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Netwerk Algemene en Kwantitatieve Economie

Netherlands Network of Economics

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PREFACE

As was announced in the previous issue of *NAKE Nieuws* we are in the process of changing the format of the AIO Presentation Day. Instead of having two days per year dedicated solely to presentations by the AIOs, we are now going to organize a new once-a-year **Dutch economics conference** with a much broader scope. The first of such one-day conferences will be held on **October 24, 1997,** probably at the University of Amsterdam. Elsewhere in this *NAKE Nieuws* you find a detailed description of the NAKE Day. Please reserve the date in your diary now. The NAKE Day is there for all Dutch economists.

Our most recent NAKE Workshop was held from December 9-13, 1996, at Maastricht University. **Martin Eichenbaum** gave an excellent course on real business cycle theory and proved to be not only a very good teacher but also to be the owner of a fine sense of humour. **Bruce Hansen** also proved to possess exceptional skills in that he was able to make very good intuitive sense out of very difficult (to an ordinary economist) econometric theory. Like Hendry before him, he managed to achieve a very high client retention rate. **Paul Klemperer** gave a series of lucid lectures on the economics of auctions. Judging from the occasional roars that emanated from the class room during his lectures it appears that he managed to entertain his audience quite well. A high point in this must have been the auctioning off of the wallet of one of the other lecturers. Last but not least, **Jürgen von Hagen** gave his views on the sense and non-sense of the Maastricht Treaty and monetary unification.

In this *NAKE Nieuws* you find the best reports on these four lecturers. **Edward Droste** (KUB) reports on 'The Economics of Auctions' by Paul Klemperer. **Marrit van den Berg** (LUW) writes on 'Lectures on Monetary Unification' by Jürgen von Hagen. **Franc Klaassen** (KUB) gives his impressions on 'The Econometrics of Structural Change and Thresholds' by Bruce Hansen. Last but not least, **Bjørn Volkerink** (RUG) writes on 'Real Business Cycle Theory' by Martin Eichenbaum.

Life does go on of course. Look at the very high quality of the field of lecturers for the forthcoming NAKE Workshop (jointly with LNBE) to be held June 2-6 at the University of Groningen. Elsewhere in this *NAKE Nieuws* you find details on the courses, registration forms, etcetera. Professor **John Roberts** (Stanford University) will give the microeconomics lectures on the topic of 'The Economics of the Firm.' Professor **James Heckman** (University of Chicago) gives lectures on 'The Econometric Approach to Evaluating Social Programs.' The macroeconomics lectures will be given by Professor **Ricardo Caballero** (Massachusetts Institute of Technology). He will lecture on 'Investment Theory and Labour Markets.' Finally, Professor **Nicholas Crafts** (London School of Economics) will lecture on economic history. The title of his series is 'Economic Growth: Lessons from Economic History.'

ANNUAL GENERAL MEETING OF MEMBERS OCTOBER 24, 1997 IN AMSTERDAM

The annual general meeting of members of the Netherlands Network of Economics (NAKE) will take place over lunch during the NAKE Day in Amsterdam, on **Friday, October 24, 1997** (exact time and place to be announced). The Annual Report will be sent to all members in May.

COURSE QUESTIONNAIRE 1997/1998 UTRECHT PROGRAMME

In the middle section of this *NAKE Nieuws* you find a removable course questionnaire plus a listing of all courses that are offered by the Fellows of the network and some visitors. Between 16 and 20 of these courses can be scheduled for inclusion in the Utrecht teaching programme for 1997/98. In order to design a well-balanced programme, it is important for me to know the potential clientele for the different courses. For this reason I would like to ask all (potential) participants to fill out the questionnaire and return it to the NAKE secretariat **before May 23, 1997**. The outlines of (almost) all courses can be found on the NAKE Home Page. Suggestions for new courses are, of course, also welcome. The new teaching programme for the academic year 1997/98 will be announced some time in June 1997 on the NAKE Home Page.

Ben Heijdra

NAKE WORKSHOP XXII

2 - 6 June 1997

University of Groningen

During the week from Monday, June 2nd to Friday, June 6th, the Netherlands Network of Economics (NAKE) will organize a Ph.D. workshop. Four distinguished economists will teach intensive courses on microeconomics, macroeconomics, econometrics and economic history. Each course consists of five lectures spread out over five days.

Courses

Ricardo Caballero, Massachusetts Institute of Technology

'Investment Theory and Labour Markets'

Nicholas Crafts, London School of Economics

'Economic Growth: Lessons from Economic History'

James Heckman, University of Chicago

'The Economic Approach to Evaluating Social Programs'

D. John Roberts, Stanford University

'The Economics of the Firm'

Register by filling out the form located in the middle of this *NAKE Nieuws* and returning it to the NAKE secretariat **AS SOON AS POSSIBLE**.

PROVISIONAL PROGRAMME NAKE WORKSHOP
GRONINGEN, 2 - 6 JUNE 1997

Monday June 2	**Tuesday June 3**
10.00 - 11.00 registration/coffee 11.00 - 12.15 Caballero 12.30 - 13.45 Roberts *13.45 - 14.45 Lunch* 14.45 - 16.00 Crafts 16.15 - 17.30 Heckman *17.30 - 18.30 Welcome reception*	09.00 - 10.45 Roberts 11.15 - 13.00 Caballero *13.00 - 14.15 Lunch* 14.15 - 16.00 Heckman 16.15 - 18.00 Crafts
Wednesday June 4	**Thursday June 5**
09.00 - 10.30 Caballero 10.45 - 12.15 Crafts *12.15 - 13.30 Lunch* 13.30 - 15.00 Roberts 15.15 - 16.45 Heckman 16.45 - 18.15 Private consultations	09.00 - 10.45 Crafts 11.15 - 13.00 Caballero *13.00 - 14.15 Lunch* 14.15 - 16.00 Heckman 16.15 - 18.00 Roberts *20.00 workshop dinner*
Friday June 6	
09.00 - 10.30 Roberts 10.45 - 12.15 Caballero *12.15 - 13.30 Lunch* 13.30 - 15.00 Heckman 15.15 - 16.45 Crafts *16.45 - ... Closing drinks*	

REGISTRATION

Participation in the workshop is free for AIO's/OIO's of the institutions participating in NAKE, and includes tea, coffee, lunches, reception, as well as dinner on Thursday. The participants cover the costs of accommodation, breakfast, and the Course Readers. These costs, together with travel expenses, can however be declared at the faculties. Hotel rooms are available in the **University Guesthouse.** It is possible to share a room. Approximate prices are ***ƒ* 90,- (single room) and *ƒ* 120,- (double room)**.

The number of participants in the workshop is subject to an upper limit. NAKE students have precedence, and the date of receipt of the registration form is also taken into consideration. Since firm arrangements must be made for lunches, dinner, accommodation etcetera, we would like you to notify the NAKE secretariat in case of any alterations to your plans. Failure to do so may result in your being charged for the service you registered for. You register by filling out the form on the middle page (legibly and as completely as possible) and returning it to the NAKE secretariat **AS SOON AS POSSIBLE**. Upon registration you will receive written confirmation together with readers for the courses, hotel information, etc.

A number of AIO's/OIO's will be presented with the NAKE diploma during the workshop dinner on Thursday evening.

PRIVATE CONSULTATIONS

During the workshop it is possible for participants to have a one-to-one talk with one (or more) of the lecturers. Students who wish to make use of this opportunity are invited to hand in a brief (one-page) description of the research (-proposal) they would like to discuss. Each consultation will be approximately 30 minutes.

METHOD OF ASSESSMENT AND CREDITS

The NAKE workshops are mandatory for all first- and second-year graduate students following the NAKE programme. Hence, each student must attend at least four workshops. For three workshops the student must submit a written summary of the lectures of one course. This report must be based both on the notes taken during the workshop and on the assigned literature. These reports are assessed by the organiser(s) of the workshop. All (NAKE) students are expected to attend all sessions on offer during the workshop.

With regard to study intensity, participation in the workshop (including the assessment by means of the written report) is worth 2 "Study Points" (SP); 1 SP = 40 hours.

ADDRESSES AND INFORMATION

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Local organizers:	Victoria Hoogenveen, 050-363.3753 Marieke Rensman, Email: m.rensman@eco.rug.nl Mirjam Koster, 050-363.5075, Email: m.koster@rechten.rug.nl

COURSE OUTLINES JUNE WORKSHOP

Investment Theory and Labour Markets

Ricardo J. Caballero

The organizing theme of this set of lectures is Aggregate Investment. However, only the first half of the course is concerned with standard equipment and structures investment. The second half broadens the interpretation of investment, and describes some of the main macroeconomic consequences of informational and appropriability problems. The latter leads the course naturally into a discussion of job flows and unemployment issues.

The basic reading of the course is "Aggregate Investment: A 90s View," which I am currently writing for the Handbook of Macroeconomics.

1. Basic Investment Theory and Findings

1. Chirinko, R.S., "Business Fixed Investment Spending: A Critical Survey of Modelling Strategies, Empirical Results, and Policy Implications," *Journal of Economic Literature* **31**, December 1993, 1875-1911.

2. Hassett, K.A. and R.G. Hubbard, "Tax Policy and Investment," NBER Wp #5683, July 1996.

3. Caballero, R.J., "Small Sample Bias and Adjustment Costs," *Review of Economics and Statistics*, 1994.

2. Lumpy and Irreversible Investment

2.1 Plant/Firm Level

1. Bertola, G. and R. Caballero, "Kinked Adjustment Costs and Aggregate Dynamics," in *NBER Macroeconomics Annual* 1990, Cambridge, The MIT Press.

2. Bertola, G. and R. Caballero, Irreversibility and Aggregate Investment" *Review of Economic Studies* **61**, April 1994, 223-246.

3. Abel, A.B. and J.C. Eberle, "A Unified Model of Investment Under Uncertainty," *American Economic Review* **84**, December 1994, pp. 1369-1384.

4. Abel, A.B. and J.C. Eberly, "Investment and q with Fixed Costs: An Empirical Analysis," mimeo January 1996.

5. Caballero, R.J. and J. Leahy, "Fixed Costs: The Demise of Marginal q," NBER WP #5508, March 1996.

2.2 Aggregation

1. Doms, M. and T. Dunne, "An Investigation into Capital and Labor Adjustment at the Plant Level," mimeo, Center for Economic Studies, Census Bureau, 1993.

2. Caballero, R. and E. Engel, "Explaining Investment Dynamics in U.S. Manufacturing: A Generalized (S,s) Approach" Mimeo MIT (1994).

3. Caballero, R., E.M.R.A. Engel, and J. Haltiwanger, "Plant-Level Adjustment and Aggregate Investment Dynamics," *Brookings Papers of Economic Activity* **2**, 1995, 1-54.

2.3 Equilibrium and Extensive Margins

1. Leahy, J., "Investment in Competitive Equilibrium. The Optimality of Myopic Behavior," *Quarterly Journal of Economics* **108**, 1993, 1105-1133.

2. Caballero, R.J. and R.S Pindyck, "Uncertainty, Investment, and Industry Evolution," *International Economic Review* **37**, August 1996, 641-662.

3. Caballero, R.J. and M.L. Hammour, "The Cleansing Effect of Recessions," *American Economic Review* **84**, December 1994, 1350-1368.

4. Goolsbee, A. "Investment Tax Incentives and the Price of Capital Goods." MIT mimeo 1995.

3. Information and Complementarities

1. Caplin, A. and J. Leahy, "Sectoral Shocks, Learning, and Aggregate Fluctuations." *Review of Economic Studies* **60**, October 1993, 777-94.

2. Chamley, C, and D. Gale, "Information Revelation and Strategic Delay," *Econometrica* **62**, 1994, 1065-1085.

3. Caplin, A. and J. Leahy, "Business as Usual, Market Crashes and Wisdom after the Fact," *American Economic Review*, June 1994.

4. Gale, D., "What Have we Learned from Social Learning?" mimeo, August 1995.

4. Specificity and Opportunism

1. Simons, H.C., "Some Reflections on Syndicalism," *Journal of Political Economy* **52**, 1944, 1-25.

2. Caballero, R. and M. Hammour, "The Macroeconomics of Specificity," NBER Wp #5757, September 1996.

3. Caballero, R. and M. Hammour, "On the Timing and Efficiency of Creative Destruction," *Quarterly Journal of Economics*, August 1996.

4. Caballero, R. and M. Hammour, "Jobless Growth. Appropriability, Factor Proportions and Unemployment," mimeo MIT 1997.

5. MacLeod, W. Bentley, and James M. Malcomson (1993): "Investments, Holdup, and the Form of Market Contracts," *American Economic Review*, **83**, 811-837.

6. Caballero, R. and M. Hammour, (1996b). "On the ills of Adjustment", *Journal of Development Economics*

7. Blanchard, O.J. and M. Kremer, "Disorganization," mimeo MIT, October 1996.

8. T. Besley, "Property Rights and Investment Incentives: Theory and Evidence from Ghana," *Journal of Political Economy* **103**, October 1995, 903-937.

9. Kiyotaki, N. and J. Moore, "Credit Cycles," mimeo 1995

10. Caballero, R.J. and M.Hammour, "The Improper Churn: Financial Constraints and Factor Markets," mimeo MIT, November 1996.

11. Davis, S.J., J.C. Haltiwanger and S. Schuh, *Job Creation and Destruction*, MIT Press, 1996.

Economic Growth: Lessons from Economic History

Nicholas Crafts

Course Outline

The lectures will consider the application of ideas from new growth economics in an historical context with a particular emphasis on the historical analysis of technological change. The course will examine both the explanation of economic growth and its implications for changes in living standards.

Lecture 1. Growth Economics and Economic History: Points in Common and Points of Difference.

Lecture 2. The Industrial Revolution Revisited.

Lecture 3. Falling Behind and Catching Up: European Economic Growth in America's Shadow, 1870-1970.

Lecture 4. Changes in Living Standards in the Long Run,

Lecture 5. The Standard of Living in the Industrial Revolution.

Pre-Course Reading

D.L. Costa and R. H. Steckel, "Long Term Trends in Health, Welfare and Economic Growth in the United States", NBER Historical Working Paper No. 76 (1995).

N.Crafts, "Endogenous Growth: Lessons for and from Economic History", CEPR Discussion Paper No. 1333 (1996).

S.L. Engerman "Reflections on 'The Standard of Living Debate': New Arguments and New Evidence", in J. A. James and M. Thomas (eds.), *Capitalism in Context* (University of Chicago Press, 1994), 50-79.

J. Mokyr, "The New Economic History and the Industrial Revolution", in J. Mokyr (ed.), *The British Industrial Revolution: An Economic Perspective* (Boulder, Westview Press 1993), 1-131.

R.R. Nelson and G. Wright, "The Rise and Fall of American Technological Leadership", *Journal of Economic Literature* (1992), 30, 1931-1964.

The Economic Approach to Evaluating Social Programs

James J. Heckman

Reading list not available yet. Will be distributed at the workshop

The Economics of the Firm

D. John Roberts

Reading list not available yet. Will be distributed at the workshop

Paul Klemperer

The Economics of Auctions

Report by Edward Droste, Tilburg University

In his lectures Paul Klemperer gave a broad overview of the economic relevance of auction theory. Many applications and examples were used to illustrate the different theoretical concepts. The first lecture was devoted to a survey of the basic types of auctions and the introduction of the revenue equivalence theorem. In addition some uses of auctions were addressed. The second lecture dealt with some of Klemperer's recent work on frenzies and crashes and gave an overview of the literature on optimal auctions. The main issue of the third lecture was the comparison between auctions and negotiations in case a company has to be sold. Also some examples with respect to optimal auctions were presented. In particular, the role of an optimal reservation price was discussed. After having discussed private value auctions during the previous lectures, the theme of the fourth lecture was the common value model. Because the partially common value model is one of Klemperer's current research topics he focussed on the theoretical consequences and practical relevance of this particular model. The last lecture consisted of some miscellaneous topics like dependent signals, risk-aversion, collusion, and asymmetric bidders.

1. The Types and Uses of Auctions

Klemperer's first lecture was partially devoted to a survey of the four basic types of auctions. The first type of auction he discussed was the English auction, which is also known as the open or ascending auction. In this particular auction the price of the object is raised until all but one bidder have dropped out. The remaining bidder gets the object and pays his own bid. Examples of objects sold by an English auction are antiques and artwork. A special version of the English auction is the so-called Japanese auction. In the Japanese auction the price of the object is raised in small quantities and during this process bidders gradually quit. The rules of the auction imply that quitters can not come back or make large jump bids. The second type of auction that Klemperer presented was the so-called Dutch auction. This auction is given her name by the fact that it is widely spread in the Netherlands for the sale of flowers. The Dutch auction is a descending auction, where potential buyers ''buzz in'' if the price, which is usually indicated on a clock, is low enough for them. Other real world examples of Dutch auctions are the sale of fish in Israel and tobacco in Canada. The third

auction type addressed in this lecture was the first-price sealed-bid auction. In this type of auction each bidder submits only one bid and in addition the bidders are not able to see the bids of the other participants. The competitor submitting the highest bid gets the object for the price he announced to the auctioneer. This kind of auctions are often used in procurement, see e.g. Laffont and Tirole (1993). Multi-equivalents of this type of auction are used for the sale of U.K. and U.S. treasury securities. The last type of auction is the second-price sealed-bid auction. This auction is also known as the Vickrey auction. In this auction the object is obtained by the highest bidder who has to pay the second highest price. A real world example of this auction is the sale of foreign exchange.

In the second part of his first lecture Klemperer introduced the basic auction model for the case of independent private values (IPV). In this model there is a fixed number of bidders who bid for a single object. Each bidder values this object independently of the other bidders. This value is private information to him or her. It is however assumed that it is common knowledge that the private values are drawn independently from the same probability distribution. Furthermore it is assumed that all bidders are risk-neutral. Some simple examples using the uniform distribution are presented to develop our understanding and intuition about the way theoretical auction models work. Using this formal framework the types of auctions presented above are investigated in more depth. The first type which is scrutinized is the first-priced sealed-bid auction. Klemperer looked in this particular case for a symmetric Nash equilibrium in which a bidder with an arbitrary value for the auctioned object choses a bid which is assumed to be a continuous and strictly increasing function of his value. A particular participant in this type of auction assumes that all competitors will bid according to this bid function in the Nash equilibrium. Under this assumption the best response of this bidder is to bid according to his or her true private value. Using the fact that the lower and upper limit are known (this is due to the fact that the distribution of values is assumed to be common knowledge) Klemperer showed that the expected revenue for the auctioneer depends on these limit values and the number of participating bidders. The next auction type which was highlighted was the Dutch auction. Klemperer pointed out that the bidder in this type of auction faces a static problem: choosing a price conditional on the fact that no other competitor has called out yet. Consequently, this type is strategically equivalent to the first-price sealed-bid type. In a second-price sealed-bid auction it is optimal to bid your true value, whatever the other bidders do. So telling the truth is a Nash equilibrium strategy. This was firstly shown by Vickrey (1961) in his seminal paper. Because everybody bids his or her true value, the expected revenue for the auctioneer is equal to the expected second highest private value for the auctioned object. In the English auction it is a dominant strategy to stay in, until the price of the object reaches the level of your private value. The competitor with the highest value will get the object at aprice equal to the second highest value. Klemperer

stressed that this type is form-equivalent to the second-price sealed-bid type. In the English type auction competitors see how opponents act and can condition their own behavior on these actions. Under the IPV assumption they will however not condition their behavior because they know exactly their private value for the object.

Comparing first-price and second-price auctions shows that in the former telling the truth is only a Bayesian-Nash equilibrium while in the latter it is a dominant strategy equilibrium. Looking at expected revenue for the auctioneer under the assumption of uniformly distributed values tells us that it is the same for both types. During the rest of his first lecture Klemperer pointed out the following theorem which is an extension and formalization of the result discussed above. It is shown that if a risk-neutral bidder with a certain private value mimics the behavior of a bidder with a different private value, he or she would have to make at least the same payments and would win the auctioned object as most as often as the bidder who is immitated would have. Following this line of reasoning Klemperer shows that any two auction mechanisms with the same probability of receiving the object in equilibrium and the same expected equilibrium surplus to the competitor with the lowest feasible private value, will yield the same expected payment by every competitor and consequently the same expected revenue for the auctioneer. Furthermore, the object is always obtained by the bidder with the highest private value. Under the IPV assumption, this reasoning is summarized in the well-known revenue equivalence theorem (henceforth RET). Klemperer links this theorem to the well-known Revelation Principle, which states that attention can be restricted to direct revelation mechanisms which satisfy the incentive compatibility condition. Extension of this result to multiple-object auctions is straightforward, but the result breaks down if the assumption of risk-neutrality or independent identically distributed valuations is dropped. The former assumption is in my opinion somewhat in contrast with real world evidence of the risk behavior of attendents in procurement auctions. Especially, if the value of the contract is large compared to the capital owned by the contractors.

2. Frenzies, Crashes and Optimal Auctions

Klemperer pointed out that his second lecture is devoted to the discussion of two papers. The first part deals with Bulow and Klemperer (1994), while in the second part of the lecture Bulow and Roberts (1989) is discussed. The former article deals with the fact that in the real world markets are not activated by a so-called Walrasian auctioneer but rather should be represented by a sequence of sales. This is largely due to the fact that potential buyers decide to buy goods now or later, instead of the decision between buying now or never.

Incorporating this kind of decisions makes the instantaneous willingness to pay much more vulnerable to price changes. A result from this assumption is that new information can lead to so-called frenzies in which demand feeds on itself and crashes where discontinuous price-drops occur. Bulow and Klemperer show that the RET can be applied to solve for dynamic price paths under the above assumption. An example of such a market is the asset market, where frenzies and crashes occur quite often. Usually it is suggested that volatilities on this market are caused by irrational behaviour or market imperfections. Contrary to this conventional wisdom Bulow and Klemperer show that rushes to trade and large price deviations can be explained by rational and strategic behavior in efficient markets. They present a simple market-clearing model in which a first sale at a new price triggers a frenzy of buying. More buyers are attracted until demand exceeds supply and then the frenzy will end with a crash. These results are due to the fact that even if expected demand is relatively inelastic, the associated willingness to pay at a given moment in time is almost perfectly elastic. Especially for buyers with a high valuation for the goods for sale because for them it is not a question of whether to buy but of when to buy. The elasticity of the willingness to pay implies that if an arbitrary asking price is able to attract any buyer, it should be able to attract many buyers. Finally, they show that the extension to other real world elements such as resale and elastic supply further accentuates the existence of frenzies. Their main result boils down to the fact that the rationality of bidders and their strategic behavior implies a high sensitivity to market information, which will lead to frenzies and crashes.

Following Bulow and Roberts (1989) the second part of the second lecture was devoted to the economics of optimal auctions. Klemperer pointed out that this paper shows that there is an equivalence between the problem an auctioneer faces when devising an optimal auction, and the problem a monopolist faces when exhibiting price discrimination. An optimal auction is supposed to maximize the seller’s expected profit. Through the equivalency of optimal auctions and standard monopoly price discrimination, the auction problem can be solved by applying the well-known logic of equating marginal revenue and marginal cost. The main result of the paper states that, just as in a monopoly problem, the auctioneer in an auction maximizes the expected marginal revenues of the consumers who receive objects, subject to a capacity constraint. Consequently, goods are allocated to the consumers with the highest marginal revenues. The solution implies that goods are allocated according to consumers’ priority based on marginal revenue until either there are no goods left to be allocated, or until there are no consumers left with a positive marginal revenue. Finally, Klemperer presented some simple examples of small auctions to illustrate the above equivalency.

3. Optimal Reservation Prices and Auctions vs. Negotiations

The third lecture started with some examples elaborating on the theory of optimal auctions presented in the previous lecture. In particular, Klemperer showed that if the values are uniformly distributed with a commonly known upper limit, then the optimal reservation price for the auctioneer is the inverse of the marginal revenue of the lower limit value. This lower limit value is usually equal to zero. In this case the optimal reservation price consequently equals half the upperlimit of the values. Notice that the reservation price does not depend on the number of competitors. On the other hand, if the value of the seller for the object is taken into account, the optimal reservation price is equal to the inverse of the marginal revenue of this particular value. The resulting payoff to the seller is therefore equal to the maximum of the marginal revenues of the buyers and the value of the auctioneer. It should be noted that the possibility is included that the object will not be sold. After having presented some numerical examples with respect to the theory of optimal auctions and its equivalence to the problem faced by a price discriminating monopolist, Klemperer devoted the second part of this lecture to the problem of auctions versus negotiations. This part of the lecture was largely based on an Bulow and Klemperer (1996).

The central question which is raised in this paper is whether a company should be sold using an auction with no reservation price or an optimally-structured negotiation process with at least one bidder less. An example of such a problem was the famous takeover battle of Paramount. The management of Paramount faced two options. On the one hand it could open private negotiations or, on the other hand, it could hold a public auction. The latter option would probably attract more bidders, but it also implies that Paramount would lose the right not to sell or to discriminate between potential buyers. Klemperer showed that under the assumption of the presence of serious bidders, symmetric probalility distributions for the values, and downward sloping marginal revenue curves, the expected payoff for the management is strictly smaller if they would sell using negotiations than using a standard open ascending or English auction with no reservation price and at least one more potential buyer. Consequently, one can say that an extra buyer beats any amount of skill or bargaining power. Klemperer also stressed that there is analogy between negotiations versus auctions and optimal regulation versus competition. Summarizing and partly repeating the result above, the main point that Bulow and Klemperer put forward is that a simple auction with $N+1$ bidders will yield a seller more expected revenue than he could earn fully exploiting his monopoly position against N buyers. Bulow and Klemperer's analysis abstracts from institutional considerations, which can make the situation more complex, but Klemperer concluded by saying that these considerations do not change their results dramatically.

4. Common Value Auctions

After having discussed private value auctions during the previous lectures, the theme of the fourth lecture was the common value model as introduced by Milgrom and Weber (1982). With respect to the latter you have to distinguish between the partially common, or equivalently almost common, value auction and the pure common value auction. Because the former are one of Klemperer's current research topics he devoted the fourth lecture to discussing the theoretical consequences and practical relevance of the common value auction.

The main assumption of the common value model is that a person's valuation of the object, contrary to the private value model, is affected by the estimations of the value by the other persons participating in the auction. Examples of this kind of auctions are bidding for a painting, bidding for an oil lease, or the ''wallet game'' discussed in class. As Klemperer indicated it is not very difficult to show that the RET continues to apply in the general common value model provided that bidders' signals are independent. Consequently, the independence of bidders' signals, not the privateness of their values, is important for the theorem to hold. This general case of the RET applies to all auction mechanisms for which it holds that the object always goes to the bidder with the highest signal and any bidder with the lowest possible signal expects a zero surplus. In particular, in the symmetric equilibrium of an open ascending auction, e.g. an English or Japanese auction, a player bids up to the value at which he would make no money if he were to find himself the winner. Note that in this case the equilibrium does not depend on the distribution of the signals. Furthermore, if there are only two bidders a player's equilibrium quitting price is the same price that he would bid in a second-price sealed-bid auction. This result only holds in this restricted case because the quitting price of the top two bidders in an open ascending auction depends on the points at which lower bidders have quit. Finally, the existence of multiple asymmetric equilibria in the pure common value model, in addition to the unique symmetric equilibrium mentioned above, should be noted.

A phenomenon related to common value auctions is the so-called Winner's Curse. The Winner's Curse states that winning the object in a common value auction is bad news because apparently all other bidders assigned a lower value to the object. Assuming equilibrium behavior in which all bidders recognise and optimally adjust for the Winner's Curse would ofcourse solve the problem. However, as illustrated by the examples discussed below, this is not what we observe in reality. In real life naive bidders fail to account for the Winner's Curse and consequently bid too much and lose money. Logically, the problem of the Winner's Curse for the bidders is larger in a sealed-bid first-price auction than in an open ascending auction. In the latter case you can observe opponents quitting ''surprisingly'' low and adjust

for that observed behavior. In a first-price sealed-bid auction you will only understand the problem if it is already too late.

Klemperer ended the fourth lecture by discussing some examples in order to illustrate the characteristics and the practical relevance of the models mentioned above. The following examples deal with the importance of asymmetric equilibria. In the U.S. airwaves auction Pactel had a small private value advantage with respect to the Los Angeles license. This advantage enabled Pactel to win the license at a relatively low price. This observation indicates that an asymmetric equilibrium was realized in this auction. Comparable situations may arise in the case of takeover battles as shown by Bulow, Huang and Klemperer (1996). Often a bidder has a small ownership state in the takeover target, a so-called toehold, which gives that particular bidder an incentive to bid more aggressively in an ascending auction because its offers are both bids for the remaining shares and asks for its own holdings. In a common value auction this effect makes competitors face an increased Winner's Curse. Consequently, they will bid more conservatively, allowing the toeholder to win the takeover auction at a low price. Asymmetric equilibria are also important in oil lease auctions. Because these auctions can be modelled as a repeated game, the reputations of the bidders will play an important role. For example, because Shell has the reputation to be an agressive bidder they are able to win oil leases at a low price quite often.

As illustrated by the following example the problem of asymmetric equilibria might be even worse if entry or bidding costs are present. When the Wellcome drugs company was taken over, it was worth a tiny bit more to Glaxo then to the other bidders, like e.g. Zeneca and Roche. After Glaxo had posted its first offer the others were not willing to participate in an ascending auction which they expected to lose. Exactly, the same argument was illustrated by Klemperer by the ‘‘modified wallet game’’ as discussed in class. These examples show that in the almost common value model it would be advisable to run an alternative form of auction rather than using an English auction. Finally, note that in the above examples the RET no longer holds because the bidder with the highest signal does not typically win the auction.

5. Miscellaneous Topics

Klemperer's last lecture dealt with some miscellaneous topics. He started discussing the consequences of dropping the important assumption that signals are independent. Instead assuming that signals are affiliated makes it impossible to calculate the equilibrium using the techniques introduces previously. Furthermore, the RET no longer holds in this case. In particular, the expected revenue in a Japanese auction is at least as large as in a sealed-bid

second-price auction. If there are at east three bidders and the value has some common component the expected revenue is even strictly larger. The sealed-bid first-price auction and the Dutch auction are still strategically equivalent and will therefore give the same expected revenue which is however strictly smaller than the expected revenue of a sealed-bid second-price auction. The above ordering of auctions according to expected revenue can be explained by the ability of the seller to reduce the private information owned by the bidders. In a Japanese auction this ability is largest causing lower information rents of the bidders. An important observation in models with affiliated signals is that the Winner's Curse may be reversed by the Linkage Principle. This principle states that a seller should fully reveal his private information to all the bidders if he can commit to it. As indicated by Levin et al. (1996) this may cause out-of-equilibrium strategies to be played in common value auctions. Optimal auctions in this setting are discussed in Cremer and McLean (1985) and Myerson (1981).

A second topic in Klemperer's last lecture was risk aversion. If the bidders in an auction are risk averse and their signals are independent it can be shown that the first-price sealed-bid auction produces a larger expected revenue than the English or second-price auction. This does not imply that the bidders automatically prefer the latter because these auctions are also riskier. If, on the other hand, the seller is risk averse the RET still holds. However, the seller now prefers a first-price auction to a second-price auction because the former is less risky.

A problem that is observed a lot in reality these days is collusion in auction procedures. Collusion is more likely to occur in a second-price auction compared to a first-price auction. According to Klemperer this can be explained by the fact that there are more incentives to deviate from collusive agreements in a first-price auction. Collusion is also likely to occur in repeated auctions. There are however more important aspects to repeated auctions. One of these aspects is the development of reputations. If we have a common value auction with asymmetric reputations the seller prefers a first-price auction. On the other hand, with private values or symmetric reputations the seller typically prefers a second-price or ascending auction. Another important observation with respect to repeated auctions is that revealing information may facilitate collusion. This leads the seller to avoid Japanese auctions. This result also holds if the bidders face budget constraints. Learning about the properties of an object in a repeated auction makes the seller also prefer a Japanese auction.

A special kind of auction is procurement where the price typically depends on profits. Consequently, in procurement the bidder buys more when the price is lower. If we look at this problem from the viewpoint of a single buyer a first-price auction is preferred to a second-price auction. The intuition behind this result is that the sellers have an incentive to lower their bids in a first-price auction because this will not only increase the chance of

winning, but also the quantity they will sell. This incentive is logically missing in a second-price auction.

The last topic addressed by Klemperer in the fifth lecture is the case of asymmetric bidders. Whether we consider a common value model or a private value model the seller will in this case typically prefer a first-price auction. Furthermore, if the distributions of valuations are identical except for their means, then the class of bidders with the lower average valuation are favored in the optimal auction. In the special case of asymmetric bidders and the presence of entry or bidding costs the first-price or Dutch auction is preferred to the second-price or Japanese auction by the seller because the former generates a higher expected revenue. If we abstract form the Linkage Principle this result holds even more generally.

To conclude his lectures Klemperer wanted to stress that intuition from auction theory can very well be used in another context. Gilbert and Klemperer (1996) take a general equilibrium theory model and show that setting a price resulting in rationing, may be optimal for a monopolist whose customers must incur costs to be able to use its product. Rationing results in ex-post social inefficiency, but the resulting distribution of ex-post surplus can compensate consumers for their incurred costs at a lower cost to the seller's profit than market-clearing prices would.

6. Concluding Remarks

What have I learned from Klemperer's lectures? As I was already familiar with most of the basic concepts used in the auction theory literature, I was particularly interested in the more recent contributions like Bulow, Huang and Klemperer (1996), Bulow and Klemperer (1996), and Gilbert and Klemperer (1996). The essential feature that of all of the above papers have in common is the practical economic relevance of the research topics. Let me be a little bit more specific with respect to the Bulow and Klemperer (1996) paper. This paper, which compares auctions with negotiations, contributes to solving some important practical problems faced by the government in the current privatization process. Municipalities, for example, often have to decide whether to privatize using an auction or to start negotiations with a private firm. Since a lot of municipalities are currently confronted with large budget deficits, the success of a privatization process depends crucially on the revenue raised by the auction or the private negotiations. If it is possible to distinguish clearly observable conditions that indicate whether auctions or negotiations yield the largest revenue, this would significantly simplify the political privatization process.

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Jürgen von Hagen

Lectures on Monetary Unification

A report by Marrit van den Berg (LUW)

In his lectures Von Hagen discussed a subject that touches us all. Maybe not professionally, but personally we are all involved in the creation of the EMU. We will feel the consequences of a possible recession as a result of the transition period, and we will experience whether the EMU will bring the economic boost we are made to believe it will bring. I think that professor Von Hagen succeeded in giving us some useful insights in what is perhaps the most important development of this decade in Europe, although he also left a few questions unanswered. However, that is of course inherent in the limited number of lectures he could give.

Theoretical foundations of monetary unification

Von Hagen started with the statement that there are two camps in the discussion about monetary unification: the ‘economist camp' and the ‘political camp'. The first starts from the traditional economic perspective. It is based on the theory of optimum currency areas, which looks at money as medium of exchange and weighs the costs of monetary unification against the benefits (Von Hagen, 1997). A generally accepted medium of exchange brings about an efficiency gain, since it prevents conversion costs and stimulates trade and international investment by removing exchange rate uncertainty. However, these arguments are not particularly convincing. There is no evidence that uncertainty impedes international investment and trade. It has never been proved that uncertainty is harmful for firms. Besides, there are various possibilities to evade uncertainty (e.g., forward markets). Moreover, the fixation of exchange rates by interest policy does not decrease uncertainty. It just shifts it. Another possible benefit of monetary unification is that it prevents competitive devaluations. A country that is in a recession has the incentive to devaluate excessively in order to decrease unemployment at the cost of other countries. This may trigger retaliation and undermine free trade. Besides these benefits of unification, the optimum currency area theory also considers the cost of losing the exchange rate as a mechanism to adjust to asymmetric shocks. The impact of this loss depends on the importance of the shocks and the availability of alternative mechanisms, like labour mobility -which is low in the EU- and fixed transfers.

The second point of view is the political approach. Money is viewed as a medium of tax payment and therefore the correlation between national borders and monetary borders -and the fact that the European Union is not a state- is stressed. In the absence of a national bank that can help a government to guarantee the price of its bonds, government bond markets will become more fragile. The European Central Bank may help instead, but then the inflationary effects of such a policy are spread over all countries and there is an incentive for countries to issue excessive debt. This reasoning indicates that according to the political view, a monetary union needs a political union to regulate the member states' behaviour. According to some, the EMU even is a vehicle towards a European state. However, it is not quite clear how this is going to happen.

The two approaches are not contradictory and Von Hagen developed an integrated framework in which they interact. He indicated that the optimal currency area theory stresses a horizontal conflict: the more heterogeneous the area, the larger the asymmetric shocks and the higher the pressure to dissolve the union. This tension can be alleviated in two ways: by fiscal integration (redistribution) or by political integration (potential treat to civil war). This is pictured by the rising line in figure 1. Besides, there is a vertical conflict, namely a principal agent problem between the centre and the member states. The more powerful the political centre, the larger its scope for abuse of the monetary union for its own benefit. According to this argument fiscal integration destabilises. This is pictured by the decreasing line in figure 1. Von Hagen illustrates with the example of the USA —where the monetary system went back and forth between more and less unification— that this vertical problem is indeed relevant. Since there is no information on the relative importance of the two conflicts, we do not know if or to which degree we need political integration to accompany monetary integration in the European Union.

Central bank decision making instruments

In his second lecture, Von Hagen argued that the contrast between monetary policy from a union perspective and monetary policy from a regional perspective plays an important role in the constitution and the decision rules of a central bank. He illustrated the influence of these differences with several voting games. His starting point is a model of monetary policy in a closed economy monetary union with an uneven number of states. In the model, union-level equilibrium employment is determined by producer price-inflation and an aggregate supply shock. In turn, producer-price inflation depends on the union money growth rate and aggregate shocks in supply and demand. The member countries may differ in size, but they have similar economic structures. Besides aggregates shocks, they face country-specific supply

and demand shocks. The representative household in the union prefers employment and price stability. Government goals are the same, except that a government likes surprise inflation in election years. Monetary policy is designed by the central bank council, which can consist of regional representatives and/or governors who are chosen through a centralised appointment procedure. Governors are interested in stabilising union employment and inflation, while regional representatives target inflation and employment in their home country. Thus, the optimal policy for a regional representative differs from the choice of a governor for three reasons: regional policy targets, policy uncertainty and regional supply shocks.

Figure Marrit here

Figure 1. Integration and stability. *The curves indicate the stable combinations of monetary and political integration according to two different theories*

The model shows that a council of governors will eliminate the demand shock entirely and the supply shock partially. State representatives try to use the common money supply to stabilise state specific shocks. Besides, they aim at surprise inflation in election years. They face more uncertainty than governors, which makes them more conservative in the sense that expected money supply is reduced and that aggregate shocks are incompletely stabilised (Von Hagen and Süppel, 1994). Von Hagen continues with a game in which each member state has a high and a low inflation party. In each period there are elections in each state. The same holds for the union. Monetary policy is decided upon after the elections and the representatives (governors) will choose according to the governing party in their state (the union). Unless political variation is maximal, the variability and the level of inflation are lower with a council of representatives than with a council of governors. So if there are no large aggregate supply and demand shocks, a council of representatives should be preferred.

However, if aggregate shocks are large, a council of governors is preferable, since it is better able to stabilise employment and inflation. This means that there is a trade-off between decentralisation and low inflation on the one hand and centralisation and monetary stability on the other hand. In his next game Von Hagen, therefore, analyses the workings of a mixed council. The number of state representatives is larger than the number of governors. Now, governors (which are considered as a uniform group) must collect the minimum amount of votes needed for majority. Thus, the position of the median state representative is strengthened.

The previously described games are all single-shot voting games. This means that council members are supposed to be myopic, which is of course a very unrealistic assumption. In reality, the political business cycle plays an important role and members will trade favours. If the council consists of state representatives and there is an election in a different country each year, there will always be a positive rate of inflation that the council can agree upon. So the trade-off between inflation and stabilisation is probably less important than was suggested before. Therefore, Von Hagen concludes that it is best to have a majority of governors in a central bank council. In the statutes of the European Central Bank Council, however, it is decided otherwise.

The European Central Bank

After Tuesday's theoretical lecture on central bank decision making, Von Hagen turned to the European case in his third lecture. The policy objective of the European Central Bank (ECB) is price stability. Nevertheless, none of the official documents contains a definition of price stability (Von Hagen, 1997). This may seem trivial, but Von Hagen clearly explained that there is no single and obvious interpretation. There are large regional differences in price movements. Besides, whether prices are perceived as stable depends on which goods are considered and the European consumption pattern is far from identical.

In order to define a workable stabilisation target for the ECB, Von Hagen looked more deeply into the possibilities. In the first place, monetary policy can either opt at price level stability or at zero inflation. In the latter case it equates the trend of the growth rate of money to the trend of the growth rate of output (Von Hagen, 1997). This does not mean that prices are stable, since there can be discrete moves in the level of prices, for example due to fiscal policy. A central bank aiming at price level stability would react to such a move, which could cause a conflict with the government. For example, a rise in taxes will be followed by a monetary contraction to counteract the rise in prices. This contraction would deepen the recession. So, zero inflation is to be preferred over price level stability. Nevertheless, in practice, also an inflation oriented central bank may need to follow some restrictive policy

after a discrete shock. The reaction of prices to a shock is mostly gradual and is easily confused with inflation by the public. This causes the inflation expectations to rise and forces the central bank to react. The more credible the bank, the less the need for a reaction. It is therefore important to make the ECB as credible as possible. Von Hagen suggests that this can be done by making it resemble as much as possible to the Bundesbank.

An inflation goal can still be interpreted in different ways; as an inflation target or an inflation norm. An inflation target includes a strict time horizon. The central bank ties itself to a certain rate of inflation in this time period, regardless of possible shocks. Therefore, co-ordination with the government is needed in order to prevent conflicts between monetary and fiscal policy. The alternative —an inflation norm— is more flexible. It fixes the rate of inflation over a long run average. In the case of a shock, you can temporarily deviate from the average (Von Hagen, 1997). Von Hagen argues that the ECB should not get an inflation target, since co-ordination with fiscal policy is impossible; there is no EU treasurer and the Bank is not allowed to talk to individual member states. Besides, a target is bad for discipline, as countries can rely on ECB's monetary policy to accommodate shocks.

Now that he defined a suitable target, Von Hagen talked about the way to get there. The instrument the ECB can use is the money markets rate. However, prices and income are only observed with lags and the relation with the instrument is uncertain. Therefore, an intermediate target must be defined. There are two possibilities: a monetary target and an inflation forecast. The monetary target is based on the quantity equation, which equals the change in money supply and the change in velocity to the change in income and inflation. On the basis of this equation, the monetary target can be computed and the money market rate can be set such that actual money growth equal targeted growth. This approach is based on two assumptions, namely that shocks to velocity are low (otherwise the quantity equation is not valid), and that the demand for money can be influenced by the interest rate. If one doubts the validity of the first assumption, an inflation target should be used instead. In this case, a complex model is used to relate inflation to a large number of variables, including income growth, money growth, changes in velocity and the money market rate. The latter is then set such that the inflation target is attained. This approach involves much more estimating and forecasting that the relatively simple monetary target approach. The counterpart of this simplicity is that the quantity of money is the only variable considered, but of course you can always look at other variables and adjust your target accordingly. Von Hagen, thus, clearly prefers a monetary target over an inflation forecast. However, he proposes to set a target for 2 or 3 years in stead of just one year because of the high uncertainty related to the new monetary union and currency (Von Hagen and Neumann, 1996).

Fiscal policy aspects of the EMU

The EMU will have several implications for the fiscal policies of the member states. Two aspects were already mentioned in earlier lectures: (i) the existence of a common central bank prompt member states to have large debts in the hope that the ECB will bail them out. Therefore debt should be restricted. (ii) the states give up the exchange rate as an instrument to deal with asymmetric shocks and need other stabilising mechanisms. Markets will not do the job, so there is need for transfer mechanisms.
In his fourth lecture, Von Hagen covered these aspects.

To prevent large debts of member states, the Excessive Deficit Procedure (EDP) is included in the Maastricht Treaty. This procedure says that members of the EMU should never have a deficit/GDP ration larger than 0.03 and a debt/GDP ratio larger than 0.60 (Von Hagen, 1997). Von Hagen's account of the history of these numbers was rather disillusioning. Economic theory suggests that a maximum debt might be a good idea, but it does not give a number. So when the procedure was invented, the current average debt of 60% was taken as the maximum. Economic growth in the long run is 5%, so for a stable deficit of 60%, a government will have to have a deficit of 3%. The average debt at this moment is 82%. If the maximum would just be set to this level, the whole problem would be solved.

Although the Maastricht treaty is very positive about the numbers, there are no other penalties than public rebuke. Germany's finance minister, Waigel, therefore proposed a 'stability pact', which implies that the debt/GDP ratio should not be larger than 0.01. If it happens to be larger than 0.03, the country gets an automatic penalty of 0.25% GDP (Von Hagen and Lutz, 1996). Von Hagen questioned the enforceability of such a penalty. It is very well possible that the penalised country is in a recession. In order to pay the penalty, the government will have to raise taxes, which will make it very impopular.

Von Hagen appeared to be sceptical not only about the numbers in the Excessive Debt Procedure (EDP), but also about the procedure as such. He first explains the background reasoning of deficit procedures. Three reasons are often mentioned to justify the EDP. Firstly, the existence of a common currency causes the need for co-ordination of fiscal policy. Von Hagen agreed with this reasoning, but he disagreed that this means a debt restriction. Secondly, a country with a large deficit will absorb a large part of the European savings. Von Hagen did not see any harm in this, since the country will pay interest. The third argument says that if the ECB will buy up debt from countries with too large deficits, the resulting inflation will be spread over the entire EU. Countries will therefore not face the whole result of fiscal crises. This is only a problem if the ECB is willing to buy debt. In the Maastricht Treaty this is prohibited, so the framers of the Treaty apparently did not believe in the treaty themselves. The reason for this is that the EU is ‘a union of solidarity and coherence' and ‘committed to the convergence of economies' (Von Hagen, 1997). The bail-out from a debt crisis could easily be justified for these reasons. Moreover, the ECB has the mandate to

safeguard the functioning of the banking system. Most government debt is hold by banks and a debt crisis would certainly harm them. The ECB could, therefore, justify the provision of loans to banks and in this way bail out the government. Von Hagen argued that if fear of this externality is needed, existing monetary unions will have similar debt restrictions. Empirical evidence from current and past monetary unions shows that in general this is not the case. However, the are not many examples, so Von Hagen also considered federal states. Half of these states have debt restrictions, but sometimes these have other reasons than the monetary union. Besides, borrowing restrictions are no typical feature of monetary unions, since most unitary states have some restrictions (Eichengreen and Von Hagen, 1996a). So then how do you explain the existence of these restrictions? A government that faces a debt crisis can do two things: either rely on the central bank or raise taxes. However, the latter is only possible if there is a decent tax base. Von Hagen, therefore, regresses the existence of deficit restrictions on the ratio of local expenditures to revenue from local taxes. The result is significant: the larger the share of own revenue in expenditures, the larger the possibility of no restrictions (Eichengreen and Von Hagen, 1996b). Von Hagen concludes from this that it is unlikely that restrictions are needed for the EU. Restrictions may even be harmful since countries may let the central government (the EU) buy for them. Empirical evidence indeed shows that the higher the restrictions, the higher the debt of the central government.

In the second part of the lecture Von Hagen discusses the use of transfer mechanisms to alleviate asymmetric shocks. Existing monetary unions commonly provide stabilisation through the national or federal system. McDougal calculated in 1977 that the EU would need a budget of at least 7% of GDP for this purpose, while the current budget is only 1% of GDP (Von Hagen and Hammond, 1996). Such a large expansion of EU finances is politically not acceptable for most member states. It has therefore been proposed to set up an insurance mechanism among member states that would channel funds from countries in a boom relative to the EU average to countries in a relative boost. The question remains whether should we insure regions or individuals. From a public-finance point of view, insuring individuals is more appealing, but this presupposes the existence of a fiscal union that is not in sight today (Von Hagen and Hammond, 1996). Therefore, Von Hagen follows the regional insurance approach. Such a scheme has several desirable properties. In order to be politically acceptable, it should be simple and automatic. It should be distributionally neutral and financially balanced. Finally, transfers should only be paid in response to asymmetric and transitory shocks. These properties are not all mutually compatible. For example, the large differences in sizes and income levels among the EU countries imply that an automatic system cannot be balanced. This suggests that the design of an insurance scheme for the EU requires choices. Von Hagen discussed two possible schemes in view of the desirable characteristics. The performance is simulated using country specific shocks constructed with GDP data

calculated on purchasing-power-parity basis from 1960 to 1993 (Von Hagen and Hammond, 1996). The first scheme Von Hagen discussed emphasises automaticity and the requirement that shocks be conditionally unexpected. Transfer payments are calculated according to a complicated econometric equation and are not balanced. On average, the resulting payments are large, but individual payments can be rather high. This would give rise to large marginal tax rates. The scheme is distributionally neutral. The simulations show that the importance of asymmetric shocks and the cost of losing the exchange rate channel of adjustment are greater for the small member countries and the later entrants of the EU. The second system that Von Hagen discussed is a very simple one. It stabilises the rate of growth of per capita real GDP around each year's EU average growth rate. Average transfers are now quite large and positive for the relatively fast growing countries and large and negative for the slow growing economies. This implies that there are permanent income transfers. Since the fast-growing countries typically are the poorer ones, the system is regressive. Moreover, payments generally go in the wrong direction. Both systems can be restricted to mechanisms that balance every year. These mechanisms mimic the other systems. In conclusion, the first system works well, but is very complicated and therefore unlikely to be implemented. The second system is very simple, but does not work well. Moreover, it makes intertemporal income variability in the member states go up. Thus, the EU may well be better off without inventing an insurance mechanism against asymmetric shocks.

The way to the EMU

Von Hagen devoted his last lecture to the question ‘if we want an EMU, how do we get there?'. In the treaties, convergence is emphasised. However, there is no agreement on when convergence should occur. Roughly speaking, there are two camps: the ‘economists', who think that a monetary union requires a large degree of fiscal and monetary convergence before it can begin; and the ‘monetarists' who take the line that the monetary union can precede convergence. The Maastricht Treaty sought a compromise between these positions and combined a time table for the beginning of the EMU with a list of criteria that countries must fulfil to be admitted. These criteria include both monetary and fiscal requirements. The most important monetary criteria are that a country's rate of inflation must be no more than 1.5% above the lowest three inflation rates in the EU, and that exchange rates must be within the normal bands of the EMS for two years prior to the start of the EMU (Von Hagen and Lutz, 1996). The most important fiscal requirement is the EDP, which Von Hagen discussed in depth on Thursday. Many politicians insist on a hard interpretation of the fiscal criteria, meaning that they will tolerate no deviation from the 60%/3% limits when the members of

the monetary union are chosen. Von Hagen argued that this interpretation requires that the fiscal criteria can be reached at a reasonable cost and that the monetary and fiscal criteria are consistent with each other. He tried to shed light on these issues with some empirical work. For this study he used an existing model for the G7 economies. This model essentially is a dynamic version of the Mundell-Fleming model augmented by a rational-expectations, sticky-price aggregate supply curve. The model includes monetary and fiscal policy parameters. The central bank uses the short term interest rate for monetary policy and the government spends a percentage of GDP on consumption. With this model, the effects of a cut in government expenditures (as required by the Maastricht Treaty) are simulated (Von Hagen and Lutz, 1996). If this cut is unexpected by the public, it results in a recession. Due to the fact that the Maastricht criteria are tied to the deficit ration, instead of the deficit level, the recession amplifies the need for fiscal restraint. Exchange rates adjust and in the long run, people realise that inflation rates are falling and they decrease their wage demands. As a result, output will return to the original level while prices will be lower. It therefore seems that the fiscal and the monetary requirements are compatible. However, if exchange rates are fixed, the picture changes. Von Hagen discussed the consequences for two countries: Italy and Germany. In Italy, the interest rate declines, which causes a decrease in the money supply and deepens the recession. So in this case there is a problem of compatibility between fiscal and monetary policies. The outcome is nicer for Germany: here the recession is less deep than with flexible exchange rates. If the cut is anticipated, the demand for investment falls immediately when the programme is announced and all currencies will depreciate. The depreciation of the DMark is mild and Germany will go through a small recession. Italy will depreciate the lire considerable, which causes a little boom in the year before the programme sets in. However, a deep recession follows. If exchange rates are fixed, the recession becomes deeper. In sum, the cost of fiscal policy under fixed exchange rates is very large. Moreover, if only fiscal criteria are targeted, it is to be expected that inflation criteria will not be met. Von Hagen concludes that insisting on a hard interpretation of the criteria is questionable and that we can only hope that there is a stable solution.

Conclusion

It was a bit disappointing that Von Hagen did not end his lecture series with a critical vision on the (non)sense and the prospects of the EMU as planned in the Treaties and with recommendations for improvements. However, I think that it is possible to give an indication of his ideas on the basis of his lectures. Von Hagen did not pronounce upon the desirability of the EMU. In his introductory lecture he mentioned several arguments that he considered

valid. The benefit of monetary unification is that it prevents competitive devaluations, the costs are the loss of the exchange rate as a mechanism to adjust to asymmetric shocks and the incentive for member to hold excessive debt. In another lecture he argues that in the case of the EMU this risk is probably not very relevant, which leaves us with one argument pro and one contra the EMU. It is not possible to deduce from his lectures which he considers more relevant, but the general impression is that he is very sceptical about the EMU. The feeling you end up with after the lectures is that the unification of monetary policy for a series of countries as divers as the EU members creates a lot of problems. Nevertheless, Von Hagen seemed to have accepted the inevitability of the EMU and concentrated on the optimal way of implementation. He disagreed on several points with the Maastricht Treaty and its interpretation by politicians. In the first place, he criticised the fact that price stability —the central aim of the ECB— is not defined. He suggested that the ECB should pursue an inflation target and use a monetary target as intermediate aim. In the Maastricht Treaty it is laid down that country representatives will form the majority of the ECB council. Von Hagen argues that this will lead to insufficient stabilisation of aggregate shocks and that a council of governors is to be preferred. Besides, he holds the view that debt restrictions are not needed, since the EU members can use their tax revenues to cope with the threat of a debt crisis. They are even harmful, because the constraints may cause the substitution of union debt for member state debt. Moreover, the cuts in government expenditure that are needed to fulfil the debt criteria cause a recession that is deepened by the fact that the criteria are tied to the deficit ratio, instead of the deficit level. Besides, a hard interpretation of the EDP leads to inflation, which means that there is a conflict between the fiscal and the monetary criteria. The detrimental effect of the EDP is strengthened when exchange rates are fixed. Von Hagen therefore pleaded for flexible exchange rates during the transition period. Finally, he reasoned that the EMU is better of without an insurance mechanism for asymmetric shocks. Complicated systems are politically not acceptable and simple systems are counter-productive. In conclusion, it seems that Von Hagen pleas for a transition period in which countries are completely free to adjust their economies to the demands of the EMU.

I am of the opinion that —being an economist— I should be able to say something sensible about the EMU. However, before the lecture I could not, because I did not have enough information. I therefore looked forward to Von Hagen's lectures. In part they brought me what I expected: I gained insight in the consequences of the requirements for the EMU and in the reasoning behind monetary unions. The foundations of Von Hagen's empirical work are not always very strong (as is often the case with empirical work) but he still convinced me that the procedures are not very well-thought out, and that in the process of negotiation large part of economic reasoning got lost in political games. However, the lectures also left me puzzled: why would we want an EMU at all? I am certain that most of the answer will

be found in politics and not in economics, but I regret that Von Hagen did not treat this question more profoundly anyway.

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The Econometrics of Structural Change and Thresholds

by Professor Bruce E. Hansen

NAKE workshop Maastricht, 9-13 December 1996

Report by Franc Klaassen (KUB)

1 Introduction

In five lectures Professor Bruce E. Hansen of Boston College taught about econometric issues on structural change and thresholds. The first three and a half lectures about structural change started with a small overview of the literature on structural change from before the late eighties (see section 2 of this summary). Those papers were characterized by fairly ad hoc approaches in the sense that they were not based on, for instance, maximum likelihood. During the nineties, the econometric literature on structural breaks has grown rapidly. The central point in all papers is, however, still the same: how to test a null hypothesis when parameters are not identified under this null? Sections 3 and 4 will discuss how the new literature tries to answer this question in simple regression models with one and multiple breaks, respectively. Section 5 will present a method to form confidence sets for the break dates. An interesting extension of the theory for standard regression models will be given in section 6 which shows how standard tests for unit roots and cointegration in models with breaks can fail to reject false null hypotheses of a unit root and no cointegration, respectively.

In the final one and a half lectures Hansen discussed regression models with additive non-linearity, such as the threshold model. The theory used for such models, as discussed in section 7, will appear to be very similar to the one in the previous sections, making all five lectures a coherent course. Section 8 contains some concluding remarks.

2 Previous Approaches

Consider the following regression model with time varying parameter θ_t: $y_t = x_t'\theta_t + e_t$, for $t = 1, ..., T$. One way to estimate θ_t is by doing Ordinary Least Squares (OLS) using only the first t observations: $\widehat{\theta}_t \equiv \left(\sum_{i=1}^{t} x_i x_i'\right)^{-1} \sum_{i=1}^{t} x_i y_i$. Rewriting this expression

yields:

$$\sqrt{T}\left(\widehat{\theta}_t - \overline{\theta}_t\right) = M_t^{-1} S_t, \tag{1}$$

where

$$M_t \equiv \frac{1}{T}\sum_{i=1}^{t} x_i x_i', \; S_t \equiv \frac{1}{\sqrt{T}}\sum_{i=1}^{t} x_i e_i \text{ and } \overline{\theta}_t \equiv \left(\sum_{i=1}^{t} x_i x_i'\right)^{-1} \sum_{i=1}^{t} x_i x_i' \theta_i. \tag{2}$$

To derive a distribution theory for the sequence $\widehat{\theta}_t$ if $T \to \infty$, Hansen defined $r \equiv t/T$ as the fraction of the sample at time t, so that, for continuous $r \in [0,1]$, $t = [Tr]$ where [.] denotes the integer part. Assuming that x_t is strictly stationary and ergodic, that $M \equiv E\{x_t x_t'\} < \infty$ and that (e_t, I_t)[1] is a martingale difference sequence, we have the following result:

$$\sqrt{T}\left(\widehat{\theta}_{[Tr]} - \overline{\theta}_{[Tr]}\right) \Longrightarrow M^{-1}\frac{B(r)}{r}, \tag{3}$$

where $\Longrightarrow$ denotes uniform convergence in probability over $r \in [0,1]$ if $T \to \infty$, and $B(r) \equiv BM(V)$ is a Brownian Motion with covariance matrix $V \equiv E\{x_t x_t' e_t^2\}$.

This result can be used to test the null of no time variance in the parameter θ_t, say $\theta_t = \theta_0$, which implies that $\overline{\theta}_t = \theta_0$. Since under this null, assuming conditional homoskedasticity, that is, $E\{e_t^2 | I_{t-1}\} \equiv \sigma^2$, and using that $\frac{1}{T}\sum_{i=1}^{T} x_i x_i' \Longrightarrow M$, result (3) implies that

$$\frac{\left(\frac{1}{T}\sum_{i=1}^{T} x_i x_i'\right)^{\frac{1}{2}}}{\widehat{\sigma}}\sqrt{T}\left(\widehat{\theta}_{[Tr]} - \widehat{\theta}_T\right) \Longrightarrow \frac{M^{-\frac{1}{2}}}{\sigma}\left(\frac{B(r)}{r} - B(1)\right), \tag{4}$$

where $\widehat{\sigma}$ is the standard OLS estimate for σ.

Another approach to test the null of no time variance, commonly known as the fluctuation test (see Krämer, Ploberger and Alt, 1988), is based on

$$\max_t \left|\widehat{\theta}_t - \widehat{\theta}_T\right| \xrightarrow{d} \max_r \left|\frac{W(r)}{r} - W(1)\right|, \tag{5}$$

where $\xrightarrow{d}$ denotes convergence in distribution for $T \to \infty$ and $W(r) \equiv BM(I)$.

Although both test procedures I have just described are still applied in empirical work, Hansen called them *ad hoc* in the sense that they are not based on, for instance, maximum likelihood (ML). In the next sections I will describe fairly new approaches dealing with structural breaks that are not *ad hoc*.

[1] I_t denotes the information set at time t.

3 Single Structural Break

Suppose a time series y_t is described by $y_t = \theta' x_t + \delta' x_t 1[t \leq k] + e_t$ which allows for one shift in the parameter vector θ at the break date k. This section, based on Andrews (1993), is concerned with the estimation of the parameters and the testing of the null of no structural break, that is, $\delta = 0$.

To estimate θ, δ and k, first compute the OLS estimates $\widehat{\theta}(k)$ and $\widehat{\delta}(k)$ for all values of k between, say, k_1 and k_2,[2] as well as the residual variance $\widehat{\sigma}^2(k)$. Then estimate k by $\widehat{k} \equiv \arg\min_k \widehat{\sigma}^2(k)$ and finally estimate θ and δ by $\widehat{\theta}(\widehat{k})$ and $\widehat{\delta}(\widehat{k})$, respectively.

To test whether δ equals zero, Hansen proposed to use the Sup-Wald statistic defined by $W_T \equiv \max_k W_T(k)$, where $W_T(k) \equiv T\left(\widetilde{\sigma}^2 - \widehat{\sigma}^2(k)\right)/\widehat{\sigma}^2(k))$ is the standard Wald statistic ($\widetilde{\sigma}^2$ denotes the ML estimate under the null). To derive its asymptotic distribution, Hansen again used the index r defined before. It appeared that, under conditional homoskedasticity,

$$W_T \Longrightarrow \max_{\pi_1 \leq r \leq \pi_2} \frac{W^*(r)'W^*(r)}{r(1-r)}, \tag{6}$$

where $W^*(r) \equiv W(r) - rW(1)$ is a standard Brownian Bridge, $\pi_1 \equiv k_1/T$ and $\pi_2 \equiv k_2/T$. Critical values for W_T, which only depend on $[\pi_2(1-\pi_1)]/[\pi_1(1-\pi_2)]$, can be found in Andrews (1993) who also gives a guideline for the choice of π_1 and π_2, so as to avoid a data-dependent choice in empirical work which would make his critical values invalid: simply choose $\pi_1 = 0.15$ and $\pi_2 = 0.85$ (this is called symmetric trimming).

As an application of the theory I have just described, Stock and Watson (1996) examined the stability of a lot of U.S. macroeconomic time series. Their results suggest that there is substantial instability, thereby indicating the importance of the subject that Hansen was talking about.

4 Multiple Structural Breaks

The analysis of the previous section is also useful in case there may be multiple breaks. Bai (1996) suggested the following sequential procedure. First, test for a single break as described above. If no break is detected, the procedure stops. However, if Andrews' test rejects stability, divide the sample into two subsamples at the (consistently) estimated break point, and perform Andrews' test on each subsample. In case of rejection of stability for a subsample, divide that subsample at the estimated break date, etc. The

[2] Clearly, k_1 and k_2 cannot be set to 1 and T, respectively. A practical choice of the boundaries will be given below.

procedure continues until all the subsamples fail to reject stability. Finally, when all, say two, of the estimated break points are obtained, say $\widehat{k}_1$ based on the whole sample and $\widehat{k}_2$ on one subsample, a refinement is needed: (only) $\widehat{k}_1$ should be reestimated using the subsample $[1, \widehat{k}_2]$ if $\widehat{k}_1 < \widehat{k}_2$ and using $[\widehat{k}_2, T]$ if $\widehat{k}_1 > \widehat{k}_2$. The resulting estimator $(\widehat{k}_1', \widehat{k}_2)$ is asymptotically equivalent to the joint estimator of (k_1, k_2) which is obtained by minimization of the residual variance $\widehat{\sigma}^2(k_1, k_2)$.

5 Confidence Sets for Break Dates

Assume the following simplified model for y_t: $y_t = \delta 1[t \leq k_0] + e_t$, where δ is known and k_0 is the true break date which is estimated by $\widehat{k} \equiv \arg\min_k \sum_{t=1}^{T}(y_t - \delta 1[t \leq k])^2$. As in section 2, Hansen concentrated on $\widehat{\tau} \equiv \widehat{k}/T$ and $\tau_0 \equiv k_0/T$ instead of $\widehat{k}$ and k_0, respectively. Under the assumption that $\delta \to 0$[3] and $\delta^2 T \to \infty$, he presented the following asymptotic result:

$$\delta^2 T(\widehat{\tau} - \tau_0) \xrightarrow{d} \sigma^2 \arg \max_{-\infty<s<\infty} (-|s| + 2W(s)) \equiv \sigma^2 \psi, \tag{7}$$

where $\sigma^2 \equiv E\{e_t^2\}$.[4]

To construct confidence sets for the change point (given that there is one change point), Hansen used the likelihood ratio $LR(k)$ for the null that the change is at time k: $LR(k) = T\left(\widehat{\sigma}^2(k) - \widehat{\sigma}^2(\widehat{k})\right) / \widehat{\sigma}^2(\widehat{k})$. A $(1-\alpha)$ confidence set for k_0 is given by those values of k at which $LR(k)$ is smaller than some critical value, such as 7.3 for $\alpha = 5\%$.[5]

6 Testing for Unit Roots and Cointegration in Models with Breaks

Testing for unit roots and cointegration is nowadays routine for researchers when analyzing time series. However, as Perron (1989) and Gregory and Hansen (1996) showed

[3] This "small break assumption" may seem strange, since δ was defined as a fixed parameter. However, just as we use results for $T \to \infty$ as an approximation for the finite sample results given a fixed finite T in empirical work, results for $\delta \to 0$ can be used as an approximation for unknown results for a fixed δ.

[4] Note that τ_0 is fixed if $T \to \infty$. Intuitively, this implies that you not only get more and more data after $t = k_0$, but also before k_0. This may seem strange, but again the asymptotic results should only be viewed as an approximation to the unknown finite sample results.

[5] Note that the confidence set may consist of two or more disjoint intervals; this is why we talk about a confidence set instead of a confidence interval.

by their Monte Carlo experiments, the conventional tests for unit roots and cointegration, such as the Augmented Dickey-Fuller (ADF) test, often fail to reject the null of a unit root and the null of no cointegration, respectively, in cases where the data generating process is one of stationary fluctuations around a breaking trend, or, in cases of cointegration, one with a break in the cointegrating vector. Hansen, therefore, discussed alternative testing procedures for the null of a unit root or of no cointegration that allow for the presence of a structural break.

Suppose we have the following model: $y_t = x_t'\theta_1 1[t \leq k] + x_t'\theta_2 1[t > k] + u_t$, where $u_t = \rho u_{t-1} + e_t$. The null is $\rho = 1$ which under $x_t = (1, t)'$ represents the unit root case and under $x_t = (1, y_{2t})'$ where $y_{2t} \sim I(1)$ represents the case of no cointegration. The testing procedure proposed consist of two steps. First, compute the standard ADF statistic for each possible k, say $ADF(k)$, and then define the test statistic $ADF^* \equiv ADF(\widehat{k})$, where $\widehat{k}$ is an estimate for k defined by $\widehat{k} \equiv \arg\min_k ADF(k)$. Critical values for ADF^* can be found in Zivot and Andrews (1992) for the unit root case, and in Gregory and Hansen (1996) for the cointegration case.

To illustrate the theory described above, Hansen first discussed Perron's model for postwar quarterly U.S. real gross national product which permits an exogenous change in the growth rate at $k = 1973 : 1$. Perron used the same data as Nelson and Plosser (1982) who found that (among others) real GNP has a unit root. However, by allowing for the break in the growth rate, Perron rejected the unit root hypothesis and concluded that real GNP is stationary around a trend which slope changed during the first oil shock.

One may, however, have one objection to Perron's approach: he specified k in advance and hence problems of data-mining are applicable to his methodology. Zivot and Andrews (1992) circumvent this by estimating k and using ADF^* as described above. Their critical values are larger (in absolute value) than the ones Perron used, and their evidence is indeed less conclusive against the unit root hypothesis.

7 Regression Models with Additive Non-linearity

Assume that a variable y_t, which may be either cross-sectional or a time series variable, is generated by the following process:

$$y_t = x_t'\theta + \alpha' h_t(\gamma) + e_t, \tag{8}$$

where, for example,

$$h_t(\gamma) = \begin{cases} x_t \Phi(\frac{z_t - \gamma_1}{\gamma_2}) \text{: smooth transition model, or} \\ \\ x_t 1[z_t > \gamma] \text{: pure threshold model.} \end{cases} \tag{9}$$

In the smooth transition model γ_1 has the interpretation of a threshold and $1/\gamma_2$ represents the speed of switch between two regimes of systematic parts, namely $x_t'\theta$ when z_t is very small and $x_t'(\theta + \alpha)$ when z_t is very large. The pure threshold model is a special case of this model, since the speed of switch is infinity.

7.1 Estimation

Since the model is partial linear (it is linear in θ and α given γ), the model can be estimated in two steps. First, fix γ and regress y_t on x_t and $h_t(\gamma)$ which gives the OLS estimates $\widehat{\theta}(\gamma)$, $\widehat{\alpha}(\gamma)$, $\widehat{e}_t(\gamma)$ and $\widehat{\sigma}^2(\gamma)$, and then estimate γ by $\widehat{\gamma} \equiv \arg\min_{\gamma} \widehat{\sigma}^2(\gamma)$. The final estimates of θ and α are given by $\widehat{\theta}(\widehat{\gamma})$ and $\widehat{\alpha}(\widehat{\gamma})$, respectively. In practice, however, gradient based minimization of $\widehat{\sigma}^2(\gamma)$ over γ often yields local minima in the model under consideration. To circumvent this, Hansen proposed two other minimization algorithms. First, if the dimension of γ is low, a grid search algorithm may be useful to obtain starting values for, say, gradient methods. Secondly, one may use gradient-free algorithms. As an example, he discussed simulated annealing which is an iterative method where the value of γ in the i-th iteration is given by $\widehat{\gamma}_i = \widehat{\gamma}_{i-1} + random\, error$ and where you proceed if you find an improvement in terms of $\widehat{\sigma}^2(\gamma)$.

7.2 Testing

An interesting hypothesis in regression models with additive non-linearity is that of no additive non-linear term, that is, $H_0 : \alpha = 0$. Testing it, however, is nonstandard, since under the null γ is not identified. Again, Hansen used a test W_T based on pointwise Wald statistics: $W_T \equiv \max_{\gamma} W_T(\gamma)$, where $W_T(\gamma) \equiv T\left(\widetilde{\sigma}^2 - \widehat{\sigma}^2(\gamma)\right)/\widehat{\sigma}^2(\gamma))$ is the standard Wald statistic ($\widetilde{\sigma}^2$ denotes the ML estimate under the null). It appears that

$$W_T \Longrightarrow \sup_{\gamma} S(\gamma)' H(\gamma)^{-1} S(\gamma), \tag{10}$$

where $S(\gamma)$ is a mean-zero Gaussian process with covariance kernel $E\{S(\gamma_1)S(\gamma_2)'\} = H(\gamma_1, \gamma_2)$[6] which is defined as $E\{h_t^*(\gamma_1)h_t^*(\gamma_2)\}$, where $h_t^*(\gamma)$ is the residual from a

[6] This means that $S(\gamma)$ behaves like: for any pair (γ_1, γ_2), $(S(\gamma_1), S(\gamma_2))'$ is normally distributed with mean zero and a covariance matrix with $(i,j) - th$ block equal to $H(\gamma_i, \gamma_j)$, for $i, j = 1, 2$.

regression of $h_t(\gamma)$ on x_t. Moreover, $H(\gamma) \equiv H(\gamma, \gamma)$. Since the asymptotic distribution of W_T depends on the function $H(.,.)$, we cannot (in general) tabulate critical values. However, since it only depends on $H(.,.)$ which is only a function of the joint distribution of (x_t, z_t) (of which we know the in-sample distribution), we can calculate the distribution of $\sup_{\gamma} S(\gamma)' H(\gamma)^{-1} S(\gamma)$ and this is can be done by bootstrapping.

7.3 Distribution of Estimators in Threshold Models

From Chan (1993) we know the asymptotic behavior of $\widehat{\theta}$ and $\widehat{\alpha}$:

$$\sqrt{T} \begin{pmatrix} \widehat{\theta} - \theta \\ \widehat{\alpha} - \alpha \end{pmatrix} \xrightarrow{d} N(0, V), \tag{11}$$

where V is "conventional". However, for $\alpha \neq 0$, the asymptotic distribution of $T(\widehat{\gamma} - \gamma)$ is complicated. Hansen provided a different approach to circumvent this. Assuming $T\alpha'\alpha \to \infty$, yet $|\alpha|^2 \to 0$, it appears that

$$T\alpha' D\alpha f(\widehat{\gamma} - \gamma) \xrightarrow{d} \sigma^2 \arg \max_{-\infty < s < \infty} (-|s| + 2W(s)) \equiv \sigma^2 \psi, \tag{12}$$

where $D \equiv E\{x_t x_t' \mid z_t = \gamma\}$ and $f \equiv f(\gamma)$ where $f(.)$ denotes the density of z_t.

Comparing this result with the assumptions and asymptotic distribution in section 5 shows a great similarity between models with structural breaks and the threshold models in this section. Therefore, although the title of Hansen's lectures might have pointed at two different subjects, Hansen made it clear that discussing both in one course has clear advantages.

8 Concluding Remarks

The econometric literature on structural breaks and thresholds is growing rapidly nowadays. Professor Hansen gave a broad overview of the existing literature. He pointed out that many econometric testing problems occur when parameters are not identified under the null hypothesis, as is the case in the structural change model (where the change date is not identified if there is no change) and in regression models with additive non-linearity (where, for instance, the threshold is not identified if the effect of the non-linear term is zero). For both cases he provided ideas to perform tests anyway.

For my own work on international trade, an important application of the structural change model concerns testing for unit roots (and cointegration). In the case of a breaking trend of a trend-stationary macroeconomic variable, standard tests often cannot reject the unit root hypothesis which implies that random shocks have permanent

effects. This runs counter to the view of real business theorists that business cycles are transitory fluctuations around a more or less stable trend. By discussing the reasons why standard unit root test may lead to wrong results, Hansen therefore implicitly motivated the usefulness of Professor Eichenbaum's course on real business cycles during the same workshop.

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Real Business Cycle Theory

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1 Introduction

In this paper, the lectures by Martin Eichenbaum about quantitative equilibrium business cycle models (henceforth RBC models) are discussed. Eichenbaum started the series of lectures with the very simple one sector growth model, during the week the models got more complicated, but also improved in the sense that they started to 'behave' like real economies. This paper follows the outline of the lectures. The second section shows the basic outline of the classical RBC models. The third section covers the factor hoarding model. The fourth section displays some models that incorporate a monetary sector. The fifth section concludes.

2 The Basic RBC Model

2.1 The Empirical Facts

Some stylized facts of the economy are discussed in Cooley and Prescott (1995). RBC models have to comply with these to withstand the criticism that they are not able to explain real life features.

- the magnitude of fluctuation in output and aggregate hours is almost equal;
- most fluctuations in hours worked are movements in and out the labor force;
- consumption of nondurables is smooth, much smoother than output;
- investment in durables is much more volatile than output;
- the capital stock hardly fluctuates and is largely uncorrelated with output;
- productivity is slightly procyclical but varies less than output;
- wages vary less than productivity, and;
- the correlation between average hourly compensation and output is basically zero.

All RBC models can be evaluated according to the way in which they can mimic this behavior.

2.2 The One-Sector Growth Model

On the basis of the neo-classical (or Solow) growth model, addition of stochastic shocks to technology can lead to cyclical behavior of the economy, as can be observed in the real world.

The one sector growth model has a production function of a very general form that can be represented as $Y_t = F(K_t, H_t)$, where K_t is the capital stock at time t, H_t is labor supply. The level of population is assumed to be constant for the moment. The utility function U can be represented by $U = \sum_0^\infty \beta^j U(c_t)$, with $0 < \beta < 1$, and $U(c_t)$ continuous and twice differentiable. Periods t budget constraint equals $C_t + K_{t+1} - (1-\delta)K_t \leq F(K_t, H_t)$, where δ is the fixed rate of depreciation. The net production function (excluding depreciation) is $f(K_t, H_t)$.

The social planner maximizes utility subject to the budget constraint, that holds as an equality to avoid waste. This maximization problem can be restated as the optimal solution to the value function $V(K_0) = \max_{0 \leq K_1 \leq f(K_0)} \{U[f(K_0) - K_1] + \beta V(K_1)\}$, where $V(K_t)$ is the maximum value of the utility function that can be obtained in that period. This analysis is relevant here because the solution to the planner's problem is equivalent to the decentralized optimum, as is shown in Cooley and Prescott (1995). The value function, here written in its recursive form, can be maximized by dynamic optimization techniques. This maximization leads to a monotone, bounded, sequence for $k_0,\ k_1, \ldots,\ k_\infty$.

Economic growth, the long term trend in the time series, can be introduced into the model by changing the production function to $F(K_t, A_t H_t)$, with constant returns to scale with respect to K_t and $A_t H_t$. A_t is a function that increases exogenously over time with a trend value.

2.3 The Data

The data used in RBC models can be obtained in two ways. One is to take first differences of the time series. Another way is to apply the Hodrick-Prescott filter to the data. This filter is used to decompose the log of the time series on e.g. y_t into a growth trend g_t and a cyclical trend c_t. The formula applied is $\min \sum_{t=0}^T (y_t - g_t)^2 + \lambda \sum_{t=0}^T (\Delta g_{t+1} - \Delta g_t)^2$. For quarterly data the 'optimal' value for λ is 1600. As λ equals zero, the growth trend equals the series, whereas, if λ approaches infinity, the growth component approaches a linear trend. For various levels of λ, the autocorrelation and volatility of the cyclical component vary widely. Consumption is relatively smooth, whereas investment is very volatile.

2.4 Some Extensions

The early RBC models only considered shocks to technology, hence productivity is procyclical. People supply more labor during a boom, and the average labor productivity goes up. An example of a stochastic growth model is explored in Cooley and Prescott (1995). To improve the performance of the model a labor/leisure choice is introduced.

The production function is changed to $Y_t = e^{z_t} F(K_t, H_t)$, where $z_t = \rho z_{t-1} + \epsilon_t,\ (0 < \rho < 1)$, an AR(1) process. The household problem is slightly modified to take account of labor-

leisure choice. The utility function is $U = E_t \sum \beta^t U(c_t, 1 - h_t)$, subject to the households budget constraint $c_t + i_t \leq w_t h_t + r_t k_t$. Since w_t and r_t depend on z_t and K_t, the value function has to be maximized over z, k and K. The recursive competitive equilibrium is the maximization of the value function $v(z, k, K) = \max_{c,x,h}[u(c, 1 - h) + \beta E[v(z', k', K')|z]$ subject to the household problem (utility maximization, s.t. the budget constraint), the firm problem (profit maximization, s.t. budget constraints), consistency between individual and aggregate decisions and satisfying the aggregate budget constraint. In a version of the model with two periods and certainty, the labor/leisure choice depends on the relative wage rates, the rate of time-preference and the interest rate. For a special case with full depreciation and uncertainty, the labor supply is still constant. The income and substitution effects of the wage rate cancel out.

Real life output behaves like an AR(2) process, one of the problems of the special case, developed above, is e.g. that the humped shape response of output to technology shocks can not be mimicked. Furthermore, there are several counterfactual features implied by the model, consumption and investment are equally volatile, due to the constant savings rate, labor supply does not move very much and the real wage is very procyclical. So another model has to be explored without full depreciation.

The recursive competitive equilibrium can be computes in several ways. One is to use loglinear approximations to the system equations. The system of equations has to be rewritten in terms of variables that do not grow in the 'steady state'. These equations are loglinearized and can be solved. The other way is to get at the numerical solution, see e.g. Blanchard and Kahn (1980) for more details.

The above model, even in the case without full depreciation and for a prolonged time period, cannot explain the basic observation in the labor market. Fluctuations are basically in the extensive margin, not, as predicted by the model, in the intensive margin. A model that does succeed in mimicking the behavior on the labor market, is one developed by Rogerson (1988), a variant of the model by Hansen (1985). A person works for a fixed amount of hours, or not at all. He does however get paid, there is perfect risk-sharing. The probability that someone is employed is π_t, that can fluctuate over time. The outcome of the model does break the link between micro and macro data although perfect risk-sharing is an unrealistic assumption.

The models described above can not account for all observable features however. One of these features is that the economy reacts in a hump-shaped way in response to a technology shock. In order to get this feature, a different class of models is investigated, in which firms can hoard factors.

3 Factor Hoarding Models

An alternative set of models is studied by Burnside et al. (1993) and Burnside and Eichenbaum (1994). These develop a model in which firms can hoard production factors so capacity can be changed quickly in response to shocks. This improves the performance of the model drastically.

The economy, a variant of the Hansen economy (1985), can be described by the following equations. Utility is represented by

$$U_t = \ln C_t + \theta \ln(T - \xi - W_t f), \tag{1}$$

where T is the time endowment, ξ the fixed cost of working and $W_t f$ labor effort times the fixed shift length. Production takes place by

$$Y_t = (K_t U_t)^{1-\alpha}(N_t W_t f X_t)^{\alpha}, \tag{2}$$

where $K_t U_t$ is the rate of capital utilization, X_t the technology shock and $0 < \alpha < 1$. The depreciation rate depends on the degree of capital utilization $\delta_t = \delta U_t^{\phi}$, where $\phi > 1$. X_t evolves according to a unit root process. Furthermore, there is a government that generates demand shocks by its consumption $G_t = X_t g_t^*$, with $\ln g_t^* = g_t = \mu_t + \rho g_{t-1} + \epsilon_t$. The social planner maximizes

$$E_0 \sum_{t=0}^{\infty} \beta^t [\ln C_t + \theta N_t \ln(T - \xi - W_t f) + \theta(1 - N_t) \ln T], \tag{3}$$

subject to the relevant constraints.

The optimal solution implies an Euler equation of $(1-\alpha)\frac{Y_t}{U_t} = \phi\delta U_t^{\phi-1} K_t$. In economic terms, the marginal product of a change in the capital utilization is equaled to the marginal change in depreciation of capital. A simplified version of the model, with $U_t = 1$ is studied in Burnside et al. (1993).

A number of problems arises however if one tries to estimate the model. There are no data on labor effort. The technology shock can not be measured from the Solow residual due to the model specification. The depreciation rate varies in the model but not in practice. All these problems are somehow overcome, see Burnside and Eichenbaum (1994) for more details.

However, the model is able to mimic the data in much more detail then the RBC model without factor hoarding. The parameters are rather similar to the benchmark (Hansen) model, yet the direction of movements, correlation etcetera shows a much better fit. Some impulse-response tests show that the hump-shaped response to shocks actually pops up.

4 RBC Models and Monetary Policy

The model developed above does quite well in mimicking the actual economic fluctuations. However, in reality we observe that in response to a monetary contraction

- the aggregate price level initially hardly responses;
- the interest rate initially rises;
- aggregate output goes down;

- real wages modestly decline, and;
- profits go down.

These are features RBC models also have to comply with. In Christiano et al. (1996) two models are discussed that incorporate monetary policy shocks in a RBC framework. These models are developed to be able to account for these real life features.

A number of explanations has been given for this non-neutrality of money. It could be self-fulfilling expectations or reflect the presence of frictions in the real economy. This 'menu of frictions' could include such things as the effect of fixed wages, the presence of information asymmetries, the effect of fixed prices and the effect of credit market imperfections. See e.g. Sargent (1987) for more details. These last two hypotheses are used in the next two subsections to see if they can provide an adequate explanation for the empirical observations.

The basic framework of the two models is equal. There are five actors in the model, a representative infinitely lived agent, a monetary authority, a competitive producer of a final good, a set of monopolists who all produce an intermediate good, and a financial intermediary, who intermediates cash loans from households to intermediate firms. The household purchases the final good, supplies labor to the intermediate good firm and supplies cash loans. These loans are necessary because the firms have to pay their labor before they sell their output. The only uncertainty in the model is the size of the transfer from the monetary authority to the financial intermediary.

4.1 Sticky Price Model

The sequence of actions that take place is the following. At first intermediary good producers set their price. Then that period's money growth rate is realized. Finally all other model variables are realized, with output of the intermediary good producer being demand determined.

The final good firm produces a single good from a continuum of intermediary goods $i \, \epsilon \, (0, 1)$, according to the production function

$$Y_t = \left[\int_0^1 Y_{it}^{1/\mu} \, di \right]^{\mu}, \tag{4}$$

where $1 \leq \mu \leq \infty$. Profit maximization leads to the Euler equation

$$\left(\frac{P_t}{P_{it}} \right)^{\frac{\mu}{\mu - 1}} = \frac{Y_{it}}{Y_t}. \tag{5}$$

After some manipulation one gets the price of the final good as function of the prices of the intermediary goods

$$P_t = \left[\int_0^1 P_{it}^{\frac{1}{1-\mu}} \, di \right]^{(1-\mu)}. \tag{6}$$

The intermediary good producer i, produces a good according to the technology

$$Y_{it} = \begin{cases} K_{it}^{\alpha} N_{it}^{1-\alpha} - \phi & \text{if } K_{it}^{\alpha} N_{it}^{1-\alpha} \geq \phi \\ 0 & \text{otherwise} \end{cases}, \tag{7}$$

where $0 < \alpha < 1$. N_{it} and K_{it} denote the amount of labor and capital used at time t to produce the ith good. There is no free entry or exit and ϕ is the fixed cost of production. The economic profits of the firms are distributed at the beginning of period $t+1$. The firms pay a rental rate r_t and a wage rate W_t. Since workers have to be paid in advance, these firms have to borrow their wage bill $W_t N_{it}$. Repayment occurs at the end of period t, at the gross interest rate R_t. So the cost function of these firms is given by

$$C(r_t, R_t W_t, Y_{it}) = A(r_t)^{\alpha} (W_t R_t)^{1-\alpha} (Y_{it} + \phi), \tag{8}$$

where $A = (\frac{1}{1-\alpha})^{(1-\alpha)} (\frac{1}{\alpha})^{\alpha}$. The firms marginal cost thus are $A r_t^{\alpha} (W_t R_t)^{(1-\alpha)}$. In equilibrium this simplifies to $\frac{1}{1-\alpha} N_t^{\alpha} W_t R_t$ (with N_t equal to aggregate employment, assuming $K_t = 1$). In case of sticky prices, the firm sets its price before the money shock is realized, so it optimizes its (weighted) expectation of profits

$$E_{t-1} \frac{U_{c,t+1}}{P_{t+1}} [P_{it} Y_{it} - C(r_t, R_t W_t, Y_{it})], \tag{9}$$

with respect to the demand function (5). Given the market structure, in equilibrium each firm sets its price as a constant markup over the expectation of its marginal cost, $P_{it} = \mu E_{t-1} \omega_t MC_t$, where ω_t is a weighted average of MC_t in different states of the world, the weight is relatively high if marginal costs are high. Flexible price firms set their price with a fixed markup, so $P_{it} = \mu MC_t$.

The financial intermediary receives deposits from the households I_t and lump sum cash injections, X_t, from the monetary authority. These funds are supplied at gross interest rate R_t. Clearing occurs when demand (by the intermediary firms) equals supply, so when $W_t N_t = I_t + X_t$. At the end of period t, the households receive $R_t I_t$ in return for their deposits and $R_t X_t$ in the form of profits. The fact that the wage bill has to be financed in advance is an explicit loan market imperfection.

Households maximize their utility subject to a number of constraints, so their problem is

$$\max E_t \sum_{j=0}^{\infty} \beta^j \log \left[C_{t+j} - \frac{\psi_0}{1+\psi} N_{t+j}^{1+\psi} \right], \tag{10}$$

with $0 < \beta < 1$, $\psi_0 > 0$ and $\psi > 0$. Subject to

$$P_t C_t \leq W_t N_t + M_t - I_t, \tag{11}$$

and

$$M_{t+1} = [W_t N_t + M_t - I_t - P_t C_t] + r_t K_t + R_t [I_t + X_t] + D_t, \tag{12}$$

where D_t denotes the profit from the intermediary firm. The maximization takes place over C_t, N_t, M_{t+1} and I_t. The first order condition for supplying labor is $W_t/P_t = \psi_0 N_t^{\psi}$. The Euler equation for I_t is given by

$$\frac{U_{c,t}}{P_t} = R_t E_t \frac{\beta U_{c,t+1}}{P_{t+1}}. \tag{13}$$

The monetary authority sets the growth rate of money (X_t/M_t) equal to x_t. It is assumed x_t follows an Markov chain with an unconditional mean growth rate of μ_x.

Define Z_t and Q_t, as vectors of nominal and other variables in the model, respectively. These can be computed, taking into account s^t, the history of economic shocks up to time t. The recursive competitive equilibrium is a set of sequences for $Z(s^t)$ and $Q(s^t)$ that solve the household and final good problems; the intermediary good problem; and clear the loan market and satisfy the resource constraints.

After substituting parameter values and simulating a monetary contraction, profits go up. This happens because the loss of revenue is 'compensated' by lower costs. In reality however, profits go down. Checking for robustness for some parameter values shows that a smaller fraction of sticky price firms lowers prices disproportionately. One way to improve the performance of the model is to assume an unrealistic utility function, to change the labor supply function.

4.2 Limited Participation Model

The sequence of actions that take place is slightly different from above. The good prices are flexible but before the monetary shock is realized, the households must decide on the size of their money deposits.

The model, as developed above, is slightly adapted. The intermediary firms do not have to set their price in advance so the pricing takes place by a constant markup over their marginal costs $P_{it} = \mu MC_t$. The households maximize (10) subject to the constraints. I_t has been set before the realization of the monetary shock. The Euler equation with respect to I_t is

$$E_{t-1}\frac{U_{c,t}}{P_t} = E_{t-1} R_t \frac{\beta U_{c,t+1}}{P_{t+1}}. \tag{14}$$

Some general equilibrium features of the model can be readily shown by analyzing a simplified version in which $\phi = 0$. Define $\Gamma_t = \frac{I_t + X_t}{M_t + X_t}$ by definition this is equal to $\frac{W_t N_t}{P_t C_t}$. This is the amount of money that is available to the financial intermediaries, relative to the total stock of money. Since $I_t < M_t$, a contraction in X_t causes Γ_t to fall, a relative shortage in the financial markets. Substitution leads to $N_t = (\frac{1}{\psi_0}\Gamma_t)^{\frac{1}{\alpha+\psi}}$. Differentiating with respect to Γ_t shows that the derivative is greater than zero, hence a contraction in X_t leads to a loss of employment.

Γ_t is also equal to $\frac{1-\alpha}{\mu R_t}$. This leads to $R_t = \frac{1-\alpha}{\mu \Gamma_t}$, since $d\Gamma/dX_t > 0$ a contraction in X_t leads to a rise in the interest rate. Profits also go down as X_t decreases. The effect of μ, the markup, is limited to an effect on the size of $d\Gamma_t/dX_t$, the effect of changes in X_t is larger.

The model is able to replicate the most important features of the data if one plugs in a very high labor supply elasticity and a very high markup. If one also adds cost of adjustment for the relevant variables, the effects of monetary shocks are large and persistent.

4.3 Monetary Policy in Practice

In the two models explored before, monetary policy was modelled as being independent of the state of the economy. This is generally not true, however, the models can account for the empirical observations. It can be argued that, although the strict modelling is wrong, as long as the relationship between monetary policy shocks and the money stock is the same, the exogeneity/endogeneity problem is irrelevant.

Furthermore, a model in which different representations have been given of the response of the money base to monetary shocks shows that the models behave quite similar in response to a shock.

The representation of the money base as being an exogenous process is observationaly equal to it being an endogenous policy outcome. In both representations it depends on past values. By incorporating capital accumulation and cost of adjustment into the model, the persistent delayed, hump-shaped effect on real variables replicates whilst the price level also shows a realistic trend.

5 Concluding Remarks

The classical RBC models, see e.g. Cooley and Prescott (1995), do not perform well in mimicking the behavior of the actual economy. The real world cannot be described by a system of fully competitive markets in which consumers maximize their utility subject to a budget constraint and technological possibilities. Technology shocks alone cannot account for the observed fluctuations of a wide range of economic variables. Policy advice cannot be based on such a simple, and empirically dissatisfying model. This is problematic since the main goals of researchers in RBC models are to understand the behavior of the economy and to be able to say what should and what should not be done. Adaptions of the models to incorporate labor market 'imperfections', factor hoarding or monetary disturbances, generally leads to models that mimic the behavior of the real world much better.

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ANNOUNCING:
NEW DUTCH ECONOMICS CONFERENCE: NAKE DAY

Background

Up until a couple of years ago, economists working in the Netherlands had the opportunity to meet and 'talk shop' with their colleagues during the annual *Ecozoekdag*, a one-day economics conference. The organizing institution, the Stichting Ecozoek, discontinued the *Ecozoekdag* after deciding that it was not part of its key activities. Many colleagues we have spoken to over the years have expressed regret at the demise of the *Ecozoekdag*.

At the same time, the twice-annual AIO Presentation Days have met with mixed success. On occasion the turnout would be quite good and the discussions quite lively, but on other occasions the interest could be embarrassingly low. In a sense this is not very surprising in view of the fact that the AIOs have access to close substitutes to the AIO Presentation Day. Indeed, with the advent of Dutch graduate schools, the AIOs now have plenty of opportunities to present their work at a level compatible with the AIO Presentation Day. What is needed for the AIOs is something in between the forum presented by their own graduate school and a full blown international conference.

Our proposed re-animation of the concept of the *Ecozoekdag* must be seen as an attempt to kill two birds with one stone. On the one hand, by upgrading the AIO Presentation Day, we provide the AIOs with a broader and more varied audience. On the other hand, we hope that the new conference, which for lack of a better term we propose to call the *NAKE Day*, will provide an opportunity for Dutch professional economists to meet and interact with each other. It is the express purpose that the NAKE Day will host both academic economists and their more policy-oriented colleagues.

What do we propose to do?

The NAKE Day will be a single-day conference, not clogged up with administrative events. We envisage a number of parallel session, say between six to eight, depending on the number of paper submissions. The sessions will be organized by themes, there will be chairpersons, and discussants. Some sessions will contain presentations by AIOs, *e.g.* the final presentations for AIOs pursuing the NAKE Diploma. We are hoping for 'pooling' rather than 'separating' equilibria in this regard.

Papers are solicited from all economists working in the Netherlands. The Programme Committee will have the final say in the selection of papers. Selection will be based on completed papers. The following people have agreed to serve as members of the Programme Committee.

Prof.dr. **Arnoud Boot**,
University of Amsterdam

Prof.dr. **Lans Bovenberg**
CPB Netherlands Bureau for Economic Policy Analysis, Tilburg University

Prof.dr. **Eric van Damme**
Tilburg University

Prof.dr. **Herman van Dijk**
Erasmus University

Prof.dr. **Kees Koedijk**
Maastricht University

Prof.dr. **Peter Kooreman**
University of Groningen

Prof.dr. **Simon Kuipers**
University of Groningen

Prof.dr. **Mary Morgan**
University of Amsterdam

Prof.dr. **Franz Palm**
Maastricht University

Prof.dr. **Frederick van der Ploeg**
University of Amsterdam

Prof.dr. **Geert Ridder**
Free University, Amsterdam

Prof.dr. **Harald Uhlig**
Tilburg University

At the end of the NAKE Day there will be the annual NAKE Day Lecture. In principle this lecture will be given by a prominent member of the Dutch economics scene. We are very proud to announce that Rick van der Ploeg, NAKE's first director and currently Member of Parliament, will give the inaugural NAKE Day Lecture.

Inaugural Keynote Speaker

Rick van der Ploeg (Member of Parliament, University of Amsterdam)

'The Political Economy of a Consensus Society'

When and where will the NAKE Day be held?

In principle the location of the event will rotate annually. The first NAKE Day will be held on **Friday October 24, 1997**. The most likely location is the Economics Faculty of the University of Amsterdam. Further information will follow by direct mailing and by Email updates. Also consult the NAKE Homepage for the latest available information.

We hope to see you at the first NAKE Day.

Steven Brakman **Ben Heijdra**
Jan van Ours **Tom Wansbeek**
Organizing Committee, NAKE Day

Reminders

The first NAKE Day will be held October 24, 1997

See for further information this *NAKE Nieuws,* pages 48-49

Register for the June NAKE workshop NOW

See the Registration Form in the middle of this *NAKE Nieuws*

Don't let your vote go to waste: Fill out the questionnaire NOW

See the Course Questionnaire in the middle of this *NAKE Nieuws*

Miscellaneous information on NAKE Homepage

http://www.fee.uva.nl/vak_groep/nake

REGISTRATION FORM

NAKE Workshop 2 - 6 June 1997, University of Groningen

Name .....

Department .....

Institute .....

Address .....

Postal code/Place.....

Phone: ..... E-mail: .....

AIO/OIO/Otherwise.....

(Please circle what is applicable)

Would like to have a private consultation with:

Caballero, Crafts, Heckman, Roberts

Will write a report on the lectures by:

Caballero, Crafts, Heckman, Roberts

Will attend the courses by:

Caballero, Crafts, Heckman, Roberts

Will attend:

reception (Monday) yes / no
workshop dinner (Thursday) yes / no
Special Dietary Requirements? yes / no
(give details if applicable)

Wants a hotel room for: Mon/Tues Tues/Wedn Wedn/Thurs Thurs/Fri

Will share a room: yes / no *(Single room ± ƒ 80, double ± ƒ 120)*

with.....

Remarks:

Please return this form AS SOON AS POSSIBLE to the NAKE secretary.

QUESTIONNAIRE
UTRECHT-COURSES 1997/98

Please circle the number of the course(s) you wish to follow next year and return the form before **23 May 1997** to the NAKE Secretariat. In principle a course can only be scheduled once every two years. The courses marked with a star (*) have been given in the academic year 1996/97 and will therefore not **normally** be available in the academic year 1997/98. Courses in bold face are new.

10-week courses (4 SP = 160 hours)

	Teacher(s)	*Institute*	*Course*
1*	van den Berg/van Ours/ den Butter	VU	Applied labour economics
2*	van Damme/Peters/Jansen	KUB/MU	Game theory
3A*	van Ewijk/van Wijnbergen	UVA	A) Economic growth and development: Macroeconomics
3B*	Gunning/Keyzer	VU	B) Economic growth and development: Development economics
4	Hartog/Teulings	UVA/MvSZW	Advanced labor economics
5	Nijman/Pfann	KUB/MU	Methods for solving and estimating models with unobserved rational expectations
6	Palm/Nijman	MU/KUB	Theory and application of financial decision making in relationship with modelling volatility
7	Ridder/Wansbeek	VU/RUG	Econometrics of panel data
8	Talman/van der Laan	KUB/VU	General equilibrium model
9A	Folmer/de Zeeuw	LUW/KUB	A) Environmental problems and policy: A theoretical introduction
9B	Withagen/Smulders	TUE/KUB	B) Growth and environment

5-week courses (2 SP = 80 hours)

10	**Backhaus**	**MU**	**Recent developments in law and economics**
11	Bovenberg	KUB	Fiscal policy in open economies
12	**Brakman/v Marrewijk**	**RUG/EUR**	**Regional economics, agglomeration and the global economy**
13	**Beetsma**	**MU**	**Topics in international macroeconomics**
14	**Booth**	**UVA visitor**	**Advanced topics in labour economics**
15*	Brenner	RUU	A critical view of economic theory
16*	Broer	CPB/EUR	Applied general equilibrium analysis
17	Burrell/Oskam	LUW	Agricultural policy analysis
18	den Butter	VU	Macroeconomic Policy Modelling
19	Cramer	UVA	Econometric applications of maximum likelihood methods
20*	Cramer	UVA	The logit model for economists
21	Cukierman	KUB	Central Bank strategy, credibility, and independence
22*	van Damme/Gradus	KUB/MvFin	Topics in applied microeconomics: Deregulation
23*	van Dijk/Boswijk	EUR/UVA	Econometric inference in dynamic models with integrated processes
24	**Ellman**	**UVA**	**The political economy of transition**
25	**van Ewijk/Oosterbeek**	**UVA**	**Economics of education**
26	de Gooijer/Franses	UVA/EUR	Recent Developments in Non-Linear Time Series Analysis
27	**Goyal/Janssen**	**EUR**	**Topics in advanced microeconomic theory**
28	de Gijsel	RL	Micro-economische onderbouwing van een monetaire economie
29	Gunning/Keyzer	VU	Current issues in development economics
30	**Hartog/Theeuwes**	**UVA/RUL**	**Labour economics: A comparative empirical perspective**

31	Heijdra/Meijdam	UVA/KUB	Intertemporal aspects of macroeconomics
32*	Heijdra	UVA	New Keynesian macroeconomics
33	**Heijdra**	**UVA**	**The macroeconomics of monopolistic competition**
34	**Herings**	**KUB**	**Theory of incomplete markets**
35	Hommes	UVA	Nonlinear economic dynamics
36	Huizinga	KUB	International factor movements and international financial markets
37	Jager/de Jong, E.	UVA/KUN	Exchange rate economics
38	**de Jong, F.**	**KUB**	**Econometrics of foreign exchange markets**
39	**Kloek**	**EUR**	**Visualising data**
40	Koedijk/de Vries	RL/EUR	Empirical distribution of speculative prices
41	Kool/Koedijk	RL	Empirical financial economics
42*	Kooreman/Kapteyn	RUG/KUB	Intertemporal Choice
43	**Kooreman**	**RUG**	**The economics of household behaviour**
44*	van der Laan/Talman	VU/KUB	Economic equilibrium under price restrictions
45*	Maks	RL	Competition and Market Coordination
46*	Meijdam/Verbon	KUB	Theories of government debt
47	Melenberg/Lee	KUB	Applied non-parametric and semi-parametric econometrics
48	Morgan	UVA	History of Economic Ideas
49*	Morgan	UVA	History and philosophy of economic models
50	Nijman	KUB	Estimation of models containing unobserved rational expectations
51	Olson/Schram/van Winden	UVA	Experimental economics and the design of mechanism
52	Otter	RUG	Economic applications of state-space modelling and control theory
53	Peters/Storcken	RL	Social Choice Theory
54	Ruys	KUB	Privatisation and network industries in Europe
55*	Schoorl	RUG	History of Dutch Economic Thought
56	**Steenge**	**UT**	**Rational choice theory and governance in the public sector**
57	Thijssen/Kuiper	LUW	Dynamic Models of the Agricultural Sector
58*	Uhlig	KUB	Business cycles
59	Verbon	KUB	Decision-making on intergenerational transfers
60	Vorst	EUR	Options pricing theory
61	Vorst/van de Sar	EUR	Behavioral Finance
62*	de Vos	VU	Bayesian views on Testing and Model Selection
63	Wansbeek	RUG	Latent variables and methods of moments estimation
64	Weddepohl	UVA	Overlapping generations models
65	van Winden	UVA	Behavioural modelling of government decision-making
66	van Wijnbergen	UVA	Economics of Transition
67	de Zeeuw	KUB	Differential games in economics