Cambridge Endowment for Research in Finance

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The form should be completed and returned in electronic form by
Monday 1 September 2014
to the email address above.

Please note that information submitted in this form may be used on the CERF website

Project Title
Nonparametric State-Price Density Estimation using High-Frequency Data

Investigator(s)
Jeroen Dalderop

Faculty/Department
Faculty of Economics

Award start date: October 2013	Expected Award End Date: September 2016
Total amount awarded: £11.760 plus college fee and tuition fee	**Total amount expended:** £11.760 plus college fee and tuition fee

Principal award holder's contact details:

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Declaration One: Conduct of the Research

This Report is an accurate statement of the objectives, conduct, results and outputs (to date) of the research project funded by CERF.

Award Holder(s) Signature

NB. This must include anyone named as a co-applicant in the research proposal.

Title	Initials	Surname	Signature
Mr	JWP	Dalderop	(Jeroen)
Date: 07/09/14			

Declaration Two: The CERF Database

The CERF Database is a publicly available online research database, containing summary details of all CERF research projects and their associated publications and outputs.

Please sign at *either* A or B below.

A. Details of relevant outputs of this award have been submitted to the CERF Database and details of any ensuing outputs will be submitted in due course.

Signature of Principal Award Holder

	Date:

B. This award has not yet produced any relevant outputs, but details of any future publications will be submitted to the CERF database as soon as they become available.

Signature of Principal Award Holder

(Jeroen)	Date: 07/09/14

1. Activities and Achievement Questionnaire

Non-Technical Summary

A 500 word (maximum) summary of the main research results, in non-technical language, should be provided below. It should cover the aims and objectives of the project, main research results and significant academic achievements, dissemination activities and potential or actual impacts on policy and practice.

Option prices contain detailed information about the risk perception of market participants. My research concerns developing new methods to analyse this information as summarized in the state-price density, which tells us how much value investors attach to payoffs in different states of the economy. My expected contribution is to use high-frequency data to model the dynamic behaviour of the state-price density. This tells us how the perception of market risk of investors changes over time, that is, in reaction to market events.

The availability of high-frequency data has dramatically increased the number of observed prices of European options and their underlying. This makes it feasible to estimate the state-price density at different time point within a day, as opposed to say only at the close of the trading day. This can be done by 'smoothing' transaction data over time using a time-varying nonparametric regression function.

The clear advantages of the large sample sizes in high-frequency data also come with some methodological challenges. In particular, trading times do not occur at a regular frequency, such as at the end of a trading day or month, but instead should be treated as random variables themselves. For example, transactions may cluster together in time in reaction to some particular news, or there can be time-of-the-day effects such as a lunch breaks. These contribute to the random behaviour of the nonparametric estimator and hence cannot be ignored. Another motivation to model trading times explicitly is that they may be related to the outcomes of the traded assets themselves, for example via a large stock price change which triggers new transactions.

Over the summer months I have focused on the theoretical part of this project, i.e. the econometric theory of random sampling times and a dynamic nonparametric estimator. I mainly worked on deriving the mean square error of the estimator and the practical issue of choosing bandwidths. This comes effectively down to choosing how many data points to include for the estimated state-price density at a specific point in time. The faster the state-price density changes, the less data points we can use without introducing large biases.

The dynamic model for the state-price density can also be used to analyse the costs of static models, such as the common practice to 'pool' together data points during a specific trading period. Also other specifications of option pricing models can be tested, such as the commonly used 'homogeneity' assumption of the stock and strike price.

To summarize, the main scientific aims of my project are to
- Develop econometric methods to model time-variation in the state-price density, i.e. incorporate random observation times within a nonparametric time series regression
- Apply the model to high-frequency S&P500 options data, report stylized facts on the dynamics of the state-price density and test existing option price models

Thus far I have presented my research once, namely at the Econometrics workshop in the Faculty of Economics in April. This was well attended and there were several useful questions and suggestions from academics.

2. Dissemination

A. Please outline any specific plans you have for further publication and/or other means of dissemination of the outcomes and results of the research.

My main aim now is finish this paper (see bullet points above) and then defend it during the first-year viva in the Faculty of Economics, which are held in November. I will then also present it during the Econometrics workshop.
Once the paper is finished, and in consultation with my supervisor, I can start applying for

relevant conferences or events to present it and get useful feedback, with the ultimate goal of submitting the paper to relevant journals in my area.

B. Discuss any potential or actual impacts on policy and practice that your work may have.

My research aims to contribute to the understanding on how risks change over time, and to develop accurate measures of market risk which may eventually be used for policy evaluation.

3. Outputs

Please give full details of the outputs which should accompany this report. For each research paper, please, provide:
 a) the title
b) an abstract
c) web link where the paper can be downloaded
d) bibliographical reference in case the paper is accepted for publication
e) details regarding conferences or seminars where the paper has been presented

For other outputs (such as software, datasets), please, provide a description of the output and a web link through which the output can be downloaded. If a web link is not available then provide an electronic copy with this report. If the grant included arranging conferences, please complete the separate conference form as well.

I am sending my first-year research proposal and the slides of my presentation in April. An advanced draft of my paper has to be finished by the end of October, by which time I can send a copy. The slides for my presentation in November will be based on that so I can send them later.

With funding from my supervisor I have purchased transaction data on S&P500 E-mini European options and future prices. Source:

http://www.cmegroup.com/market-data/datamine-historical-data/timeandsales.html

4. Major difficulties

Please detail below any major difficulties, scientific or administrative/logistical, encountered during your research and comment on any consequent impact on the project. Further details can be included in section 11 at the end of this report, including any advice you might have for resolving such problems in future projects.

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5. Other issues and unexpected outcomes

Please describe any outcomes of your research, beneficial or otherwise that were not expected at the outset or other issues which were important to the research, where these are not addressed above. Further details can be included in section 11 at the end of this report.

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6. Web Links

Please insert here any web links to relevant outputs and web pages.

Thus far no research output is available online, once my paper is in a more advanced stage I can upload it.

7. Mid-of-Award Report

This final section can be used to provide any additional information that may be relevant.

During the first-year of my PhD in Economics as funded by the CERF scholarship the main aim has been to pass the requirements of the CPGS (four advanced courses plus research proposal) in Economics, which I have passed, to attend many seminars and conferences by CERF and others, and to learn about the relevant existing research in my area. For my second year I do not have to do any courses and hence can focus on my actual research project.

I look forward to keeping CERF updated on my research progress, and am thankful for the support that has been provided so far.