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Speech for the Investiture Ceremony as Doctor Honoris Causa of Dr. Robert F. Engle and Dr. Eduardo Schwartz

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RECTOR MAGNIFICUS,
DISTINGUISHED AUTHORITIES,
PROFESSORS,
STUDENTS,
LADIES AND GENTLEMEN.

This day,
this week,
this month,
this year,
will live in our memory.

It is a great honor to take part in today's ceremony, where we bestow our university's highest recognition upon esteemed colleagues. Today, we celebrate the exceptional contributions of Professor Robert Fry Engle III and Professor Eduardo Schwartz, whose work has profoundly shaped our understanding of economics, finance and climate related risks. Let us all take inspiration from this event to advance the spirit of scientific excellence.

As a professor and researcher in Finance and Econometrics, I am deeply moved to present the nomination for Doctor Honoris Causa for Professor Robert Fry Engle III. Robert Engle, an Emeritus Professor of Finance at New York University Stern School of Business, received the 2003 Nobel Prize in Economic Sciences for his pioneering work on "methods of analyzing economic time series with time-varying volatility (ARCH)." These techniques have proven essential in accurately capturing the dynamics of several time series. He shared the Prize with his close friend and collaborator, Sir Clive W. J. Granger, who was recognized for his work on "methods of analyzing economic time series with common

trends (cointegration)." Robert Engle was also involved in the discovery of cointegration.[1]

Engle's innovative approaches to practical problems have led him to develop groundbreaking econometric methods that have transformed empirical analysis in Economics and Finance. Throughout his career, Robert Engle has established an extraordinary legacy, marked by the creation of pioneering analytical tools, as well as his co-authorship and mentorship of numerous PhD students, some of which are here today with us. His significant influence has greatly enriched their professional and personal lives. He has imparted his ideas and insights, and has nurtured a generation of leading economists across the globe.

Robert Engle graduated from Williams College with Highest Honors in Physics in 1964. His four years were full of fun, sports, music, growing up and science. He was a standout performer in several dimensions. As a highly athletic youngster in his sophomore year, he was named in the All American Team as a Lacrosse goalie.[2] (I played this game as a school pupil in St Andrews, Scotland, and enjoyed it a lot.) We shall see later that the amazing coordination he developed playing lacrosse contributed towards his becoming an ice-skating champion.

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1 The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2003 was divided equally between Robert F. Engle III "for methods of analyzing economic time series with time-varying volatility (ARCH)" and Clive W.J. Granger "for methods of analyzing economic time series with common trends (cointegration)"

2 I also played Lacrosse when at school in Scotland. I did not make it to goalie but enjoyed the game very much. Lacrosse is a team game similar to hockey but it uses a stick with a triangular net. It was originally played by North American Indians: the ball is thrown, carried, and caught with a long-handled stick which has a triangular frame at one end with a piece of depthless netting in the angle.

By that time Robert had decided to call himself “Rob” as he felt it was more masculine and mature. I will therefore call him “Rob” for the rest of this laudation! Academically, Rob studied Physics and Math at an advanced level and continued to excel as undergraduate. His brilliant performance led him to the nomination to “Phi Beta Kappa”, America´s most prestigious academic´s honor society constituted with the motto “Love of Learning is the Guide to Life.” [3] It was also at Williams that Rob first flirted with Economics. He had taken Introductory Economics as an elective course and loved it. This course later served as the stimulus that changed the direction of his life. He finished an MSc in Physics in 1966 at Cornell and then completed a PhD in Economics there in 1969.

Rob was simply outstanding at everything he touched. He was also string bass player at the All State Orchestra and later played in the symphonies at Williams College, Cornel University and Massachusetts Institute of Technology (MIT).

In the subsequent sections of this laudation, I will highlight the aspects of Rob’s work that have been most influential to academic careers. I will explore for this purpose his contributions in Time Series Econometrics during his time at University of California San Diego and the work in Empirical Finance developed at NYU. The transition from time series to empirical finance will be bridged by the ARCH model.

1. The explosion of Time Series Econometrics in the University of California San Diego (UCSD)

While working as an associate professor at MIT, Rob accepted an “irresistible” offer from UCSD where he was hired as an urban

3 Members include 17 U.S presidents 42 supreme court justices, and more than 150 Nobel Laureates

economist in 1975, although he would work in broader fields. The work that he developed in San Diego with Clive Granger and others (such as Hal White and Jim Hamilton) marked the start of the golden era of time series econometrics. At the time, UCSD was a world-leading, if not the world's foremost department in Time Series.

Rob was intrigued by Milton Friedman´s hypothesis (1977) that inflation unpredictability was a cause of business cycles. Rob felt that Friedman´s conjecture should be tested with a time series model with variances that could change over time. A time series model uses a sequence of data points collected over a given period. This framework would take quarterly observations of inflation over a long history and calculate the variance as a measure of dispersion from mean values. The model needed to account for changing variances. In Econometrics, we use the term "heteroskedasticity" to consider variances that are not constant over time. As you might know, "hetero" derives from the Greek word *heteros* meaning "different". "Skedastic" comes from the Greek word *skedasis* which means "dispersion". The word "Econometrics" owes *its* origins to the two Greek words *Oiknonomiia* meaning "household" and *metria* which means *"measure of"*.

In Finance, if we look at an asset, its returns are seen (in other words, are observed to be) uncorrelated. On the other hand, its squared returns exhibit correlation. This presented a problem for the models of the day, which operated under an assumption of independence; for under this assumption, *both* the returns themselves *and* any function of them, including their squares, should be uncorrelated. But that's not what was seen in the data. Clearly, the models had to be revised. One approach would be to model the squared returns directly. The brilliance of Rob was to see that modelling the squares could be achieved

using a standard model if prediction errors exhibited a property known as conditional heteroskedasticity. This led to the ARCH model, that became a building block for financial time series. Geneneralizations of the model allow for better model fitting on the basis of data. What is remarkable is that Rob took this idea, grew and developed it, and enhanced it with other models and approaches, leading to the volatility and risk approach that he and other take towards financial time series that we see in universities and financial markets today.

From my own perspective, it was fascinating for me to discover while reading Rob's biography that ARCH was invented in 1979 when he went for a sabbatical to the London School of Economics (LSE). I was fortunate to study there for my Master's degree, but I was there much, much later! And in his biography, he says that it was in London in a rented flat in Hamsptead that the great EUREKA moment arrived.

"Eureka" comes from the Ancient Greek word εὕρηκα heúrēka, which means "I have found [it]". Indeed, it is the first person singular perfect indicative active of the verb εὑρίσκω heurískō, "I find"!. The term is associated with the sudden spark of inspiration of Archimedes that led him to arrive at the principle of buoyancy. In a fit of exultation, he leapt straight out of the bath and ran naked down the streets of Athens shouting "Eureka!" We will presume that the gentrified London suburb of Hampstead was not treated to such an episode, but the idea of ARCH was brilliant in its simplicity and yet encompassing in its applicability, and for the idea and pioneering contribution, Rob was awarded the 2003 Nobel Prize in Economics.

I learnt about non-constant volatility for the first time as an undergraduate in Queen Mary, University of London in 1995. Professor Christopher L. Gilbert, taught the final year Time

Series Econometrics course. It took me a while to pronounce the term "heteroskedasticity" but it soon became part of my orbit during my Ph.D with I took with Chris Gilbert as supervisor. It turned out Chris had completed his Ph.D in 1987 at Oxford under the supervision of Professor Sir David F. Hendry.[4] It was highly emotive for me when I discovered at last year's Climate Finance conference that David was not just a collaborator but a great friend of Rob's, and that it was he who had invented the name ARCH. Indeed, it was because of David Hendry that the first ARCH program was written. David participated here last year as a keynote speaker alongside Rob in the conference I organized with the Center for Low Carbon Hydrogen studies (ICAI-ICADE) and the Faculty of Economics and Business Administration. David F. Hendry was supposed to be here today but, unfortunately, has had to send his apologies.

Robert Engle published his ARCH model in the journal *Econometrica* in 1982. He writes in his Nobel biography "one might think that new ideas are easy to publish. At least for me they are not. It took me a bit of rewriting and persuading to finally get it accepted. In fact, I don´t think that any of my papers have had an easy time of it!" I think that we should all take note of this.

When Rob returned to UCSD, the ARCH model was well on its way and he became very interested in a concept introduced by Clive Granger that addressed low frequency (or long term) correlations, that Granger had called "co-integration". It too had its genesis in a problem with the econometric models of the day: simultaneous equations models based on economic theory were being outperformed in forecasting by atheoretical statistical models that were built on the basis of the data. Rob helped to construct

4 Gilbert, C. L. (1986) "Professor Hendry's Econometric Methodology", Oxford Bulletin of Economics and Statistics, 48, 3, 283—307

an econometric approach to resolve these issues. The pioneer paper on the estimation and testing of cointegrated systems was published with Clive Granger in 1987, also in *Econometrica*.

2. The ARCH that bridges the transition from time series Econometrics to Finance

One aspect about Rob Engle's career – and one that distinguishes him from the majority of Nobel Laureates in Economics – is that he has a whole body of work and contribution *after* he won the Prize. Not for him to sit on his laurels! And indeed, whether by design or through a natural consequence of his move to New York, Rob's interests have leaned more heavily towards Finance. He became increasingly involved with the notion of volatility, and its association with risk. The trade-off between risk and return was a central paradigm in financial analysis and the ARCH model offered a mechanism, for addressing it. He would, however, go on to develop many other models as he integrated the perspectives of volatility and risk and their measurement more and more into his thinking, and to find real application of his methods in the financial sector.[5]

Economic and financial agents use the concept of volatility to measure risk. Quantifying uncertainty (or risk) is pivotal to the

5 Rob Engle was also delighted to meet finance faculty such as Michael Brennan and Eduardo Schwartz a moment that de defines as the "peek into the new profession." In the early 1990s he started talking to financial practitioners in a series of RISK meetings and introduced the audience into ARCH models. He started consultancy projects at Salomon Brothers and the GARCH model (a generalization of ARCH) was incorporated into trading systems while became part of a steering committee of a Zurich Financial Services company that was doing path breaking work on high frequency data. He developed the Autoregresive Conditional Duration or ACD to model the speed of trading treating the time between trades as a random variable. These contributions on microstructure allowed him to approach the market microstructure main figures such as Maureen O´Hara and led him to develop a microstructure approach to optimize trades for Morgan Stanley. Engle produced additional innovative statistical methods such CAViaR and dynamic conditional correlation (DCC) models among many others.

decision-making process of any individual. The advantage of knowing about risk is that we can change our practices to prevent them. However, risk cannot be fully eliminated. A zero-risk exposure would mean that humans would still live in the caves, they would not have discovered America, nor stepped on the moon. However, there are risky activities that we choose to do simply because they are worth it, meaning that the perceived underlying benefits of doing them exceed the perceived costs.[6]

When practitioners allocate their financial resources, they need to measure price variances. They usually used the square root of the mean dispersion of returns. When applying this volatility measure, they realized that the volatilities were changing over time.

To cut a long story short, this was the agenda that Rob has followed at NYU as founder and codirector of Sten´s own Volatility Institute. His research in Financial Econometrics has produced additional innovative statistical methods and concepts such as common features, autoregressive conditional duration (ACD), Conditional Value at Risk (CAViaR) and dynamic conditional correlation (DCC) models.[7]Classic models based on the ARCH model and its generalizations, as well as the state-of-the-art advances are now featured in the

6 Harry M. Markowitz in 1952 and William L. Sharpe in 1964 had associated risk with portfolio returns Their contributions allowed managers to decide when a potential return is worth the risks of the investment. Markowitz and Sharpe were awarded the Nobel the prize in 1990 (along with Merton H. Miller) for their pioneering work in the theory of financial economics. Black and Scholes (1972) and Merton (1973) recognized the importance of risk in the development of their seminal work for pricing options. Option prices depended on risk and that were measured as the variance of asset returns. Their work was recognized with by a 1997 Nobel prize.

7 His current application of multiplicative error models (MEM) and factor spline GARCH (FSG) models combine into ever more powerful statistical tools

Volatility Laboratory (VLAB) which provides daily estimates of volatilities and correlations for more than a thousand assets.[8]

Since Rob has just participated in our Climate Finance conference, it would be remiss of me not to mention the work he is now doing modeling termination risk and the design of portfolios that synthetically hedge climate risk exposure. The VLAB now uses the tools of modern finance and risk management, to model environmental risks.

Finally, even as we celebrate Rob's great academic achievements, we should note that his greatest attribute is the role he plays in supporting his family. It was in January of 1968 before the start of the new term in Cornell that a beautiful young woman caught Rob´s eye. She was starting graduate study in Child Development at Cornell. Her name was Marianne Eger, a distinguished clinical and sports psychologists. She became Rob´s wife in August 1969. She is his intellectual companion as well as being mother to his two children, Lindsey and Jordan. Their children and five grandsons constitute the delights of their lives. In presenting this lauration, I would like to express my gratitude to Robert Engle for his incommensurable contributions to the understanding of the world in economics finance and climate. Though now in his eighties, he is still pushing scientific frontiers for us. It is my greatest privilege of confer upon Robert Fry Engle III the highest honorary degree awarded by the Universidad Pontificia Comillas: doctor *honoris causa*.

8 Risk computations provided by VLAB are now used in evaluating portfolio risk, asset allocation, derivative pricing and systemic risk measures now incorporated in the NYU Stern Systemic Risk Rankings. Rob has built upon the foundation of the work on ARCH for which he was awarded the Prize to produce methods based on volatility and risk that can be taken beyond the university and into the financial world. The philosophy is simple, yet is holistic, and many financial institutions and regulators are now using his methods. If I were to try get to the core of why they have been so popular and successful, it is the effort he has made to ensure that, while his methods are effective, they are simple to apply and interpret. It's not an exaggeration to say that his methods are designed, say, to produce numbers that will tell you whether or not we're moving towards or are in financial crisis.

"THUS, HAVING CONSIDERED AND PRESENTED THESE FACTS, DISTINGUISHED AUTHORITIES AND FACULTY MEMBERS, I HEREBY ERNESTLY REQUEST WITH ALL DUE CONSIDERATION THAT PROF. ROBERT FRY ENGLE III BE AWARDED AND CONFERRED THE HIGHEST DEGREE OF DOCTOR HONORIS CAUSA BY THE UNIVERSIDAD PONTIFICIA COMILLAS"

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