Preface

How time flies when life is interesting! It is already more than three months ago that I started as director of NAKE. It was a flying start as already in my second week the 27th NAKE Workshop took place at the University of Amsterdam. Luckily, everything was perfectly organized by Ben Heijdra and Janna Mesker, assisted by the local organizers, Albert van der Horst, Bas Jacobs and Henk van de Velden. So my main duty was to be a good host and take the lecturers out for dinner etcetera. Because they formed a very pleasant company this was not a very hard task. Even more important than being good table company, the visiting professors Ben invited for this workshop turned out to be very good lecturers indeed. In this issue of *NAKE Nieuws* you find three reports on their lectures. **Thomas Dohmen** (UM) has written a very good report on the lectures by Dale Mortensen on "The flow approach to the labour market". The second report is by **Hong Bo** (RUG) who writes very lucidly on the Amsterdam lectures by Tony Atkinson on "The economics of the welfare state". The last report in this issue of *NAKE Nieuws* is by **Adriaan Soetevent** (RUG), who managed to summarize Richard Blundell's lectures on "Microeconometrics and household behaviour" in a very clear and concise report. I saved the report on the provocative and stimulating lectures by Ken Binmore for the next issue of *NAKE Nieuws*, not because I have not yet read the reports but to give you a reason to watch out for next issue of this periodical.

One of the other pleasant things I was allowed to do at the December 1999 workshop was handing out NAKE diploma's[1]. The following people received this valuable piece of paper:

Koos Gardebroek	Gijsbert van Lomwel
Petra Hellegers	Maria Nijnik
Albert van der Horst	Jolanda Peters
Thijs Knaap	Maarten van Ravenswaay
Udo Kock	Arno van der Vlist
Emiel Maasland	Aico van Vuuren

I would like to congratulate them once more with this achievement.

A lot has happened in the three months that passed since the workshop. Firstly, the NAKE secretariat was moved from Groningen to Tilburg. (See the opposite page for

[1] Thijs Knaap mailed me some nice pictures of the workshop dinner. You can find them on the NAKE homepage.

the new address). This move made it inevitable to take leave of Janna Mesker. I would like to thank her for all she did for NAKE. She did a great job and we will all miss her. As of February, Marty Roovers is the secretary of NAKE. You can turn to her for all questions regarding NAKE activities. For a picture of her, see the NAKE-homepage.

The second thing that happened since my start as director of NAKE was the launching of a completely new homepage where you can find all information on NAKE activities. The new address is **http:/few.kub.nl/nake**.

The third thing that I would like to mention here is that I managed to contract three distinguished economists to complete the team for the June workshop. The provisional programme for this workshop can be found on page 4. You can now register for this workshop on the NAKE homepage. Note that, in contrast to what was announced before, the June workshop will not be at the Free University in Amsterdam, but at the University of Groningen. This move is due to the European football championship which takes place at that time in Amsterdam.

Finally, we managed to update the list of courses offered by NAKE Fellows. You can find this list in the middle section of this *NAKE Nieuws*.The outlines of (almost all) these courses can be found on the NAKE homepage. Between 16 and 24 courses can be scheduled for inclusion in the Utrecht teaching programme for 2000-2001. I can only design a well-balanced and attractive programme if the potential clientele reveals its preferences. For that reason the list of courses also serves as a (removable) **QUESTIONNAIRE.** I would like to ask all (potential) course participants to fill out the questionnaire and return it to the NAKE secretariat **before May 5**. Even if you are not sure that you will actually enrol when time comes around, please let us know what you want. Of course, suggestions for new (i.e. non-existing and currently unplanned) courses are also welcome. We will try to find an appropriate NAKE Fellow to develop and teach the course of your liking. The provisional teaching programme for the academic year 2000-2001 will be announced some time in June on the Nake homepage.

Best regards,

Lex Meijdam

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NAKE WORKSHOP

5 - 9 June 2000

University of Groningen

During the week from Monday, June 5th to Friday, June 9th, the Netherlands Network of Economics (NAKE) will organize a Ph.D. workshop. Four distinguished economists will teach intensive courses on microeconomics, macroeconomics, econometrics and public economics. Each course consists of five lectures spread out over five days.

Courses

Ernst Fehr, Institute for Empirical Research in Economics, Zürich, Switserland

'Behavioral Microeconomics'

Oded Galor, Brown University, Providence, USA

'From Stagnation to Modern Growth:
Population, Technology and Inequality in the Process of Development'

Joel L. Horowitz, University of IOWA, USA

'Bootstrap methods in econometrics'

Hans-Werner Sinn, University of Munich, Germany

'Systems Competition - A Construction Principle for Europe?'

Course outlines will be placed on the NAKE Homepage as soon as they are available.

PROVISIONAL PROGRAMME NAKE WORKSHOP
GRONINGEN, 5 – 9 JUNE 2000

Monday June 5	**Tuesday June 6**
10.00 – 11.00 registration/coffee 11.00 – 12.30 Fehr *12.30 – 13.30 Lunch* 13.30 – 14.45 Horowitz 15.00 – 16.15 Galor 16.30 – 17.45 Fehr *17.45 – 19.15 Welcome reception*	09.00 – 10.45 Horowitz 11.00 – 12.45 Galor *12.45 – 14.00 Lunch* 14.00 – 15.45 Sinn 16.00 – 17.45 Fehr
Wednesday June 7	**Thursday June 8**
09.00 – 10.30 Galor 10.45 – 12.15 Sinn *12.15 – 13.30 Lunch* 13.30 – 15.00 Fehr 15.15 – 16.45 Horowitz 16.45 – 18.15 Private consultations	09.00 – 10.45 Fehr 11.00 – 12.45 Sinn *12.45 -- 14.00 Lunch* 14.00 – 15.45 Horowitz 16.00 – 17.45 Galor *20.00 Workshop dinner*
Friday June 9	
09.00 – 10.30 Sinn 10.45 – 12.15 Galor *12.15 – 13.30 Lunch* 13.30 – 15.00 Horowitz 15.15 – 16.45 Sinn *16.45 - ... Closing drinks*	

Equilibrium Labor Market Flows
Dale T. Mortensen

Report by Thomas J. Dohmen, Maastricht University[¤]

1 Introduction

This is a report on the lectures on Equilibrium Labor Market Flows given by Dale T. Mortensen at the NAKE. Workshop in Amsterdam in December 1999. Dale Mortensen gave a good overview of the "°ow approach to labor markets", an important sub¯eld of labor economics. He considered a simple job search model to introduce the main concepts and tools of the °ow approach in some depth, which enabled him to cover extensions of the model in a brisk but clear way. These tools were subsequently applied in an equilibrium model of unemployment which is characterized by two sided search. The basic framework was extended to incorporate, inter alia, job creation and job destruction, to explain stylized facts on worker reallocation, and to analyze labor market policies. Finally a search model with wage posting was presented which can explain wage dispersion. In this report I follow a similar thread as in the lecture and choose to describe the basic framework in some detail while sketching possible extensions.

2 A Simple Model of Job Search

The key idea of equilibrium labor market °ow models is that labor markets are characterized by search and recruiting frictions. A job seeker is not informed about all existing job o®ers, but receives an o®er at random intervals. Upon arrival of an o®er, a decision has to be made whether to accept the job at the o®ered wage or reject it and search further. Similarly, ¯rms have to decide whether or not to post vacancies. In a simple version of a job search model, a number of simplifying assumptions are made.

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It is assumed that job offers arrive following a Poisson process with arrival rate λ in continuous time models, while job offers arrive with probability π in each period in discrete time models. This offer is a random draw from the wage offer distribution with distribution function $F(W)$. Job seekers know the offer distribution and hence the probability that the next job offer is more favorable than the current. While job seekers also know the rate at which a job offer arrives, they are uncertain about the exact timing and the wage, W, that will be associated with it. Next, it is assumed that job seekers enjoy some benefit b in each period of search, but incur a search cost c. Agents discount the future at rate r.

2.1 A Simple Stationary Job Search Model

Only transitions from employment to unemployment and vice versa are possible in a simple version, so that on-the-job search is precluded. Moreover, separations are final, i.e. there are no recalls. To greatly facilitate the mathematics, the simple model assumes stationarity, meaning that the parameters of the model (F, b, c, r, and λ or π) are constant over time. Unemployed individuals maximize the expected present value of their income over a finite horizon. Solving the model requires to determine an optimal stopping strategy, which maximizes the expected present value of acceptable employment net of the accumulated costs of search. An offer is acceptable, if and only if the wage W exceeds the value of the search option U_t, where U_t is given by

$$U_t = \frac{1}{1+r}\left[\begin{array}{c} b - c + (1-\pi)\,U_{t+1} \\ +\pi \int \max\langle \tilde{W}; U_{t+1}\rangle dF(\tilde{W}) \end{array}\right] \tag{1}$$

and $U_T = 0$ in the finite horizon case with discrete time. This can be solved by backward induction. In a discrete time stationary environment model, one can use the property that $\lim_{t\to\infty} U_t = U$.to obtain the infinite horizon solution for the reservation value U, which solves

$$U = \frac{b-c}{r+\pi} + \frac{\pi}{r+\pi}\int \max\langle \tilde{W}; U\rangle dF(\tilde{W}). \tag{2}$$

Similarly, one can solve for the reservation value in continuous time models. The assumption that offer arrivals follow a Poisson process with rate λ is useful because it conceptually connects the model with discrete time and the model with continuous time. The reservation value that follows from equation (1) approximates the continuous time solution with offer arrivals following a Poisson process when the time period becomes sufficiently small. In fact, the reservation value has to satisfy the following equation (in the limit)

$$rU = b - c + \dot{U} + \lambda\int \max\langle \tilde{W} - U; 0\rangle dF(\tilde{W}). \tag{3}$$

in the finite horizon case. In the infinite horizon model a unique solution to the Bellman equation for U exists satisfying

$$U = \frac{b - c}{r + \lambda} + \frac{\lambda}{r + \lambda} \int \max\langle \tilde{W}; U\rangle dF(\tilde{W}): \qquad (4)$$

The last two equations have the familiar structure of an asset pricing equation. The return to the "asset" U equals the sum of a utility flow in an interval, the expected capital gain in the interval and an option value. The option value arises from the fact that an offer can be rejected if it falls below the reservation wage. This essentially truncates the distribution of future income flows. The reservation wage, W^R, is the smallest acceptable wage offer which satisfies $W^R = rU$, such that the optimal strategy can be characterized by a reservation wage given by

$$W^R = b - c + \frac{\lambda}{r + \lambda} \int_{W^R}^{\tilde{W}} \max\langle w - W^R\rangle dF(w) \qquad (5)$$

The reservation wage rises with increases in b and λ, but is decreasing in c and r. Moreover, the larger the variance of the offer distribution, the larger will be W^R, as the option value increases. A job seeker becomes more likely to wait for another offer the larger is the probability that it is higher, and the larger is its expected value given that it is higher than the current offer.

The reservation wage does not depend on elapsed unemployment duration, a result of the stationarity assumption. Since the reservation wage is constant, the exit rate out of unemployment is constant, too. The exit rate θ is defined as the product of the job arrival rate and the conditional probability of accepting an offer which is in turn determined by the job offer distribution, i.e. the probability that an offer exceeds the reservation wage. But the job offer distribution is assumed to be constant as a result of stationarity and hence the hazard rate for the transition from unemployment to employment is constant.

This standard job search model can be extended to more realistically account for a number of features of labor markets. One could relax the stationarity assumption and allow some structural parameters to vary over time. The offer arrival rate may, for example, exhibit negative duration dependence because of a stigma effect on long-term unemployed. Alternatively parameters may change because of policy chances or business cycle effects. These are common examples of unanticipated nonstationarity.

2.2 Anticipated Nonstationarity

There are situations in which nonstationarity is anticipated. As an illustration, Mortensen analyzed the model when unemployment benefits are paid only for a finite period, as is the case in the U.S. Agents anticipate benefits b to change. As a result, the reservation wage falls at the end of the benefit period. The solution proceeds by noting that the reservation wage is stationary after exhaustion of the benefit period. During the benefit period, the value of unemployment, and hence the reservation wage, is determined by an asset pricing equation. The value of unemployment U must fall, i.e. the "capital gain" must be negative as the return of the asset, i.e. the stream of benefits, falls to zero at time T, because the exhaustion of benefits is anticipated.

In models with anticipated nonstationarity, the optimal strategy of job seekers can be characterized by a reservation wage function $W^R(t) = rU(t)$ which is a differential equation of the form

$$\frac{dW^R(t)}{dt} = (r+\delta)\begin{bmatrix} rW^R(t) + \delta W^R(0) - (r+\delta)(b-c) \\ -\lambda \int_{W^R(t)}^{\bar{w}} [w - W^R(t)]dF(w) \end{bmatrix} \qquad (6)$$

where δ is the separation rate. This differential equation has a unique solution, given some boundary condition, which derives from the assumption that the model is stationary for large enough t: In the example considered in the lectures, the model is stationary after the benefit period is exhausted at time T. We can determine the stationary value of the reservation wage W^{R*} for $t \geq T$. Using the boundary condition $W^{R*} = W^R(T)$, the differential equation (5) can be uniquely solved.

2.3 Other Extensions: Endogenous Search Intensity, Search on the Job and Job Shopping

The simple job search model can be extended to account for endogenous search intensity. This is readily done by making the offer arrival rate and search costs a function of search intensity. One can assume, for example, that the arrival rate is proportional to search effort, s, i.e. $\lambda(s) = \lambda s$, while search costs are given by $c(s)$ satisfying $c''(s) > 0$. Such a model implies that search intensity falls when benefits rise.

Another important feature of labor markets are job-to-job transitions such that many new hires do not experience a spell of unemployment. This has motivated the development of repeated search models in which workers can search for better jobs after having accepted a job offer. A simple model with on-the-job search assumes a stationary environment where employed search is similar to unemployed search.

An employed worker then receives an offer at rate λ_1 while an unemployed job seeker receives an offer at rate λ_0. If the two rates are the same, the reservation wage equals the benefit level. As soon as an offer exceeds b, it is accepted because the probability of receiving a better offer in the future is not affected. However, if offers arrive at a lower rate when employed, the reservation wage is higher than b because it pays to wait as the probability of obtaining a better offer is higher when unemployed. The size of this mark-up on benefits is determined by the offer distribution and the difference between arrival rates.

The job separation rate exceeds the exogenous separation rate of the simple model with unemployed search only. The difference is due to the rate at which workers leave for other employers, which is equal to the product of the job offer arrival when employed and the probability that the wage exceeds the current wage.

Another extension of the model takes account of the phenomenon of "job shopping", which refers to the empirical fact that young workers experience many short job spells separated by unemployment spell. This can be modelled by assuming that the marginal product of an unexperienced worker in a given job is not known but that only the mean of the distribution is known. After a period of expected length $1/\eta$, the true productivity is observed and the worker separates if the value of unemployment is larger. Hence separation rates for inexperienced workers exceed those of experienced workers by η times the probability that the actual wage is smaller than the reservation wage.

3 Models with Equilibrium Unemployment

3.1 Two Sided Search

Mortensen introduced a search model with equilibrium unemployment, which works as follows. The economy consists of workers and employers. Workers seek jobs while employers can post vacancies. When a job-seeking worker meets an employer who has posted a vacancy, they decide whether to form a match that has some value X, which is drawn from a distribution F. To satisfy individual rationality, the worker and the firm only form the match if the share that each of them receives, $W(X)$ for the worker and $J(X)$ for the firm, exceeds the respective values of search, U for the worker and V for the firm. The value of search to the worker is described by equation (1). The value of search to the employer, V, solves

$$rV = \eta\left[\int \max\langle J(X); V\rangle dF(X) - V\right] - c; \qquad (7)$$

where c is the cost of posting a vacancy and η is the frequency with which an employer encounters workers seeking a job. Assuming that utility is transferable, such that $X = W(X) + J(X)$, a match will be formed iff the condition $X \geq U + V$ is satisfied. The reservation product R, which is defined as the minimum value of a match required to be accepted by the worker and the employer, is therefore given by $R = r(U + V)$.

The wage schedule $W(X)$ results from a rule to split the surplus that the match creates above the sum of the reservation values. It is often assumed that the wage schedule $W(X)$ is determined by a generalized Nash bargaining game, where U and V are the threat points for the worker and the firm respectively[1]. The resulting wage compensates workers for the forgone value of unemployment, rU, and pays in addition the fraction β of the surplus, where β is the (exogenous) bargaining power of workers. Since the wage rate, $w(x)$, is the money flow associated with employment, the value of employment $W(X)$ is given by $w(x) = rW$. Therefore we obtain

$$w(x) = rU + \beta[x - rU - rV]. \qquad (8)$$

Other mechanisms for splitting the surplus can be formulated, which may give rise to other wage schedules. In fact, any division of the rents that satisfies individual rationality is possible. Alternative mechanisms include, for example, strategic bargaining games as described by Rubinstein (1982). The expected wage and hence the wage schedule is the same as in the generalized Nash bargaining game under the following rules: The worker is allowed to make a wage demand with probability β. After an offer is made the other party decides whether or not to accept. Given rejection the bargaining continues as long as the surplus remains positive, but both parties discount future returns at rate r. Alternatively, the same outcome obtains if negotiation stops in case of rejection and worker and employer both search for an alternative partner. However, other outcomes can result in general when the rules are changed, for example allowing for search during bargaining or introducing a breakdown possibility. Mortensen (1999a) discusses such issues in more detail and refers to the relevant literature.

3.1.1 The Matching Technology and Participation Assumptions

So far it has been described what happens when a worker encounters an employer with a vacancy, but it is not clear how and why they meet nor who searches. The matching technology and the participation assumptions are crucial elements of search models.

The matching technology relates the search and recruiting activities. Clearly, the flow rate at which unemployed workers meet vacancies must equal the rate at which employers with vacant jobs meet job-seeking workers. Since an individual unemployed

[1] See for example Pissarides (1990) and Mortensen and Pissarides (1994).

worker receives an offer at rate λ, the aggregate rate at which job-seeking workers meet vacancies is given by λu, where u equals the number of unemployed. If η is the rate at which an employer with a vacancy meets a job seeker and v represents the number of posted vacancies, then the matching technology, $M(v;u)$, satisfies by definition

$$\lambda u \equiv M(v;u) \equiv \eta v. \qquad (9)$$

It is not sufficient to specify the matching function in an equilibrium model. A description of a search equilibrium requires the specification of u and v and the participation values of workers and employers, U and V. While the participation values U and V are generally determined as described above, different assumptions can be made about the specifics of unemployment and vacancy determination. One approach is to assume an unlimited number of workers and firms. In that case workers and employers enter until they are indifferent between participating and not participating. In the Pissarides (1990) model, introduced below, the supply of workers is inelastic while employers post vacancies until the value of a vacancy is driven to zero.

The participation assumptions and the matching technology have crucial consequences for the existence of a search equilibrium. The models discussed below generally assume that the matching technology, $M(v;u)$, is increasing, concave and homogeneous of degree one. But alternative specifications are possible. These include, for example, linear specifications, i.e. $M(v;u) = fu + gv$, linear homogeneous ($M(v;u) = \frac{(f+g)uv}{u+v}$) or quadratic ($M(v;u) = \left(\frac{f}{k} + \frac{g}{l}\right) vu$) specifications, where f and g are respectively the frequencies at which each unemployed worker calls a vacant job and vacancy posting employers call an unemployed worker. These different specifications result, as described in detail in Mortensen (1999a), from different informational assumptions. The linear model arises when each agent on one side of the market has a list of all unmatched agents on the other side of the market and calls one of these unmatched agents at a frequency of f and g.

So far, little has been said about job destruction. Implicitly it has been assumed in the discussion that jobs last forever. The model by Pissarides (1990) discussed in the next section assumes a constant exogenous rate of job destruction which results from a shock to productivity x. Job creation is endogenous in the model and determined by the participation assumption. Clearly, the probability that a match terminates is taken into account and changes the participation values U and V.Otherwise, the model works as outlined so far. A further extension of this model by Mortensen and Pissarides (1994) integrates job destruction by modelling the match product x as a stochastic jump process. This model will also considered.

3.2 The Pissarides (1990) Model

Pissarides specifies the match product x as a random variable that is realized at the beginning of the match and remains constant until the match resolves. Matches are destroyed due to idiosyncratic shocks that arrive at the constant exogenous rate δ. Given the destruction rate, the values of the match to worker and employer are given by

$$\begin{aligned} rW(x) &= w(x) + \delta[U - W(x)], \\ rJ(x) &= x - w(x) + \delta[V - W(x)]. \end{aligned} \tag{10}$$

Wages are determined by generalized Nash bargaining, which leads to a sharing rule as described in the previous section.

The process of job creation obeys the following rules. Employers post vacancies until all profit opportunities are exhausted, such that the value of a vacancy is zero in equilibrium. This requires that the expected cost of filling a vacancy equals the expected present value of hiring a worker. Participation of workers is determined by a fixed supply such that $u = 1 - n$, where n is the number of matches. The number of matches changes according to $\dot{n} = M(v, u)[1 - F(R)] - \delta n$. A new match is created if an employer with a vacancy meets an unemployed worker, which occurs at a rate determined by the matching technology $M(v, u)$, while at the same time the value of the match exceeds the reservation product, which happens with probability $[1 - F(R)]$. At the same time, matches are destructed at rate δ.

If the matching technology $M(v, u)$ is increasing, concave and homogeneous of degree one, a unique non-degenerate steady state search equilibrium exists. In that case the matching technology can be written as $M(v, u) = uM(\theta, 1) = m(\theta)u$, where $\theta = v/u$. θ is a measure of labor market tightness. The equilibrium unemployment rate equates the endogenous job creation rate with the constant job destruction rate and is therefore given by

$$u = \frac{\delta}{\delta + m(\theta)[1 - F(R)]}. \tag{11}$$

Consequently, the equilibrium wage is given by

$$w(x) = (1 - \beta)b + \beta(x + c\theta). \tag{12}$$

Obviously, the wage increases with the unemployment benefit b, with job productivity x, and with labor market tightness θ. An increase in cost of posting a vacancy reduces the value of search for an employer and hence increases the surplus of a match, i.e. results in a higher wage. An increase in benefits raises the reservation product, reduces tightness and therefore increases unemployment and the equilibrium wage. The effect of changes in F on unemployment is ambiguous as both the reservation product and labor market tightness increase when the variance of F increases.

3.3 A Model with Job Destruction: The Mortensen-Pissarides (1994) Model

Empirical evidence suggests that the rate of job destruction is not constant.[2] Mortensen and Pissarides (1994) take account of this empirical fact and make job destruction endogenous. They assume that the match product changes according to a stochastic jump process $x(t)$, where new values of x arrive according to a Poisson process with rate δ, where values of x are random with distribution function $F(x)$. These idiosyncratic shocks to the productivity of a given match affect the value of that match and hence the job destruction rate. A worker-employer pair separates when the value of the match falls below the reservation product R. Since a shock arrives at rate δ, the job destruction rate equals $\delta F(R)$, where $F(R)$ is the probability that the shock is sufficiently bad to drive the value of the match below the reservation product.

The reservation product depends on the values of the match for the worker and employer which are given by

$$\begin{aligned} rW(x) &= w(x) + \delta \int [\max\langle W(\tilde{x}), U\rangle - W(x)]\, dF(\tilde{x}); \\ rJ(x) &= x - w(x) + \delta \int [\max\langle J(\tilde{x}), V\rangle - J(x)]\, dF(\tilde{x}) \end{aligned} \tag{13}$$

The individual values of the match depend on the current state of match productivity, x, only. This is because productivity x evolves according to a stationary, persistent Markov process, so that it is sufficient to condition on the present state. Losses, arising when realizations of $\tilde{x}$, which represents all possible future states of productivity, are below the current match productivity, are truncated at $U - W(x)$ and $V - J(x)$ for workers and employers respectively. Workers always receive at least the returns from search, while employers can always obtain rV, by entering another business which has an initial productivity x_0. The model assumes that all jobs have the same initial productivity x_0.

Therefore the participation assumptions are virtually the same as in the Pissarides (1990) model. The free entry condition $V = 0$, must still hold. Moreover, since wages are renegotiated after each shock and are determined by generalized Nash bargaining, the wage rate is derived as $w(x) = (1 - \beta)b + \beta(x + c\theta)$, just as in the Pissarides (1990) model.

[2] See for instance Davis et al. (1996).

In the steady state, the flow from employment to unemployment, i.e. $\delta F(R)(1 - u)$, equals the flow from unemployment to employment, which is determined by the matching technology, $M(v; u)$. A non-degenerate steady state search equilibrium satisfies this steady state condition, the free entry condition and the reservation product equation. It can be shown that a unique equilibrium exists if $M(v; u)$ is increasing, concave and homogeneous of degree one.

The equilibrium wage and the equilibrium unemployment are then given by

$$u = \frac{\delta F(R)}{\delta F(R) + m(\theta)}$$

and

$$w(x) = R + \beta(x - R).$$

Since higher unemployment benefits, b, raise R and lower θ, the equations suggest that an increase in unemployment benefits results in a higher equilibrium wage and higher equilibrium unemployment. The new equilibrium comes about by a rise in the job destruction rate, $\delta F(R)$, and a lower job creation rate. The fall in θ suggests that the number of vacancies must fall.

4 Social Efficiency

The arrival rate of a job offer equals the number of matches per unemployed worker; i.e. $\lambda = \frac{M(v;u)}{u}$. Similarly the rate at which unemployed workers apply for a vacancy equals the ratio of encounters and vacancies, i.e. $\eta = \frac{M(v;u)}{v}$. Since the expected time until a vacancy is filled equals $1/\eta$, the participation decision creates two offsetting external effects. An additional vacancy reduces the rate at which vacancies are filled. But on the other hand it increases the rate at which unemployed workers receive an offer. Similarly, an additional unemployed worker imposes congestion effect on other job seekers, but positively affects the rate at which vacancies are filled. Given these externalities, it is not clear a priori whether the search equilibrium is socially efficient.

Social efficiency requires that the private returns to search equal the marginal social contribution of participation. It was shown in the lecture that social efficiency only obtains if $M(v; u)$ is homogenous of degree one and the surplus shares equal the elasticities of the matching function.[3] Hence a constant returns to search technology is necessary to ensure a social efficient equilibrium.

[3] Hosios (1990) shows this for a related class of models. Mortensen (1999a) contains a detailed analysis of the social planner's problem and derives the conditions for the matching function.

Alternative approaches to obtain social efficient outcomes are by Moen (1997) and Mortensen and Wright (1995). The basic idea behind these approach is that social inefficiency generally results because participants to search cannot trade future income after matching against the expected duration of the matching process. Moen (1997) solves this problem by changing the wage formation process. Mortensen and Wright (1995) obtain the same result by introducing a third party that offers searchers a pair of expected waiting time and expected income. If there is perfect competition among such middlemen, implicit prices are generated for expected waiting times which provide the correct incentives for participation that is socially optimal.

5 Fluctuations and Reallocation

The Mortensen-Pissarides (1994) model generates worker and job flows as a reallocation process from less productive to more productive jobs. In the version of the model as outlined above, job destruction results from idiosyncratic shocks. It is straightforward to include aggregate shocks as well by rewriting job productivity as px where x represents the idiosyncratic component that evolves as described above, while p is an aggregate measure describing the state of productivity. As p is the same for all agents in the economy at a given time, the equilibrium conditions can be rewritten as

$$\frac{cp\theta}{m(\theta)} = (1-\beta)\frac{cp\beta\theta}{r+\delta} \tag{14}$$

$$\left(R + \frac{\delta}{r+\delta}\int (x-R)\,dF(x)\right)p = rU. \tag{15}$$

Such a representation also lends itself for analyzing the implications of skill differences which can be interpreted as structural differences in productivity. Hence, in a model with two types of workers, high-skilled workers have a higher productivity index p than less-skilled workers. The equilibrium conditions imply that labor market tightness is higher for high-skilled workers and that the reservation product is lower for high-skilled workers. The latter conclusion might seem counterintuitive at first sight, but logically results from the fact that the returns to participation are higher for high-skilled workers.

The effects of cyclical fluctuations are assessed by assuming that p is the realization of a productivity shock. In a simple version, where $\{p(t)\}$ evolves as a Markov chain on $\{p_l, p_h\}$ with transition rate πt, job creation rates and job destruction rates are negatively correlated. Mortensen and Pissarides (1999a) discuss such a model in detail. They devote special attention to job reallocation and employment fluctuation and the macroeconomic consequences for unemployment. In addition, they focus on how well the °ow approach, and in particular a model with productivity shocks, can explain the data.

The negative correlation is consistent with empirical ¯ndings. Mortensen explained the main ¯ndings of a detailed study of job and worker °ows in U.S. manufacturing by Davis et al. (1996). Some of the stylized facts, that a model of the labor market would have to be consistent with, include that job creation and destruction °ows are large and persistent in all industries and regions, that creation is procylical and destruction is counter cyclical - with a correlation between creation and destruction of -.36 for U.S. manufacturing. Moreover, destruction is more variable, idiosyncratic variation is large and worker °ows appear to be caused by job °ows.[4]

Cole and Rogerson (1996) have calibrated the Mortensen -Pissarides model and ¯nd that a model in which p is a stochastic process for an aggregate shock is broadly consistent with the time series features of job creation and job destruction.[5] Mortensen also showed how one can solve for the structural parameters of the model given the reduced form parameters. However, their parameters imply a low probability of ¯nding employment and hence a relatively high unemployment rate. The authors argue that this implies high "hidden unemployment", which shows up in non-participation in reality. However, the model does not account for °ows into employment from non-participants although this °ow roughly equals the unemployment-to-employment °ow. Moreover, the number of non-participants that reports a willingness to work is approximately as large as the number of unemployed.

6 Labor Market Policy

Mortensen explained how the Mortensen-Pissarides Model can be extended to assess active and passive labor market policies. In particular, the e®ects of unemployment insurance and social security ¯nanced by a payroll tax, ¿, levied on employers, as well as employment protection policies were analyzed. Firing restrictions can be modeled as a tax T that is paid when the match ends. Active policies like wage or employment subsidies can be

[4] Other real world features, that the model presented here cannot address, are that net changes increase with establishment size and decrease with age, while reallocation decreases with establishment size and age. These issues cannot be addressed because the model treats one employer-worker match as a ¯rm, such that ¯rm size is identical. The model does not consider job-to-job °ows either as it does not allow for employed search and therefore worker °ows equal job °ows, while in reality accession and separation rates are two to three times hire than creation and destruction rates. Such issues can however be incorporated in the search framework by extending the model in suitable ways.

[5] Mortensen and Pissarides (1999b) discuss the approach in detail in section 4.1.

modeled as a reduction in τ, while training or hiring subsidies can be modeled as a payment to the employer, or as a reduction in training costs C in models with training. Instead of deriving the results mathematically, which is done by Mortensen and Pissarides (1999a), I focus on the main implications and provide intuitive justifications for the results.

Since the payroll tax is levied on the employer, employers are concerned with $(1+\tau)w$ rather than w when calculating the value of the match. This reduces the match surplus and consequently lowers the wage, so that part of the tax is shifted to the worker. A firing cost reduces the employers' threat point in the wage bargain by T, which has a positive effect on wages. Higher unemployment benefits raise the search value U and hence wages.

An increase in unemployment income and higher payroll taxes both raise the reservation product, R, of matches and therefore increase the effective supply price of labor. This impacts on the match surplus and hence on job destruction. Job creation is also affected. The rate at which vacancies are posted decreases with a lower surplus, which results from a payroll tax and firing costs. Moreover, initial training costs affect the job creation decision by reducing the rate at which vacancies are posted.

A qualitative analysis of policy effects is conveniently done in the $R-\theta$ space. As job creation is given by

$$c\theta = m(\theta)(1-\beta)\left[1-\frac{\tau\beta}{1+\tau}\right]\left(\frac{x_0-R}{r+\delta}\right)-(T+C);$$

while job destruction is given by

$$\begin{aligned} & R+\frac{\delta}{r+\delta}\int_R^{\bar{x}}(x-R)\,dF(x) \\ = \; & \frac{\tau\beta R}{1+\tau}+[1+(1-\beta)\tau] \\ & \cdot\left(\frac{\beta c}{1-\beta}\theta+b-\frac{rT}{1+\tau}\right); \end{aligned}$$

the job creation curve is downward sloping and the job destruction rate is upward sloping in the $R-\theta$ space. Since equilibrium unemployment is given by $u=\frac{\delta F(R)}{m(\theta)+\delta F(R)}$, higher values of R and lower values of θ are associated with higher equilibrium unemployment.

Hence, an increase in b only affects the job destruction curve. It lowers θ and increases R and therefore unambiguously increases equilibrium unemployment. An increase in the payroll tax shifts the job creation curve up and the job destruction curve down which reduces tightness while the effect on the reservation product depends on the relative slopes and the size of the shift. Hence the effect on unemployment is ambiguous. Similarly an increase in firing costs has ambiguous effects on unemployment. While the reservation product falls unambiguously, tightness may either rise or fall, depending on other parameters in the model. Finally, a rise in training costs reduces both tightness and the reservation product such that the effect on unemployment is again ambiguous.

Mortensen assessed the policy effects quantitatively in computational experiments where he assumed the same parameter of values as Cole and Rogerson (1996) in addition to setting $r = 0.01$ and $\beta = 0.5$, $M(v,u) = kvu/(v+u)$ and $F(x) \sim \text{uniform}(1-\sigma, 1+\sigma)$. These calculations suggest that an increase in the replacement rate ρ and an increase in the payroll tax τ have large effects on steady state employment and equilibrium wages in the absence of firing regulations. Moreover, the size of these effects is sufficiently large to explain differences in European and U.S. unemployment rates. However, the effects of a payroll tax and unemployment benefits on equilibrium income and employment are less clear in presence of firing regulation. In fact, steady state income can be raised above the no intervention level with moderate costs in terms of employment loss.

7 Wage Dispersion

One problem of the search models discussed so far is that they cannot explain wage dispersion. This has motivated a strand of the literature to develops models which generate wage dispersion. Simply assuming that employers set wages while job seekers either accept or reject has been shown not to work. In models with perfect information a Bertrand equilibrium results. Moreover Diamond (1971) found that in models with sequential unemployed search only, a unique equilibrium in which all employers post the same wage obtains even under imperfect information about offers. Hence different assumptions are necessary to generate wage dispersion.

Albrecht and Axell (1984) assume that agents have different costs of search; Burdett and Judd (1983) show that wage dispersion exists in models where workers receive more than one offer at a time. Finally Burdett and Mortensen (1998) generate wage dispersion in a model with on-the-job search. A similar model by Mortensen (1998) was explained in depth in the lectures.

The model allows workers to search when employed. The driving element of the model is the assumption that offer arrival rates are strictly positive, but that job offers arrive at different rates for employed and unemployed workers. The offer arrival rates for unemployed search, λ_0, and employed search, λ_1, are characterized by $\lambda_0 = m(\theta)$ and $\lambda_1 = sm(\theta)$. The properties of the equilibrium depend crucially on the value of s. As long as $0 < s < 1$, a unique dispersed equilibrium exists given that the matching technology satisfies certain assumptions. However, if $s = 0$, there is essentially no employed search and the model degenerates to a version of the Mortensen-Pissarides (1994) model; if $s = 1$, workers are indi®erent between employment and unemployment, such that all ¯rms o®er the reservation wage. Finally, van den Berg (1999) has shown that multiple equilibria can exist when $s > 1$.

In equilibrium, the unemployment rate balances the °ows into and out of unemployment. The wage distribution is then determined by equating the °ows out of and into employment at each wage o®er. It should be noted that the wage o®er distribution may di®er from the actual wage distribution. Wages and vacancies are determined by employers setting wages once and for all such that the value of the vacancy is maximized subject to the wage o®ers of all other employers. Di®erent wage o®ers can result which implies the possibility of dynamic monopsony. O®ering a higher wage attracts more workers and makes the current workforce less likely to be poached by other employers.

One implication of the model is that there is no symmetric wage equilibrium, because if everyone chose the same wage, an employer could deviate by o®ering a sightly higher wage to attract more workers. Therefore, o®ering a wage slightly above the equilibrium wage results in a discrete discontinuity in e®ective supply. As this is a contradiction, no symmetric equilibrium exists.

A discomforting feature of the equilibrium is that the wage distribution has an increasing density, while the opposite is observed in reality. A decreasing wage density can be generated by introducing productivity di®erences among employers. Such di®erences may stem, for example from heterogeneous production technologies. Examples of this approach are Mortensen (1990), Burdett and Mortensen (1998) and Bontemps et al (1999). These models have equilibria in which more productive employers o®er higher wages. Di®erences in productivity lead to non-degenerate o®er distributions. The wage distribution is contingent on the o®er distribution and search friction. The shape of the wage o®er distribution in turn depends on the productivity distribution. Consequently, a decreasing wage distribution results for particular shapes of the productivity distribution.

Intuitively these models work as follows. If ¯rms di®er in productivity, they will o®er di®erent wages in frictional labor markets. High productivity ¯rms likely o®er high wages as there is always a trade o® between the time it takes to ¯ll a vacancy (a®ecting the opportunity cost of no production) and the o®ered wage (a®ecting the ¯rm' share of output). Firms with a smaller marginal revenue product o®er lower wages, but can still ¯ll their vacancies because of the search frictions. Although their employees will accept higher wage o®ers from more productive ¯rms, i.e. will be poached away, there is also a steady in°ow as there are always unemployed workers who prefer a (temporary) job at the low-productivity ¯rm. Otherwise, the low-productivity ¯rm would not enter and post the vacancy in the ¯rst place. If there are su±ciently many ¯rms with below-than-average productivity, a skewed wage distribution as observed in reality will result.

8 Concluding remarks

Dale Mortensen has given a very good overview of the literature on equilibrium search models. Starting from a basic framework which introduces the main ingredients and tools, he has shown how the model can be extended to generate results consistent with empirical facts and how it can serve as a tool to analyze labor market policies. Just as the literature on the °ow approach matured over the past decade, the model presented in the lectures became more involved to ¯nally illustrate what happens on the frontier of present research on search models.

References

Albrecht, J.W. and B. Axell (1984), An Equilibrium Model of Search Unemployment, Journal of Political Economy, 92, 824-840

Bontemps, C., J.M. Robin, and G.J. van den Berg (1999), Equilibrium search with continuous productivity dispersion: theory and non-parametric estimation, International Economic Review, forthcoming.

Burdett, K. and K. Judd (1983), Equilibrium Price Distributions, Econometrica, 51, 955-970.

Burdett, K. and D.T. Mortensen (1998), Wage Di®erentials, Employer Size and Unemployment, International Economic Review, 257-273.

Cole, H. and R. Rogerson (1996), Can the Mortensen-Pissarides Matching Model Match the Business Cycle Facts?,University. of Minnesota Working Paper.

Davis, S.J., J. Haltiwanger, and S.Schuh (1996), Job Creation and Job Destruction, Cambridge, MA, MIT Press

Diamond, P.A. (1971), A Model of Price Adjustment, Journal of Political Economy, 3, 156-168.

Hosios, A.J. On the E±ciency of Matching and Related Models,Review of Economic Studies, 57, 279-298.

Moen, E.R. (1997), Competitive Search Equilibrium, Journal of Political Economy, 105, 385-411.

Mortensen, D.T. (1990), Equilibrium Wage Distributions: A Synthesis, in Hartog, Ridder and Theeuwes (eds.), Panel Data and Labor Market Studies, North Holland, 279-296.

Mortensen, D.T. (1998), Equilibrium Unemployment with Wage Posting, CLS Working Paper #98-14, Aarhus, DK, June 1998.

Mortensen, D.T. and C.A. Pissarides (1994), Job Creation and Job Destruction in the Theory of Unemployment,Review of Economic Studies, 61, 397-415.

Mortensen, D.T. and C.A. Pissarides (1999a), New Developments in Models of Search in the Labour Market,CEPR Discussion Paper No. 2053, Jan 1999. Also forthcoming in Ashenfelter and Card, eds., The Handbook of Labor Economics, vol. 3, Amsterdam: North Holland.

Mortensen, D.T. and C.A. Pissarides (1999b), Job Reallocation, Employment Fluctuations and Unemployment,CEPR Discussion Paper No. 421, LSE, April, 1999. Also forthcoming in Taylor and Woodford, eds., The Handbook of Macroeconomics, Amsterdam: North Holland.

Mortensen, D.T. and R. Wright (1997), Competitive Pricing and E±ciency in Search Equilibrium, Northwestern Working Paper.

Pissarides, C.A. (1990), Equilibrium Unemployment Theory, Basil Blackwell.

Van den Berg, G.J. (1999) Multiple Equilibria and Minimum Wages in Labor Markets with Informational Frictions and Heterogeneous Production Technologies, October 13, Amsterdam.

The Economics of the Welfare State
Anthony B. Atkinson

Report by Hong Bo, University of Groningen

Professor Atkinson talked about the economic consequences of rolling back the welfare state at the NAKE workshop, 6-10 December 1999, Amsterdam. The welfare state has been attacked by some economists because it causes a big size of the government at the risk of inefficiency and it distorts the market system. Rolling back the welfare state is then proposed to be a solution. Prof. Atkinson defended the welfare state by demonstrating possible consequences if the welfare state were cut back.

The whole lecture includes five subtopics. He first introduced the current situation of the welfare state and raised his reservations. In the second lecture he focused on labour market and analysed some consequences of cutting unemployment benefits. In the third lecture, he took the state pension as an example to illustrate possible negative impacts of rolling back state pension expenditures. Empirical evidence on the relationship between the welfare state and economic performance is the topic of the fourth lecture. The fifth lecture concerns issues on policy design.

1. Introduction

Prof. Atkinson started with quoting main criticisms on the welfare state. He took a report of the European Union by Jacques Drèze and Edmond Malinvaud (1994) as an example. Three major objections to the welfare state are listed in the report:

(1) measures of income protection or social insurance introduce undesired rigidities in the functioning of labour market.

(2) welfare programmes increase the size of government at a risk of inefficiency; their funding enhances the amount of revenue to be raised, and so the magnitude of tax distortions.

(3) welfare programmes may lead to cumulative deficits and mounting public debts.

Prof. Atkinson stated that rolling back the welfare state based on the above-mentioned criticisms seems not to be a reasonable solution. His first reservation concerns the balance view of the welfare state. The common criticisms on the welfare state are mainly raised based on the cost of the welfare state. Economic costs of the welfare state are easier to be measured. These criticisms, however, are ignoring the benefit side of the welfare state. The social objectives of welfare state programmes are diverse and some of them are not measurable, such as the reduction of uncertainty faced by individuals provided by the welfare state. To evaluate the welfare state one needs to consider the success of the welfare state in meeting its diverse social objectives. His second reservation is that when evaluating the welfare state one should also recognise the positive economic consequences of the welfare state. Thirdly, the institutional structure of the welfare state plays a role, which is neglected by the common criticisms. His fourth reservation concerns the public choice aspect of the welfare state.

2. Labour market and the consequences of cutting unemployment benefits

The first welfare programme discussed by Prof. Atkinson is unemployment benefit. He first analysed the consequences of cutting unemployment benefits using a particular model. After that he emphasised the role played by the institutional structure of the welfare state.

2.1. A labour market model

In this model, an employee in the modern sector is either engaged at wage w, unemployed with no wage, or self-employed with the home production of $(a+b')$ which is constant. The firm recruits from the unemployed. The rate of outward flow from unemployment is m. Any worker faces a probability d that his job will be involuntarily terminated. The discount rate faced by individuals is r. b is the expected unemployment benefit. An individual decides his supply of work to the modern sector by considering three possible situations he may involve:

— The present value of being at home production :

$$r\Omega_h = (a+b') \qquad (1)$$

where Ω_h represents the value of being self-employed.

— The present value of being unemployed:

$$r\Omega_v = b + m(\Omega_E - \Omega_h) \tag{2}$$

where Ω_E denotes the value of holding a modern sector job and $(\Omega_E - \Omega_h)$ is the expected capital gain of being unemployed, Ω_v is the value of being unemployed.

— The present value of being employed:

$$r\Omega_E = w - d(\Omega_E - \Omega_v) \tag{3}$$

Solving the above three equations simultaneously, we obtain the equilibrium wage rate decided by the supply side of labour market:

$$w = (a + b')\left(1 + \frac{r+d}{m}\right) - \frac{r+d}{m} b \tag{4}$$

Considering trade unions bargain power over the wage rate, the wage rate set by the demand side of labour market is:

$$w = (a + b')\left(1 + \frac{b}{1-b}\frac{1}{1+x}\right)(a + b')(1+m) \tag{5}$$

where x measures the relative bargaining power of employees. m is the wage mark-up factor.

Combining the supply and the demand sides of labour market, we can solve for the parameter that indicates the labour market condition:

$$m\left(\frac{U}{V}\right) = \frac{r+d}{m}\left(1 - \frac{b}{a+b'}\right) \tag{6}$$

where U,V are the employed and the unemployed in labour market. Therefore, in case of no unemployment benefits, i.e. $b = 0$, there is no impact of the welfare state on labour market. If $b = b'$, the welfare state does not matter either because b, b' are working in the opposite direction. When $b \neq b'$, cutting unemployment benefits increase the instantaneous probability for an unemployed person of finding a job. It also increases the reserved wage rate as shown by the supply function (4). It is evident that these changes will lead to an increase in employment. However, there is another effect of cutting unemployment benefits if the labour demand side comes to the picture. If union wage negotiations are affected by the increased wage of the supply side, the net wage will rise. This causes labour demand curve shift to the left, which discourages the employment. Therefore, cutting unemployment benefits reduces queue unemployment on the one hand, and it reduces the demand for labour on the other. The net effect depends on the trade-off between these two opposite effects. This example illustrates that cutting unemployment benefits does not necessarily leads to an increase in employment.

2.2. The role of the institutional structure of the welfare state

In this section, a segmented labour market model is set up, based on which the consequences of cutting unemployment benefits taking account of its institutional structure is analysed. It is assumed that in the primary sector wages are determined by trade union bargaining. In the secondary sector, shirking-based efficiency wages are assumed. The firms in the secondary sector pay wage premia to reduce turnover or to attract higher quality workers. It is also assumed that the unemployed (due to the probability of job termination) in the primary sector is insured and the unemployed (due to being caught of shirking) in the secondary sector is not eligible to unemployment benefits because dismissal from shirking is an example of industrial misconduct. The assumption that the unemployed in the secondary sector is not eligible to unemployment benefits is an important feature of the model. This is the point based on which Prof. Atkinson emphasised the importance of the institutional structure of the welfare state. So in this model, unemployment benefits only enter the wage decision rule of the primary sector but do not present in the wage equation (no shirking condition) of the secondary sector. The equilibrium wage in labour market is decided by the interaction between the wage bargaining outcome in the primary sector and the no shirking condition in the secondary sector as shown by Figure 1. Noticing that the no shirking condition (NSC) is a vertical line in Figure 1, indicating that people being caught of shirking would be no entitlement to unemployment benefits. The wage bargaining curve (WB) in the primary sector is upward sloping, implying a positive relationship between the wage in the primary sector and the wage in the secondary sector. It suggests that a rise in the wage bargain outcome in the primary sector requires that secondary sector employers have to pay a higher premium to induce effort.

What is the consequence of cutting the level of unemployment benefits? Cutting unemployment benefits directly affects the wage bargaining outcome in the primary sector. It shifts the wage bargaining curve to the left, because wage bargain outcome is negatively related with the present value of unemployment benefits. As the consequence, secondary sector employers have to pay a higher premium, leading the no shirking condition curve shifts to the right as shown by the dotted vertical line in Figure 1. The new market wage rate is higher as compared to the equilibrium wage rate before policy changes. What is not consistent with the common prediction is that a cut in unemployment benefits may increase unemployment but not the other way around. This example again illustrates that rolling back the expenditures on unemployment benefit does not necessarily lead to an increase in employment.

3. The state Pension and the consequences of its reform

The second example that Prof. Atkinson used to demonstrate the consequences of rolling back the welfare state is the retirement pension. He first analysed the impact of the state pension (pay-as-you-go) on economic growth. Then he pointed out the consequences on economic performance of the minimum income guarantee (the mean-tested pension) and private provisions of pensions. The latter two programmes are proposed to be the alternatives to the state pay-as-you-go pension.

3.1. The state pay-as-you-go pension and economic growth

The state pay-as-you-go pension requires the young generation (the working generation) of the society to pay tax out of the wage rate. In return they will obtain the retirement pension as they become the old generation. It is equivalent that the government takes out of the pension by tax from private savings and transfers the payment to the old generation. The state pay-as-you-go pension affects economic growth via savings because tax levied on the working generation reduces total savings in the economy. Nevertheless the impact of the state pay-as-you-go pension on the economy depends on how to model economic growth.

In the Solow neo-classical growth model:

$$g_y = bg_k + (1-b)(g_A + n) \qquad (7)$$

where g_y, g_k, and g_A are the growth rate of output, the growth rate of capital, and the growth rate of technology. b is the income share of capital in the aggregate Cobb-Douglas production function. n is the growth rate of population. Since savings decides g_k, the state pension affects the growth of the economy via g_k. By definition $g_k = \frac{S}{K} = \frac{S/Y}{K/Y}$, where S, K, Y represent savings, the capital stock, and output, respectively. Obviously the reduction in savings immediately causes the reduction of the growth rate. However, the long-run effect is not clear. Because in the long-run, the capital output ratio also falls. Therefore a reduction in the savings rate lowers the level of output but does not affect the steady state rate of growth.

Nevertheless, the impact of the state pension on economic growth differs in the "AK" model. In the "AK" model (Arrow, 1962), the steady state growth rate of the economy is:

$$g = g_y = g_k = \frac{S}{K} = sa(L) \qquad (8)$$

It shows that the reduction of the savings rate always causes the reduction of the growth rate. To further understand the impact of the state pension on economic growth, the overlapping generations (OLG) model is needed to explain individual's saving behaviour. From the OLG model, the optimal saving behaviour of an individual is:

$$s = s\,(1-t) - t(1-s\,)(1+g)/(1+r) \qquad (9)$$

where s is the savings rate. s is the elasticity of the substitution of consumption between two periods. t is the pay roll tax for financing the state pension. r is the discount rate. Therefore, the impact of the state pension on economic growth depends on the comparison between the growth rate of the economy (g) and the discount rate (r) faced by individuals. If $g = r$, the state pay-as-you-go pension has no impact on economic growth since the state contributions displace private savings at the same rate. If $g \neq r$, it is evident that the existence of a state pension reduces savings, and the reduction in the savings rate reduces the growth rate in the long-run in a AK model.

The AK model shows that there is indeed a possible negative effect of the state pension on economic growth. However, rolling back the welfare state is not necessary a good solution because we have to evaluate the consequences of the alternatives to the state pay-as-you-go pension.

3.2. *Is the minimum income guarantee better?*

Replacing the state pension by the minimum income guarantee may not bring about better consequences although total expenditures on the welfare state are likely to be reduced. Since the state benefit is withdrawn progressively from those with other source of income, it will create savings trap. A fraction of the population saves sufficiently to be completely independent of the minimum income guarantee, on the other hand the other fraction of the population will not save at all and solely depends on the state benefit in old age. The net effect on aggregate savings is ambiguous. Figure 2 displays the effect of the minimum income guarantee on savings. The figure is drawn for the case of the Cobb-Douglas preferences. For people with wage rates above a critical value, savings are higher than the case of a universal pension. Because the tax rate is lower and it is a pure tax in the case of the minimum income guarantee. However, for the people who have wage rates below the critical value, savings are reduced to zero. Whether or not aggregate savings increase depends on the number of people above and below the cut-off, their relative wage, and other parameters. One undesirable outcome of introducing the minimum income guarantee is that it obviously creates dependence.

3.3. *Will private pension funds do the job?*

The private provision of retirement pensions is the second alternative to replacing the state pension. Since private pension funds are closely associated with the capital market, firms' behaviour is relevant to analysing the consequences of private pension funds on the economy. Prof. Atkinson adopted a corporate growth model to show the link between private pension funds and the growth of the firm, in which the rate of profit and the interest rate are distinguished.

In this corporate growth model, the dividend per unit of capital is: $(r-\frac{I}{K})$, where r is the gross profit per unit of capital, I, K are investment and the capital stock, respectively. The steady state value of a share is: $v=\left(\frac{r-I/K}{(i-g)}\right)$ or $iv=(r-I/K)+gv$, where i is the interest rate and g is the rate of capital gain. Assuming that the growth of the firm incurs cost and the cost function takes the form : $\frac{I}{K}=c(g)$, then the objective of the firm is to maximise its share value $v=\frac{(r-c(g))}{(i-g)}$ by choosing an optimal growth rate g .

Deriving the optimal growth rate from the first-order condition of the above-mentioned problem, we notice that the rate of growth is a declining function of the interest rate. Because replacing the state pension by private pension funds increases savings and hence lowers the interest rate, it raises the equilibrium growth rate of firms. This is good news for the private provision of pensions. However, there are two possible negative effects of private pension funds. First, private pension funds, implying monopoly power in supplying capital, distort the function of capital markets. As a consequence financially unhealthy firms, such as small firms will face more difficulties in accessing to external capital markets. This will retard the growth of these firms. Secondly, agency costs between the managers and the stockholders of the firm will be larger than that without private pension funds. An increase in the share of equity owned by private pension funds leads to increased monitoring on their part, which increases the risk of take-over bids. Managers of the firm will respond by reducing their chosen rate of growth. All in all, the net effect of private pension funds on the growth of firms is ambiguous.

4. Empirics of the impact of the welfare state on economic performance

Prof. Atkinson focused in this section on the evidence of the relationship between economic performance and the welfare state. The question to be answered by looking at the evidence is: whether there is enough and convincing evidence that lends a support to the call of rolling back the welfare state? His discussions on the evidence are at both the aggregate-level and the micro-level.

4.1. Aggregate evidence I: the growth of GDP

Prof. Atkinson first set up the framework that is commonly adopted in empirical studies. Focusing on the growth rate of GDP, the following specification is derived based on the neo-classical growth model:

$$g_y = bg_k + (1-b)g_n + (1-b)g_a + aOthers \qquad (10)$$

where g_y, g_k, g_n, g_a are the growth rate of GDP, the growth rate of capital , the growth rate of labour, and the growth rate of technology, respectively. *b* is the capital share in the Cobb-Douglas production function. *Others* represent other variables that may explain the growth of GDP. He pointed out that the welfare state might affect either the growth of factor supply (capital and labour) or the growth of productivity or both.

Many empirical studies adopted the empirical growth equation based on the above general framework (10). The measure of the size of social transfers can be included in estimations. The commonly used measure of the size of the welfare state is the ratio of spending on the welfare state to GDP. Among different empirical studies, Prof. Atkinson mentioned three in the lecture: Castles and Dowrick (1990), Weede (1986) , and Korpi (1985). The evidence about the impact of the size of the welfare state on economic growth is mixed with respect to both the sign and the estimated magnitude of the impact.

4.2. *Aggregate evidence II: unemployment*

One problem of empirical studies on the impact of the welfare state on unemployment is the measurement of the size of the welfare state. The ratio of the welfare spending to GDP can be decomposed into the replacement rate, the wage share, and the dependency ratio. These three parts differ across countries. This means that using the ratio of the spending of the welfare state to GDP may be misleading. One distinguished feature of the study by Layard, Nickell, and Jackman (1991) is that they take care of this problem and contains measures of both replacement rates and of benefit duration that affects the dependency rate in their empirical specification. They find that both measures are significantly and positively related with unemployment. Although this piece of work provides some evidence on the negative impact of unemployment benefits on labour market, the evidence is not convincing. Another study by Nickell (1997) finds that unemployment benefits had little impact on employment to population ratios. Nickell's explanation is that while high benefits lead to high unemployment, they also lead to high participation because they make participation in labour market more attractive. Therefore, again there is no convincing evidence supporting the notion that the size of the welfare state increases unemployment.

4.3. *Microeconomic evidence: unemployment*

The research on the impact of the welfare state at the micro-level has been focusing on the impact of unemployment benefits on labour market. In general, there may be adverse effects on the incentive for the unemployed to leave unemployment but the micro-level evidence shows that this effect is smaller than that of aggregate analysis. Prof. Atkinson pointed out that some aspects are missing from the micro empirical research on the impact of the welfare state on labour market. For instance, exit from

unemployment may have quite different consequences depending on the destination. Little is known about the effect of unemployment benefits on people leaving the labour force or about their taking up marginal jobs. Finally, Prof. Atkinson utilised three examples to show the disadvantages of the existing micro-level studies. The first example was taken from UK about the married women going back to employment. The second example concerns activity rate of mothers of young children in France. The third example is about unused labour capacity.
To summarise, the evidence of the impact on economic performance of the welfare state is not consistent at both the aggregate and microeconomic levels. Therefore there does not exist convincing evidence proving that it is the welfare state that depresses economic performance. We can ask ourselves the question: if there is not reliable evidence proving that the size of the welfare state retards economic performance, then why should the welfare state be cut?

5. Policy design

Prof. Atkinson came to the issue of the optimal policy design after demonstrating some possible consequences of rolling back the welfare state. He emphasised that the optimal design of the policy requires us to first understand the 'grammar of the argument' i.e. the sources of arguments on the welfare state, while the sources of arguments depend on the objectives of the policy. Some economists attack the welfare state mainly based on the concern about the economic objective of the policy i.e. the economic costs of the welfare state. However, there are many aspects of social objectives of the welfare state. This point was emphasised by Prof. Atkinson throughout the whole lecture. Therefore, to understand 'the grammar of arguments' is in fact to understand the objective of the policy. Prof. Atkinson took Samuelson (1975) as an example here to illustrate how important it is to understand the 'grammar of arguments'. Samuelson (1975) argues that the state pension is not efficient because its distortion effect and hence the quantity of state pensions should be cut by allowing private pension funds. Prof. Atkinson pointed out that there may be an adverse effect. However, one cannot look at the burden of the welfare state ignoring the positive impact on the economy. For example, the positive impact of the welfare state on capital accumulation is often ignored. In addition, there are some questions on the choice of the social utility function. For instance, the utility function used in Samuelson (1975) does not necessarily express the real objective of the public choice.

The points made by Prof. Atkinson with respect of the policy design mainly concern: (1) the objectives of the welfare state are important. Optimal policy design requires us to balance the economic costs with the social objectives of the welfare state. (2) the size (scale) of the welfare state is not relevant. (3) targeting is the key issue in policy design. Since the social welfare policy affects the individual decision-making through the budget constraint, some adverse effects might be avoided. With regard to the issue of targeting, Prof. Atkinson put forward some relevant issues that need further investigations: (a) how sharp are objectives? (b) heterogeneity across individuals, (c) different information required, (d) non-take up problem, and (e) work/other incentive.

6. Conclusions

Being an economist is not an easy job. Prof. Atkinson shared his honest views towards the reform of the welfare state with us during his lectures. The important message we obtained is that the call of rolling back the welfare state just based on its economic costs does not show the responsibility as an economist. Economic policies are interacted with social policies. Economic costs should be balanced by the social objectives of the welfare state. The consequences of rolling back the welfare state demonstrated by Prof. Atkinson are helpful in making up the minds of economists, although he said nothing about that the welfare state should not be cut. His attitude towards the attacks on the welfare state is modest.

References

Arrow, K.J. (1962) The Economic Implications of Learning by Doing. *Review of Economic Studies* 29, 155-173

Castles, F. G. and S. Dowrick (1990) The Impact of Government Spending Levels on Medium-Term Economic Growth in the OECD, 1960-85. *Journal of Theoretical Politics* 2, 173-204

Drèze, J.H. and E. Malinvaud (1994) Growth and Employment: the Scope for a European Initiative. *European Economy* No.1, 77-106

Korpi, W. (1985) Economic Growth and the Welfare System: Leaky Bucket or Irrigation System? *European Sociological Review* 1, 97-118

Layard, R., S. Nickell, and R. Jackman (1991) *Unemployment*. Oxford University Press, Oxford

Nickell, S.J. (1997) Unemployment and Labour Market Rigidities: Europe versus North America. *Journal of Economic Perspectives* 11(3), 55-74

Samuelson, P.A. (1975) Optimal Social Security in a Life-Cycle growth Model. *International Economic Review* 16, 531-538

Weede, E. (1986) Sectoral Reallocation, Distributional Coalitions and the Welfare State as Determinants of Economic Growth Rates in Industrialised Democracies. *European Journal of Political Research* 14, 501-19

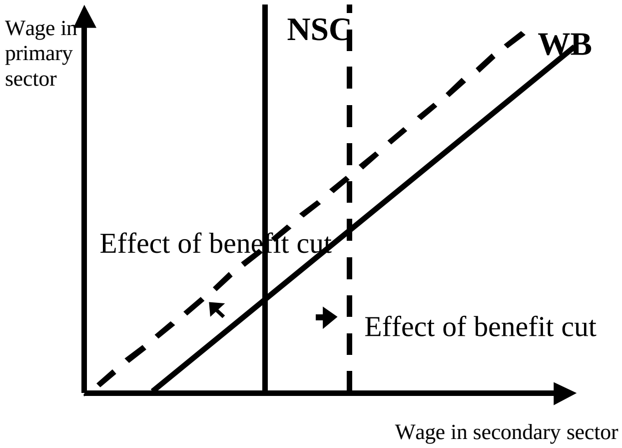

Figure 1. Effects of cut in unemployment insurance benefit

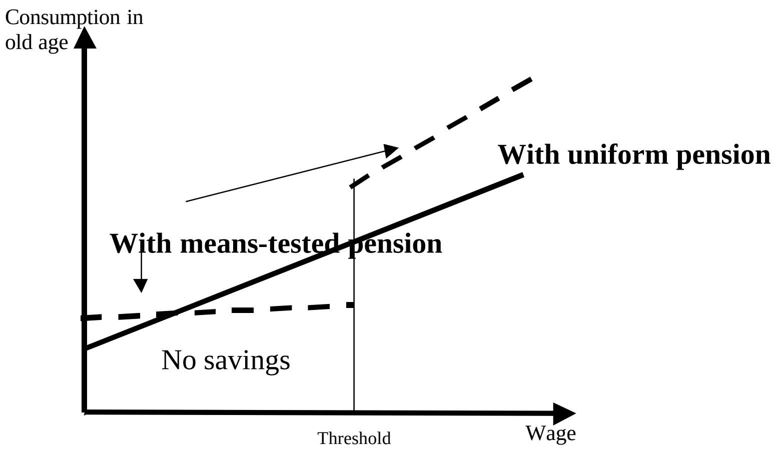

Figure 2. Effects on savings of mean test

Micro-Econometrics and Household Behaviour
Richard Blundell

Report by Adriaan R. Soetevent, University of Groningen[*]

1 Introduction

This paper reviews the lectures given by Richard Blundell at the 27th NAKE Workshop, held in Amsterdam in December 1999.

In this paper, only a concise overview can be given of the topics Blundell discussed and touched on during the week. I will preserve the same order as Blundell and therefore kick off with a discussion about the usefulness of non- and semiparametric methods. These methods are useful for examining the relationship between the expenditure on specific commodities and the total expenditure for an individual and they provide useful benchmarks to test parametric specifications against. In Section 3, the data set considered consists of panel data. In particular, the problem of using the common GMM estimator for estimating a dynamic panel data model when the instruments are weak, is discussed and a solution to this problem is given. Section 4 deals, also on the basis of panel data, with the question how the impact of treatments, like e.g. a labor market program, can be evaluated. This problem can be seen as a missing data problem. The measure proposed is the difference-in-difference estimator. Finally, in Section 5, matters are combined: attempts are made to describe the consumption of an individual over his life cycle by solving the dynamic programming problem. The issue which IV variables to use is elaborated on.

2 Non- and Semiparametric Estimation

The relationship between expenditure on specific commodities and total expenditure at a particular point in time and location (the Engel curve) as stated in the classical Working-Leser form is $\frac{p_j q_j}{x} = \alpha_j + \beta_j \ln x + \varepsilon_j;\ \forall j = 1;\ldots;n$. p_j is the price of commodity j, q_j the quantity, x total expenditure and ε_j an error term for which it is assumed that

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$E(\varepsilon_j|x) = 0\ \forall j$. A number of studies has indicated that this linear specification of the relationship between the commodity expenditure and log income is inaccurate for an appreciable number of goods. For some commodities, e.g. food, the linear specification is reasonably in accordance with reality but for others, like alcohol, the curvature indicates that further terms in income are required (see Banks, Blundell and Lewbel (1997)).

One way to analyze the actual relationship is with the use of non- and semiparametric methods. These methods are increasingly used in the field of microeconometrics. They are used as a means to relax distributional assumptions. In many cases, non- and semi-parametric analysis is a useful alternative to test a parametric specification against. Two requirements that limit the potential use of nonparametrics are a lot of observations are needed and that the variable x is not measured with errors.

Nonparametric Regression

I will first outline how nonparametric methods are applied to Engel curve analysis. Subsequently, I explain how a particular subset of semi-parametric models, the partial linear models, can be used to include demographic shifts in the regression model. Finally, I will show how outcomes can be compared with the parametric alternative. Details can be found in the article of Blundell and Duncan (1998) which covers a large part of the material.

Suppose that the relation of interest is given by

$$y = g(x) + \varepsilon; \tag{1}$$

where ε is an independent random error satisfying $E(\varepsilon|x) = 0$; $var(\varepsilon|x) = \sigma^2(x)$. In the Engel curve analysis y represents the expenditure share on some good and x the total budget. Nonparametrics allows us to investigate the relationship between y and x without making parametric assumptions on g. The object of interest is the conditional expectation $E(y|x) = g(x)$ which can be estimated by the use of Kernel regression[1]. The conditional expectation can be rewritten as

$$E(y|x) = \int y f(y|x)dy = \frac{\int y f(x;y)dy}{f(x)}. \tag{2}$$

Given observations $\{X_i; Y_i\}$, the quantities on the right hand side to be estimated are $f(x;y)$ and $f(x)$. The general form for the multivariate density estimator is

$$\hat{f}_H(x) = \frac{1}{n}\sum_{i=1} K_H(x_i - x); \tag{3}$$

[1] Note that this is just one out of more non-parametric estimation techniques, which also include for example Nearest Neighbour, Splines and Median Smoothing.

where $K_H(x) = \det(H)^{-1}K(H^{-1}x)$ and H the (nonsingular) bandwidth matrix. One form the multidimensional kernel function $K(H^{-1}x)$ may take on is the product kernel $K(H^{-1}x) = K_1((H^{-1}x)_1)\cdot\ldots\cdot K_n((H^{-1}x)_n)$. Plugging the above in to (2) and using this product kernel , after some manipulations, the Nadaraya-Watson estimator

$$\hat{g}_h(x) = \frac{n^{-1}\sum_{i=1}^{n} K_h(x - x_i)y_i}{n^{-1}\sum_{j=1}^{n} K_h(x - x_j)} \qquad (4)$$

is obtained. Conditions for the consistency and the asymptotic normality of this estimator are given in Blundell and Duncan (1998) and Härdle (1990). These conditions allow us to derive pointwise confidence bands around the estimated regression curve. Popular choices for $K(\cdot)$ are the Gaussian kernel $K(u) = \frac{1}{\sqrt{2\pi}}\exp^{-u^2/2}$ and the Epanechnikov kernel $K(u) = \frac{3}{4}(1 - u^2 1(|u| \leq 1)$, where $1(\cdot)$ denotes an indicator function. The last one has the useful property that it truncates the distribution.

Particularly important is the choice of the bandwidth h. This can be chosen on the basis of plug-in methods or using the method of Cross Validation (CV). An example of a plug-in method is Silverman's rule of thumb which asymptotically minimizes the expected mean squared error of the estimate $\hat{g}(x)$ of the density $g(x)$ over the range of x. The optimal choice for h is in this case $\hat{h} \approx 1.06\hat{\sigma}n^{-1/5}$. This bandwidth choice has the disadvantage that it is sensitive to outliers due to the estimator of σ occuring at the right hand side.

In an alternative approach, the method of Cross Validation, the function minimized is

$$CV(h) = \frac{1}{n}\sum_{i=1} w(x_j)(y_j - \hat{g}_{h,j}(x_j))^2;$$

with $w(x_j)$ some trimming function[2]. This criterion function gives the average squared error between the observation y_j and the estimator $\hat{g}_h(x)$, where $\hat{g}_h(x)$ is replaced by the leave-one-out-estimator

$$\hat{g}_{h,j}(x_j) = \sum_{i \neq j} y_i \pi_{ih}^{-j}(x_j);$$

with

$$\pi_{ih}^{-j}(x_j) = \frac{K_h(x_i - x_j)}{\sum_{k \neq j}^{n} K_h(x_k - x_j)};$$

in order to obtain an unbiased estimate of the average squared error. Note that when using $\hat{g}_h(x)$ instead, the criterion function could be made arbitrarily small by letting $h \to 0$.

[2] This trimming function may be used to assign less weight to observations at the tail of the distribution of x.

Semiparametric Regression

Sometimes, it is useful to add to the purely nonparametric part $g(x)$ on the right hand side of (1) a purely parametric part $\gamma' z$ which represents an index in terms of a finite vector of observable exogenous regressors z and unknown parameters γ. Then the partially linear model

$$y = g(x) + \gamma' z + \varepsilon; \qquad (5)$$

is obtained, which is a subset in the class of semiparametric models. Assume $E(\varepsilon|z; x) = 0$ and $Var(\varepsilon|z; x) = \sigma^2(z; x)$. One reason to make a partitioning between the explanatory variables x and z may be that the variables x are continuous and the variables z binary or discrete. In the Engel curve analysis this gives a convenient way to account for heterogeneity in the population, in particular differences in family size; Blundell and Duncan (1998) show that the difference in number of children leads to a difference in share equations that is sufficient to consider semiparametric estimation techniques. To obtain an estimate for γ a transformation is made by taking expectations of (5) conditional on x and subtracting from (5), yielding

$$y - E(y|x) = (z - E(z|x))' \gamma + \varepsilon:$$

The conditional expectations in this expression can be estimated using nonparametric kernel regression and subsequently γ can be estimated by applying OLS to the resulting equation. Finally, these estimates and (5) can be used to derive an estimate for $g(x)$.

Parametric versus Nonparametric Models

For the Engel curve estimates, Blundell and Duncan (1998) compared the nonparametric specification with both the Working-Leser specification and the quadratic parametric regression curve. This last specification is extensively discussed in Banks, Blundell and Lewbel (1997). Using the goodness-of-fit statistic derived by Aït-Sahalia, Bickel and Stoker (ABS), Blundell and Duncan, the results given in Table 1 are obtained. Looking at the P-values given in this table, it is not possible to reject linearity for the food share equation, whereas for the alcohol share the quadratic specification is sustained by the empirical evidence.

Local Polynomial Regression

Till now, in the kernel regression the Nadaraya-Watson estimator (4) was used, which is in fact a local constant estimator. However, I can do better by using prior information on the shape of the curve. For example, from Table 1 I might conclude that for the food share Engel equation a local linear estimator is appropiate and for the alcohol equation a local

Table 1: Estimates of the ABS test statistic

	Food	Alcohol
H_0: linear	1.679	4.633
	[.195]	[.031]
H_0: quadratic	0.567	0.526
	[.451]	[.468]

Note: The nonparametric estimates are based on a Gaussian kernel with bandwidths chosen by Least Squares CV. The statistics are distributed as χ^2 under H_0 and the values between brackets give the P-values.

quadratic fit. The estimator is now defined as $\hat{g}_h(x) = m\{x;\hat{\alpha}_n(x)\}$ where $m(x_i;\alpha) = \alpha_0 + \alpha_1 x_i + \dots + \alpha_p x_i^p$. The Nadaraya-Watson estimator corresponds to the choice $p = 0$ and the local linear and local quadratic estimator to $p = 1$ and $p = 2$ respectively. When the parametric model is indeed true, using the higher order polynomial estimators will lead to a reduction in the asymptotic bias of the estimator. Another advantage of using local polynomial regression is that it makes the estimation less sensitive to the choice of the bandwidth h.

3 Dynamic Panel Data Estimation

The preceding discussion on non- and semiparametric estimation techniques dealt with cross section data. The subject of the current section is how to act when one has data that combine time series and cross sections. These panel, or longitudinal data sets contain observations of many individuals i, $i = 1, \dots, N$, each observed at several points t in time, with $t = 1, \dots, T$. Typically, T is small compared to N. Panel data models incorporating dynamic effects are called dynamic panel data models.

This section points out why the first differenced GMM estimator may perform poorly in a dynamic panel data context and how this can be solved.

GMM Estimation

The idea of the Method of Moments is, that one estimates k parameters by expressing these parameters in terms of k population moments and one then replaces these population moments with the corresponding sample moments. However, when there are more moment conditions than parameters, the system is overdetermined. One way to reconcile conflicting estimates is to minimize a certain criterion function. Suppose the criterion function has the form $q = \hat{m}(\theta)' A \hat{m}(\theta)$ where the element $\hat{m}_j(\theta)$ of $\hat{m}(\theta)$ denotes the to moment j corresponding sample mean and A a positive definite matrix that is not a function of θ. Then the Generalized Methods of Moments (GMM) estimator is the estimator that minimizes this function (see Greene (1999)).

GMM Estimation and the Dynamic Panel Data Model

Within the context of the dynamic error components model, the standard first differenced Generalized Method of Moments (GMM) estimator performs very poorly in situations characterized by a moderately large autoregressive parameter and a small amount of observations (Blundell and Bond (1998)). Therefore, an alternative linear estimator is considered. Many of the details can be found in Blundell and Bond (1998).

In order to define these estimators, I consider the following AR(1) model

$$y_{it} = \alpha y_{i,t-1} + \eta_i + v_{it}; \text{ for } i = 1;\dots;N \text{ and } t = 1;\dots;T \qquad (6)$$

where $u_{it} \equiv \eta_i + v_{it}$ is the usual 'fixed effects' decomposition of the error term and where it is assumed that η_i and v_{it} are independently distributed across i. The familiar error components structure implies the $\frac{1}{2}(T-1)(T-2)$ orthogonality conditions

$$E(y_{i,t-s}\Delta v_{it}) = 0 \text{ for } t = 3;\dots;T \text{ and } s \geq 2;$$

where $\Delta v_{it} = v_{it} - v_{i,t-1}$. These conditions rely on the absence of serial correlation in v_{it} and on the initial condition restrictions $E(y_{i1}v_{it}) = 0$ for $i = 1;\dots;N$ and $t = 2;\dots;T$. These moment restrictions can be compressed to

$$E(Z_i'\Delta v_i) = 0;$$

with Z_i a $(T-2) \times m$ instrument matrix given by

$$Z_i = \begin{pmatrix} y_{i1} & 0 & 0 & \cdots & 0 & \cdots & 0 \\ 0 & y_{i1} & y_{i2} & \cdots & 0 & \cdots & 0 \\ \cdot & \cdot & \cdot & \cdots & \cdot & \cdots & \cdot \\ 0 & 0 & 0 & \cdots & y_{i1} & \cdots & y_{iT-2} \end{pmatrix};$$

and Δv_i the $(T-2)$ vector $(\Delta v_{i3}; \Delta v_{i4}; \dots; \Delta v_{iT})'$

Using these conditions and the assumed absence of serial correlation in the v_{it}, the two-step GMM estimator $\hat{\alpha}$ can be calculated. In case $T = 3$, this estimator is just identified which means that no weighting improvements are available to enhance the asymptotic efficiency.

The Problem of Weak Instruments

The instruments in the standard first-differenced GMM estimator become less informative when α in (6) is close to 1 or when the relative variance of the fixed effects η_i gets large. In case $T = 3$, the GMM estimator $\hat{\alpha}$ reduces to a simple Instrumental Variable (IV) estimator with y_{i1} as instrument for Δy_{i2} with the corresponding reduced form equation

$$\Delta y_{i2} = \pi y_{i1} + r_i \text{ for } i = 1, \ldots, N. \tag{7}$$

Notice that (6) implies

$$\Delta y_{i2} = (\alpha - 1) y_{i1} + \eta_i + v_{i2} \text{ for } i = 1, \ldots, N. \tag{8}$$

Since η_i and y_{i1} are correlated, $\alpha - 1$ will be biased upward, causing the reduced form coefficient to be biased towards zero, such that the instrument y_{i1} is only weakly correlated with Δy_{i2}. One can show that under the assumption of stationarity and denoting $var(\eta_i) = \sigma_\eta^2$ and $var(v_{it}) = \sigma_v^2$, the plim of $\hat{\pi} \to 0$ as $\alpha \to 1$ or as $(\sigma_\eta^2 / \sigma_v^2) \to 1$ (Blundell and Bond (1998)).

Imposing Restrictions on the Initial Conditions

One way of gaining precision of the GMM estimator in finite samples and asymptotically, is to use additional nonlinear moment conditions. A number of these conditions can be found in Blundell and Bond (1998). Another way of improving precision, is to impose some mild conditions on the initial conditions and using the $T - 3$ linear moment conditions

$$E(u_{it} \Delta y_{i,t-1}) = 0 \text{ for } t = 4, 5, \ldots, T \tag{9}$$

This amounts to using the lagged differences of y_{it} as instruments for the equations in levels. Since I observe Δy_{i2}, I can use the additional restriction

$$E(u_{i3} \Delta y_{i2}) = 0. \tag{10}$$

This equation can be written as $E[(\eta_i + v_{i3})(y_{i2} - y_{i1})] = E[(\eta_i + v_{i3})(v_{i2} + (\alpha - 1)u_{i1})] = 0$ which requires restrictions on the initial condition y_{i1}. When y_{i1} is expressed as $y_{i1} = \frac{\eta_i}{1-\alpha} + u_{i1}$, (10) is equivalent to $E[(\eta_i + v_{i3})(v_{i2} + (\alpha - 1)u_{i1})] = 0$, and necessary conditions for (10) to hold are then $E(u_{i1}\eta_i) = E(u_{i1}v_{i3}) = 0$ for $i = 1, \ldots, N$, so that the key requirement is that the deviations of the initial conditions from $\eta_i/(1-\alpha)$ are uncorrelated with the level of $\eta_i/(1-\alpha)$ itself (Blundell and Bond (1998)). When this requirement is satisfied, Δy_{i2} stays informative as an IV estimator for y_{i2} as α increases towards 1.

Comparisons of the asymptotic variance of the GMM estimator using (9) and (10) with that of the standard first differenced GMM estimator and the nonlinear GMM estimator, shows that large efficiency gains are obtained when using the former and T is small.

4 Evaluation Methods

In the previous section, a problem related to the estimation of dynamic panel data was discussed. In this section, the econometric approaches to evaluation methods will be explored, also in the context of panel data. The evaluation problem central in this discussion is the measurement of the impact of a program, e.g. a labor market program, on each type of individual. The di¢cult point is constructing the right counterfactual for assessing the impact of a particular treatment and therefore, the evaluation problem can be seen as a missing data problem. Blundell and Costa Dias (1998) and Blundell and MaCurdy (1998) give a profound discussion on these subjects.

Social Experiments and Di¤erence-in-Di¤erences

The evaluation problem arises because one is unable to observe the outcome variable for participants in a particular program had they not participated and the same goes the other way round for members of the control group. In appropriately de…ned social experiments, the measurement problem can be overcome by randomly assigning individuals out of a particular group to the treatment. However, often, experimental data are not available and even when they are, side e¤ects occur like people dropping out in a nonrandom way or a change in the behavior of the participants due to external factors or caused by the experiment itself. Other disadvantages of experiments are that they are di¢cult to extrapolate; they might be expensive to administer and the ethical approval might be doubtful — can you deny someone a promising new treatment which will likely cure him from a life threatening disease?

On the other hand, social experiments have some clear advantages, like a minimization of statistical assumptions and that the answers can be easily understood by non-economists. The counterpart of social experiments are natural experiments, where the experimental and control group are put together in a natural way. One example is the length of the time someone enjoys schooling, which is dependent on the year and month of birth. Another is an enquiry into the in‡uence of minimum wage laws; the di¤erent states in the US introduced di¤erent minimum wage laws, whereas they are subject to the same macro economical in‡uences.

One way to measure the impact of a treatment in the setting of a natural experiment, is using the di¤erence in di¤erence (DID) estimator. To apply this estimator, longitudinal or repeated cross section data are needed, with at least one wave before and one wave after the program change. Assume that treatment takes place in period k, then the outcome equation can be written as

$$\begin{aligned} Y_{it} &= X_{it}\beta + d_i\alpha + U_{it} \quad \text{if} \quad t > k \\ Y_{it} &= X_{it}\beta + U_{it} \quad \text{if} \quad t \leq k. \end{aligned} \tag{11}$$

In this equation, d_i is a dummy which takes on the value 1 if individual i participates in the program and 0 if otherwise. α measures the impact of treatment; the parameters β define the relationship between the exogeneous variables X and the dependent variable Y. U_{it} is an error term of mean zero which is assumed to be uncorrelated with X (Blundell and Costa Dias(1998)). When t^0 denotes the pre-program period and t^1 the after program period, the DID estimator can be written as

$$\hat{\alpha}_{DID} = (\bar{Y}^T_{t^1} - \bar{Y}^T_{t^0}) - (\bar{Y}^C_{t^1} - \bar{Y}^C_{t^0});$$

where $\bar{Y}^T$ and $\bar{Y}^C$ are the mean outcomes for the treatment and comparison groups, respectively.

However, for the DID estimator to yield consistent estimates of the treatment effect, two assumptions have to be made. The first is that the composition of groups needs to be time invariant and the second is, that macro effects must affect the two groups in the same way. If the first assumption is violated, differencing does not eliminate averages of the individual effects in both the experimental as the control group. Violation of the second assumption — for example by differences in demographic composition of the experimental and control group — may contaminate the estimate of α.

The solution put forward by Blundell and Costa Dias (1998) to solve the latter problem, is the use of an additional time interval t^* to t^{**} over which a similiar macro trend has occured. The resulting differentially adjusted DID estimator can be written as

$$\hat{\alpha}_{DADID} = [(\bar{Y}^T_{t^1} - \bar{Y}^T_{t^0}) - (\bar{Y}^C_{t^1} - \bar{Y}^C_{t^0})] - [(\bar{Y}^T_{t^{**}} - \bar{Y}^T_{t^*}) - (\bar{Y}^C_{t^{**}} - \bar{Y}^C_{t^*})];$$

5 Consumption Growth

The life-cycle model plays an important role in understanding consumer behaviour. Within the life-cycle framework, it is assumed that consumers maximize their expected discounted sum of period-specific utilities conditional on the information set at time t. The life-cycle hypothesis implies that households will allocate consumption expenditures in such a way that the marginal utility of wealth λ_t stays constant over time. This variable is unobservable in practice so that the consequences of imposing the life- cycle hypothesis can only be inferred from observing expenditures on individual goods. Usually, this is done by specifying a parametric utility function and then to derive the Euler equation that governs individual expenditures (Blundell, Browning and Meghir (1994)).

Choosing a utility function with constant relative risk aversion leads to a constant intertemporal substitution elasticity (ISE)[3] .

[3] The ISE is defined as $\Phi_t = \partial \ln C_t / \partial \ln(1 + i_t)$, that is, the percentage change in consumption in period t when the real price level increases with one per cent in period t (Blundell, Browning and Meghir (1994)).

Estimation of the ISE is done by applying GMM. I use the orthogonality conditions $E(\varepsilon_{it+1}|\Omega_{it})$, where the ε_{it}'s are residuals from regressing the first difference of the logarithm of consumption for individual i at time t on the real interest rate and income for individual i at time t (with $t = 1, \ldots, T$ and $i = 1, \ldots, N$). Ω_{it} is the information set available to individual i in period t. For estimation purposes, I use the observable instruments $z_{it} = \{r_{it}, r_{it-1}, \ldots, x_{it}, x_{it-1}, \ldots\}$, with $z_{it} \subset \Omega_{it}$ and where r and x denote the nominal interest rates and income, respectively. With the help of these instruments, the GMM estimator of the ISE can be obtained.

Naturally, you may worry about measurement erors in the logarithm of consumption, which may urge you to lag instruments a further period, thereby running the risk that the problem of weak instruments pops up.

Estimation with Cross-Section, Panel and Pseudo Panel Data

However, in most cases, income shocks will be correlated with current consumption growth such that $E(v_{it}|\Omega_{it}) \neq 0$, where the v_{it}'s denote the residuals after regressing the first difference of the logarithm of consumption on the instrumental variables z_{it}. This is for example the case if the income process is modelled as $x_{it+1} = \alpha_i m_{t+1} + \xi_{it+1}$, with m_{it+1} a macro economic shock and ξ_{it+1} idiosyncratic risk. In this case $cov_i(v_{it+1}, z_{it}) \neq 0$ and one needs to average over a long time series of macro economic shocks.

This long time series can be obtained in two different ways. Firstly, when available, one can use long panels. That means, a series of observations on the same observational units for a substantial amount of years. Drawbacks of these data are that the measurement error is typically large and that in most cases, only observations on food are tracked for a long time.

An alternative is to use time series of repeated cross-sections. From these data pseudo-panel can be constructed by grouping individuals into cohorts, e.g. on basis of their date of birth. This has the convenience of having a long time series and maintaining the 'life-cycle' evolution of cohorts and information. On the other hand, disadvantages are that by aggregating over cohorts, some micro variation is smoothed out and that the assumption is made that there is no systematic entry or exit from the cohort.

Blundell, Browning and Meghir (1994) come with the help of such a series of repeated cross-sections to the conclusion that household characteristics, like the number of children, are of great importance in explaining the growth of consumption over a households' life-cycle and that controlling for these characteristics is sufficient to eliminate excess sensibility of consumption growth to predicted income growth.

References

Banks, J. W., R. W. Blundell and A. Lewbel (1997), “Quadratic Engel curves, indirect tax reform and welfare”, Review of Economics and Statistics, 79, 527–539.

Blundell, R.W., M. Browning and C. Meghir (1994), “Consumer demand and the life-cycle allocation of household expenditures”, Review of Economic Studies, 61, 57–80.

Blundell, R. W. and A. Duncan (1998), “Kernel regression in empirical microeconomics”, Journal of Human Resources, 33, 63–87.

Blundell, R.W. and S. Bond (1998), “Initial conditions and moments restrictions in dynamic panel data models”, Journal of Econometrics, 87, 115–143.

Blundell, R.W. and M. Costa Dias (1998), “Evaluation methods for non-experi-mental data”, unpublished manuscript.

Blundell, R.W. and T. MaCurdy (1998), “Labor supply: A review of alternative approaches”, in O. Ashenfelter and D. Card, editors, Handbook of Labor Economics, North Holland, 1559–1695.

Greene, W. H. (1999), Econometric Analysis, 4th edition, Prentice Hall, New Jersey.

Härdle, W. (1990), Applied Nonparametric Regression, Econometric Society Monographs No. 19, Cambridge University Press.