Doctor *honoris causa*
Timothy J. Kehoe

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TIMOTHY J. KEHOE

Discurs llegit
a la cerimònia d'investidura
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UAB
Universitat Autònoma de Barcelona

PRESENTACIÓ
DE
TIMOTHY J. KEHOE
PER
JORDI CABALLÉ

Academic life tends to combine long periods of monotony, in which quiet but constant work is the rule, with isolated moments to celebrate your own or other people's success as a result of that work. Today is one of those infrequent and, therefore, especially joyful times when we come together in celebration to honour one of the most prestigious members of our profession of academic economists. This is also an especially happy moment for me, as my friend Tim Kehoe has been a benchmark throughout my professional life.

I will begin by highlighting some of the biographic aspects and abundant merits of Dr. Tim Kehoe. He is currently Professor of Economics at the University of Minnesota and Adviser to the Federal Reserve Bank of Minneapolis. He obtained his PhD from Yale University in 1979, under the supervision of Professor Herbert Scarf and the co-supervision of Professor Andreu Mas-Colell. Since obtaining the PhD, he has lectured at the Wesleyan University, at the MIT, at the University of Cambridge and, since 1987, he has been a Professor at the University of Minnesota. Over this period, he has supervised 74 PhD theses. It should be stressed here that he is ranked 29th in the RePEC ranking of all academic economists worldwide as regards the subsequent research quality of his students. This proves that Tim Kehoe, through his excellent teaching and supervision, has planted the seeds of the abundant scientific production conducted by several generations of economists.

Some of the numerous articles that he has written have been published in the most prestigious journals in Economics (such as the *Journal of Political Economy*, the *Review of Economic Studies*, the *Quarterly Journal of Economics* and *Econometrica*). He has also published his research in top-level journals within the most specialized fields of tax policy (for example the *Journal of Public Economics*) and economic theory (such as the *Journal of Economic Theory*) and in other very prestigious journals in the fields of international economics and macroeconomics (such as the *Journal of International Economics*, the *Review of Economic Dynamics*, the *Journal of Monetary Economics*, etc.). Although merely anecdotal, we can also mention that eight of these publications have been written in Spanish and two in Catalan, in the *Revista Econòmica de Catalunya*, thus corroborating Professor Kehoe's links to our academic environment to which I will refer later. Finally, in order to demonstrate the undeniable impact of Dr. Kehoe's scientific work, I would like to mention that he has accumulated around 8,000 citations on Google Scholar.

Tim Kehoe is Fellow of the Econometric Society since 1991, this being one of the highest honours to which an academic economist can currently aspire. Since 1982, he has uninterruptedly received the most competitive grants of the National Science Foundation of the United States. He is currently President of the Society for Economic Dynamics, the most important association for economists doing research on the dynamic aspects of Economics.

The current regulations about Honoris Causa PhDs of the Universitat Autònoma de Barcelona consider a candidate's link to our university as an important merit. Dr. Kehoe truly deserves this merit, as since 1983 he has been a regular visitor of our Department of Economics and Economic History. His continued visits have enabled him to contribute regularly to the teaching of the IDEA graduate programme, on which in recent years he has taught an advanced course in International Trade and Finance.

His link to the IDEA programme has also allowed many students on the programme to spend short stays both in the Department of Economics of the University of Minnesota and at the Minneapolis Fed, thanks to his generous invitations. Some students from the master's degree programme have moreover pursued their PhD studies at the University of Minnesota, even with Dr. Kehoe as their thesis supervisor. This is the case of the PhD-holders Cristina Echevarría, Claustre Bajona and Antonia Díaz. Finally, I would like to mention that one of the professors of the Department of Economics and Economic History of the UAB, currently on leave of absence, Dr. Juan Carlos Conesa, had Tim Kehoe as his thesis supervisor and is a co-author of several papers with him.

As far as our School of Economics and Business is concerned, we could mention that Professor Kehoe delivered the inaugural lecture of the 2012-13 academic year. He has also been linked to several institutions in Catalonia and the rest of Spain, as he is a frequent visitor to our country, with which he has close ties. Proof of this is the fluency with which he is able to express himself in both Spanish and Catalan. Tim Kehoe is a member of the Scientific Council of the Barcelona Graduate School of Economics, has been a Visiting Professor at the Universities of Barcelona, Alicante and Pompeu Fabra and at the CEMFI in Madrid, and has been a member of various public commissions to assess Catalan and Spanish research.

He has also promoted several initiatives that affect us closely. Some of these initiatives are academic, such as the "Workshop on Dynamic Economics", which is held annually in Vigo and is already in its 21st edition. This workshop provides an incomparable environment for relaxed interaction among advanced PhD students and world-class professors in the field. Some of his other initiatives are of a more festive and/or gastronomic nature and I will not describe them in detail, although they are consistent with the bonhomie and joie de vivre inherent in his delightful personality.

I would also like to recall that Tim Kehoe has been invited speaker at plenary sessions of the former "Symposium of Economic Analysis" and the current "Symposium of the Spanish Economic Association." Tim Kehoe is indeed one of the most loyal participants in this annual scientific meeting held in Spain. Finally, he was a member of the Editorial Board of the *Revista Española de Economía* and is fellow of the Spanish Economic Association.

I will now offer a selective summary of the research carried out by Dr. Kehoe. Over his career he has tackled several topics of study within the general framework of dynamic economics and macroeconomics, making in all of them essential contributions that have made them easier to understand for our profession.

The study of the determinacy, uniqueness and regularity of the equilibria in dynamic economies and, in particular, in economies of overlapping generations is a line of research that Dr. Kehoe addressed from when he finished his thesis in 1979 until 1992. His contribution made it possible to extend to a dynamic environment the results on these same questions that had been tackled by, among others, the Nobel prize-winner Gerard Debreu in the context of static economies. In this dynamic environment, the equilibria are no longer points of the Euclidean space but rather paths (that is, sequences indexed by time) of prices and quantities. The regularity of equilibria is an essential property since it allows us to use, in a justified manner, the techniques of comparative statics to characterize the effects of changes in the values of the exogenous variables of the economic model under study. Tim Kehoe's contribution is based on the use of a technique originating in differential topology (the index theory) to solve a question that is very complex from a technical viewpoint. Dr. Kehoe was, without a shadow of a doubt, the most prestigious researcher from this area of study during the period for which it was the centre of attention of theoretical economists.

Applied general equilibrium is another area of research to which he has been devoted and in which the benchmark researcher is precisely the supervisor of his PhD thesis, Herbert Scarf. His articles on applied general equilibrium cover a period which goes from 1982 to 1995. In these articles, Dr. Kehoe applies the techniques of general equilibrium to explicitly quantify the impact of different economic policy changes, whether concerning energy prices, general price control or tax reforms, in different countries such as Spain or Mexico, a country to which he is also closely attached. Here, I would like to highlight his article published in 1988 in the *European Economic Review* on the tax reform carried out in Spain, in which the co-authors are the current rector of our university, Ferran Sancho, a UAB Professor, Clemente Polo, and a former Professor from our university, currently at the University of Barcelona, Antonio Manresa, together with Pedro Javier Noyola.

Since 1992, Dr. Kehoe has published frequent articles (one with the former UAB student Claustre Bajona) on international trade and, in particular, on the welfare and macroeconomic effects of the several trade liberalization processes that have taken place in the world. The assessment of these processes is generally positive, despite the sectoral reallocation that they have triggered. In this field, Dr. Kehoe has especially analyzed the implications of the North American Free Trade Agreement (NAFTA) signed between Canada, the United States and Mexico.

Dr. Kehoe also made a crucial contribution to the analysis of debt and liquidity constraints in his articles with David Levine published in the *Review of Economic Studies* in 1993 and *Econometrica* in 2001. In these articles debt and liquidity constraints, which are essential to understand many macroeconomic phenomena, are generated endogenously starting from an explicit consideration of the role of both the seizable collateral of the individuals who apply for credit and the potential future exclusion from the credit market in the event of default.

This endogenous characterization of credit restrictions starting from the individual rationality constraints was at the time completely innovative and had a transcendental influence on that literature.

At the end of the 90s, Dr. Kehoe wrote, together with Harold Cole, a series of articles which changed the way in which economists approached the problem of sovereign debt crises. In particular, they emphasized the possibility of crises induced by the loss of confidence in governments and how that loss of confidence was confirmed by subsequent events characterized by a reduction in the real investment level. In one of my favourite articles from that literature, published in the *Review of Economic Studies* in 2000, Kehoe and Cole characterize the conditions under which these self-fulfilling debt crises can appear. In other articles, these same authors illustrate how their model helps to explain the financial problems faced at that time by countries such as Mexico or some East Asian countries.

To end this summary of his research, I would like to say that, since 1996, Tim Kehoe has become one of the international leaders in the study of economic recessions. His approach is based on the behaviour over time of the amount used of production inputs and on the efficiency of this use. From this approach it is thus possible to reach the general conclusion that recessions always tend to be accompanied by reductions in productivity and that these reductions end up triggering financial crises. The results of this pioneering literature are largely included in the book "Great Depressions of the Twentieth Century", which Dr. Kehoe, together with the Nobel prize-winner Edward Prescott, published with premonition in 2007. In particular, Tim Kehoe personally analyzed the recessions of countries such as Mexico, Finland and Argentina.

We can thus conclude, both from his extremely prestigious academic merits, which are certified by the importance of his scientific contributions and teaching, and from the links to our university and to the

Catalan and Spanish academic community, that Dr. Timothy Kehoe is an economist who fully deserves the PhD honoris causa granted by our university.

I therefore have the pleasure, honour and privilege to request the Honourable Rector of the Universitat Autònoma de Barcelona, to bestow the PhD honoris causa on Mr Timothy J. Kehoe.

DISCURS
DE
TIMOTHY J. KEHOE

APPLIED GENERAL EQUILIBRIUM MODELING
IN SPAIN AND MEXICO

My history at the Autònoma

I first came to Barcelona in December 1984. I had met Andreu Mas-Colell, then a professor at the University of California, Berkeley, in 1978 when I was working on my Ph.D. thesis, which used differential topology to study the properties of general economic equilibrium models.[1] Andreu provided me with a tremendous amount of help and guidance, and we became friends. I introduced Andreu to my good friend and collaborator from graduate school at Yale, Jaime Serra-Puche, a Mexican who was the son of Catalan refugees from the Spanish Civil War. In fact, Jaime's grandfather, Jaume Serra i Hunter, had been the Rector of the Universitat de Barcelona and the President del Parliament de Catalunya for a time during the Republic. Andreu arranged for first Jaime, and then Jaime and me, to visit Barcelona. Jaime and I showed the economists at the Autònoma how we had developed applied general equilibrium models to analyze the impact of tax reforms in

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1   Timothy J. Kehoe, "An Index Theorem for General Equilibrium Models with Production," *Econometrica*, 48 (1980), 1211–32.

Mexico.[2] At the Autònoma, Xavier Calsamiglia and Joan Maria Esteban helped us obtain support from the Ministerio de Economía and to assemble a team of young economists to build an applied general equilibrium model to analyze the 1986 entry of Spain into what was then the European Community. Besides Jaime and me, the researchers on this team were three economists from the Autònoma, Antonio Manresa, Clemente Polo, and Ferran Sancho, and a Mexican economist, Pedro Noyola. Cristina Echevarria and Walter Garcia Fontes were the first research assistants. The Autònoma, with its masters program, was the center for modern economic research and education in Spain the 1980s, and it was an exciting place to be. Jaime Serra-Puche and Pedro Noyola had to give up working on the Spanish project when they entered the Mexican government in 1986, but I continued. I have spent some part of every year since 1984 in Spain, mostly in Barcelona but also in Alicante, Vigo, and Madrid, doing research and teaching. In Barcelona, I have been a visiting professor at the Universitat de Barcelona and at the Universitat Pompeu Fabra, but I have mostly spent my time at the Autònoma.

Applied general equilibrium and the Spanish model

A general economic equilibrium model describes how the interaction of consumers, producers, and the government determines the prices, consumption levels, and production levels in an economy.[3] During the summers of 1985 and 1986, our team built an applied general equilibrium model of the Spanish economy by assembling am extensive data set — which we subsequently published as the first social accounting

2   Timothy J. Kehoe and Jaime Serra-Puche, "A Computational General Equilibrium Model with Endogenous Unemployment: An Analysis of the 1980 Fiscal Reform in Mexico," *Journal of Public Economics*, 22 (1983), 1–26.

3   Patrick J. Kehoe and Timothy J. Kehoe, "A Primer on Static Applied General Equilibrium Models," *Federal Reserve Bank of Minneapolis Quarterly Review*, 18:2 (1994), 2–16.

matrix developed for Spain[4] — and using it to specify the behavior of consumers, producers, and the government in a computer model. In the model that we implemented on the computer, these agents acted in accordance to economic theory — the consumers worked, consumed, and saved to maximize their utility, the producers hired factors of production, purchased intermediate inputs, and produced to maximize their profits, and the government taxed, spent, and made transfers to follow specified policy rules. In equilibrium, the markets for goods and services cleared, and we specified a rule for how unemployment in labor markets — we had two labor markets, one for skilled workers and the other for unskilled workers — changed in response to economic conditions. Using our data set, we were able to specify the behavior of our agents so that they replicated the actions of their counterparts in Spain in 1985.

One of the two most useful features of applied general equilibrium analysis is that we can use the model to conduct policy experiments. The principle policy experiment that we conducted was to change Spanish indirect taxes to a value added tax as required by Spain's accession treaty to the European Community.[5] We also changed Spain's trade barriers with the Community-member countries, but these changes were small compared to the tax changes. The other useful feature of applied general equilibrium analysis is that, after policy changes have been enacted in the economy, we can compare our predictions with what actually occurred. I do this in the first table, which compares the changes in the prices of the major components of the consumer price index in Spain that occurred in 1986 after the value added tax reform with the changes in prices that we predicted.

4   Timothy J. Kehoe, Antonio Manresa, Clemente Polo, and Ferran Sancho, "Una Matriz de Contabilidad Social de la Economía Española," *Estadística Española*, 30 (1988), 5–33.

5   Timothy J. Kehoe, Antonio Manresa, Pedro Javier Noyola, Clemente Polo, and Ferran Sancho, "A General Equilibrium Analysis of the 1986 Tax Reform in Spain," *European Economic Review*, 32 (1988), 334–42; Timothy J. Kehoe, Antonio Manresa, Clemente Polo, and Ferran Sancho, "Un Análisis de Equilibrio General de la Reforma Fiscal de 1986 en España," *Investigaciones Económicas*, 13 (1989), 337–85.

Changes in consumer prices in the Spanish model (percent)

sector	data 1985-1986	model policy only	model shocks only	model policy & shocks
food and nonalcoholic beverages	1.8	−2.3	4.0	1.7
tobacco and alcoholic beverages	3.9	2.5	3.1	5.8
clothing	2.1	5.6	0.9	6.6
housing	−3.3	−2.2	−2.7	−4.8
household articles	0.1	2.2	0.7	2.9
medical services	−0.7	−4.8	0.6	−4.2
transportation	−4.0	2.6	−8.8	−6.2
recreation	−1.4	−1.3	1.5	0.1
other services	2.9	1.1	1.7	2.8
weighted correlation with data		**−0.08**	**0.87**	**0.94**
regression coefficient a		**0.00**	**0.00**	**0.00**
regression coefficient b		**−0.08**	**0.54**	**0.67**

The first column labeled model presents our raw prediction. The numbers at the bottom report two measures of the accuracy of the prediction. The first measure is the simple correlation coefficient between the prediction and the data weighted the importance of the different components. A value close to one indicates that the prediction was accurate. The second measure are the coefficients of a regression of the data on what occurred on the predicted values of the variables:

$$z_i^{data} = a + b z_i^{model} + e_i$$

Here the coefficient a, which is the regression constant, indicates how well the model did in matching average change; a value of a close to zero indicates that the prediction was accurate. The coefficient b,

which is the coefficient on the prediction, indicates how well the model did in matching the signs and magnitudes of the changes; a value of b close to one indicates that the prediction was accurate. Notice that our raw predictions of changes in relative prices were not very accurate. In 1990, when Clemente, Ferran, and I were comparing our predictions with the 1986 data, we realized that much of the discrepancy could be accounted for by major shocks that hit the Spanish economy in 1986.[6] In particular, oil prices fell by half and there was a major drought that sharply reduced productivity in the agricultural sector. It was easy to incorporate these shocks into our model, and, when we did, we found that the model was capable of capturing the changes that had occurred in relative prices in Spain in 1986, although we were no longer justified calling the model output a prediction because it relied on knowledge of the other two major shocks that occurred in 1986.

Public finances in the Spanish model (percent GDP)

variable	data 1985-1986	model policy only	model shocks only	model policy & shocks
indirect taxes and subsidies	2.38	3.32	−0.38	2.98
tariffs	−0.58	−0.82	−0.04	−0.83
social security payments	0.04	−0.19	−0.03	−0.22
direct taxes and transfers	−0.84	−0.66	0.93	0.26
government capital income	−0.13	−0.06	0.02	−0.04
correlation with data		**0.99**	**−0.70**	**0.92**
regression coefficient a		**−0.06**	**0.35**	**−0.17**
regression coefficient b		**0.74**	**−1.82**	**0.80**

6   Timothy J. Kehoe, Clemente Polo, and Ferran Sancho, "An Evaluation of the Performance of an Applied General Equilibrium Model of the Spanish Economy," *Economic Theory*, 6 (1995), 115–41.

It was in analyzing the predictions on relative prices that Clemente, Ferran, and I realized the importance of taking into account other shocks that had occurred in 1986. We found that, for many other variables, however, the raw predictions, which did not take these shocks into account, were much more accurate and incorporating the oil price shock and the agricultural productivity shock did little to improve the model's predictions. This was especially true of the most important prediction of the model, that the 1986 value added tax reform was, in fact, a major tax increase. The officials in the Ministerio de Economía who were supporting our research were not happy with this prediction since they were on record as claiming that the tax reform would make collection more efficient but would be revenue neutral. In fact, they utilized a clause in their contract with us to prohibit us from publishing our results in Castilian at least before or immediately after the tax reform. We circumvented this prohibition by publishing a paper in Catalan in the *Revista Econòmica de Catalunya* in 1986.[7] The second table compares our predictions on the changes in different components of government revenue with what actually occurred in 1986. We predicted that revenues from indirect taxes, which included the value added tax, would double from being about three percent of GDP to being about six percent of GDP. Our predicted increase was only slightly larger than what actually occurred. In subsequent research, Clemente and Ferran identified much of the difference between our predicted increase in tax revenues and actual increases as being tax evasion.

Applying general equilibrium models to North American economic liberalization

As I mentioned, my friend Jaime Serra-Puche had to give up working on the Spanish project when he joined the Mexican Government as

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[7] Timothy J. Kehoe, Antonio Manresa, Pedro Javier Noyola, Clemente Polo, Ferran Sancho, and Jaime Serra-Puche, "Política Econòmica i Equilibri General. Quins són els Efectes de l'IVA?" *Revista Econòmica de Catalunya*, 2 (1986), 76–81.

Subsecretario de Ingresos in the Secretaria de Hacienda y Crédito Público in 1986. In 1988, he was appointed Secretario de Comercio y Fomento Industrial. In 1990, Jaime asked me to serve as his Special Economic Advisor when he was negotiating the North American Free Trade Agreement with Canada and the United States. Given our success with applied general equilibrium models in analyzing tax reforms in Mexico and Spain, we decided to rely heavily on these sorts of models to evaluate alternative policy changes. We also tried to incorporate the impact of the liberation of trade and foreign investment on economic growth. In doing this, we were influenced the endogenous growth theories that were popular at the time. Our team used these models to forecast that NAFTA would result in a substantial increase in economic growth in Mexico.[8] NAFTA resulted in a substantial increase in North American trade, in fact, more than our models had predicted, but the increases in trade by sector were uncorrelated with our forecasts, and the economic growth rate of Mexico did not increase significantly. Much of my research over the past twenty years has been dedicated to understanding where and how we went wrong.

Using the new products margin to predict expansion of trade at the industry level

The models that we used to evaluate the potential impact of NAFTA typically had a large number of industrial sectors, something like twenty to forty. In this sort of model, countries traded goods and services because they had comparative advantages in different industries

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8   Timothy J. Kehoe, "Modeling the Dynamic Impact of North American Free Trade," in *Economy-Wide Modeling of the Economic Implications of an FTA with Mexico and a NAFTA with Canada and the United States*, United States International Trade Commission Publication 2508, 1992, 249–76; Timothy J. Kehoe, "Towards a Dynamic General Equilibrium Model of North American Trade," in Joseph Francois and Clinton R. Shiells, editors, *Modeling Trade Policy: Applied General Equilibrium Assessments of North American Free Trade*, Cambridge University Press, 1994, 328–47.

driven by differences in production technologies or by differences in endowments of such factors of production as skilled labor, unskilled labor, and physical capital. To generate the volumes of trade observed in the data, modelers also assumed that the outputs of the same industries in different countries were close, but imperfect, substitutes. This assumption, named for the economist at the IMF who first employed it in the 1960s, Paul Armington, was useful in allowing modelers to match any trade pattern they observed in the data, especially the large volume of cross hauling, where, for example, not only does the United States export large quantities of automobiles to Mexico but Mexico also exports large quantities of automobiles to the United States. This hybrid mixture of classic comparative advantage and country specific differentiation of outputs also embodied a general approach to modeling what drives trade and changes in trade patterns: A country's comparative advantage is revealed by trade patterns before trade liberalization. That is, if a country is exporting the output of a given industry before trade is liberalized, it will export even more after trade is liberalized, and the largest increases in trade volumes will occur in those industries where trade barriers like tariffs are reduced the most. The models that Jaime Serra-Puche and I had used in the 1980s to analyze policy reforms in Mexico and Spain, had perfect competition in all sectors. The models that we used in the early 1990s to analyze NAFTA had increasing returns and imperfect competition in some sectors, but the implementation of these models and the general approach to modeling the drivers of trade and changes in trade patterns remained the same.

Unfortunately, when I repeated the same sort of ex post performance evaluation exercise that we had done on the Spanish model for the models that we used to analyze the impact of NAFTA, the results were discouraging.[9] I compared the predictions of three of

9   Timothy J. Kehoe, "An Evaluation of the Performance of Applied General Equilibrium Models of the Impact of NAFTA," in Timothy J. Kehoe, T. N. Srinivasan, and John Whalley, editors, *Frontiers in Applied General Equilibrium Modeling: Essays in Honor of Herbert Scarf*, Cambridge University Press, 2005, 341–77.

the most prominent models of the NAFTA with the changes in trade patterns that actually occurred, and I could find no consistently positive correlation between the predictions and subsequent changes. The next table presents results typical of those that I found. It compares the predictions of the model developed by Drusila Brown, Alan Deardorff, and Robert Stern with the changes in trade patterns between Canada and the United States that occurred following the implementation of the U.S.-Canada FTA in 1989 and NAFTA in 1994. Notice that the correlation coefficient between predictions and outcomes is positive for U.S. exports to Canada but negative for Canadian exports to the United States. Furthermore, Alan Fox, in his 2000 Ph.D. thesis at the University of Michigan could not find any exogenous shocks that he could introduce into the model to improve the comparison.

One reaction to the poor performance of models of NAFTA in predicting the sectoral impact of trade reform would be to give up on industry as a unit of analysis. Indeed, much of the research in international trade over the past fifteen years has focused on the characteristics of firms that exports but ignores the industries in which they operate and the products that they produce. I think that this is an unfortunate trend because policy makers think of trade policy at the industry level. Furthermore, we can trace the impact of changes in trade pattern through the economy using input-output linkages if we can identify the industries in which these changes take place.

Although my first reaction to the failure of applied general equilibrium models to predict the sectoral impact of NAFTA was to be discouraged about international trade modeling, I later perked up. Comparing the evaluation of the NAFTA models with that of the Spanish model, I came to interpret these results as indicating that we economists understand international trade far less than we understand public finance. In spite of my 1990–1994 stint as Special Economic Advisor to the Secretary in Mexico, I am basically a professor, that is, a researcher, a teacher, and, especially, a supervisor of graduate student research. Our profes-

Changes in Canada-U.S. trade relative to exporter's GDP (percent)				
	Canada to U.S.		U.S. to Canada	
industry	1989–2009 data	BDS model	1989–2009 data	BDS model
agriculture	12.5	3.4	−6.4	5.1
mining and quarrying	237.6	0.4	51.3	1.0
food	101.2	8.9	124.1	12.7
textiles	42.4	15.3	−35.9	44.0
clothing	50.2	45.3	−3.0	56.7
leather products	−67.7	11.3	−64.0	7.9
footwear	−49.9	28.3	−67.2	45.7
wood products	−54.5	0.1	−30.6	6.7
furniture and fixtures	−46.6	12.5	22.5	35.6
paper products	−65.9	−1.8	13.7	18.9
printing and publishing	0.7	−1.6	−19.6	3.9
rubber products	45.8	9.5	30.2	19.1
chemicals	99.6	−3.1	50.2	21.8
petroleum products	−79.8	0.5	−43.1	0.8
glass products	−45.7	30.4	−20.0	4.4
nonmetal mineral products	−0.4	1.2	−1.9	11.9
iron and steel	−12.7	12.9	53.5	11.6
nonferrous metals	−20.9	18.5	−20.8	−6.7
metal products	17.7	15.2	−5.3	18.2
nonelectrical machinery	−8.4	3.3	−38.9	9.9
electrical machinery	−16.4	14.5	−42.6	14.9
transportation equipment	−44.3	10.7	−37.8	−4.6
misc. manufactures	56.1	−2.1	−19.2	11.5
weighted correlation with data		**−0.28**		**0.39**
regression coefficient a		**21.82**		**−26.62**
regression coefficient b		**−3.33**		**1.34**

sion's lack of understanding of international trade presents a tremendous opportunity for me and my students.

Composition of Exports: United States to Mexico
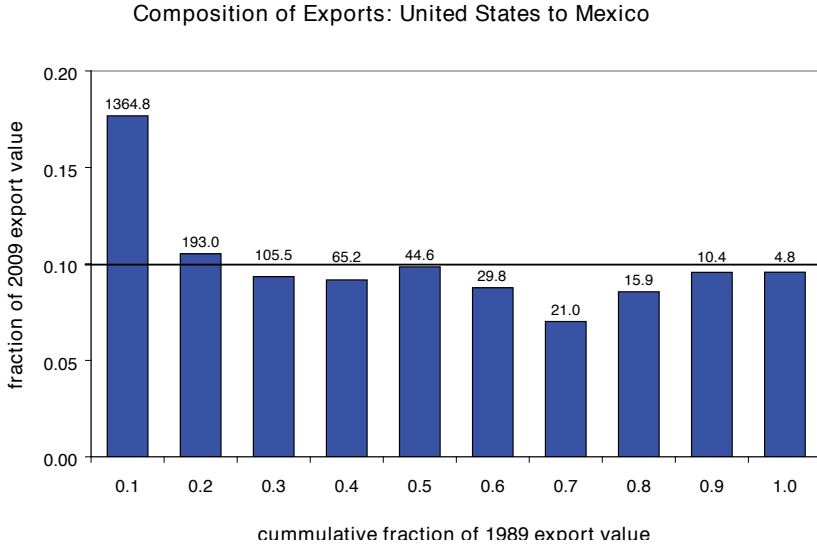
Kim Ruhl, originally a student of mine at Minnesota, and I have found that a large share of the increase in trade following trade liberalizations like NAFTA is the result of countries exporting products that they had exported little or not at all previously. Let me be precise about my vocabulary: When I say industry, I mean something like the 23 industries in the BDS model or the 37 3-digit ISIC (International Standard Industrial Classification), revision 3, industries. When I say product, I mean something like the 1,836 5-digit SITC (Standard International Trade), revision 2, products. Notice that, on average, every BDS industry is made up of almost ninety products. Kim and I listed the 1,836 products that one country potentially exported in order of how large the exports were before liberalization. We then sorted these products into ten bins, each of which accounted for 10 percent for trade in the base year of our analysis, before liberalization. Notice that, in the figure for U.S. exports to Mexico, the 4.8 products that were exported the most accounted for 10 percent of exports in 1989 as did the 1,364.8

products that were the least traded. After trade liberalization, trade increased in all of the bins — something we do not see in the figure — but the largest increase occurred for the least traded products. Furthermore, this pattern is typical for country pairs where there is significant trade liberalization or where one of the countries is going through significant structural change, but not otherwise.[10]

Comparisons of forecasts, NAFTA (correlations with data)

exporter	importer	BDS model	LTP model
CAN	MEX	–0.10	0.55
CAN	USA	–0.28	0.30
MEX	CAN	0.06	0.33
MEX	USA	–0.13	0.17
USA	CAN	0.39	0.54
USA	MEX	–0.06	0.47
weighted average		**–0.00**	**0.39**
pooled regression		**0.06**	**0.24**

Working with Jack Rossbach, a recent Minnesota student, Kim and I have been able to use our observation that much of the increase in trade comes from exports of least traded products into a simple forecasting model.[11] Letting z_j be in the increase in the exports of industry j as a fraction of GDP, we predict that

$$z_j = a + b s_j \, ,$$

where s_j is the fraction of exports accounted for by least traded products in the base year, 1989. We assume that b is positive. In other

10 Timothy J. Kehoe and Kim J. Ruhl, "How Important Is the New Goods Margin in International Trade?" *Journal of Political Economy*, 121 (2013), 358–92.

11 Timothy J. Kehoe, Jack M. Rossbach, and Kim J. Ruhl, "Using the New Products Margin to Predict the Industry-Level Impact of Trade Reform," *Journal of International Economics*, 96 (2015), 289–97.

words, we simply predict that industries with many least traded products will have the largest increases in exports. We evaluate our model by "predicting" the industry-level effects of NAFTA using only data that would have been available in 1989 — before the implementation of NAFTA. We compare our predictions with the actual growth in trade that occurred from 1989 to 2009 and find that the model does well: The table shows that the weighted correlation between our predictions and the data averages 0.39 across all six NAFTA country pairs. This result is even more striking when we compare our forecasts with those from general equilibrium models actually used to forecast the effects of NAFTA, whose weighted correlation with the data averages 0.00.

I interpret the results of the exercise that Kim Ruhl, Jack Rossbach, and I have performed as giving us hope that we can develop models to provide more accurate analysis and predictions the impact of trade liberalization at the industry level. Notice that our results indicate that the previous approach, which "locked in" the pattern of comparative advantage, was wrong. In particular, the pattern of trade before liberalization does not reveal where the largest increases in trade will occur. Developing new models will be challenging, but exciting. We are working on them now.

The perils of financial liberalization

One of the most important features of Spain's integration into the European Community was that it opened the economy to foreign investment. Gonzalo Fernández de Cordoba and I developed a dynamic general equilibrium model to analyze the impact of the increased capital flows that occurred.[12] We found that these capital flows had a large impact

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12   Gonzalo Fernandez de Cordoba and Timothy J. Kehoe, "Capital Flows and Real Exchange Rate Fluctuations Following Spain's Entry into the European Community," *Journal of International Economics*, 51 (2000), 49–78.

on the Spanish economy, causing an increase in the relative price of nontraded goods and causing a reallocation of resources from the production of traded goods to producing nontraded goods, that is, services and construction. In fact, the impact of this increased foreign investment in Spain was larger than the impact of the changes in tax and trade policy that our original, static model of was meant to capture. A notable feature of the capital inflows was how volatile they were. When the costs of German reunification lead the German government to raise interest rates in 1992, foreign investment in Spain dried up quickly leading to a recession.

Kim Ruhl and I, using a dynamic model similar to Gonzalo's and mine, found that volatile capital flows had an even larger impact on the Mexican economy when it opened.[13] These capital flows came to a two-year stop in 1995 and 1996 following the Mexican financial crisis of December 1994 and January 1995. In the beginning of December 1994, my friend from Yale, Ernesto Zedillo took office as President of Mexico and he asked Jaime Serra-Puche to be his Secretario de Hacienda. Once again, Jaime asked me to be his Special Economic Advisor, but within three weeks the market for government bonds in Mexico started to collapse and within four weeks Jaime had to resign.

What had happened was that starting earlier in the year, the previous Secretario de Hacienda had started to covert Mexican government debt into very short-term, dollar-indexed, bonds, known as tesobonos. Although the overall level of Mexican government debt was low by international standards, its short maturity meant that the government had to roll this debt over frequently. Back in Minneapolis, I was depressed about what was going on in Mexico, but I was well informed, and I gave a couple of presentations to the local economics community. My friend, Hal Cole, then a researcher at the Federal Reserve

13 Timothy J. Kehoe and Kim J. Ruhl, "Sudden Stops, Sectoral Reallocations, and the Real Exchange Rate," *Journal of Development Economics*, 89 (2009), 235–49.

Bank of Minneapolis, convinced me to work with him developing a dynamic, stochastic general equilibrium model in which the need to frequently sell large quantities of bonds leaves a government vulnerable to a self-fulfilling financial crisis.[14] In this sort of crisis, if investors panic and only buy bonds at a very low price — which means that the interest rate on these bonds is very high — the government is pushed towards default. If, however, the investors do not panic and buy the bonds for a higher price, there is not crisis.

I became identified as an expert on sovereign debt crises, which was identified as specialty associated mostly with Latin America. In 2011, I spent most of the year here on sabbatical at the Autònoma, and, as sovereign debt crises rolled through Greece, Ireland, and Portugal, towards Spain and Italy, Juan Carlos Conesa suggested that we extend the Cole-Kehoe sovereign debt model to analyze the European debt crises.[15] We found that Spain, like Mexico, had a low level of debt by international standards. In the case of Spain, it was the high level of the deficit that made it necessary for the government to sell large quantities of bonds. Furthermore, the severe recession in Spain made it difficult for the government to cut spending and raise taxes to eliminate this deficit.

The stages of economic growth

When Mexico opened to foreign trade and investment in the late 1980s and early 1990s, it was the first large less developed country to do so, followed soon after by China. In spite of my optimistic predictions about increased growth in Mexico, Mexican growth perfor-

14 Harold L. Cole and Timothy J. Kehoe, "A Self-Fulfilling Model of Mexico's 1994–95 Debt Crisis," *Journal of International Economics*, 41 (1996), 309–30; Harold L. Cole and Timothy J. Kehoe, "Self-Fulfilling Debt Crises," *Review of Economic Studies*, 67 (2000), 91–116.

15 Juan Carlos Conesa and Timothy J. Kehoe, "Gambling for Redemption and Self-Fulfilling Debt Crises," Federal Reserve Bank of Minneapolis Staff Report 465, 2012.

mance has been disappointing, while Chinese growth performance has been spectacular. Kim Ruhl and I argue that Mexico has had poor growth performance since the 1980s because of problems in its financial system, immobility in labor markets, and lack of rule of law.[16] We point out that these sorts of barriers to growth are also present in China, and are perhaps even worse there. We propose a theory in which the barriers that slowed growth in Mexico have not yet slowed China because China has not reached the stage of growth where these barriers are binding. Instead, China is still benefiting from the massive movement of the population from rural areas to urban areas, accompanied by expansion of basic education and the movement of workers from agriculture to manufacturing. These are exactly the forces that made Mexico one of the fastest growing countries in the world during the period 1950–1980. As the figure shows, China is still has a larger agricultural sector than does Mexico, and it is still behind Mexico on a large number of development indices. When we published our paper in 2010, Kim and I hypothesized that, as China continued to develop, the problems in its financial system, immobility in labor markets, and lack of rule of law would start to bind and Chinese growth would slow sharply, perhaps before China reached the level of development of Mexico. It seems that this may be happening now.

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16   Timothy J. Kehoe and Kim J. Ruhl, "Why Have Economic Reforms in Mexico Not Generated Growth?" *Journal of Economic Literature*, 48 (2010), 1005–27.

Share of agriculture in GDP
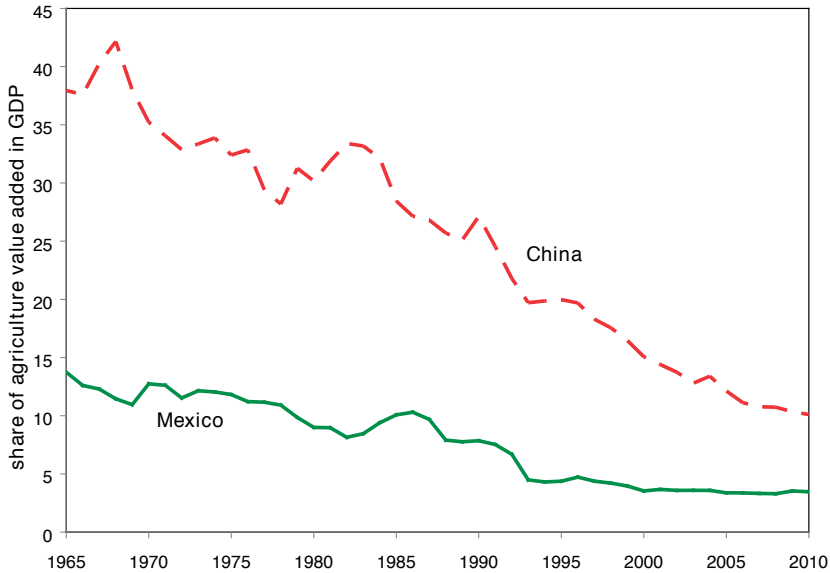
Working with a number of current and former students, I recently have been working on expanding our comparison of Mexico and China into a theory of stages of economic growth inspired by Walt Rostow's seminal 1960 work.[17] Felipe Meza and I, in our modern economic history of Mexico, hypothesize that Mexico would be currently doing much better, if it had opened to foreign trade and investment earlier. Jose, Asturias, Sewon Hur, Kim Ruhl, and I develop a dynamic model in which growth in driven by entry and exit of heterogeneous firms.[18] We argue that, if a country is going to open to foreign trade, it is better that it do so early in its development process

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17 Daniela Costa, Timothy J. Kehoe, and Gajendran Raveendranathan. "The Stages of Economic Growth Revisited, I: A General Framework and Take Off," *Federal Reserve Bank of Minneapolis Economic Policy Paper*, forthcoming; Daniela Costa, Timothy J. Kehoe, and Gajendran Raveendranathan, "The Stages of Economic Growth Revisited, II: Catching Up to and Joining the Economic Leader," *Federal Reserve Bank of Minneapolis Economic Policy Paper*, forthcoming.

18 Jose Asturias, Sewon Hur, Timothy J. Kehoe, and Kim J. Ruhl, "The Interaction and Sequencing of Policy Reforms," *Journal of Economic Dynamics and Control*, forthcoming.

so that it has builds up a distribution of firms suited to international competition. There is obviously more work to be done developing a theory of stages of growth, but I am excited about the potential of our approach.

CURRICULUM VITAE
DE
TIMOTHY J. KEHOE

Biographical sketch — Timothy J. Kehoe

Education

Ph.D. Economics, Yale University, with distinction, 1979 (H. E. Scarf, supervisor; A. Mas-Colell, co-supervisor; D. J. Brown).
M.A. Economics, Yale University, 1977.
B.A. Mathematics/Economics, Providence College, *summa cum laude*, 1975.

Professional experience

Professor of Economics, University of Minnesota, 1987–present.
President, Society for Economic Dynamics, 2015–2018.
Advisor, Federal Reserve Bank of Minneapolis, 1987–present.
Nonresident Fellow, Mexico Center, Baker Institute for Public Policy, Rice University, 2014–present.
Research Associate, National Bureau of Economic Research, 2006–present.
Scientific Council, Barcelona Graduate School of Economics, 2007–present; Advisory Board, Society for the Advancement of Economic Theory, 2010–present; Scientific Advisory Board, MOVE, Universitat Autònoma de Barcelona, 2010–present.
Visiting Professor: Universitat Autònoma de Barcelona, 1987, 1990–1996, 2007–2016; Instituto Autónomo Tecnológico de México, 2004–2009, 2013–2016; Barcelona Graduate School of Economics, 2009–2016;

Banco de Portugal, 2016; CEMFI, 2011; MOVE, Universitat Autònoma de Barcelona, 2011; McMaster University, 2009; Universidad Carlos III de Madrid, 2009; University of Pennsylvania, 2009; Indiana University, 2008; Norwegian School of Economics, 2007; Universitat de Barcelona, 1996–1998, 2000, 2006; University of Texas at Austin, 2006; Universitat Pompeu Fabra, 1998–1999, 2002–2005; Stockholm School of Economics, 2002, 2004; University of Maryland, 2003; University of California, Los Angeles, 1999; Victoria University of Wellington, 1995; Universidad de Alicante, 1993; El Colegio de México, 1992.

Director of Graduate Studies, Department of Economics, University of Minnesota, 2006–2009, 2012–2015.

Evaluation Panels: Agència de Gestió d'Ajuts Universitaris i de Recerca de la Generalitat de Catalunya, 2007–present; Programas Ramón y Cajal y Juan de la Cierva, Spain, 2010; Fundação para a Ciência e Tecnologia, Portugal, 2008–2009.

Patronato (Governing Board), Instituto Madrileño de Estudios Avanzados (IMDEA) en Ciencias Sociales, 2006–2012.

Visiting Scholar, IMF Institute, International Monetary Fund, 2003, 2006.

Consultant: Government of Panama, 1997; World Bank, 1982–1984; Banco de México, 1980–1982.

Special Economic Advisor to the Secretary, Secretaría de Comercio y Fomento Industrial, México, 1990–1994.

University Lecturer, Faculty of Economics and Politics and Fellow, Clare College, University of Cambridge, 1984–1987.

Assistant Professor, then Associate Professor of Economics, Massachusetts Institute of Technology, 1980–1984.

Lecturer, then Assistant Professor of Economics, Wesleyan University, 1978–1980.

Selected fellowships, honors, grants

Distinguished McKnight University Professor, University of Minnesota, 1996–present.

Fellowship, John Simon Guggenheim Memorial Foundation, 2015–2016.

Doctor *honoris causa*, Universidade de Vigo, 2008.

Fellow, Econometric Society, 1991–present; Miembro de Honor, Asociación Española de Economía, 2010–present; Economic Theory Fellow, Society

for the Advancement of Economic Theory, 2011–present; Fellow, Society for Economic Measurement, 2014–present.

Dean's Medal, 2013, Scholar of the College, 2005–2008, College of Liberal Arts, University of Minnesota.

National Institute on Aging Grant, 2014–2019 (with D. E. Bloom, D. J. Canning, and J. C. Conesa), National Science Foundation Grants, 1982–1984, 1985–1987 and 1987–1989 (with D. K. Levine), 1990–1992, 1992–1995, 1997–2000, 2001–2004, 2005–2009 and 2010–2015 (with K. J. Ruhl); Proyectos de Investigación de Excelencia, Consejería de Innovación, Ciencia y Empresa, Junta de Andalucía, 2008–2011; US Air Force Office of Scientific Research Grant, 1995–1996; Sloan Foundation Grant, 1983–1984.

Fellowship, Mathematical Sciences Research Institute, 1985; University Fellowship, Yale University, 1975–1979; Presidential Scholarship, Providence College, 1971–1975.

Editor, co-editor

Editor, *Review of Economic Dynamics* (1999–2007); series editor, *Studies in Economic Theory*, Springer (2010–present); co-editor, *Economic Theory* (2007–present); co-editor, *Economic Theory Bulletin* (2013–present), co-editor, *Journal of International Economics* (2008–2013).

Editorial boards

Cuadernos Económicos del ICE (1991–present), *Economic Theory* (1991–1997), *Ensayos Revista de Economía* (2009–present), *Estudios Económicos* (1991–present), *International Journal of Economics* (2005–present), *Journal of Economic Integration* (2002–present), *Journal of Economic Studies* (2007–present), *Journal of International Economics* (2008–present), *Journal of Mathematical Economics* (1985–2013), *Latin American Economic Review* (2013–present), *Macroeconomic Dynamics* (1996–present), *New Zealand Economic Papers* (2009–present), *Review of Economic Dynamics* (1999–2013), *Pacific Economic Review* (2012–present), *Revista de Análisis Económico* (2000–2008), *Spanish Economic Review* (1999–2002).

Selected Publications

"The Interaction and Sequencing of Policy Reforms", *Journal of Economic Dynamics and Control*, forthcoming, with José Asturias, Sewon Hur, and Kim J. Ruhl.

"Using the New Products Margin to Predict the Industry-Level Impact of Trade Reform", *Journal of International Economics*, 96 (2015), 289–297, with J. Rossbach and K. J. Ruhl.

"Is It Too Late to Bail Out the Troubled Countries in the Eurozone?", *American Economic Review*, Papers and Proceedings, 104 (2014), 88–93, with J. C. Conesa.

"How Important Is the New Goods Margin in International Trade?", *Journal of Political Economy*, 121 (2013), 358–92, with K. J. Ruhl.

"Catch-up Growth Followed by Stagnation: Mexico, 1950–2010", *Latin American Journal of Economics*, 48 (2011), 227–68, with F. Meza.

"Why Have Economic Reforms in Mexico Not Generated Growth?", *Journal of Economic Literature*, 48 (2010), 1005–27, with K. J. Ruhl.

"Trade, Growth, and Convergence in a Dynamic Heckscher-Ohlin Model", *Review of Economic Dynamics*, 13 (2010), 487–513, with C. Bajona.

"The Current Financial Crisis: What Should We Learn from the Great Depressions of the Twentieth Century?" (Federal Reserve Bank of Minneapolis Annual Report Essay), *The Region*, 23 (2009), 7–39, with G. Fernández de Córdoba.

"Sudden Stops, Sectoral Reallocations, and the Real Exchange Rate", *Journal of Development Economics*, 89 (2009), 235–49, with K. J. Ruhl.

"Are Shocks to the Terms of Trade Shocks to Productivity?", *Review of Economic Dynamics*, 11 (2008), 804–19, with K. J. Ruhl.

Great Depressions of the Twentieth Century, Federal Reserve Bank of Minneapolis, 2007, edited with E. C. Prescott.

"U.S. Real Exchange Rate Fluctuations and Relative Price Fluctuations", *Journal of Monetary Economics*, 53 (2006), 1297–326, with C. M. Betts.

"An Evaluation of the Performance of Applied General Equilibrium Models of the Impact of NAFTA", in T. J. Kehoe, T. N. Srinivasan, and J. Whalley, editors, *Frontiers in Applied General Equilibrium Modeling*, Cambridge, 2005, 341–77.

"A Decade Lost and Found: Mexico and Chile in the 1980s", *Review of Economic Dynamics*, 5 (2002), 166–205, with R. Bergoeing, P. J. Kehoe, and R. Soto.

"Lotteries, Sunspots, and Incentive Constraints", *Journal of Economic Theory*, 107 (2002), 39–69, with D. K. Levine and E. C. Prescott.

"Liquidity Constrained Markets versus Debt Constrained Markets", *Econometrica*, 69 (2001), 575–98, with D. K. Levine.

"Capital Flows and Real Exchange Rate Fluctuations Following Spain's Entry into the European Community", *Journal of International Economics*, 51 (2000), 49–78, with G. Fernández de Córdoba.

"Self-Fulfilling Debt Crises", *Review of Economic Studies*, 67 (2000), 91–116, with H. L. Cole.

"A Self-Fulfilling Model of Mexico's 1994–95 Debt Crisis", *Journal of International Economics*, 41 (1996), 309–30, with H. L. Cole.

"An Evaluation of the Performance of an Applied General Equilibrium Model of the Spanish Economy", *Economic Theory*, 6 (1995), 115–41, with C. Polo and F. Sancho.

Modeling North American Economic Integration, Kluwer Academic Publishers, 1995, edited with P. J. Kehoe.

"Distinguished Fellow: Herbert Scarf's Contributions to Economics", *Journal of Economic Perspectives*, 8 (1994), 161–81, with K. J. Arrow.

"Debt Constrained Asset Markets", *Review of Economic Studies*, 60 (1993), 865–88, with D. K. Levine.

"More on Money as a Medium of Exchange", *Economic Theory*, 3 (1993), 297–314, with N. Kiyotaki and R. D. Wright.

"Computation and Multiplicity of Equilibria", in W. Hildenbrand and H. Sonnenschein, editors, *Handbook of Mathematical Economics*, vol. IV, North Holland, 1991, 2049–143.

"L'estat actual de la ciència econòmica i les seves perspectives per aquesta dècada", *Revista Econòmica de Catalunya*, 17 (1991), 64–69.

"In Search of Scale Effects in Trade and Growth", *Journal of Economic Theory*, 58 (1992), 377–409, with D. K. Backus and P. J. Kehoe.

"Gross Substitutability in Large-Square Economies", *Journal of Economic Theory*, 54 (1991), 1–25, with D. K. Levine, A. Mas-Colell, and M. Woodford.

"Determinacy of Equilibria in Dynamic Models with Finitely Many Consumers", *Journal of Economic Theory*, 50 (1990), 1–21, with D. K. Levine and P. M. Romer.

"Determinacy of Equilibria in Large-Square Economies", *Journal of Mathematical Economics*, 18 (1989), 231–62, with D. K. Levine, A. Mas-Colell, and W. R. Zame.

"A General Equilibrium Analysis of the 1986 Tax Reform in Spain", *European Economic Review*, Papers and Proceedings, 32 (1988), 334–42, with A. Manresa, P. J. Noyola, C. Polo, and F. Sancho.

"Una matriz de contabilidad social de la economía española", *Estadística Española*, 30 (1988), 5–33, with A. Manresa, C. Polo, and F. Sancho.

"Política econòmica i equilibri general. Quins són els efectes de l'IVA?", *Revista Econòmica de Catalunya*, 2 (1986), 76–81, with A. Manresa, P. J. Noyola, C. Polo, F. Sancho, and J. Serra-Puche.

"Comparative Statics and Perfect Foresight in Infinite Horizon Economies", *Econometrica*, 53 (1985), 433–53, with D. K. Levine.

"Multiplicity of Equilibria and Comparative Statics", *Quarterly Journal of Economics*, 100 (1985), 119–47.

"Regularity and Index Theory for Economies with Smooth Production Technologies", *Econometrica*, 51 (1983), 895–917.

"A Computational General Equilibrium Model with Endogenous Unemployment: An Analysis of the 1980 Fiscal Reform in Mexico", *Journal of Public Economics*, 22 (1983), 1–26, with J. Serra-Puche.

"Regular Production Economies", *Journal of Mathematical Economics*, 10 (1982), 147–76.

"An Index Theorem for General Equilibrium Models with Production", *Econometrica*, 48 (1980), 1211–32.

Acord 29/2015, de 19 de març, del Consell de Govern

Vist l'acord de la Junta de la Facultat d'Economia i Empresa de data 29 de gener de 2015 pel qual se sol·licita al Consell de Govern el nomenament del doctor Timothy Jerome Kehoe, com a doctor honoris causa de la UAB.

Atès que la Normativa que regula el procediment per a l'atorgament del títol de doctor Honoris Causa aprovada pel Consell de Govern en data 26 de maig de 2004 en el seu article 5.2 estableix que el Consell de Govern podrà atorgar un nomenament cada dos anys a la Facultat de Ciències, la Facultat de Filosofia i Lletres i a la Facultat de Medicina, i un nomenament cada quatre anys a cadascun dels centres restants.

Atès que el Consell de Govern va atorgar un doctor honoris causa de la UAB a l'antiga Facultat de Ciències Econòmiques i Empresarials, transformada en l'actual Facultat d'Economia i Empresa per la fusió amb l'Escola Universitària de Ciències Empresarials, en data 19 de desembre de 2007 i, per tant, compleix els requisits temporals exigits a la normativa abans esmentada.

Vista la conformitat del Gabinet Jurídic.

Per tot això, a la vista de les consideracions anteriors, a proposta de la Facultat de d'Economia i Empresa, el Consell de Govern ha adoptat els següents

ACORDS

Primer.- Nomenar el doctor Timothy Jerome Kehoe, doctor honoris causa de la UAB.

Segon.- Encarregar a la secretària general i al vicerector de Relacions Institucionals i de Campus l'execució i el seguiment d'aquest acord.

Tercer.- Comunicar el present acord a la Facultat d'Economia i Empresa.