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# The long-term impacts of vocational rehabilitation

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# MEMORANDUM

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# The Long-term Impacts of Vocational Rehabilitation

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# The Long-Term Impacts of Vocational Rehabilitation

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## Abstract

This paper investigates empirically how five different vocational rehabilitation (VR) programs affect the transition rate into employment, the consecutive monthly earnings and the employment duration. VR programs increase the employment probability of the participants, but this effect varies substantially between the different programs. VR programs also lead to more stable jobs while the impact on monthly earnings is of minor magnitude. The costs and revenues of the VR programs are calculated, based on the estimated model. The results of wage subsidies, public education and work training in ordinary firms are noteworthy. The employment effect is clearly the strongest factor relative to the job quality effects, in describing the economic return of the VR programs.

Keywords: Vocational rehabilitation, program evaluation, multivariate hazards, cost-benefit analysis

JEL classification: C14, C15, C41, D61, I21, J24, J64

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## 1. Introduction

Vocational rehabilitation (VR) programs are considered to be important policy instruments in helping persons with severe difficulties, mostly health-related, to re-enter the labor market. Although the operating costs of these programs are sizable, some 4.8 billion NOK in 2007 (around 600 million Euros), the economic revenues from these programs has never been fully investigated. The existing Norwegian literature has mainly focused on the employment probability up to five years after VR entry (Aakvik et al. (2005); Aakvik (2001,2003)). All these studies report an average treatment effect close to zero, when unobserved selection bias is controlled for. Similar results are reported on Swedish data in Frölich et al. (2004). However, in a recent study Westlie (2008) shows the importance of long-lasting time panels when evaluating these programs. This is due to the long average duration of programs, frequent use of multiple programs and strong lock-in effects during participation. Based on a nine year data panel, that study evaluates how the programs affect several outcome probabilities at the end of the VR spell and concludes that they have a strong positive effect on employment and a somewhat smaller negative effect on disability.

While the primary target of VR programs is employment, VR programs may also affect the quality of the jobs the participants end up in. This may include hourly wages, number of working hours per month and employment stability. This aspect has received little attention in the studies mentioned above, an exception being Aakvik (2003) who investigates the employment probability of participants in educational programs one, two and three years after the participants left the VR regime. He finds no causal program effect on the short-term or long-term employment probability. However, this study is only conducted on VR clients with a maximum VR duration of between one and two years. This may be too short to capture the effect of public education. In addition, this study does not capture job stability effects in terms of prolonged employment duration, i.e. different persons may be employed at different periods.

To this author's knowledge, no cost-benefit analysis has previously been conducted on VR programs. In fact, cost-benefit analyses on ordinary labor market programs are also quite uncommon (Kluve 2006). Some studies, however, include attempts. In Norway, Raaum et al. (2002) undertake a cost-benefit analysis on classroom

training for those in ordinary unemployment (AMO-courses). Their findings suggest that for women with previous labor market experience the benefits exceed the operating costs. In a recent study of all Norwegian labor market programs, Gaure et al. (2008) find that the income gain from participating does not cover the operating costs. However, by including the value of production during work training programs, the calculation ends up with a surplus of around 13,000 NOK per participant. From Danish data, Jespersen et al. (2007) estimate the benefits to exceed the costs for private- and public job training, while classroom training gives a negative return. Among the work training programs, wage subsidies in the private sector have the most favorable effects.

The model used in this paper is an extension of the one presented in Westlie (2008), which focused on how the programs affected the hazard rates and probabilities of three different exits out of the VR regime. The present paper extends the analysis by including two additional outcomes, i.e. the employment termination rate and the monthly earnings. Due to the similarity of the models some of the results have already been discussed in the previous paper. In order to avoid repetition, this paper will only pay attention to new developments and refer to the previous paper where no new insights are found.

The main finding in this paper is as follows. Over a six-year period, all VR programs apart from work training in a protected environment generate an economic surplus. That is, the additional revenue in the labor market due to program participation exceeds the costs of operating these programs. Along with the existing literature, wage subsidies (WS) generate the largest surplus. In addition, work training in ordinary firms (WTO) and re-education into a new profession (EDU) both generate a considerable surplus. Adding the value of production during participation strengthens the surplus from work training even further.

EDU has the largest impact on job stability in terms of a reduced employment termination rate. This result, combined with the long average program duration, makes the gains from EDU quite sensitive to the evaluation period. Expanding the evaluation period from six to nine years increases the revenue from EDU far more than for the other programs.

This paper continues as follows: Section 2 outlines the data and institutional settings. Section 3 explains the model and the identification strategy. Section 4 presents the most important estimates of the model while the cost and benefits of the VR programs are calculated in section 5. Section 6 concludes.

## 2. Data and institutional settings

One of the main objectives of the Norwegian vocational rehabilitation (VR) regime is to provide income support to persons who experience severe difficulties in (re)entering the labor market. Most VR clients have long-term illness experiences, usually of a duration of between one and two years. However, being admitted requires that the health status of the client has improved sufficiently to enable a return to the labor market. Other VR clients have suffered an occupational injury, which has made it impossible for them to continue in their former line of work but not eliminated their work capacity. Unemployed individuals with socially related problems (i.e. drugs, prison or behavioral problems) may also be included. The VR regime offers a large selection of programs in order to rebuild the labor market ability or re-educate participants into a new profession. This is either done by work training or by classroom education. The work training programs include wage subsidies (WS), work training in ordinary firms (WTO) and work training in protected environments (WTP). In WS the participants work in ordinary firms (public and private sector), but the employment office finances around 50 percent of the wage for a limited period of time. The idea is for participants to continue working for the firm beyond the subsidy period. WTO and WTP both provide ordinary work training. WTO takes place in ordinary firms, whereas WTP provides work training with extra tight supervision, often in sheltered firms (i.e. firms with work training as their main objective). Classroom training consists of ordinary public education (EDU) and courses provided by the employment office (AMO). While EDU may last for several years, the duration of AMO is usually six months or less. For a more comprehensive description of the VR regime and the participants, see Aakvik (2001) and Westlie (2008).

The data consists of all persons with a new VR entry between January 1994 and September 2003 (i.e. the VR clients). “New” is here defined as not having any VR experience during the past twelve months. Persons older than 55 years at the time of entry

are excluded. Table 1 presents some statistics regarding the VR clients. On average, VR clients are 35.8 years old at the time of entry. They have been working for 10.0 years with an average income of 246,634 NOK. Their estimated public disability pension is somewhat smaller (162,247 NOK). However, pension is taxed at a lower rate than labor market income so the real difference is not that large. The genders are more or less equally represented. Around 48 percent have children while 35 percent are married. Most have spouses who are still in the labor market (71.2 percent).

Table 1
Descriptive statistics of VR clients (mean values at VR entry)

| | |
|---|---|
| Age at VR entry | 35.8 |
| Previous work experience (years) | 10.0 |
| Average labor market income in previous working years* | 246,634 |
| Estimated public disability pension | 162,247 |
| Male (percent) | 51.1 |
| Married (percent) | 35.0 |
| With a spouse in the labor market (married only) | 71.2 |
| With children below 16 years of age (percent) | 48.7 |
| Number of children (parents only) | 1.8 |

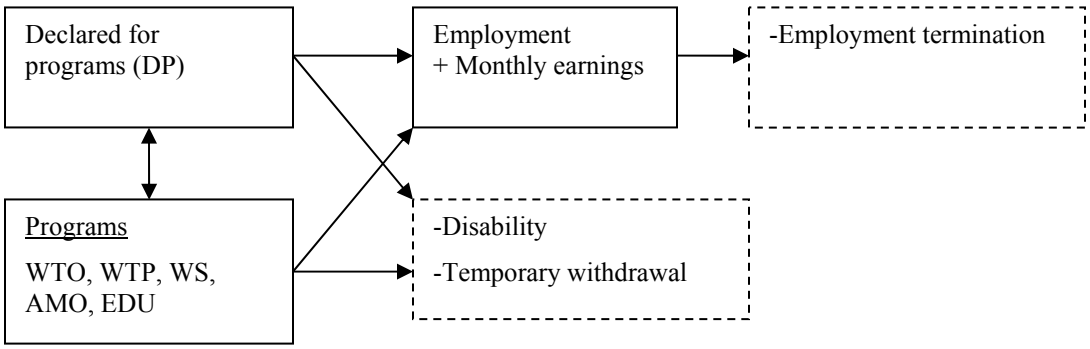
Note: Currency is normalized to 2006 NOK.
*Persons with previous work experience only.

From the point of entry, a *VR spell* is recorded on a monthly basis, distinguishing between six different states. The first state is called *Declared for Programs* (DP) and consists of all activities that are not actual program participation. This includes waiting for an available program slot, job search activities or applying for a disability pension. Next we have the five programs described above, i.e. WTO, WTP, AMO, EDU and WS. VR clients may at any time land a job, embark upon self-financed education or be granted a disability pension. In addition, a period of three consecutive months without employment or any relevant public transfer is considered as *temporarily withdrawals from the labor market*. All these outcomes are treated as final and will terminate the VR spell. In the rest of this paper receiving a job or entering self-financed education (i.e. not as part of a VR program) is regarded as employment in order to simplify the empirical

analysis. Furthermore, most persons entering self-financed education will probably acquire a job at a later point in time[1].

The current data also include *monthly earnings* and *employment spells* for all VR clients who acquire a job at the end of the VR spell (spells ending in education are not included). These employment spells are also constructed on a monthly basis until the person receives any type of welfare payment that implies employment termination (i.e. long-term sickness or unemployment benefits). None of the employment spells are recorded for more than two years. By that time, the VR client is assumed to have (re)established a foothold in the labor market. All ongoing spells, both VR and Employment, are treated as censored at the end of the time window (September 2003). Figure 1 presents an overview of the data construction. The arrows show the possible transitions, boxes with solid lines are included in the spells, while dots indicate final destinations.

Figure 1. An overview of the data construction

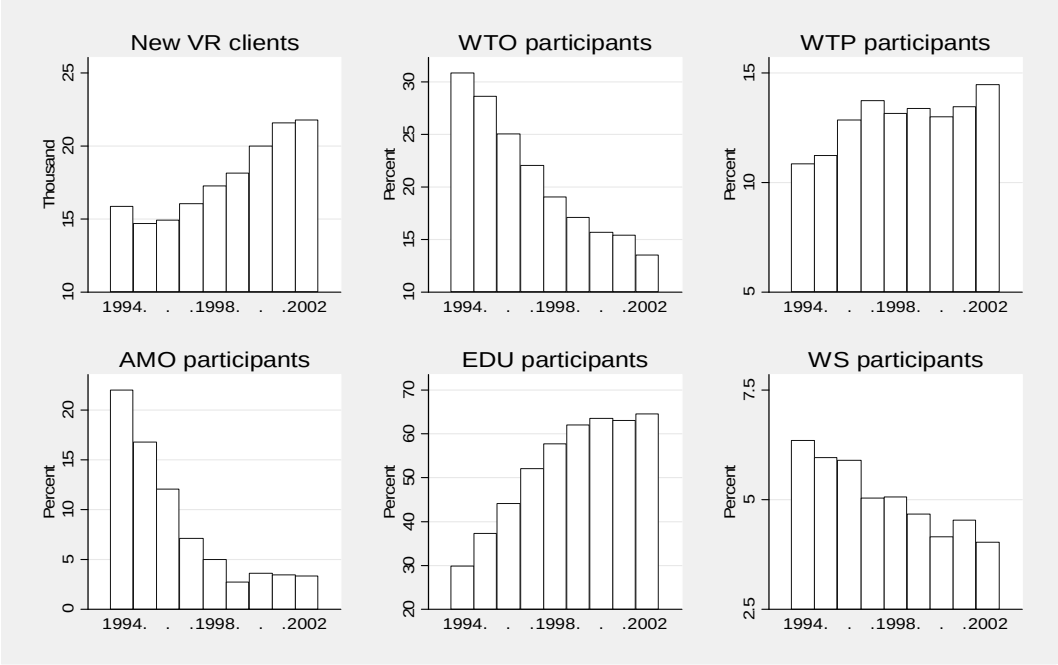



Ideally, the earnings outcome should differentiate between pay per hour and hours worked. Unfortunately, this is not directly observable in the data. Instead, I construct the *monthly earnings,* defined as the average monthly labor market income within the first calendar year of the employment spell. It is calculated as the annual labor market income reported to the tax authorities divided by number of working months (i.e. months without any type of public benefits or program participation). This leads to a problem with the

[1] The VR spells are the same as those used in Westlie (2008). Interested readers may refer to that paper for a more comprehensive presentation of the construction of VR spells as well as a detailed descriptive analysis.

income from participation in WTP and WS during the calendar year in which employment occurs (bear in mind that WTO participants do not receive labor market income during participation). The income earned in WTP is identified in the data and subtracted from this calculation. Income earned during WS, on the other hand, is not identified. However, WS participants are entitled to the same wage as those in ordinary employment. I will therefore assume that the earnings of the WS participants are the same before and after the end of the subsidy. If the entry into employment occurs after September, the calculation will be based on the labor market income during the subsequent year.

Figure 2. Number of new VR clients and the share of participants in each program by year




Note: 2003 is not included due to the lack of information from the last months.

The Norwegian VR regime has been subject to important changes during the time period covered, as presented in figure 2. The first graph shows the number of new VR entries year by year. Except for the first year, the number of new clients has grown steadily during the whole period from around 15,000 in 1994 to more than 21,000 in 2002. The next five graphs show the program intensity for each of the five programs within the same period. This is defined as the share among all participants in each program. The

share of participants in WTO has fallen steadily from 30 percent in 1994 to less than 15 percent in 2002, indicating that the number of new WTO slots has not increased at the same rate as the number of new VR clients. The share of AMO and WS participants is also declining, while the share of participants in WTP has been quite consistent during these ten years. EDU has met this growing demand for programs to a greater extent than the others, and in fact doubled its share from 30 to more than 60 percent.

Table 2
Some descriptive statistics from the data

| | |
|---|---|
| Number of VR spells | 177,353 |
| Average VR spell duration* | 26.6 |
| Average number of months spent in programs* | 14.3 |
| Share of spells containing at least one program | 70.4 |
| | |
| Share of VR spells that are right-censored | |
| Censored due to time window | 30.5 |
| Censored for other reasons | 10.3 |
| Share of non-censored VR spells ending in | |
| Employment | 39.9 |
| Education (self-financed) | 7.9 |
| Disability | 23.5 |
| Temporary withdrawal | 28.7 |
| | |
| Number of employment spells | 41,275 |
| Share of terminated employment spells (within the first two years)** | 36.9 |
| Average monthly earnings (2006 NOK)*** | 20,437 |

* Only VR spells starting before 1999
** Only employment spells starting before 2001
*** Average monthly earnings for an industrial worker in 2006 was 26,500 NOK

Table 2 presents some statistics on the VR spells and employment spells. There are 177,353 VR spells in the data. The average duration of spells starting before 1999 (and thereby likely to be completed) is 26.6 months, and 14.3 of these months include program participation. As many as 70.4 percent of all VR clients have started in at least one program. Due to the long average spell duration, as many as 30.5 percent of the VR spells are not completed at the end of the time window. In addition, 10.3 percent of the spells are treated as censored for other reasons, i.e. emigration, death, entering other programs than the five mentioned above or child birth (women only). Among the non-censored spells, 39.9 percent end with a job and 7.9 percent start a self-financed education (i.e. education that is not a part of a program). 23.5 percent end with disability while 28.7 percent end with temporarily withdrawals from the labor market. The data also consists

of 41,275 employment spells. 36.9 percent of all employment spells end within the first 24 months. Finally, the average monthly earnings of VR clients who get a job are 20,437 NOK.

Table 3
Employment quality conditioned on program experience

| | Non-participants | WTO | WTP | AMO | EDU | WS |
|---|---|---|---|---|---|---|
| Monthly earnings in the working years before VR* | 21,500 | 20,494 | 19,246 | 20,847 | 21,306 | 21,641 |
| Monthly earnings after VR | 20,427 | 19,937 | 18,253 | 19,727 | 21,248 | 20,590 |
| Difference (after – before) | -1,073 | -557 | -993 | -1,120 | -58 | -1,051 |
| Difference relative to non-participants | - | 516 | 80 | -47 | 1,015 | 22 |
| Monthly earnings one year after start of employment | 21,136 | 20,398 | 18,851 | 20,694 | 22,953 | 21,306 |
| Difference (after – before) | -364 | -96 | -395 | -153 | 1,647 | -335 |
| Difference relative to non-participants | - | 268 | -31 | 211 | 2,011 | 29 |
| Share of VR spells ending in | | | | | | |
| Employment + education | 38.3 | 39.6 | 31.5 | 48.5 | 62.8 | 71.1 |
| Employment | 32.6 | 36.0 | 26.8 | 32.6 | 49.0 | 68.2 |
| Share of terminated employment spells** | 44.1 | 34.2 | 50.3 | 40.2 | 28.8 | 35.7 |

Note: Programs refer to the last program attended within the spell. Income before VR spell is calculated as average labor market income in all working years (i.e. years with labor market income above 124,000 NOK 2006) prior to the VR spell. The monthly earnings are only considered for persons with labor market experience before and after the VR spell.
*Conditioned on at least one year with previous labor market experience.
**Within the first two years. Only employment spells starting before 2001 are considered. Spells ending in education are not included.

Table 3 compares previous labor market income[2] with the monthly earnings in a new job conditioned on program experience. For participants with multiple program experience, only the last program is considered. Not surprisingly, participants in different programs have different income histories. On average, the previous monthly earnings of a WS participant are 21,641 NOK. This figure is approximately 2,400 NOK higher than the previous earnings of the WTP participants. Between these two extremes we have EDU, followed by AMO and WTO. On average, all VR clients, EDU excepted, experience a drop in their monthly earnings compared to their previous labor market income. This

[2] Previous labor market income is defined as the average labor market income during all previous working years. Previous earnings are deflated by the national insurance basic amount ("grunnbeløpet").

drop may be caused by the health problems that led to the need of VR in the first place. In addition, previous job-specific knowledge and length of service may be less valued in the new job. By using the non-participants as a reference group, a simple difference-in-difference analysis indicates that both WTO and EDU provide increased monthly earnings.

Table 3 also presents the monthly earnings one year after the start of employment for those still employed. These earnings are calculated in the same way as the monthly earnings presented above. Conditioned on being employed in the following calendar year, the earnings of the participants are almost the same as before the VR spell. The only exception is EDU participants, who experience an increase of 1,647 NOK in their monthly earnings. This is an increase of 2,011 relative to the non-participants. The other participants experience only minor differences. This result indicates that EDU is more successful in increasing the human capital of the participants, resulting in a higher wage premium. In addition, EDU participants may be re-educated into professions where their health problems are less problematic. However, the selection of EDU participants may be based on characteristics that are uncorrelated with previous income and labor market history. For instance, EDU participants may on average have experienced less extensive injuries than other participants. This concern will be addressed further in the statistical model.

The last part of table 3 presents the breakdown of the employment outcome (into ordinary jobs and education) in addition to the employment termination rate for the different participants. Not surprisingly, participants in classroom training (AMO and EDU) are more likely than work training participants to enter into education. As many as 33 percent of AMO participants and 22 percent of EDU participants choose to continue their training (self-financed). EDU participants obtain the most stable jobs, only 28.8 percent have experienced employment termination. Among WTP participants, the corresponding share is as high as 50.3 percent. For WTO and WS participants, this figure is similar, at around 35 percent, while AMO participants experience a termination rate of 40.2 percent. The employment stability of the non-participants is worse than for all participants, WTP excepted.

## 3. *The empirical model*

This section presents the empirical strategy used in this paper to estimate the long-term effects of the VR programs, i.e. how the different VR programs affect the monthly earnings and the employment stability of the participants. However, due to individual heterogeneity in the selection into programs, an evaluation based exclusively on the employment spell might lead to biased estimates of the program effect. Put differently, if participants are selected into programs based on characteristics not accounted for in the outcome equations, these characteristics would bias the parameters of interest. To remove any bias from unobserved heterogeneity, program participation and all outcomes of interest are estimated simultaneously within the same model. The intention of doing this is that all time-invariant individual heterogeneity will be captured by a heterogeneity distribution and the parameter of interest will not be biased.

### 3.1 Model setup

This section presents the statistical model explaining the transitions into the five different programs (k=1 to 5), the three different VR outcomes (k=6 to 8) and employment termination (k=9) by use of a mixed proportional hazard rate model (MMPH). The monthly earnings (k=10) are also explained in the model. As the labor market status is observed at the end of each month only, the econometric model is set up in terms of grouped hazard rates (Prentice and Gloeckler (1978); Meyer (1990)). It is assumed that the effects of all time-varying covariates, including calendar time and spell duration, are constant within each month.

Equation (1), *the participation equation*, and equation (2), *the VR outcome equation*, explain the monthly integrated hazard rates to each of the five different programs (k=1,…,5) and into the three VR outcomes (k=6,7,8) respectively. This part of the model is almost identical to the one presented in Westlie (2008). The new developments in the present model are based on the model in Gaure et al. (2008) and consist of two additional equations. Equation (3) explains the *employment termination* (i.e. the monthly integrated hazard rate out of employment), while equation (4) explains the monthly earnings (W). All equations are given for individual (*i*) at time (*t*).

(1) $$\varphi_{kit} = \exp\left(\mu_k o_{ijt} + \pi_k a_{ijt} + \sigma_k s_{it} + \nu_k r_{it} + \beta_k x_i + \alpha_k z_{it} + v_{ki}\right), \quad k = 1,...,5$$

(2) $$\varphi_{kit} = \exp\left(\mu_k\left(x_{it}^o\right)o_{ijt} + \pi_k\left(x_{it}^o, r_{it}\right)a_{ijt} + \sigma_k s_{it} + \lambda_k d_{it} + \beta_k x_i + v_{ki}\right), \quad k = 6,7,8$$

(3) $$\phi_{kit} = \exp\left(\pi_k\left(x_{it}^0\right)a_{ijt} + \sigma_k s_{it} + \lambda_k d_{it} + \beta_k x_i + v_{ki}\right), \quad k = 9$$

(4) $$W_{it} = \exp\left(\pi_k\left(x_{it}^0\right)a_{ijt} + \sigma_k s_{it} + \lambda_k d_{it} + \beta_k x_i + v_{ki} + \varepsilon_i\right), \quad k = 10$$

The explanatory variables, *o,a,s,r,d,x,z,v* and ε are described in table 4 as well as further below.

Table 4
Overview of explanatory variables

| Explanatory variable | Description |
|---|---|
| o | 5 dummies indicating the current treatment status and 5 dummies capturing any additional effect of multiple program experience. |
| a | 5 dummies indicating previous treatment status and 5 dummies capturing any additional effect of multiple program experience. |
| s | 22 dummies indicating calendar year and month in addition to a local business cycle indicator. |
| d | 36 dummies indicating spell duration. |
| r | 12 dummies indicating consecutive months in the DP state. In equation (2), *r* enters into the program effect function linearly. |
| x | Age, previous labor market history, family status, gender, education, country of birth, previous social security history, medical diagnoses. |
| $x^o$ | Gender, age, pre-VR state, previous work experience and program duration. Program duration is measured as ln(program duration) - ln(average program duration). |
| z | Three instruments (variables that only affect program transitions, k=1,…,5). |
| v | Unobserved individual heterogeneity components. |
| μ() and π() | Linear functions describing treatment effect. |
| ε | Normally distributed error term. |

In equation (1) and (2), programs may affect the hazard rates differently while the programs are ongoing and after completion. While ongoing, the model captures the *on-program effect* by a set of five dummies (*o*), one for each program. After program completion, the *after-program effect* is captured by another set of program dummies (*a*). Both *o* and *a* include information about multiple program experience. In (3) and (4) all subjects have left the VR regime, and naturally the on-program effect is excluded. Equations (2), (3) and (4) allow the program effect to differ depending on observed characteristics of the participants as well as the ongoing/completed program duration. In addition, the after-program effect on the hazard rates out of VR is a linear function of time since completion (r).

Calendar time and business cycle conditions are captured by s. This includes 22 dummies capturing seasonal and calendar year effects in addition to (changes in) governmental priorities and changes in the regulations (see figure 2 for a description of changes in the participation pattern and the increase in new VR clients during the data period). In addition, a local business cycle indicator is included. This indicator is calculated as the transition rate out of unemployment for those in ordinary unemployment, who are registered at their local employment office (i.e. the VR clients are not included in the calculation of this business cycle indicator). In equation (1) duration is defined as consecutive months in the DP state, recalculated after each program completion. In equation (2) and (4), duration is measured as number of months in the VR regime and represented by 36 and 6 dummies respectively. In equation (3) duration is the number of months in employment. However, time spent in the VR regime is also included by six dummies.

A common concern when estimating program effects is that participants may be (self) selected into programs based on observable or non-observable characteristics. If these characteristics are correlated with the final outcomes, we have the so-called *selection problem,* resulting in biased estimates if not handled correctly (for more on the selection problem, see Heckman et al. (1999) for a comprehensive survey). As a first step towards eliminating this spurious correlation from the estimated program effects, the model includes a large set of individual characteristics. These are to a large extent included as flexibly as possible, using dummy variables. All individual characteristics are represented by x. This includes age, previous labor market experience, family status, gender, education, country of birth and time since immigration (immigrants only), previous social security history and medical diagnoses. Age and previous labor market experience are modeled as a set of 28 dummies where the VR clients are grouped according to years of work experience relative to other VR clients in the same age group. In addition, the average labor market income for these years is included. Family status includes marital status, the labor market status of the spouse (if married) and a set of 32 dummies capturing the number of children in different age groups. Country of birth is a set of 8 dummies, constructed as a combination of born abroad (OECD or non-OECD),

number of years since arrival (more or less than nine years) and gender. The reference group is native born.

As previously mentioned, VR clients may have different social security backgrounds. First, the main target group consists of persons who have experienced long-term illnesses (defined as at least twelve months on sickness benefits). In addition, some participants enter the VR regime quite soon after the sickness incident (less than twelve months). This group is labeled short-term ill. Finally, VR clients without previous sickness benefits are labeled unemployed. Each group is represented by a dummy.

Even though this large set of explanatory variables captures many of the important aspects that affect the different hazard rates and monthly earnings, there could still be residual individual heterogeneity. As an example, in a related study on Swedish data Frölich et al. (2004) show the importance of including the subjective recommendations of physicians and caseworkers regarding the subjects' health status and labor market chances. My data however, only includes an illness diagnosis which may be less accurate. To sort out any potential source of unobserved heterogeneity, a time-invariant individual heterogeneity distribution ($v$) is included. This heterogeneity is approximated by a discrete multivariate mass-point distribution where the number of points is endogenously determined within the estimation process (this will be discussed in more detail at the end of the likelihood section below). As a final note, $v$ is only time-invariant within a spell. A person with several VR entries and thereby several VR spells, may have different realizations of $v$.

## 3.2 Identification

The identification of causal program effects rests on certain assumptions. First, all explanatory variables (including the programs) are assumed to have a proportional effect on the different hazard rates (the proportionality assumption). This is an assumption of the functional form of the model. Second, all VR clients have a non-zero probability of entering each program or final outcome each month (the non-defective risk assumption). Third, conditioned on $x^o$, all programs are assumed to have the same program effect on all VR clients (the conditional homogeneous treatment effect assumption).

Conditional on these assumptions, the model is nonparametrically identified (i.e. no parametric assumptions regarding the heterogeneity distribution) based on the *timing of events* result of Abbring and van den Berg (2003). In addition, time-varying variables strengthen the identification process (McCall (1994); Brinch (2007)). As pointed out by Eberwein et al. (1997, p.663), past values of the time-varying variables affect the current hazard rates only through the selection process. For instance, as shown in Gaure and Røed (2007) the tightness of the labor market has varied quite considerably over the time period covered, indicating large fluctuation in the labor demand. Furthermore, figure 2 shows a large variation in the participation pattern over the nine years covered by the data. A new VR client would probably have a smaller chance of participating in WTO in 2002 than in 1994, ceteris paribus. However, the variation in the participation pattern may be (partly) explained by changes in the VR clients' preferences. In addition, the labor market qualities of the VR clients may have declined (on average) over time, causing more reluctance among employers to accept WTO and WS clients. In that case, this variation is not exogenously determined.

To address this concern, a special type of time-varying covariates are included in the model, namely a set of instruments (z) that are assumed to only have an impact on the participation hazards (k=1-5). These variables (often referred to as *exclusion restrictions* in the literature) are tried and tested in Westlie (2008) and based on the theory in Aakvik et al. (2005) that different practices at different VR offices or in different time periods, may induce exogenous variation in the participation propensity. More specifically, I construct variables capturing regional shocks in the supply and demand of programs within the local labor market office[3]. I assume that the VR candidate was unable to anticipate or make adjustment for these shocks in advance. The first instrument is called *work pressure on the caseworker* and is defined as the relative change in the inflow of new potential participants in month *t* relative to the average inflow in the previous three months. The idea here is that in months with a relatively high inflow, the caseworker will be under more work pressure and thus have less time to help each potential participant.

[3] There were around 200 different regional offices in Norway within the observation period.

Furthermore, the local employment office will not be able to adjust the number of program slots on such short notice.

The final two instruments are called the *share of new training programs* and *share of new AMO courses*. The first is calculated as the rate of new available program slots in the three programs WS, WTO and WTP in the previous month relative to the number of applicants waiting for a new program within a region. The second is constructed in the same way, only with new AMO slots rather than new training slots. The reason for distinguishing between programs that are provided in workplaces and programs that are given in classrooms is that the supply elasticity may differ. While it may be hard to raise the capacity rapidly in the training sector, as recruitment of new firms or increasing the number of slots in existing firms may take some time, the program administrator can always find a bigger classroom for an AMO-course. These last two instruments are meant to capture differences in the supply of programs. In months with many new program slots relative to the number of people waiting, we expect an increase in the transition rate into the respective program group. Both of these instruments may be correlated with the local unemployment rate and seasonal cycles. These factors are included in s, however, and should therefore not represent a problem. New slots in EDU are not counted in any of these instruments since new slots in this sector would be difficult to quantify. In addition, public education follows the calendar year so this pattern is picked up by the calendar time dummies.

## 3.3 The likelihood function

This section shows how the nine competing hazard rates and the monthly earnings are simultaneous estimated within the same nonparametric maximum likelihood estimator (NPMLE). This NPMLE is explained and tested in Gaure et al. (2007).

The likelihood function is set up as follows. Let $K_{it}$ be the set of all feasible events for individual *i* in period *t*. The non-feasible event is entering program j while already attending this program. Also, during the employment spell, employment termination (k=9) is the only feasible transition. Let $y_{kit}$ be an outcome indicator variable, which equals to 1 if the corresponding observation ended in a transition to state *k* at time *t* for individual *i*. In addition, $y_{Wit}$ equals one if the person makes a job transition from VR,

and zero otherwise. The individual likelihood function conditional on the vector of unobserved variables $v_i$ can then be formulated as:

$$(5)\quad L_i(v_i) = \prod_{y_{kit}\in Y_i}\left[\prod_{k\in K_{it}}\left[\left[\left(1-\exp\left(-\sum_{k\in K_{it}}\phi_{kit}\right)\right)\frac{\phi_{kit}}{\sum_{k\in K_{it}}\phi_{kit}}\right]^{y_{kit}}\right]\times\left[\exp\left(-\sum_{k\in K_{it}}\exp(\phi_{kit})\right)\right]^{\left(1-\sum_{k\in K_{it}}y_{kit}\right)}\times\left[\frac{1}{\sigma\sqrt{2\pi}}\exp\left(-\frac{(\ln W_{it}-w_{10it}-v_{10i})^2}{2\sigma^2}\right)\right]^{y_{Wit}}\right]$$

Here $w_{10it} = \pi_{10}\left(x_{it}^0\right)a_{ijt} + \sigma_{10}s_{it} + \lambda_{10}d_{it} + \beta_{10}x_i$, i.e. all observed covariates in equation (4). Equation (5) is a function of unobserved heterogeneity and can not directly be included in the estimation. Instead I use the expectation of $L_i(v_i)$. This is done by approximating the heterogeneity distribution in a nonparametric fashion by means of a discrete distribution, Lindsay (1983). Let Q be the (a priori unknown) number of support points in this distribution and let $\{v_m, q_m\}$, $m = 1,...,M$, be the associated location vectors and their probabilities. Expressed in terms of observed variables, the likelihood function is then given as

$$(6)\qquad L = \prod_{i=1}^{N} E\left[L_i\left(v_i\right)\right] = \prod_{i=1}^{N}\sum_{m=1}^{M} q_m L_i\left(v_m\right),\quad \sum_{m=1}^{M} q_m = 1$$

where $L_i\left(v_i\right)$ is given in equation (5).

The estimation procedure consists of maximizing (6) with respect to all the model parameters and parameters in the heterogeneity distribution repeatedly for alternative values of $M$. We start out with $M$=1, and then expand the model with new support points until a stop criteria is reached. Gaure et al. (2007) recommend the Akaike information criterion (AIC) when choosing the preferred model. Given the computational challenges associated with non-parametric maximum likelihood estimation, estimating this model is a time consuming process. Therefore, the estimation was ended at 28 points even though AIC was not fulfilled.[4] At this stage, all the parameters of interest had stabilized, and the

[4] At this stage adding one additional mass point took approximately 3 days on a cluster of 40 CPU's.

increase in the likelihood were mainly due to improvements in the heterogeneity distribution. The optimization routine is described in detail in Gaure et al. (2007). The estimation was performed using a supercomputer at the University of Oslo.[5]

## 4. Estimation results

The selected model contains 28 support points involving a likelihood improvement of 10,009 from -1,531,172 (M=1) to -1,521,164 (M=28). A total of 2,122 parameters were estimated in this process, 307 describing the heterogeneity distribution and 420 describing the treatment effects. Due to this large number of estimates, only the main estimation results will be presented here. A complete list of the estimation result can be downloaded from www.frisch.uio.no/docs/VR_eff_job_qual.html.

As previously explained, the part of the model explaining transitions out of the VR regime (equation 2) is almost identical to the one presented in Westlie (2008) and the results are therefore nearly identical. In fact, the only new development in equation (2) is the effect of program duration. Therefore, this section only presents a cursory introduction to the treatment effects on the employment hazard, particularly for the on-program effect which is presented merely as a brief summary. The various program effects on the *job quality*, on the other hand, are not presented in Westlie (2008) and will naturally be given more attention. The next section rounds up by calculating the costs and revenues of the VR programs.

### 4.1 Program effects on employment hazard

Figure 3 presents the employment hazard two years after VR entry for a reference person, conditioned on different program experience. These monthly hazard rates are approximately equal to the monthly transition probabilities. Therefore, in order to simplify the following presentation, I will refer to these hazard rates as monthly probabilities. The *reference person* is a female below 45 years old with previous work

[5] The program is developed by Simen Gaure at USIT and the Frisch Centre and can be studied at www.frisch.uio.no/NPMLE.html.

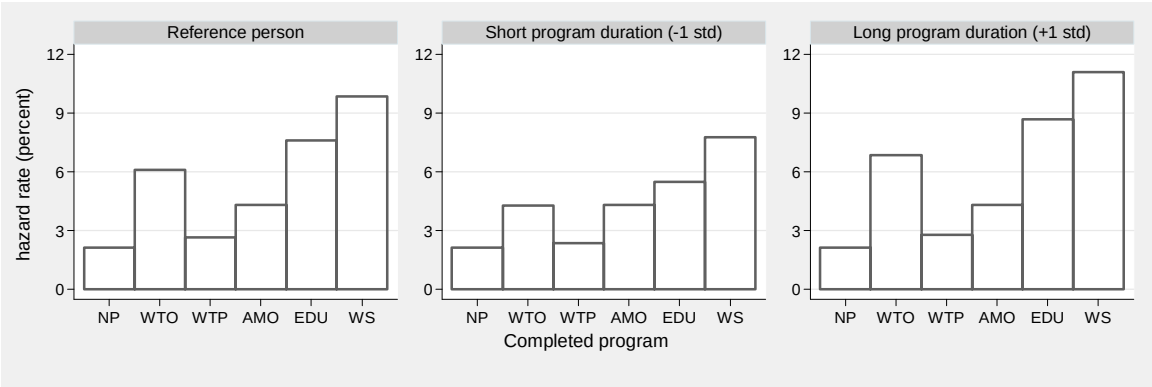
experience[6] and without previous program experience. In addition the program effects are evaluated at average program duration (for each specific program) in the first month after completion. The reference person can be regarded as a typical VR client. The first bar in the first graph shows a hazard rate for a non-participant (NP) of 2.1 percent after two years. If the same person had completed WTO with the average duration, the hazard rate would have been 6.1 percent. WS is even more successful, raising the hazard rate to 9.8 percent, while WTP has least effect of all the programs on the employment hazard, resulting in a hazard rate of 2.6 percent, though even this effect is statistically significant. The same pattern can be found in several previous studies (Gerfin et al. (2005); Carling and Richardson (2004); Gerfin and Lechner (2002)), i.e. the more these programs resemble a "real job", the more effective they are. This may be due to more relevant and effective training as well as a signaling effect. Looking at classroom training, EDU clearly dominates AMO. The hazard rate of the reference person is 7.6 and 4.3 percent respectively. These estimated effects are quite similar to the one reported in Westlie (2008). However, the estimated employment effects are somewhat larger in the present model. The main explanation for these larger effects is that all programs in the graph concerned are evaluated at average program duration. The program duration has been shown to be an important determinant of the effect and this is not taken into account in the previous paper. Based on several Monte Carlo simulations, Gaure et al. (2007) shows that omitting important heterogeneous treatment effects in a MMPH model leads to negatively biased treatment effects (compared to the true mean). However, the present model relies on the perhaps questionable assumption that program duration is exogenously determined.

The effect of program duration is illustrated by the next two graphs in the first line of figure 3. These hazard rates are calculated for the same reference person, the only amendment being that the program durations are evaluated at ± one standard deviation. Program duration has a strong (positive) impact on the estimated effect of WTO, EDU and WS. This is hardly surprising, given that longer programs often give more time to

[6] Here, having previous work experience is defined as having more working years than the 25th percentile within the same age group.

accumulate human capital. The effect of AMO and WTP is less affected by program duration. In the case of AMO, this may be explained by the short average duration and thereby lack of variation. WTP, on the other hand, generally has a small effect on the employment hazard regardless of duration.

Figure 3 Employment hazards conditioned on completed program experience




Note: The reference person is female, less than 45 years old, with previous work experience above the 25th percentile and no previous program experience. The program effects are evaluated at average program duration the first month after completion. All hazard rates are calculated for this reference person with the only alteration explained in the title. NP=Non-participants while the five other bars represent the five different programs.

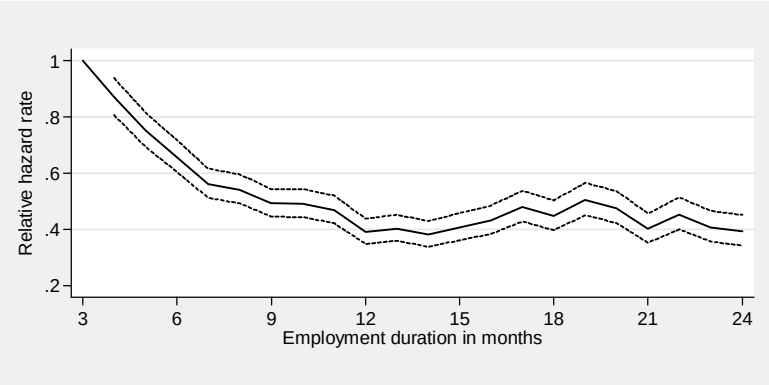
The estimated on-program effects are very similar to the ones reported in Westlie (2008) and therefore not presented in this section. All programs have strong lock-in effects on all transitions out of VR during participation. The only exception is WS, which has a positive on-program effect on the hazard rate to employment. This effect probably owes to the intention of the WS program, namely for participants to continue being employed after the funding ends. All negative on-program effects are diminishing by time spent in a program.

## 4.2 Program effects on employment stability

Before the different program effects are discussed, we consider figure 4 which presents the hazard rate out of employment (i.e. the employment termination rate) relative to the third month of employment (bear in mind that the employment definition requires a job to last for at least two months). This hazard rate drops by around 60 percent within the first twelve months of the employment spell, indicating that job security improves rapidly with length of service. After the first year, however, this termination rate flattens out. This pattern is consistent with Ekhaugen (2007) who studies the job durations of VR

participants after the end of the VR period. Note that figure 4 presents the relative hazard rate. As an example, the average employment termination rate for a non-participant at the third month of employment is 5.5 percent. Based on the estimated employment termination rate, this would imply a 32 percent probability of employment termination within the first 12 months, and a 47 percent probability of employment termination within a two-year period.

Figure 4. The estimated hazard rate out of employment (relative to the first month)




Note: The employment termination rate is measured relative to the third month of employment. None of the employed face the risk of loosing their job during the two first month of employment.

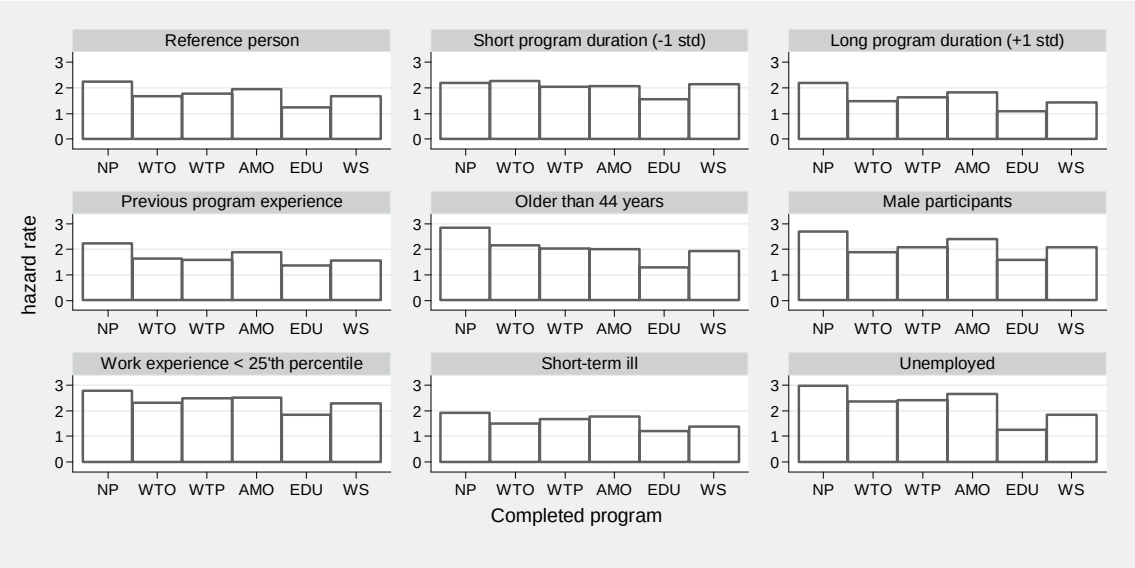
Figure 5 presents the estimated hazard rates out of employment (i.e. the employment termination rate) six months after entry into employment conditional on program experience. The hazard rates in the first graph are calculated for the reference person (explained above) while the other eight graphs are based on this reference person with partial variations of one characteristic. All programs, with the exception of AMO, reduce the employment termination rate for the reference person. EDU has the strongest effect, indicating that re-educating VR clients into a new profession where their previous injuries may be less of a burden, leads to more stable jobs than the three work training programs do.

Program duration has an important impact on the program effect. For all three work training programs, reducing the program duration by one standard deviation eliminates the estimated effect. The effect of EDU is also significantly reduced. Having previous program experience, on the other hand, only leads to modest alterations, weakening the effect of EDU and strengthening the effect of WTP and WS.

All individual characteristics other than short-term illnesses entail a higher level of employment termination for a previous VR client without program experience (NP).

Participants above 44 years old benefit largely from participating, especially in the case of EDU. Furthermore, they experience the same effect from AMO as from all the three work training programs, indicating that this group has much to gain from classroom training. Male participants have the same relative effect as females, but the termination rates are somewhat higher.

Figure 5. Estimated employment termination rates conditional on program experience (percent)




Note: The reference person is female, less than 45 years old with previous work experience above the 25th percentile and no previous program experience. The program effects are evaluated at average program duration the first month after completion. All hazard rates are calculated for this reference person with the only alteration explained in the title. NP=non-participants while the five other bars represent the five different programs. All termination rates are calculated at the sixth month of employment.

Participants with little previous work experience seem to gain a smaller effect from all the programs. However, this group of participants experiences a large effect on the employment hazard. One explanation may be that work training programs mostly have a signaling effect on these participants, i.e. dealing with the characteristics that made their previous labor market career so unstable. Once employed, these characteristics are revealed and thus render the programs ineffective. Re-educating these participants into a new profession through EDU, however, leads to more stable jobs. This also applies to the previously unemployed, who seem to gain more employment stability from EDU than any other group.

## 4.3 Program effects on monthly earnings

As seen in table 5, VR programs have no statistically significant effect on the monthly earnings for females with long-term illnesses (i.e. the reference person). The earnings effect of WTP, however, is estimated to be around 4 percent and statistically significant at a 10 percent level. A clear pattern from table 5 is that classroom training (i.e. AMO and EDU) has no impact on monthly earnings. The only exception is the 2 percent effect of EDU for male participants. Male participants also gain a 3 and 5 percent wage premium by completing WS and WTO while participants with short-term illnesses get a wage premium of 2 and 4 percent by completing WTO and WTP. EDU excepted, these results correspond well to the frequencies previously presented in table 3. The estimation shows, however, that the EDU participants' 5 percent increase in monthly earnings relative to non-participants (the difference-in-difference result in table 3) is merely due to the EDU participants' individual heterogeneity and not a program effect. Finally, WTP and WS participants older than 44 experience a negative effect on their monthly earnings.

Table 5
Program effects on log monthly earnings (π)

| | WTO | | WTP | | AMO | | EDU | | WS | |
|---|---|---|---|---|---|---|---|---|---|---|
| | est. | s.e. | est. | s.e. | est. | s.e. | est. | s.e. | est. | s.e. |
| The reference person* | .002 | *.014* | .038 | *.021* | -.017 | *.020* | -.002 | *.013* | .011 | *.016* |
| + Program duration (dev. from the mean)** | **.032** | *.005* | **.050** | *.007* | .011 | *.009* | .002 | *.004* | **.027** | *.006* |
| Heterogeneous effects (interaction terms) | | | | | | | | | | |
| + Short-term ill | **.027** | *.012* | **.042** | *.020* | -.005 | *.018* | .007 | *.011* | .008 | *.012* |
| + Unemployed | .032 | *.021* | -.014 | *.019* | -.033 | *.028* | -.002 | *.020* | -.027 | *.020* |
| + Older than 44 | -.013 | *.013* | **-.052** | *.020* | .016 | *.021* | -.002 | *.013* | **-.028** | *.013* |
| + Little prev. work exp. | .011 | *.015* | .028 | *.019* | .032 | *.023* | .006 | *.014* | .003 | *.016* |
| + Male | **.050** | *.012* | -.009 | *.017* | .016 | *.018* | **.020** | *.010* | **.031** | *.012* |
| + Previous program exp. | .010 | *.010* | .006 | *.014* | -.011 | *.016* | -.006 | *.008* | -.015 | *.010* |

Note: The heterogeneous effects are included as interaction parts (i.e. in addition to the effect for the reference person. The relative effect on the hazard rate may be calculated as exp(π)-1. Estimates significant at a 5 % level are given in **bold** letters.
* The reference person is a female between 30 and 44 years old with a long-term illness, with more previous work experience than the 25th percentile (conditioned on age) and no previous program experience.
** Deviation from the mean is calculated as ln(program duration)-ln(average program duration).

Monthly earnings are also affected by time spent in the work training programs, i.e. for all three work training programs there is a negative wage premium from short programs and a positive one from quite long-lasting programs. The negative effect of short

programs may be a signaling effect. Participants who end their work training after a short period may be signaling an inability to fulfill the expectations of the program providers (i.e. less productive than expected) which makes them worse off relative to the non-participants. Note also that these estimates only focus on the monthly earnings at the beginning of the employment spell. Wage progression during employment is not taken into account. If the programs have (positive) effects on the earnings progression, we might have a (negatively) biased estimate on the long-term earnings.

## *5. Costs and revenues of the VR programs*

In this section i attempt to sum up all the different program effects by calculating the total costs and revenues of VR programs over a six-year period. In accordance with the dominant approach in the evaluation literature (see Heckman et al. (1999)) the costs in this analysis consist of the operating costs of the programs and forgone earnings associated with time spent in programs. Individual welfare payments are not included. The revenue of the VR programs is defined as the additional labor market income due to program experience, i.e. the earnings during the employment spell relative to the potential earnings in the absence of programs. In order to calculate this revenue, an estimate of the counterfactual labor market earnings is needed. In other words, how many of the participants would be employed, for how long would they stay employed and what would their monthly earnings be, had they not participated. This calculation is based on a simulation procedure where the estimated model is used to construct new VR spells and employment spells for each client. This is done separately with and without program effects, where the simulation without effects represents the counterfactual world without programs. However, the hazard rates into the different programs (equation 1) enable us to identify those who would have participated in the different programs if they had existed.

In order to conduct this simulation strategy, some simplifying assumptions are made. First and foremost, no VR client is allowed to participate in more than one program. This is done to separate the effects of each program. Even though this assumption neglects the effect of multiple programs, this effect has shown to be quite small. Second, all business cycle and calendar year effects are set to the average level. This is done to ensure that spells with long durations are subject to the same labor market

conditions as shorter spells. Third, no spell faces the risk of exogenous censoring. Put differently, no one dies, gives birth, leaves the country or drops out of the data for other reasons. The only way to terminate a spell is by entering one of the final destinations or reaching the end of the simulation window which is six years. Finally, employment spells may last longer than two years. Due to the relatively flat employment termination pattern during the second year of employment (see figure 4 above), the termination rate is assumed to stay constant at the final level for the rest of the employment spell.

In order to capture the statistical uncertainty of the estimated model, we apply a parametric bootstrap procedure. Here, the estimates are randomly drawn from their joint normal distribution (see Røed and Westlie (2007) for a more detailed description of this procedure). This procedure results in 120 different sets of the estimates and thereby 120 simulations *with* and *without* program effects.

## 5.1 Revenues in the labor market

Table 6 presents the simulated labor market outcomes for the participants, conditional on simulated program experience. The first part presents how the different programs affect the employment probability at the end of the VR spell. This effect varies considerably between the different programs. WS has the largest effect, increasing the employment probability by 32.8 percentage points. EDU increases the employment probability by 21.2 percentage points while the increase from AMO and WTO is 10.8 and 9.8 percentage points respectively. Finally, WTP has a positive effect of 1.7 percentage points. All these differences are statistically significant at a 5 % level. The effect of WTO and EDU is somewhat stronger compared to those obtained in Westlie (2008). This may have several explanations. First, disregarding the existence of multiple programs affects the selection into treatment. This will again affect the overall treatment effect due to the heterogeneous treatment effects. Second, participants with previous program participation experienced a reduced effect of EDU in the previous study. This is mainly due to variations in program duration (i.e. EDU often has a shorter duration when preceded by other programs). Since program duration is included in the present model this difference is not so distinct. Third, as discussed in the previous section, when we let the program effect interact with program duration, the estimated treatment effects are stronger. Also, note that the

simulation window in the present paper is shorter than in Westlie (2008), making these simulations not directly comparable. The employment probability without program effects indicates how participants are selected into programs based on initial employability. The most employable ones (on average) enter EDU, followed by WS and AMO. WTO and WTP participants are initially the least employable ones.

The second part of table 6 presents the average VR duration for the different participants. All programs apart from WS increase the time spent in the VR regime. However, due to the strong after-program effect, the increased VR duration is considerably shorter than the average program duration. Due to long-lasting programs combined with strong lock-in effects, EDU has the largest impact on VR duration, increasing it by 10.6 months. VR duration also increases substantially, by 8.4 months, for WTP participants. For WTO and AMO participants, on the other hand, there is only a minor increases of 4.6 and 2.8 months respectively, whereas for WS the average duration is actually reduced by 0.9 months.

The third part of table 6 presents the average duration of the employment spells. It is important to realize that employment duration is affected in two ways. As explained in the previous section, program experience leads to more stable employment spells and thereby increased employment duration. However, a large share of these employment spells are not terminated within the simulation window of six years. The duration of these non-terminated employment spells are only affected by the starting point, i.e. the VR duration. In other words, program participation postpones the starting point of the employment spell and thereby results in forgone earnings. The importance of these forgone earnings relative to the employment stability effect depends on the length of the simulation window.

WS participants experience the longest average employment duration, with 32.0 months. This is both due to initial characteristics (i.e. they would also experience the longest employment duration in the absence of programs) and due to a large program effect of 2.9 months. This effect is both due to shorter VR spells and to more stable jobs. WTO and AMO participants also experience an increased employment duration, 1.7 and 0.8 months respectively, while the employment duration is reduced for EDU participants in the simulations with program effects. This is due to the large effect on the VR

duration. Even though this program had the highest effect on employment stability (see figure 5 above), it does not outweigh the effect of a late employment transition within these six years. Finally, in the case of WTP, the different effects cancel each other out, causing no effect on employment duration within these six years.

All work training programs (WTO, WTP, WS) affect the monthly earnings in the same way, increasing them by around 1,000 NOK. EDU has an effect of 475 while AMO has no significant effect. Participants are selected based on their initial earnings potential. EDU participants are the ones with the highest initial earnings prospects (without program effects) followed by WS and AMO participants. WTO and WTP participants also differ when it comes to initial earnings. WTO participants would gain around 1,000 NOK more per month than WTP participants in the absence of programs.

Table 6
Overall effects of program participation

| | WTO | WTP | AMO | EDU | WS |
|---|---|---|---|---|---|
| **Employment probability** | | | | | |
| With | 35.8 | 28.6 | 40.0 | 56.7 | 65.8 |
| Without | 26.0 | 26.9 | 29.2 | 35.5 | 33.0 |
| With – without | 9.8 | 1.7 | 10.8 | 21.2 | 32.8 |
| | [8.1, 11.4] | [0.1, 3.3] | [8.2, 13.3] | [19.8, 22.7] | [30.0, 35.9] |
| **VR duration** | | | | | |
| With | 28.4 | 30.4 | 27.1 | 36.4 | 21.3 |
| Without | 23.8 | 22.0 | 24.3 | 25.8 | 22.2 |
| With – without | 4.6 | 8.4 | 2.8 | 10.6 | -0.9 |
| | [4.0, 5.1] | [7.6, 9.0] | [2.0, 3.5] | [9.9, 11.3] | [-1.9, 0.1] |
| **Employment duration*** | | | | | |
| With | 29.6 | 22.6 | 28.7 | 27.3 | 32.0 |
| Without | 27.9 | 22.8 | 27.9 | 28.5 | 29.1 |
| With – without | 1.7 | -0.2 | 0.8 | -1.2 | 2.9 |
| | [-0.6, 3.8] | [-3.3, 2.2] | [-1.1, 2.7] | [-6.3, 3.9] | [0.9, 5.3] |
| **Monthly earnings*** | | | | | |
| With | 20,580 | 19,230 | 20,355 | 21,524 | 21,623 |
| Without | 19,530 | 18,351 | 20,185 | 21,050 | 20,619 |
| With – without | 1,050 | 878 | 171 | 475 | 1,004 |
| | [519, 1,476] | [288, 1,501] | [-358, 720] | [172, 795] | [185, 1,815] |
| **Total labor market income per participant (six years)** | | | | | |
| With | 224,757 | 132,086 | 243,643 | 344,830 | 473,833 |
| Without | 147,620 | 121,032 | 172,463 | 224,402 | 207,804 |
| With – without | 77,137 | 11,054 | 71,180 | 120,428 | 266,030 |
| | [45’, 101’] | [-4’, 22’] | [29’, 105’] | [92’, 138’] | [104’, 372’] |

Note: A 95 % confidence interval of the differences is reported in brackets [ ]. Probabilities are given in percent, duration in months and earnings in 2006 NOK.
*Only for those employed.

The total labor market income for the participants is calculated based on their monthly earnings, the number of months in employment and the share of spells ending in employment. However, due to the positive correlation between the monthly earnings and the employment duration, this calculation has to be performed on an individual level before summing up. WS participants have the highest labor market income during this six-year period, at around 474,000 NOK. Even though WS participants would experience a relatively high income in the absence of programs (only EDU participants have a higher initial level), the total labor market income is strongly affected by the program effects. In particular, the effect on the employment probability is the most important one. EDU participants also experience a high income effect, at 120,000 NOK. Next, WTO and AMO participants have nearly the same effect at around 70,000 NOK. The total income effect from WTP participation, on the other hand, is close to zero.

On a final note, this income calculation does not include a discounting factor. Then again, wage increases are also neglected since all earnings are based on the monthly earnings at the beginning of the employment spell. In Norway, the average annual wage increase has been around 5 percent[7] during the last fifteen years.

## 5.2 Calculating the net income from the VR program

As mentioned at the start of this section, program costs include the operating costs and forgone earnings. The forgone earnings affect the earnings in the labor market, calculated above. The operating costs must be calculated separately, however. These operating costs include the manpower used to provide this training (such as teachers in the classroom, a supervisor during work training and administrative costs). Welfare payments on the other hand are not included. This is only a transfer of consumption and does not involve reduced production. However, this strategy does not take into account tax distortion arising from increased taxes.

The monthly costs of operating the VR programs are provided by the Norwegian Labor and Welfare Administration (NAV). In the case of WS, the wage subsidies to the employer are included. These subsides are transfers from NAV to the program providers

[7] See Uhttp://www.ssb.no/histstat/aarbok/ht-0901-lonn.htmlU for statistics about annual wage increase.

and do not reflect the actual operating costs. Hence, I will assume that the operating costs of WS are the same as the ones of WTO. In that case, the costs of WTO and WS are 1,190 NOK[8]. The operating costs of WTP, on the other hand, are considerably larger, at 9,208 per month[9]. Bear in mind, however, that these programs take place in protected environments, often in sheltered firms, where training is the main intention.

As for classroom training, the costs of AMO and EDU differ considerably. The operating costs of AMO are 7,766 NOK. Unlike the other programs, EDU is not financed by the employment office. In Norway, most public education is free of charge[10] and the costs of providing these programs financed through another budget. Therefore, the operating costs of EDU will be based on the financing system for higher education in Norway. This financing system includes a student component that captures the marginal cost of including one more full-time student. In the national budget for 2008, these constitute 2,972 NOK per student per month (calculated based on KD (2008))[11]. In addition, students receive a monthly transfer of approximately 362 NOK to cover book and equipment costs. In total, the monthly operating costs of EDU are 3,334 NOK.

The average costs of each program are calculated based on these monthly costs and the average program duration (from the simulation). From the second part of table 7, WTP is clearly the most expensive one, with an average cost of 117,000 NOK. Next, except for WTP, classroom training is more expensive than work training. The costs of EDU and AMO are 65,000 NOK and 42,000 NOK respectively, while the costs of WTO and WS are 12,000 NOK and 9,000 NOK respectively.

WS is the most successful of the VR programs in terms of net income (i.e. labor market income minus operating costs). During these six years the net income of an average participant is more than 256,000 NOK. This surplus is especially influenced by

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[8] All costs are inflation corrected to 2006 NOK, by a rate of 2.5%.

[9] This cost is calculated as the weighted average of several programs.

[10] There are a few private providers in the education sector as well, and any direct costs are paid by the employment office.

[11] Raabe (2005) reports the average monthly costs of education per student to be around 9,166 NOK (2004). However, these costs include both R&D among the educational staff as well as fixed costs (costs of buildings). For the rest of the analysis I base my calculations on the marginal cost as presented above.

the large effect on the employment probability and the non-existence of the lock-in effect. As mentioned in the survey in Martin (1998), several evaluations have shown that these effects may be upwardly biased due to dead-weight effects (i.e. employers use the subsidy to hire workers they would have hired anyway) and this criticism applies to my model as well. However, as discussed in Westlie (2008), this bias will only affect the on-treatment effect of WS, which captures the probability of a participant remaining at the WS provider after the funding ends (i.e. the direct transition). The after-program effect on the employment hazard should not be affected. So even if this criticism holds, the gain from WS is likely to be at least as large as that of the other programs.

Table 7
Costs and revenues from VR participation over a six-year period (2006 NOK)

| **Labor market income** | WTO | WTP | AMO | EDU | WS |
|---|---|---|---|---|---|
| Additional labor market income in ordinary employment due to program experience* | 77,137 | 11,054 | 71,180 | 120,428 | 266,030 |
| **Operating costs of programs** | | | | | |
| Average program duration (months) | 10.3 | 12.7 | 5.4 | 19.5 | 7.9 |
| Monthly costs | 1,190 | 9,208 | 7,766 | 3,334 | 1,190 |
| Total costs | 12,257 | 116,942 | 41,936 | 65,013 | 9,401 |
| **Net income (Income – Costs)** | 64,880 | -105,888 | 29,244 | 55,415 | 256,629 |
| | [33’, 89’] | [-121’, -95’] | [-13’, 63’] | [27’, 74] | [95’, 362] |
| **Production value of programs** | | | | | |
| # of months spent in program | 10.3 | 12.7 | 5.4 | 19.5 | 7.9 |
| Monthly production value | 9,765 | 9,176 | - | - | 10,310 |
| Total production value | 100,580 | 116,535 | - | - | 81,449 |
| **Net income + program production** | 165,460 | -10,647 | 29,244 | 55,415 | 338,078 |
| | [133, 189] | [-3, 22’] | [-13’, 63’] | [27’, 74] | [176, 445] |

Note: A 95 % confidence interval of the differences is reported in brackets [ ]. All effects are measured per participant. All numbers are in 2006 NOK.
* Calculated in table 6

The net income of EDU and WTO is 55,000 NOK and 65,000 NOK respectively. Note however, that EDU is evaluated at the marginal cost, which is considerably below the average cost of 9,630 NOK. In fact, by using the average of these two costs, the net income of EDU equals zero. On the other hand, due to the large program duration, the time horizon of six years may be too short to really capture the return from EDU. In a sensitivity analysis presented below, the simulation window is expanded to nine years. This has a substantial effect on the labor market return of the EDU program, increasing the net income of EDU to nearly 200,000 NOK.

The income effect of AMO also exceeds the operating costs which results in a net income of nearly 30,000 NOK. WTP, on the other hand, is the only program where the costs exceed the revenue, with a net revenue of -117,000 NOK. These costs are in fact almost equal to the total labor market income of 132,000 NOK (from table 6). These results are in line with the cost-benefit analysis of Danish ordinary labor market programs in Jespersen et al. (2007). In their study, wage subsidies generate the highest surplus, followed by public job training (which only covers part of the WTO) and classroom training (close to AMO). However, they report a negative surplus from classroom training.

In the calculation above, program participation is only considered as a cost. However, participants in work training programs are actual producing something. As an example, working in a grocery or a kindergarten in either WS or WTO adds some value to society. Jespersen et al. (2007) also include this value of output during participation in their cost-benefit analysis. The estimated model is not able to predict the value of this production directly, but the predictions of monthly earnings for each participant, with all program effects deducted, may work as a starting point. However, the program providers do not face all hiring costs and participants may therefore be accepted into programs even if they do not have the necessary qualifications for this particular type of work. In the last part of table 7, the monthly production value in work training programs is assumed to be 50 percent of the (potential) monthly earnings without program effects. This number is taken from WS, where this amount is paid by the employer.

This program production value should be carefully considered. For instance, both WTO and WS may be exposed to displacement effects (Martin (1998); Dahlberg and Forslund (2005)), i.e. program participants displace others who would have been hired if not for these programs. In addition, the program production value may have been taken into consideration when the program subsidies were determined. Put differently, the costs of operating these programs may actually be higher than those presented above, and the reason for admitting participants is that this production value covers these additional hidden costs. Nevertheless, table 7 also presents a calculation that includes program production value. This production value is almost identical for all three work training programs, at around 100,000 NOK. By adding this to the net income, WTO becomes far

more favorable than EDU. Furthermore, the negative surplus of WTP has all but disappeared. In fact, with a program production value above 70 percent of the potential monthly earnings, WTP would also yield a positive net income.

In this calculation all non-employed persons are assumed to have zero income. While this may be a valid assumption for those who end up on disability, it may be a bit rash in the case of those defined as temporary withdrawals from the labor market. Any attempt to distinguish between these two outcomes would benefit EDU, AMO and WS relative to WTO and WTP. This statement is based on table 14 in Westlie (2008) where the first three programs have a large negative effect on the disability probability while WTO and WTP in fact has a positive effect. The present model also shows the same pattern, but due to the similarity this has not been presented. Nor has the value of leisure been discussed in this analysis. Naturally, participants experience reduced leisure during participation and this may be seen as a cost. In addition, programs may affect future leisure. If programs affect pay per hour in the new job, participants may reduce the hours worked. As pointed out by Greenberg (1997), ignoring this will benefit programs that emphasize hours worked at the expense of programs that increase wages through pay per hour. However, although this analysis does not observe pay per hour, the program effects on monthly earnings are of little importance compared to the effects on employment probability and employment stability for all programs.

## 5.3 Sensitivity analysis – Costs and revenues within a 9-year horizon

Table 8 presents the costs and benefits over a nine-year period based on the same procedure as the one presented above. Naturally, expanding the simulation window to nine years increases the labor market revenue from all programs. WS is still the most successful one compared to the other programs, with an income effect of 377,000 NOK. This is an increase of 111,000 NOK compared to the calculation for six years reported above. EDU participants, however, experience an even larger increase of 144,000 NOK. Expanding the simulation window to nine years has in fact made EDU considerably more successful than WTO. If the program production value is included, however, the net surplus of WTO and EDU is roughly the same at around 200,000 NOK. AMO and WTP are least affected by the expansion of the time horizon. Revenues increase for both

programs, however. In addition, the net income of WTP is not significantly positive when we include the value of program production.

Table 8
Costs and revenues from VR participation over a nine-year period (2006 NOK) per participant

| | WTO | WTP | AMO | EDU | WS |
|---|---|---|---|---|---|
| Additional labor market income due to program participation | 130,209 | 32,409 | 105,436 | 263,874 | 376,938 |
| Operating costs of programs | 12,257 | 116,942 | 41,936 | 66,347 | 9,401 |
| **Net income (Income – Costs)** | 117,952 | -84,533 | 63,500 | 197,527 | 367,537 |
| | [46', 168] | [-112, -58'] | [-8', 132] | [85', 254] | [114, 557] |
| Production value of programs | 100,580 | 116,535 | - | - | 81,449 |
| **Net income + program production** | 218,532 | 32,002 | 63,500 | 197,527 | 448,986 |
| | [146', 268'] | [3', 59'] | [-8', 132] | [85', 254] | [195', 640] |

Note: A 95 % confidence interval of the differences is reported in brackets [ ]. All effects are measured per participant. All numbers are in 2006 NOK.

## 6. Concluding remarks

This paper analyzes the effect of vocational rehabilitation (VR) programs on labor market earnings. The earnings effect is separated into the effect on employment probability, the effect on employment duration and the effect on monthly earnings. The value of output during program participation is also considered. These effects are evaluated empirically by use of a mixed proportional hazard rate model on a set of Norwegian register data covering more than nine years. The VR programs are divided into five groups: work training in ordinary firms (WTO), work training in a protected environment (WTP), wage subsidies (WS), education provided by the employment service (AMO) and ordinary education (EDU). Furthermore, the effect of each program is allowed to differ depending on the characteristics of the program and the participants.

The findings indicate that all programs apart from AMO lead to improved job matches in terms of employment duration. Especially re-education into a new profession (EDU) where the health problem may be less of a burden, provides longer employment spells. All employment stability effects are strengthened by time spent in each program. In fact, increasing the program duration by one standard deviation results in a positive effect from AMO as well. In addition, participants older than 44 years experience stronger effects on employment duration from all programs relative to the younger ones.

Work training (WTO, WTP and WS) increases the monthly earnings of the participants by around 5 percent. This effect can largely be ascribed to male participants and participants with short-term illnesses. In contrast, classroom training (AMO and EDU) has almost no impact on monthly earnings. A single exception is that male participants experience a 2 percent increase from participating in EDU.

All programs increase the labor market income of their participants over a six-year period. However, the effect of WTP is not significantly different from zero. The program effect on the employment probability has larger impact on total earnings than the program effect on job quality. Furthermore, in line with the existing literature, the more similar to a real job, the more effective the programs are. Classroom training provided through the public educational system is also more effective than classroom training provided by the labor market office. These differences between programs may reflect signaling effects as well as more relevant training. Not surprisingly, the additional labor market income from program experience is sensitive to the number of years covered by the analysis. This applies especially to EDU, which has the largest effect on VR duration, thereby prolonging the time until employment actually occurs. Expanding the evaluation window from six to nine years doubles the additional income caused by EDU participation.

For all programs, except WTP, the income generated exceeds the operating costs. WS generates the largest surplus, followed by EDU and WTO. The relative strength between the latter two depends on the number of evaluation years and how the production value during participation is valued. Over a nine-year period and including the production value generated by participation, the net surplus of a participant in either of these programs amounts to around 200,000 NOK. Using the same criteria the surplus from WS is nearly 450,000 NOK per participant. This surplus, however, may be upwardly biased if the WS participants would have been employed by the program provider even without the subsidies (dead-weight loss). Anyway, this paper argues that the surplus of WS exceeds the one of WTO even if this possible bias is removed. One final thing worth noting is the possible bias in the program production value. If this production value compensates the cost faced by the program provider, or if participants displace other workers, this value may be upwardly biased. Reducing the impact of the program

production value would clearly benefit EDU relative to WTO and WTP. Based on these arguments, this paper concludes that WS, WTO and EDU all produce large surpluses. The relative strength of these three programs however rests on assumptions regarding program production value and dead-weight loss, which is not completely examined within the model. The results for AMO and WTP, on the other hand, are less uplifting, although AMO produces a surplus of more than 30,000 NOK over a six-year period (although not statistically significant). A surplus from WTP on the other hand, rests entirely on the program production value, and even then it is close to zero over a nine-year period.

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