \alpha_R\right)} (Y_N^*)^{1-\beta_2}\left(Y_R^*\right)^{\beta_2} = \frac{\left(r - \alpha_N\right)\left(\frac{c_0}{r} - E\right)}{D_0},$$

and the constant $B_R$ is equal to

$$B_R = -\frac{1}{\beta_2^R \left(Y_R^*\right)^{\beta_2^R - 1}} \left(\frac{D_0}{r - \alpha_N} \frac{r + \lambda - \alpha_N}{r + \lambda - \alpha_R} + \beta_2 \frac{\lambda}{\lambda + \beta_2\left(\alpha_N - \alpha_R\right)} B_N \left(Y_R^*\right)^{\beta_2 - 1}\right).$$

# 3 Regulation

The government of the country in which the firm operates installs a temporary unemployment regulation that can affect the firm as follows. The cash outflow drops to $c_1$ ($< c_0$) and the cash inflow drops to $D_1Y$, where $D_1 < D_0$.

# 4 Government view

# 5 Conclusions