Summary

X-inefficiency and subsidy systems in non-profit organisations

The basis of this dissertation is the idea that actors within organisations will strive for private goals, alongside the formal goal of the organisation. Examples of such private goals, mentioned frequently in the literature, are on-the-job-leisure and a preference for high quality. Whether the actors can fulfill their private preferences depends on the environment in which they or their organisation have to function. This study focuses on non-profit organisations that charge a fee for the services they provide but have government subsidies as their main source of income. The relationship between the government agency that grants the subsidy and the organisation that receives it is that of a principal to its agent.

Important features of the agent's environment are (1) his advantage in relation to the principal in terms of information about the costs and the quality of the service, (2) his discretion based on his monopoly position on the output market and unclear hierarchical lines and (3) lack of adequate incentives and institutions that would encourage efficiency. The environmental factors may lead to substantial discretionary power in the hands of the agent which he can use to pursue his private ends. For the principal, this implies X-inefficiency, or slack: the costs of the service the agent is supposed to deliver are higher than is necessary.

In this context, when the agent has discretionary power, it has been investigated how the principal can provide his agent with an incentive to act in a more X-efficient manner by means of a sophisticated subsidy mechanism. The types of subsidy that have been analysed are: input subsidy, lump-sum subsidy, output subsidy and revenue subsidy. In the theoretical part of the study their impact on output and on slack, or X-inefficiency, has been investigated. Next, the model has been used to predict the impact of changes in the subsidy regime for adult residential education in The Netherlands ('Vormingswerk in Internaatverband', VIV), which occurred in the period 1969 to 1985. In the empirical part of the study, the actual impacts of changes in the subsidy regime on output and X-inefficiency of VIV organisations have been identified with an econometric model and the hypotheses derived in the theoretical analysis have been tested by comparing them with the econometric results.

The theoretical model is relatively simple. The non-profit organisation maximizes a utility function, which contains both the formal goal of the organisation ('delivery of services') and the private goal of staff members in the organisation ('slack'). Maximization takes place under a number of constraints, such as the cost and demand functions. The study concentrates on how a
change in the constraint set by the subsidy regime affects the choices of the organisation regarding production and slack or X-inefficiency. In this way, the theoretical model can predict what the consequences are of a change in subsidy system.

With complete subsidization of inputs, the agent can increase both the level of production and X-inefficiency to high levels, as all the costs associated with these goals are compensated by the principal. Output can be increased to the level at which the demand of clients is satisfied at the zero price. The output subsidy sets a limit to the cost per unit of production. If the efficient marginal cost is lower than the output subsidy rate the agent will increase output to saturation point. The lump-sum subsidy is the only regime which effectively limits the total amount of subsidy to which the agent is entitled. Output depends on how much of the subsidy budget the agent decides to use for the formal goal and how much he assigns to his private goal. The different subsidy regimes with regard to output and X-inefficiency can only be compared if further budget restrictions are added in the case of input and output subsidy. Output subsidy with a limit to the total subsidy appears to be the best mix of systems from the point of view of the principal: it limits the relative X-inefficiency and restricts the total subsidy.

While complete subsidy financing is most usual for bureaucratic organisations, partial subsidization in combination with financing out of prices is the usual budget regime for private non-profit organisations. The monopoly demand function of the clients sets an extra restriction, limiting the possibilities open to the agent. The analysis suggests recommendations for policy makers to improve X-inefficiency. Output subsidy should always be the number one choice for the principal, since output is highest and absolute X-inefficiency is lowest. Price elasticity of demand determines which subsidy regime is the next best option. Under inelastic demand the lump-sum subsidy is the second best choice and under elastic demand, the input- and/or revenue subsidy.

The intuition of this result is as follows. With elastic demand a reduction in price not only increases output but also increases the total revenue of selling output to clients. Extra revenue is spent as extra cost (efficient cost plus slack). With input subsidy the extra revenue brings in additional subsidy. With lump-sum subsidy the additional revenue from selling output does not entitle the organisation to extra subsidies. Therefore, the opportunity cost of output in terms of slack is lower with input subsidy than it is with lump-sum subsidy and there is an incentive to increase output relative to slack. With inelastic demand, on the other hand, the incentive works in the opposite direction. In this case there is a drop in the total revenue of selling output if one unit of output extra is sold. Total costs have to be reduced and with input subsidy the organisation receives less subsidy. With lump-sum subsidy the total subsidy would not have changed. A transition from lump-sum subsidy to input subsidy provides the agent with an incentive to substitute slack for output, because of the new higher opportunity cost of output; hence the relative X-efficiency deteriorates. The principal requires supplementary information about the demand situation in order to be able to make the right choice between input and lump-sum subsidy. Finally, it appears that the revenue subsidy works in the same way as the input subsidy.
As an extra explanatory variable, we introduced and analysed the impact of changes in demand on output and X-inefficiency. In case of pure forms of subsidy systems there is always a positive effect on output. As a result of substitution and income effects with opposite signs, the impact on relative and absolute X-inefficiency can be positive, negative or neutral.

It is interesting to find out whether the conclusions of the theoretical model are similar to those found in the literature. The literature on the efficiency of subsidy systems mentions the output subsidy as the best option: a clear incentive to produce output for a reasonable compensation, fixed in advance. On the other hand, the input subsidy provides no incentive to produce efficiently as extra costs will be subsidized. The lump-sum subsidy lies between the output and the input subsidies.

These conclusions are similar to those derived from our model with complete subsidy financing (the bureaucratic non-profit organisation type). In our theoretical analysis, we have extended and amended the theory: with partial financing from subsidies and with a price elastic demand for output it is not the input subsidy that is the least efficient type of subsidization but the lump-sum subsidy.

A major question is whether our hypotheses about the efficiency of different types of subsidization hold in the real world. The changes in the subsidy regime for adult residential education in the Netherlands (VIV) in the late seventies and early eighties provide an experiment and opportunity to test the hypotheses.

VIV is carried out by non-profit-organisations in a monopolistic market setting. They are mainly financed out of public subsidies (70%) and for the rest out of prices. As a first step in the analysis, we have to explain that indeed the relation between VIV and the Ministry that subsidizes its activities has the characteristics of a principal-agent relation with information and power advantage for the institutions, creating an environment in which X-inefficiency can thrive. We have observed that, especially in the ‘good’ years in the seventies with the input subsidy regime, the course load (X-efficiency indicator) slowly but steadily decreased. From 1969 to 1985 the drop in the mean course load was 19 percent. We have also observed that there are considerable differences in the course load between institutions which amount to 32 percent in 1975 between the institution with the mean highest course load and the institution with the mean lowest course load in the period under consideration. This suggests that the constraint concern within VIV institutions with regard to the course load was not very strong and differed largely between institutions. The actual changes in the subsidy scheme will now be described.

In the period 1969-1981, financing of VIV was based on an input subsidy regime with co-financing out of prices. Until 1979, the regime was a pure input subsidy, but between 1979 and 1981 the VIV was confronted with a mixed subsidy regime because a lump-sum restriction was added to the input subsidy scheme. In 1976 the legal basis of the input subsidy was renewed. The formal tariff of the input subsidy was raised from 50-60 to 70 percent. However, our analysis
clearly shows that in fact the tariff did not increase at all, but rather showed a slight decrease. In the theoretical analysis, we have assumed that the new input subsidy regime implied an unchanged or slight decrease in the input subsidy tariff.

In 1979, a lump-sum restriction was added to the input subsidy by setting the maximum subsidy budget at the same level as the subsidy budget of the previous year. This implies a budget neutral transition of a pure input subsidy to a mixed system of an input subsidy to which a lump-sum restriction is added. This was continued in the years 1980 and 1981.

The next change was more rigorous. In 1982, a regime of output subsidy with a new legal basis was introduced for VIV. However, a closer look reveals that it too was a mixed form of subsidy as a restriction was set to the total amount of units being subsidized. When the organisation produced more, the system worked as a lump-sum subsidy. Only for levels of output below the maximum the organisation was subsidized according to output. The transition was budget neutral, that is to say, the lump-sum limit was equal to the budget of 1981. It implies a budget neutral transition of an input-cum-lump-sum subsidy to an output-cum-lump-sum subsidy.

The new output subsidy regime had been in place for somewhat more than one year when massive cuts in the subsidy budget followed in 1983 and 1984. The (net) budget cuts took the form of changes in the output subsidy tariff and decreases in the maximum number of subsidized units. Both had an effect on the lump-sum restriction and the changes in the tariff also affected the output subsidy restriction. Therefore the (net) budget cuts altered both components of the mixed subsidy regime.

The theoretical model has been applied to predict the impact of the subsidy regime changes on output and X-inefficiency for VIV in the period 1969-1985. The applied econometric method is the 'Pooled Least Squares' method, which combines cross-sectional data with time series (panel data). In three regression models the explained variables - output, and absolute and relative X-inefficiency - are explained by fixed or a priori differences (fixed effects) between VIV organisations, changes in the subsidy regime and budget, and changes in demand. This is called variant I. A graphical analysis of the confrontation between the actual development of output and X-inefficiency and the predicted development of these variables shows, among others, that a trend could have been at work in the observed period, both regarding production and X-inefficiency. For this reason, we also included a trend variable in the regression model; this is called variant II. As both variants suffered from autocorrelation (Durbin Watson statistic < 2), an autoregression factor (of the first order AR(1)) has been included in the regression models of both variants. The results with these variants Ia and IIa show an acceptable Durbin Watson statistic. As the results are not always similar, both variants have been used for testing the hypotheses.

In order to test the hypotheses (in econometric terms), the concepts subsidy, demand, output and X-inefficiency had to be made operational and data had to be collected and constructed. The output of the VIV organisation (d,) has been made operational by two indicators: the number of mornings, afternoons and evenings (parts of the day) that the courses last (odd) and parts of the

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day multiplied by the number of students taking part during these parts of the day (csdd). X-inefficiency is derived from the output per staff member (the course load). The X-inefficiency per staff member is defined as the maximum course load found in the analysed period during one year in one of the institutions (not in the sample), minus the actually realized course load of the institution concerned. Multiplying this value by the total number of staff members gives the absolute amount of slack or X-inefficiency (d_r) of the institution. The relative X-inefficiency is the absolute X-inefficiency over the total production of the institution (d_r/d_t). Changes in subsidy regime have been made operational by dummy variables and demand by the national income. All variables expressed in financial terms have been translated into real values using the changes in prices for private or household consumption.

We shall now discuss the hypotheses or predictions about the impact of actual changes in the subsidy regime on output and X-inefficiency in VIV for the period 1969-1985 and compare them with the results of the econometric results with both variant Ia and IIa.

For an increase in the tariff with the input subsidy the theory predicts some unambiguous outcomes. Under elastic demand conditions, the absolute X-inefficiency will certainly increase, but production can rise, fall or remain unchanged; therefore, the relative X-inefficiency can rise, fall or remain unchanged. With an inelastic demand, the theory predicts that production will certainly increase, but that the absolute X-inefficiency could rise, fall or remain unchanged and, therefore, the relative X-inefficiency can rise, fall or remain unchanged. It is quite obvious that if the input subsidy tariff remains almost unchanged, as was the case in 1976, this will have no effect on either output and X-inefficiency. The econometric result (with both variants) shows that the new input subsidy had no significant effect on either output or X-inefficiency. Thus proving the hypothesis that the new input subsidy arrangement did not really change and for that reason had no effect on output and X-inefficiency.

The theory predicts that the next change in subsidy regime, budget neutral addition of a budget limit to the existing input subsidy in 1979, will have no effect on production and X-inefficiency. The institutions had already made their optimal choice of output and X-inefficiency under the pure input subsidy regime. The budget neutral addition of the lump sum subsidy did not provide them with an incentive to change their position. However, the regression results do not fully support this prediction. With variant Ia, the hypothesis that there will be no effect on the number of courses (csdd) has to be rejected. According to variant Ia (with csdd indicator), it appears that the new system made the institutions decide to cut output. On the other hand, the hypotheses that at the same time there will be no effect on the absolute and relative X-inefficiency could be substantiated. (Variant Ia with csdd indicator and variant IIa both with csdd and csdd indicator gave the same total score for the explanatory variables).

The most spectacular change in subsidy regime in the observed period occurred in 1982: the termination of the input subsidy regime and its replacement by an output subsidy, leaving the lump-sum restriction in place. Dependent on the elasticity of demand, two series of hypotheses
about the effects on output and X-inefficiency could be derived. Under elastic demand conditions, the theory predicts no change in output and X-inefficiency because no better options for \( V \) became available. The test results with regression variant IIa are in accordance with these predictions and, therefore, also with the hypothesis that demand for courses is elastic.

On the other hand, if demand is inelastic the theory predicts that the change in subsidy regime will lead to larger production of courses and lower absolute and relative X-inefficiency. The explanation for these differences is that the lump-sum restriction added to the output subsidy was the binding constraint. The change in subsidy regime - which formally was a change from input to output subsidy - actually worked out as a change from input to lump-sum subsidy. As was explained earlier, the lump-sum subsidy is more efficient than the input subsidy under inelastic demand conditions. The results of regression variant Ia are in agreement with the assumption of inelastic demand, that is to say, the change in subsidy regime in 1982 had a positive impact on output and on relative X-efficiency. Moreover, these conclusions are backed up by additional information. For this reason we consider variant Ia the most trustworthy. The additional information shows that the production of the institutions was larger than the subsidized number of courses during the whole period of output subsidy with lump-sum constraint. Therefore, the lump-sum restriction was effective during the whole period while the output subsidy was not. This situation is only in accordance with a change in the mixed regime under an inelastic demand. Acceptance of the predictions implicates at the same time acceptance of the hypothesis that demand for courses is price inelastic.

If the found positive effects on relative X-efficiency could in effect have been attributed to the output subsidy, then this is good news for the Ministry that implemented the change because these effects were expected and aimed at. However, as was stated earlier, the theoretical analysis indicates that the reduction in X-inefficiency has to be attributed to the removal of the input subsidy while keeping the lump-sum restriction in place, and not to the introduction of the output subsidy, as the Ministry claimed. Notwithstanding the actually improvement of the relative X-efficiency, the positive effect on X-efficiency could even have been larger, if the government had settled for an unmixed output subsidy without additional lump-sum restriction.

The massive budget cuts in 1983 and 1984 resulted in a decrease in the maximum subsidy budget, while maintaining the lump-sum restriction in place as the binding constraint. The theory predicts a decrease in both output and absolute X-inefficiency. The regression analysis with variant Ia (cdd indicator) does indeed show a significant drop in output and absolute X-inefficiency due to the budget cuts (variant Ila with cdd indicator, the effect on output is not significant). With both variants Ia and Ila with csdd indicator, the effect on output (cdd) is not significant. This can easily be explained as the number of clients per course has increased, so that the revenue from clients is secured. An intriguing result, more specific than could have been predicted by theory, is that the budget cuts have had the effect of increasing output per unit of subsidy. However, the regression analysis does not show a positive effect on relative X-efficiency.

According to the regression variant Ia, which we consider to be the most trustworthy, the
decrease in relative X-inefficiency, which means an increase of course load per staff men the years 1982, 1983 and 1984, is attributable to the change in subsidy regime. The cut subsidy budgets during this output subsidy period did not significantly improve the rel efficiency of the work. What was significant was their negative impact on product absolute X-inefficiency.

The analysis of the mixed systems predicts a positive effect of a change in den output, but with one exception: under elastic demand with input-cum-lump-sum subsidy the possibility of a negative effect on output, accompanied by positive effects on relat absolute X-inefficiency. The econometric test of the effects of demand in the three : periods gives mixed results. The predicted positive impact on output has been found, impact is not always significant. There is one clear exception: the third period with var shows a negative and significant effect of demand on output. Variant Ila confirms significant negative trend in output and a significant positive trend in absolute X-inefficiency at work during the whole period; a positive trend in relative X-inefficiency is also found, is not significant.

In summary, the analysis of the subsidy changes for VIV in the period 1969-1985 and the t of the hypotheses (with econometric variant Ia and cdd indicator) produced with the folc results.

The prediction that the new input subsidy arrangement in 1976 did not result in a ch in input tariff, hence that no effects on production and X-inefficiency were to be expected been confirmed by the econometric test.

Similarly, the theory predicts that the budget neutral addition of a lump-sum restrictic the input subsidy in 1979 will not affect output or X-inefficiency. The hypotheses regarding zero effect on absolute and relative X-inefficiency could be accepted, but regarding output hypothesis had to be rejected because, as we have observed, the econometric test identifies significant decrease.

The output subsidy period (1982-1984) stands out as being the regime about which most unambiguous predictions could be made. The model predicts that with inelastic demand courses the change in subsidy regime in 1982 did have a positive impact on output and redu relative X-inefficiency; the subsequent cuts in output subsidy did reduce output of courses as as absolute X-inefficiency. All these predictions are confirmed by the econometric test. explanation probably lies in the fact that the change from input-cum-lump-sum into a constr output subsidy regime was the most outspoken change in the whole period, and in the fact the cuts in the total subsidy budget of VIV that followed were massive, namely 16 perc average.