

START PAGE

MARIE SKŁODOWSKA-CURIE ACTIONS

**Individual Fellowships (IF)
Call: H2020-MSCA-IF-2014**

PART B

“Post-GFC Monetary Policy”

“Forecast of time-varying effects of post-GFC monetary policy + a novel computing application”

This proposal is to be evaluated as:

[Standard EF]

TABLE OF CONTENTS

In drafting PART B of the proposal, applicants **must follow** the structure outlined below.

LIST OF PARTICIPANTS

START PAGE COUNT

1. SUMMARY
2. EXCELLENCE
3. IMPACT
4. IMPLEMENTATION

STOP PAGE COUNT

5. CV OF THE EXPERIENCED RESEARCHER
6. CAPACITIES OF THE PARTICIPATING ORGANISATIONS
7. ETHICAL ASPECTS
8. LETTERS OF COMMITMENT OF PARTNER ORGANISATIONS

NB:

- Applicants must ensure that sections 1 - 4 do not exceed the limit of 10 pages.
- No reference to the outcome of previous evaluations of this or any similar proposal should be included in the text. Experts will be strictly instructed to disregard any such references.

List of Participants

Participants	Legal Entity Short Name	Academic	Non-academic	Country	Dept./ Division / Laboratory	Supervisor	Role of Partner Organisation
<u>Beneficiary</u>							
Basque Center for Applied Mathematics	BCAM	X		SPAIN	--	Prof. Luis Vega	Host
<u>Partner Organisation</u>							
Universidad del Pais Vasco / Euskal Herriko Unibertsitatea	UPV/EHU	X		SPAIN	Dep of Applied Economics III	Prof. Eva Ferreira	Secondment
Koç University	KU	X		TURKEY	Dep of Economics	Assoc. Prof. Selva Demiralp	Secondment

B.1. Summary

Central banks worldwide routinely use models in assessing and forecasting the global and domestic economic outlook in order to determine the most suitable monetary policies. Economies evolve over time and policies that worked in the 1980s might not be viable at the present time, thus models must be flexible to account for these changes. Undoubtedly, it is difficult to identify the exact point in time when a change in macroeconomic behaviour occurs, particularly a change that will trigger a reactive monetary policy to neutralise its negative effects. The current project proposes a new methodology, which due to its local nature can react faster to changes in the process than other existing methodologies. This project aims at breaking new ground in several respects. First, by proposing for the first time a nonparametric local linear estimator of multivariate processes with possible smooth or abrupt changes in the parameters. Second, by developing a user-friendly computational package with the aforementioned functionality. Finally, by investigating the effect for G7 and Eurozone economies of the monetary policies driven by the global financial crisis.

B.2. Excellence

B.2.1 Quality, innovative aspects and credibility of the research

The assessment and forecast of the effects of monetary policy on macroeconomic variables such as inflation, economic output, and employment is commonly modelled using the econometric framework of vector autoregression (VAR) and forecasted by the impulse response function (IRF). In recent years, scholars of macroeconometrics have searched intensely for a way to include time variation in the coefficients and covariance matrix of the VAR model (amongst many others, see: Boivin and Giannoni 2006¹; Primiceri 2005²). The reason for this is that the macroeconomic climate evolves over time and effects of monetary policy must be identified locally rather than globally. Finding a methodology that automatically spots structural breaks, i.e. points in time where the model changes, and estimating the time-varying IRF (tv-IRF) consistently is a key issue for good forecasting. No research on kernel smoothing estimators has been carried out in the context of tv-IRF, despite the fact that these estimators adapt easily to situations of change – such as those provoked by a financial crisis or a new monetary policy. The reason for this “unpopularity” might be the lack of computer applications with this functionality, which is difficult for the non-specialised end-user to code. The current project is therefore innovative from theoretical, empirical and engineering perspectives, producing new statistical results and computational tools to aid monetary policymakers and researchers of other disciplines that benefit from tv-IRF modelling. The project is therefore not only relevant and original but also timely.

The parametric approach to time-varying VAR (tv-VAR) and tv-IRF is not feasible for a large number of breaks. Commonly the existence of only a few breaks, often determined ad hoc and based on historical knowledge, is assumed. The

¹ Jean Boivin and Marc P. Giannoni (2006). Has Monetary Policy Become More Effective? *The Review of Economics and Statistics*, 88, 445-462.

² Giorgio E. Primiceri (2005). Time Varying Structural Vector Autoregressions and Monetary Policy. *Review of Economic Studies*, 72, 821-852.

Bayesian approach on the other hand assumes the coefficients vary continuously over time like a random walk, see Carter and Kohn (1994)³. The latter approach has proved to be quite reliable in studying economic phenomena, however it suffers from two main problems: it is very computational intensive and it does not compute feasible values in the presence of a sudden break in the time series.

Both approaches described above make strong assumptions about the functional form of the model and may be too inflexible to adapt to different types of change or mixing models. One way of adding flexibility is to assume that the coefficients are undefined functions of time and to estimate them with kernel smoothing methodologies such as the time-varying local linear (tv-LL). The pros of this theory are that it does not dictate the time-dependency functional form, the asymptotic behaviour of these estimators is known and asymptotically normal, and it is not necessary to predetermine the locations of change.

In the first part of the project we will assume locally stationary processes – in the sense of Dahlhaus (1997)⁴. This covers processes with smooth changes and a heteroskedastic covariance structure. In this regard, two different tv-LL estimators of the coefficients are proposed (based on Orbe et al. 2005⁵; Cai 2007⁶; Kristensen 2012⁷; and Orbe et al. 2003⁸) and two different estimators of the covariance from Aslanidis and Casas (2013)⁹ and Koop and Korobilis (2013)¹⁰. A comparison of several combinations of these will yield the best estimator of tv-IRF. The formalisation of its asymptotic theory and distribution following Lütkepohl¹¹ guidance and the abovementioned nonparametric works is the first contribution of this project.

None of the methodologies mentioned above can assess models with abrupt breaks consistently. This project also proposes the time-varying break preserving local linear (tv-BPLL) based on Casas and Gijbels (2012)¹² to deal with this eventuality. Additional theoretical work to manage abrupt breaks in the Bayesian framework is also necessary. Gerlach et al (2000)¹³ have made some progress in this direction for univariate models, and Koop et al (2009)¹⁴ for multivariate models. In practice, however, the latter is unfeasible because the number of possible combinations of parameters either changing or not changing grows larger with the dimension of the dependent vector. This project advances by

³ Chris Carter and Robert Kohn (1994). On Gibbs Sampling for State Space Models. *Biometrika*, 81, 541-553.

⁴ Rainer Dahlhaus (1997). Fitting time series models to nonstationary processes. *Annals of Statistics*, 25, 1-37.

⁵ Susan Orbe, Eva Ferreira and Juan Rodriguez-Poo (2005). Nonparametric Estimation of Time Varying Parameters Under Shape Restrictions. *Journal of Econometrics*, 126 53-77.

⁶ Zongwu Cai (2007). Trending time-varying coefficient time series models with serially correlated errors. *Journal of Econometrics*, 136, 163-188.

⁷ Dennis Kristensen (2012). Non-parametric detection and estimation of structural change. *Econometric Journal*, 15, 420-461.

⁸ Susan Orbe, Eva Ferreira and Juan Rodriguez-Poo (2003). An algorithm to estimate time-varying parameter SURE models under different types of restriction. *Computational Statistics & Data Analysis*, 42, 363-383.

⁹ Nektarios Aslanidis and Isabel Casas (2013). Nonparametric Correlation Models for Portfolio Allocation. *Journal of Banking & Finance*, 37, pp. 2268-2283.

¹⁰ Gary Koop and Dimitris Korobilis (2012). Large Time-Varying Parameters VARs. Working Papers 2012_04, Business School, University of Glasgow.

¹¹ Helmut Lütkepohl (1990). Asymptotic distributions of impulse response functions and forecast error variance decompositions of Vector Autoregressive Models. *Review of Economics & Statistics*, 72, 116-125.

¹² Isabel Casas and Irene Gijbels (2012). Unstable Volatility: the Break-Preserving Local Linear Estimator. *Journal of Nonparametric Statistics*, 24, 883-904.

¹³ Richard Gerlach, Chris Carter and Robert Kohn (2000). Efficient Bayesian Inference in Dynamic Mixture Models. *Journal of the American Statistical Association*, 95, 819-828.

¹⁴ Gary Koop, Roberto Leon-Gonzalez and Rodney W. Strachan (2009). On the Evolution of the Monetary Policy Transmission Mechanism. *Journal of Economic Dynamics and Control*, 33, 997 – 1017.

suggesting a new feasible algorithm to handle this problem in the Bayesian framework and compares it with the tv-BPLL performance.

Publicly available code is uncommon in the field of kernel smoothing. They are not part of the common statistical and econometric packages and their implementation into code is not straightforward. Thus, considering the flexibility and suitability of these methodologies for a large variety of models, their use is not as widespread as one might expect. There is a well-established R package for univariate estimation called “np”, written and maintained by Hayfield and Racine (2013)¹⁵, which we will use as a basis to develop a new package with the functionality of the multivariate tv-LL.

It has long been accepted that changes in interest rates affect macroeconomic variables like bank loans, securities, deposits, output, etc., e.g. Bernanke and Blinder (1992)¹⁶ and Carpenter and Demiralp (2008)¹⁷. The current consideration is whether the inherent transmission mechanism is different when interest rates are nearly zero, as in the present post-GFC economic climate of the G7 and Eurozone countries.

The main research objectives of the present proposal are:

- a) to specify an estimator of tv-IRF for processes varying smoothly over time and offer the theoretical framework, proofs of asymptotic inference, and performance comparison with existing methodologies;
- b) to develop an R package with the aforementioned functionality, input and output interface and user-friendly documentation;
- c) to analyse monetary policy transmission in G7 and Eurozone economies; and,
- d) to specify the tv-BPLL estimator of the tv-IF for processes with smooth or abrupt changes, as well as a feasible Bayesian estimator for abrupt changes, and performance comparison.

Research methodology and approach

The expression of the tv-VAR(p) with k variables is given by,

$$(1) \quad y_t = A_{0,t} + A_{1,t}y_{t-1} + A_{2,t}y_{t-2} + \dots + A_{p,t}y_{t-p} + u_t$$

for $t = 1, 2, \dots, T$, $A_{0,t}$ and y_t are vectors of size k and each $A_{j,t}$, $j = 1, 2, \dots, p$ is a $k \times p$ matrix which may change with time. The non-systematic shocks u_t , any change that is not accounted for in the lags of y_t , are independent with mean zero and a covariance matrix Σ_t following a dynamic correlation structure.

The tv-IRF) is computed for each time t , if the process is locally stationary, using the matrices of coefficients of (1) as,

$$(2) \quad \bar{y}_t = \Psi_{0,t} L_t e_t + \Psi_{1,t} L_t e_{t-1} + \Psi_{2,t} L_t e_{t-2} + \dots$$

¹⁵ Tristen Hayfield and Jeffrey S. Racine (2013). np: Nonparametric Kernel Smoothing Methods for Mixed Data Types. <http://cran.r-project.org/web/packages/np/index.html>.

¹⁶ Ben S. Bernanke and Alan S. Blinder (1992). The Federal Funds Rate and the channels of monetary transmission. *American Economic Association*, 82, 901-921.

¹⁷ Seth Carpenter and Selva Demiralp (2008). The Liquidity Effect in the Federal Funds Market: Evidence at the Monthly Frequency. *Journal of Money, Credit and Banking*, 40, 1-24.

where $\Psi_{0,t} = I_k$, $\Psi_{s,t} = \sum_{j=1}^s \Psi_{s-j,t} A_{j,t}$, the index s is the number of periods in the future, for example number of quarters for quarterly data, $\Sigma_t = L_t L_t'$ is the Cholesky decomposition and e_t are uncorrelated errors with variance one.

The tv-IRF forecasts the expected changes in the value of y_{it} during the following quarters due to a shock on variable y_{jt} , by looking at elements in row i and column j of matrices $\Psi_{0,t}$, $\Psi_{1,t}$, $\Psi_{2,t}$... A classical problem for example is to forecast the effect of a shock in the short-term interest rates on future inflation.

The four objectives described above will be met by dividing the project into four work packages.

In *Work Package 1*, two estimators of $A_{j,t}$ in equation (1) within the family of the tv-LL are proposed and theoretically analysed: i) the ordinary least squares local linear (OLS-LL) estimator (extension of Kristensen (2012) and Cai (2007) into the multivariate framework). Rows of $A_{j,t}$ are estimated independently of each other for each of the k equations. It is important to notice that this estimator will need k different bandwidth; and ii) the generalised least squares local linear (GLS-LL) which is likely to be more efficient, i.e. the variance of the estimates is smaller, in problems with heteroscedasticity and high correlation in the error term. Using the residuals of these estimations, the covariance matrix Σ_t is estimated as in Aslanidis and Casas (2013), and Koop and Korobilis (2013). Finally, the asymptotic properties of the coefficients in equations (1) and (2) will be formalised. The consistency of $\Psi_{s,t}$ will be derived from the consistency of $A_{j,t}$ and Σ_t , which are the initial focus of the project. The asymptotic normality derivation will be based on the parametric result in Lütkepohl (1990). Comparison performance, through simulation and real data forecasting, with the ML and Bayesian estimators of the tv-IRF will be carried out. Results from *Work Package 1* will achieve objective a).

Most econometric and statistical computing languages have functions of the parametric maximum likelihood (ML) estimator. Matlab routines to obtain the Bayesian estimator of tv-VAR is also available online. The aim of *Work Package 2* is to upload a new package in R (a free software programming language widely used amongst econometricians and statisticians) with the tv-LL methodology together with a user-friendly manual.

Objective c) will be achieved in *Work Package 3*: Forecast the effects of monetary policy on current macroeconomic data from G7 and Eurozone countries. This data is publicly available at the FRED, OECD, Eurostat, and ECB database websites.

Specification and statistical inference of a novel tv-BPLL to estimate processes with abrupt breaks, as well as the specification of a feasible competitor in the Bayesian framework, will be the focus of *Work Package 4* and objective d).

B.2.2 Clarity and quality of transfer of knowledge/training for the development of the researcher in light of the research objectives

During the stay in Spain, the FELLOW will visit the Dep. of Applied Economics III (UPV/EHU) to train on the theoretical and computational aspects of

nonparametric SUR models, to achieve objectives a) and d). Eva Ferreira and Susan Orbe, who work at this department, are among the few scholars worldwide who have worked on multivariate kernel smoothing in the context of locally stationary variables.

The Basque Center for Applied Mathematics (BCAM) offers excellent research resources such as seminars, courses and workshops where visitors and topics related to the FELLOW's training may be encountered. The Center also has valuable expertise in the development of computational tools, numerical methods and programming languages, which will be indispensable for the development of an efficient R package as part of objective b) in the time constraints of the project.

The leaders of both institutions maintain an excellent professional relationship of collaboration in undergraduate and graduate activities. The present project will be the baseline to launch the Applied Economics Topic as a research line at the BCAM. In this way, the FELLOW will have the opportunity to improve her project management skills under their supervision.

The Dep. of Economics at Koç University is a hub of high qualified economists with world competitive undergraduate and postgraduate programmes. Selva Demiralp is a specialist in US monetary policy with professional experience at the Federal Reserve and publications in renowned macroeconomic journals. The FELLOW's collaboration with Selva to achieve objective c) will expand her multidisciplinary background and the new knowledge will be used to carry out research on European data. The FELLOW also has the opportunity of attending their macroeconomics PhD course during the stay at Koç University as part of her training.

The FELLOW's collaboration with internationally recognised researchers such as Richard Gerlach at Sydney University, to work on objective d), is important not only for allowing the applicant to widen her econometrics skills, but also for the BCAM and more broadly for European research.

B.2.3 Quality of the supervision and the hosting arrangements

The BCAM is an elite institution for applied mathematics that was recently accredited as a "Severo Ochoa" research centre – the highest possible recognition of a Research Centre in Spain. Accordingly, it provides an outstanding environment in terms of quality of research, resources and multidisciplinary collaborations with technical expertise in the implementation of computational packages which will be a fundamental input in the development of the R package of this project. Luis Vega, a mathematician with a prominent international research career, was appointed as the BCAM's leader for his vision for the future of the BCAM. His strategy is to expand BCAM's competencies to other areas of applied mathematics, such as applied economics. This has motivated a fluent communication between L. Vega and Eva Ferreira, leader of the Dep. of Applied Economics III (UPV/EHU), to consolidate a solid economics research environment in the Basque Country. The FELLOW and the present project will represent the starting point for making this project a reality. This will be possible under the advisory eye of L. Vega, who will follow the development of the BCAM's new research line closely, and the direct training on the theoretical aspects of the project from E. Ferreira and other researchers at the UPV such as Susan Orbe.

B.2.4 Capacity of the researcher to reach and re-enforce a position of professional maturity in research

The FELLOW has an Honours Degree in Mathematics (Autonomous University of Madrid), and a Postgraduate Higher Diploma in Computational Methods (University College Dublin) with an emphasis on high performance computing applied to numerical methods. After this, she spent four years working in the private sector as a Software Engineer. These experiences resulted in a PhD in Econometrics in 2006 from the University of Western Australia. She has since worked at University Carlos III (Spain), K.U. Leuven (Belgium), CREATES at Aarhus University (Denmark), and she is currently employed as an Associate Professor at the University of Southern Denmark.

The FELLOW has seven publications in peer reviewed journals and a further seven papers published as conference proceedings and working papers. The quality of the journal publications is very high, showing her ability to perform at a high level. Most of her recent work has focused on nonparametric methods applied to time series data and so the theme of the application is very much in line with her existing work. In particular, Aslanidis and Casas (2013) and Casas and Gijbels (2012) develop and analyse very similar estimation techniques as described in the application. Moreover, preliminary work published in conference proceedings, e.g. Casas and Grassi (2014), shows that the OLS-LL estimator of the tv-VAR coefficients is more robust than the Bayesian estimator, demonstrating that the proposed research hypotheses are feasible.

In addition, the FELLOW has supervised 5 masters students and 2 undergraduates, showing herself to be capable of supervising and managing projects. Similarly, she has significant experience of working in research teams as most of her papers are co-authored with other researchers.

The FELLOW's mathematical skills have been key to understanding and developing the theoretical framework of stochastic and time series processes, as well as their statistical properties and inference, innate to this field. Her computational skills were established during her professional experience in the private sector programming mathematical algorithms for data mining and option pricing. All these skills are relevant for the proposed work making her well qualified for the present project.

B3. Impact

B.3.1 Enhancing research- and innovation-related human resources, skills, and working conditions to realise the potential of individuals and to provide new career perspectives

The main training objective is to enhance the FELLOW's professional development through the opportunity of working on a major project for a considerable period of time at a centre of excellence that performs cutting-edge research. It is hoped that the project and its results will establish her as a leading independent, international researcher in her field and improve her prospects for further career progression.

The projects at the HOST and SECONDMENT INSTITUTIONS will increase the FELLOW's abilities by allowing her to expand her research lines into areas that are not studied by scholars at her home organisation. It also will diversify the

FELLOW's area of expertise as the project is related to the new areas to explore at BCAM, UPV and Koç University. The FELLOW will develop complementary skills related to research management and widen her research network.

B.3.2 Effectiveness of the proposed measures for communication and results dissemination

Every year, the UPV/EHU organises "The Science Week" for the public dissemination of all kinds of research. The FELLOW, with BCAM computing expertise, will code an interactive application to disseminate the basics of monetary policy to a wide audience for "The Science Week 2017". This application will consist of an engine in R with the latest results of the project and a user-friendly interface and will be developed during the last two months of the project. Visitors will be able to change the size of shocks in the application to see how this will change the effects on inflation, unemployment, etc., for countries of the G7 and the Eurozone. In this way, they will be able to understand the basics of central banks policymaking and share with us their impressions about this economic theory. Moreover, empirical results will be disseminated in the UPV/EHU associated blogs "Mapping-Ignorance" (in English) and "Cuaderno de Cultura Científica" (in Spanish).

With regard to the academic dissemination, the methodological results of *Work Packages 1*, and *4* will target leading econometric and statistics journals such as *Journal of Econometrics* and *JASA*. The computing programme from *Work Package 2* will be made available worldwide through the R Computing Programming website and its description will be submitted to the *Journal of Statistical Software*. *Work Package 3* is related to a prominent literature within macroeconomics and results will be sent to top journals such as the *Journal of Money, Credit and Banking* and the *European Economic Review*. Manuscripts will be sent to workshops and international conferences within macroeconomics, econometrics and time series such as the INFINITI Conference in International Finance, the Australasian Meeting, the North American Meeting and the European Meeting of the Econometrics Society. These results will be also presented in seminars at SECONDMENT INSTITUTIONS and other departments where invited.

The project results will abide by the intellectual property laws of the institutions involved. Articles, seminars and the R package will acknowledge all the authors and institutions, as well as the European Commission funding. The R package is open source and will be freely available for downloading at the CRAN server in the R Computing Programming website.

B4. Implementation

B.4.1 Overall coherence and effectiveness of the work plan

The project is planned to run from the 1st of September 2015 until the end of August 2017. It consists of the following work packages:

- Work Package 0: Project management with the involvement of the Coordination Board and the Scientific Committee as described in Section B.4.2.
- Work Package 1: this package aims at achieving objective a). The FELLOW's stay at UPV/EHU is scheduled as part of this package where the theoretical framework of the project will be developed.

- Work Package 2: this package aims at achieving objective b), i.e. the development of an R package including documentation. The BCAM computational resources and expertise is crucial to this part of the project.
- Work Package 3: this package aims at achieving objective c), i.e. the application in macroeconomics which involves the FELLOW’s direct work with S. Demiralp at Koç University.
- Work Package 4: this package aims at achieving objective d). This part of the package will involve a research visit (May-Jun, 2017) to R. Gerlach who is based in Australia. This will allow the FELLOW and R. Gerlach to work together on a daily basis and accelerate the completion of this part of the proposal.

The major deliverables of the project are: Five articles to be published in major economics and statistics journals; an R package; one course on nonparametric methodologies in R at the BCAM; six seminars and conference presentations; and the development of an interactive application on macroeconomic behaviour for “The Science Week” of 2017.

Two stays at secondment organisations are planned: From November 2015 until January 2016 in the Dep. of Applied Economics III (UPV/EHU) with E. Ferreira as supervisor during the development of *Work Package 1*; and during February and March 2017 at the Dep. of Economics (Koç University) with S. Demiralp as supervisor during the development of *Work Package 3*.

Time allocation details are shown in the Gantt chart below.

Sep 1 st , 2015 – Aug 30 th , 2017	Semester 1	Semester 2	Semester 4	Semester 5
Work Package 0				
Work Package 1				
Secondment 1(UPV/EHU)				
Deliverables Work Package 1				
1. Conferences/Seminars				
2. Journal submission				
Work Package 2				
Deliverables Work Package 2				
1. R package upload				
2. Course in R				
3. Conference/Seminar				
4. Journal Submission				
Work Package 3				
Secondment 2 (Koç Univ.)				
Deliverables Work Package 3				
5. Work on public dissemination				
6. Journal Submission				
Work Package 4				
Visit to R. Gerlach				
Deliverables Work Package 4				
7. Work on public dissemination				
8. Conference/seminar				
9. Journal Submission				

B.4.2 Appropriateness of the management structure and procedures, including quality management and risk management

The coordination of the project will be managed by the Coordination Board and Scientific Committee described below. It will lead and assist partners in the execution of their scientific objectives, reports, organisation of workshops and courses, and mobility management based on the work packages, tasks and deliverables provided in the Work Description.

Coordination Board: I. Casas (FELLOW), L. Vega and L. Gómez (BCAM). Miguel Benítez, Program Manager at the BCAM, will take charge of the communication with the European Commission on behalf of participating partners, submitting the necessary reports and information to the Project Officer and the partners. The financial cost regarding research, training and networking will be distributed by I. Casas as described in the Grant Agreement contracted with the EU if no major deviation is observed. All official reports for the European Commission will be prepared in advance by I. Casas, using the input of all partners and validation by work package leaders.

Scientific Committee: L. Vega (BCAM), I. Casas (FELLOW) and E. Ferreira (UPV/EHU). The Scientific Committee will be responsible for providing guidance and overall scientific direction.

The research proposal and schedule for its completion are realistic and feasible. The FELLOW has good knowledge of the field, as do the other collaborators. The proposed work is predominantly theoretical, thus requiring no special resources, and the data is publicly available. There are no major overlaps between the four different work packages. Therefore if one of them should be delayed, this will not affect the successful completion of the others. Management risks such as the resignation of a secondment organisation are also unlikely. The first SECONDMENT INSTITUTION is in the same city as the HOST INSTITUTION, making the interaction very easy. The commitment with the second SECONDMENT INSTITUTION is solid and the stay may be substituted by a few shorter visits and virtual communication between I. Casas and S. Demiralp in case of any issues. The training in monetary policy to be undertaken at Koç University could be carried out at UPV/EHU in the worst case scenario.

B.4.3 Appropriateness of the institutional environment (infrastructure)

The HOST INSTITUTION offers a remarkable infrastructure of research expertise suitable to accommodate the requirements of the research project. The BCAM is a part of the BERC (Basque Excellence Research Centres) network. Located in the Basque Country, it benefits from a long industrial tradition its links with the French Atlantic corridor – a region of excellence in Applied Mathematics. A Scientific Committee, composed of highly regarded international scientists and led by Professor Maria Jesus Esteban of the CEREMADE, Paris, is actively participating in shaping the Strategy and Scientific decisions of the BCAM. This makes it an important hub of multidisciplinary research in the area.

The activities of the BCAM include weekly seminars on applied mathematics and computational skills, workshops and summer schools and activity groups. It also contributes to postgraduate training in applied mathematics (a Master Programme of UPV/EHU is run yearly at the BCAM); organises a visitors

programme (short term visits including conferences and courses); and offers training courses on the most commonly used software packages. The computer resources are also exceptional with powerful workstations and access to high performance computing clusters.

The key research areas at the Department of Applied Economics III (UPV/EHU) are Quantitative Methods for Economics and Finance, Biostatistics and Operational Research. All members are part of a research project and publish in specialised journals in Statistics, Econometrics and Operational Research. Importantly, there is a group specialised in nonparametric estimation that will host the FELLOW as a visiting researcher. This group is led by E. Ferreira who has published in top journals such as the Journal of Econometrics and JASA.

Founded in 1993, Koç University has become one of the world's leading Higher Education centres being ranked the 20th best institution in the category of BRICS & Emerging Economies by Thomson Reuters. The Dep. of Economics runs a competitive PhD programme with a course in macroeconomics available for the FELLOW's training. The supervisor, Selva Demiralp, is an active economist with a strong interest in monetary policy. Her previous professional experience as a researcher in the Federal Reserve makes her an expert in the field of monetary policy and the perfect choice for the empirical work of this project.

B.4.4 Competences, experience and complementarity of the participating organisations and institutional commitment

The BCAM's interest in initiating research on applied economics has driven the collaboration with UPV/EHU, and in particular with the Dep. of Applied Economics III, creating a mutually beneficial relationship: UPV/EHU has the theoretical knowledge in economics and BCAM has the funding and research resources associated with a centre of excellence. Thus UPV/EHU has been a strategic partner of the BCAM since its creation, playing an active role in the Managing Board. They often organise common activities, including: the organisation of the BCAM-UPV Basque Colloquium; postgraduate collaboration in the Masters Course and the Doctoral Course in Mathematics; collaboration in the UPV/EHU Masters in Advanced Information Technology Systems, and in Quantitative Finance; registering doctoral theses at UPV/EHU; and collaboration in attracting research projects and talent to the Basque Country. All of this is a good indication of the commitment from both institutions to the present project.

The classical economic training will be obtained during the FELLOW's stay at Koç University in the Dep. of Economics, which is more focussed on micro and macroeconomics rather than econometrics. The training and research network resulting from the FELLOW's stay at Koç University and Sydney University will be transferred back to the BCAM and UPV/EHU, formally in the shape of an article on monetary policy for Eurozone economies, as well as a public engagement activity of dissemination of knowledge. It will also open the door for further collaboration amongst the participants of the project, with possible visits from R. Gerlach and S. Demiralp to the BCAM.

STOP PAGE COUNT – MAX 10 PAGES

B.5. CV of the Experienced Researcher

Isabel Casas

RePEC number: pca472

Birth: 25/01/1972

Homepage: www.icasasweb.com

EDUCATION

PhD in Econometrics [Sep 2003 – Apr 2006]

Dep. Mathematics and Statistics, University of Western Australia, Australia.

Preliminary PhD in Financial Statistics [Oct 2002 – Sep 2003]

Dep. Mathematics and Statistics, University of Western Australia, Australia.

Higher Diploma in Computational Methods and Numerical Software

Departments of Computer Science and Mathematics Physics, University College
Dublin, Ireland. [Sep 1998 – Jun 1999]

CURRENT POSITIONS

Associate Professor [01/02/2011 – Present]

Dep. Business and Economics, University of Southern Demark (SDU).

Research Fellow [01/02/2011 – Present]

CREATES, Aarhus University, Denmark.

PREVIOUS POSITIONS

Postdoc [Aug 2008 – Feb 2011]

CREATES, Aarhus University, Denmark.

Assistant Professor [Jan 2007 – Sep 2008]

Dep. Statistics, University Carlos III, Spain.

Research Assistant [Oct 2006 – Dec 2005]

Dep. Mathematics and Statistics, University of Western Australia, Australia.

PUBLICATIONS IN MAJOR INTERNATIONAL PEER-REVIEWED JOURNALS

[1] Nonparametric Correlation Models for Portfolio Allocation. *Journal of Banking and Finance*, 37, pp. 2268-2283, with Nektarios Aslanidis (2013).

[2] Personal Health and Care Services Deployment: Experiences in Eight European Countries. *International Journal of Medical Informatics*, 82, pp. 626-635, with Elena Villalba, Fabienne Abadie and Maria Lluch (2013). Citations: 1.

[3] Unstable Volatility Functions: the Break Preserving Local Linear Estimator. *Journal of Nonparametric Statistics*, 24, pp. 883-904, with Irene Gijbels (2012). Citations: 1.

[4] Econometric Estimation in Long--Range Dependent Volatility Models: Theory and Practice. *Journal of Econometrics*, 147, pp. 72-83, with Jiti Gao (2008). Citations: 17.

[5] Specification Testing in Discretized Diffusion Models: Theory and Practice. *Journal of Econometrics*, 147, pp. 131-140, with Jiti Gao (2008). Citations: 8.

[6] Estimation of Stochastic Volatility with LRD. *Mathematics and Computers in Simulation*, 78, pp. 335-340 (2008).

[7] Nonparametric Methods in Continuous Time Model Specification. *Econometric Reviews*, 26, 91-106, with Jiti Gao (2007). Citations: 3.

PUBLICATIONS IN PEER-REVIEWED CONFERENCE PROCEEDINGS

[1] Time-Varying VAR: a Nonparametric Approach. *Proceedings International Work-Conference in Time Series Analysis*, pp. 866-867, with Stefano Grassi (2014).

[2] Towards Integrated Personal Health and Care Services Deployment in Europe. *Proceedings IV Workshop on Technology for Healthcare and Healthy Lifestyle*, pp. 1994-1995, with Elena Villalba Mora, Maria Lluch, Fabienne Abadie and Ioannis Maghiros (2012).

[3] Stochastic Volatility with Long-Range Dependence. *MODSIM 2005 International Congress on Modelling and Simulations*, pp. 802-806, with Jiti Gao (2005).

[4] Efficient Monte Carlo Linear Solver with Chain Reduction and Optimization Using PLFG. *Proceeding HPCN Europe 2001 Proceedings of the 9th International Conference on High-Performance Computing and Networking*, pp. 405-414, with Chih Jeng Kenneth Tan (2001).

REFEERING FOR

Journal of Econometrics, Econometrics Journal, Journal of Applied Econometrics, Applied Stochastic Models in Business and Industry, Computational Statistics and Data Analysis, Journal of Nonparametric Statistics, and the European Commission.

FELLOWSHIPS AND AWARDS

Research Fellowship [Sep 2008 – Dec 2011]

Awarded by the Danish Council for Independent Research, Denmark.

José Castillejo **Mobility Scholarship** [Feb 2008 – July 2008]

Awarded by the Spanish Ministry of Science and Innovation.

Australian **Postgraduate Award** [Jan 2004 – Apr 2006]

Awarded by the Australian Department of Foreign Affairs and Trade, Australia.

RESEARCH VISITS

Visiting Scholar [Mar 2014 – Apr 2014]
Discipline of Business Analytics, The University of Sydney, Australia.

Honorary Visiting Fellow [Mar 2014 – May 2014]
School of Economics, La Trobe University, Australia.

Visiting Fellow [May 2014]
Department of Econometrics and Business Statistics, Monash University,
Australia.

Specialised Personal. Institute for Prospective Technological Studies, Joint
Research Centre, The European Commission, Spain. [May 2012 – Aug 2012]

TEACHING

Lecturer [Feb 2011 – Present]
Microeconometrics and Time Series Econometrics, SDU, Denmark.

Lecturer [Feb 2007 – Jun 2008]
Econometrics, Statistical Inference, and Experiments Design, Universidad Carlos
III, Spain.

Lecturer [Feb 2004 – Jun 2004]
Multivariate Calculus, University of Western Australia, Australia.

Teaching Assistant [Feb 2003 – Dec 2005]
Introduction to Statistics for Economics and Business (tutorials), Statistics for
Mathematics and Statistics (tutorials), University of Western Australia.

SUPERVISION

Five Master Projects, Dep. Business and Economics, SDU, Denmark, June 2011 –
June 2014.

One Master Project, CREATES, Aarhus University, Denmark, February 2010 –
June 2010.

Three Bachelor Projects, Dep. Business and Economics, SDU, Denmark, March
2013 – June 2014.

ORGANISATION OF SCIENTIFIC MEETINGS

Co-chair of Local Organising Committee [Jul 2005 – Jun 2006]
International Conference on Time Series Econometrics, Finance and Risk,
Australia

International Program Committee Member [Jul 2005 – Jun 2006]
International Conference on Time Series Econometrics, Finance and Risk,
Australia

Local Organising Committee Member [Jul 2004 – Apr 2005]
International Workshop on Financial Econometrics and Statistics, Australia

INSTITUTIONAL RESPONSIBILITIES

- Department Council Member** [Jun 2013 – Present]
Advisory to the Head of the Department of Business and Economics, University of Southern Denmark
- International Staff Coordinator** [May 2012 – Present]
Advisory and aid to newly arrived staff on matters of residence, Department of Business and Economics, University of Southern Denmark.

COMMISSION OF TRUST

- Editorial Board Member** [Jan 2013 - Present]
Econometrics (MDPI Journal).
- PhD Committee Member** [Aug 2014 – Present]
Department of Business and Economics, SDU, Denmark.

MAJOR COLLABORATIONS

- [1] Prof Jiti Gao, “Nonparametric Modelling”, Dep of Econometrics and Business Statistics, Monash University, Australia.
- [2] Prof Irene Gijbels, “Nonparametric Modelling”, Dep of Statistics, K.U. Leuven, Belgium.
- [3] Prof Eva Ferreira, “Nonparametric Modelling”, Dep of Applied Economics III, University of the Basque Country, Spain.
- [4] Assoc Prof Helena Veiga, “Nonparametric vs Bayesian Volatility Forecasting”, Dep of Statistics, University Carlos III, Spain.
- [5] Assoc Prof Nektarios Aslanidis, “Correlations and comovements”, Dep of Economics, Univeristy Rovira I Virgili, Spain.
- [6] Assoc Prof Selva Demiralp, “Transmission of Monetary Policy”, Dep of Economics, Koc University, Turkey.
- [7] Assoc Prof Sandy Suardy, “Oil prices volatility forecasting”, Dep of Economics, La Trobe University, Australia.
- [8] Lecturer Stefano Grassi, “Nonparametric vs Bayesian multivariate models”, Dep Economics, University of Kent, UK.
- [9] Senior Researcher Elena Villalba Mora, “Impact and diffusion of eHealth”, University Hospital of Getafe, Spain.
- [10] Assoc Professor Alfredo Garcia-Hiernaux, “Insurance forecasting”, Dep Quantitative Economy, Complutense University, Spain.

B.6. Capacity of the Participating Organisations

Beneficiary BCAM	
General Description	<p>BCAM is a world-class research center on Applied Mathematics with a focus on interdisciplinary research in the frontiers of mathematics, attraction and training of talented scientists, development of new numerical and simulation methods, interaction with industry, and promotion of scientific and technological advances worldwide. The research structure of the Center is grouped into Research Areas and Lines. Consolidated Research Lines consist of a Group Leader, senior researchers, post-doctoral researchers and doctoral students.</p> <p>Starting in 2008 with 3 Professors and 1 Research Line and, up to Dec 2013, with 41 Researchers (Professors, Post-doc fellows, PhD Students and External Scientific Members), a high number of visiting fellows and internships, supported by a Staff team, integrating people from more than 21 different countries, the Center has accomplished a long and intense path, full of high quality scientific activities and hard work.</p>
Role and Commitment of key persons (supervisor)	Luis VEGA (Scientific Director of BCAM and Highly Cited Researcher).
Key Research Facilities, Infrastructure and Equipment	We have acquired in 2012 a new 1500 sq. m. facility in the center of Bilbao. In addition to great office spaces, we also count with excellent administrative support. We also own powerful workstations and a small-shared memory parallel machine, and we have access to i2Basque HPC cluster. Since we are located in the center of Bilbao (a city with over 400k inhabitants), we have easy access to all services needed by visitors.
Independent research premises?	YES
Previous Involvement in Research and Training Programmes	In 2010, the Center reached 2 important milestones: (1) The first project funded by the industry was achieved with Artech group, and (2) we obtained an ERC Advanced Grant NUMERIWAVES. In 2014, BCAM has achieved its major collective goal in a competitive call: the accreditation as a Severo Ochoa Research Center, which is the highest possible national recognition that a research center can obtain in Spain (only a total of five centers from all areas of knowledge are awarded each year). The aim of this accreditation is to strengthen BCAM research capabilities and international scientific leadership, high level scientific label that will help us to increase and improve our relationships with public and private stakeholders.
Current involvement in Research and Training Programmes	<p>1) SEV-2013-0323 SEVERO OCHOA accreditation and grant, funded by the MINECO (Spanish Ministry of Science and innovation), Institutional strengthen 2013 call. PI: L.Vega; budget: 4.000.000 €. Duration: 01/07/2014 – 31/06/2018.</p> <p>2) 246775 NUMERIWAVES – New analytical and numerical methods in wave propagation, funded by ERCEA; PI: E. Zuazua; Host Institution: BCAM; Budget: 1.663.000,00 €; Duration: 01/02/2010 – 31/01/2015.</p>
Relevant Publications and/or research/innovation products	<p>[1] Asua, JM, Akhmatkaya, E. (2011). Dynamical modelling of morphology development in multiphase latex particles. Book: European Success Stories in Industrial Mathematics, Eds: Lery, T.; Primicerio, M.; Esteban, M.J.; Fontes, M.; Maday, Y.; Mehrmann, V.; Quadros, G.; Schilders, W.; Schuppert, A.; Tewkesbury, H. ISBN: 978-3-642-23848-2, Area: Mathematics, Applied</p> <p>[2] Hannukainen A., Korotov S., Krizek M (2012). The maximum angle condition is not necessary for convergence of the finite element method. <i>Numerische Mathematik</i>, 120, 79-88.</p> <p>[3] Gameiro M. and Lessard, J.P.(2011). Rigorous computation of smooth branches of equilibria for the three dimensional Cahn-Hilliard equation. <i>Numerische Mathematik</i>, 117, 753-778.</p> <p>[4] Ponta L., Scalas E., Raberto M., and Cincotti S (2011). Statistical analysis and agent-based microstructure modeling of high frequency financial trading. <i>IEEE J. of Selected Topics in Signal Processing</i>, 99</p>

Partner Organisation Dep. Applied Economics III (UPV/EHU)	
General description	The Department of Applied Economics III belongs to the Faculty of Economics which is one of the biggest centres in this discipline in the Basque Country. The main activities are teaching and researching in Advanced Econometrics and Statistics.
Key Persons and Expertise (supervisor)	Eva Ferreira (supervisor) is a full Professor at the department with publications in top econometrics and statistics journals. Susan Orbe is an Assoc. Professor at the department who also has leading publications in econometrics. One of their common research interests is within the area of nonparametric statistics. In particular, they are two of the few worldwide scholars who have recently applied those techniques to multivariate models.
Key Research facilities, infrastructure and equipment	All University facilities are available for the project (offices, computers, seminar rooms, licences of software packages, etc.)
Previous and Current Involvement in Research and Training Programmes	The department is involved in two Masters and their respective PhD programs, which are accredited as excellent by the Ministry of Education. Research seminars for visitors are organised weekly, as well as a “brown bag” seminar where local researchers share their ideas.
Relevant Publications and/or research/innovation product	[1] Susan Orbe, Eva Ferreira, Juan M. Rodriguez-Po (2006). On the estimation and testing of time varying constraints in econometric models. <i>Statistica Sinica</i> , 16 (4) 1313-1333. [2] Susan Orbe, Eva Ferreira, Juan M. Rodriguez-Po (2005). Nonparametric estimation of time varying parameters under shape restrictions. <i>Journal of Econometrics</i> , 126. 53-77. [3] Susan Orbe, Eva Ferreira, Juan M. Rodriguez-Po (2003). An algorithm to estimate time varying parameter SURE models under different type of restrictions. <i>Computational Statistics & Data Analysis</i> , 42, 363-383.

Partner Organisation: Dep. Economics (Koç University)	
General description	The Department of Economics belongs to the College of Administrative Sciences and Economics. Their 15 members of staff publish regularly in leading Economics journals as it can be seen at their website: (http://case.ku.edu.tr/research/econ-publications) Research seminars for international visitors are arranged weekly.
Key Persons and Expertise (supervisor)	Selva Demiralp has a PhD in Economics from the University of California Davis (2000). Her recent research focuses on the areas of monetary transmission mechanism. On top of her academic experience, she worked as an economist at the Board of Governors of the Federal Reserve System during 2000-2005.
Key Research facilities, infrastructure and equipment	All University facilities are available for the project (offices, computers, seminar rooms, licences of software packages, etc.)
Previous and Current Involvement in Research and Training Programmes	The department has a MA and a Ph.D. program in Economics. There are weekly research seminars. In addition, Koç University-TUSIAD Economic Research Forum organises conferences and workshops throughout the year.
Relevant Publications and/or research/innovation product	[1] Seth Carpenter, Selva Demiralp and Jens Eisenschmidt (2014). The effectiveness of non-standard monetary policy in addressing liquidity risk during the financial crisis: The experiences of the Federal Reserve and the European Central Bank. <i>Journal of Economic Dynamics and Control</i> , 43, 107-129. [2] Selva Demiralp and Seth Carpenter (2008). The liquidity effect at the Federal Funds Market: Evidence at the monthly frequency". <i>Journal of Money, Credit, and Banking</i> , 40, 1-24. [3] Selva Demiralp, Kevin D. Hoover and Stephen J. Perez (2008). A Bootstrap Method for Identifying and Evaluating a Structural Vector Autoregression. <i>Oxford Bulletin of Economics and Statistics</i> , 70, 509-533.

B.7. Ethics Issues

There are no ethical issues associated with the project.

Ethics Self-Assessment in Part B

Research on human embryos/foetuses:

- Does your research involve Human Embryonic Stem Cells (hESCs)? NO
- Will they be directly derived from embryos within this project? NO
- Are they previously established cells lines? NO
- Does your research involve the use of human embryos? NO
- Does your research involve the use of human foetal tissues / cells? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Research on Humans:

- Does your research involve human participants? NO
- Are they volunteers for social or human sciences research? NO
- Are they persons unable to give informed consent? NO
- Are they vulnerable individuals or groups? NO
- Are they children/minors? NO
- Are they patients? NO
- Are they healthy volunteers for medical studies? NO
- Does your research involve physical interventions on the study participants? NO
- Does it involve invasive techniques? NO
- Does it involve collection of biological samples? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Research on Human Cells /Tissues:

- Does your research involve human cells or tissues (other than from Human Embryos/Foetuses, i.e. section 1)? NO
- Are they available commercially? NO
- Are they obtained within this project? NO
- Are they obtained within another project? NO
- Are they deposited in a biobank? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Research on Personal Data:

- Does your research involve personal data collection and/or processing? NO
- Does it involve the collection and/or processing of sensitive personal data (e.g.: health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)? NO
- Does it involve processing of genetic information? NO

- Does it involve tracking or observation of participants? NO
- Does your research involve further processing of previously collected personal data (secondary use)? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Research on Animals:

- Does your research involve animals? NO
- Are they vertebrates? NO
- Are they non-human primates? NO
- Are they genetically modified? NO
- Are they cloned farm animals? NO
- Are they endangered species? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Research on Third Countries:

- Does your research involve non-EU countries? NO
- If your research involves low and/or lower middle income countries, are benefits-sharing measures foreseen? NO
- Could the situation in the country put the individuals taking part in the research at risk? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Research on Environment, and Health and Safety:

- Does your research involve the use of elements that may cause harm to the environment, to animals or plants? NO
- Does your research deal with endangered fauna and/or flora and/or protected areas? NO
- Does your research involve the use of elements that may cause harm to humans, including research staff? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Dual Use:

- Does your research have the potential for military applications? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Research Misuse:

- Does your research have the potential for malevolent/criminal/terrorist abuse? NO

I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL: YES

Other Ethics Issues:

- Are there any other ethics issues that should be taken into consideration?
NO

ENDPAGE

MARIE SKŁODOWSKA-CURIE ACTIONS

**Individual Fellowships (IF)
Call: H2020-MSCA-IF-2014**

PART B

“Post-GFC Monetary Policy”

“Forecast of time-varying effects of post-GFC monetary policy + a novel computing application”

This proposal is to be evaluated as:

[Standard EF]