U.S. Engineering in a Global Economy
National Bureau of Economic Research

Officers
Karen N. Horn, chair
John Lipsky, vice-chair
James M. Poterba, president and chief executive officer
Robert Mednick, treasurer
Kelly Horak, controller and assistant corporate secretary
Alterra Milone, corporate secretary
Denis Healy, assistant corporate secretary

Directors at Large
Peter C. Aldrich
Elizabeth E. Bailey
John H. Biggs
John S. Clarkeson
Kathleen B. Cooper
Charles H. Dallara
George C. Eads
Jessica P. Einhorn
Mohamed El-Erian
Jacob A. Frenkel
Judith M. Gueron
Robert S. Hamada
Peter Blair Henry
Karen N. Horn
Lisa Jordan
John Lipsky
Laurence H. Meyer
Karen Mills
Michael H. Moskow
Alicia H. Munnell
Robert T. Parry
James M. Poterba
John S. Reed
Marina v. N. Whitman
Martin B. Zimmerman

Directors by University Appointment
Timothy Bresnahan, Stanford
Pierre-André Chiappori, Columbia
Alan V. Deardorff, Michigan
Ray C. Fair, Yale
Edward Foster, Minnesota
John P. Gould, Chicago
Mark Grinblatt, California, Los Angeles
Bruce Hansen, Wisconsin–Madison
Benjamin Hermalin, California, Berkeley
George Mailath, Pennsylvania
Marjorie B. McElroy, Duke
Joel Mokyr, Northwestern
Cecilia Rouse, Princeton
Richard L. Schmalensee, Massachusetts Institute of Technology
Ingo Walter, New York
David B. Yoffie, Harvard

Directors by Appointment of Other Organizations
Jean-Paul Chavas, Agricultural and Applied Economics Association
Martin J. Gruber, American Finance Association
Philip Hoffman, Economic History Association
Arthur Kennickell, American Statistical Association
Jack Kleinhenz, National Association for Business Economics
Robert Mednick, American Institute of Certified Public Accountants
Peter L. Rousseau, American Economic Association
Gregor W. Smith, Canadian Economics Association
William Spriggs, American Federation of Labor and Congress of Industrial Organizations
Bart van Ark, The Conference Board

Directors Emeriti
George Akerlof
Jagdish Bhagwati
Don R. Conlan
Franklin Fisher
George Hatsopoulos
Saul H. Hymans
Rudolph A. Oswald
Peter G. Peterson
Andrew Postlewaite
John J. Siegfried
Craig Swan
1. The object of the NBER is to ascertain and present to the economics profession, and to the public more generally, important economic facts and their interpretation in a scientific manner without policy recommendations. The Board of Directors is charged with the responsibility of ensuring that the work of the NBER is carried on in strict conformity with this object.

2. The President shall establish an internal review process to ensure that book manuscripts proposed for publication DO NOT contain policy recommendations. This shall apply both to the proceedings of conferences and to manuscripts by a single author or by one or more co-authors but shall not apply to authors of comments at NBER conferences who are not NBER affiliates.

3. No book manuscript reporting research shall be published by the NBER until the President has sent to each member of the Board a notice that a manuscript is recommended for publication and that in the President’s opinion it is suitable for publication in accordance with the above principles of the NBER. Such notification will include a table of contents and an abstract or summary of the manuscript’s content, a list of contributors if applicable, and a response form for use by Directors who desire a copy of the manuscript for review. Each manuscript shall contain a summary drawing attention to the nature and treatment of the problem studied and the main conclusions reached.

4. No volume shall be published until forty-five days have elapsed from the above notification of intention to publish it. During this period a copy shall be sent to any Director requesting it, and if any Director objects to publication on the grounds that the manuscript contains policy recommendations, the objection will be presented to the author(s) or editor(s). In case of dispute, all members of the Board shall be notified, and the President shall appoint an ad hoc committee of the Board to decide the matter; thirty days additional shall be granted for this purpose.

5. The President shall present annually to the Board a report describing the internal manuscript review process, any objections made by Directors before publication or by anyone after publication, any disputes about such matters, and how they were handled.

6. Publications of the NBER issued for informational purposes concerning the work of the Bureau, or issued to inform the public of the activities at the Bureau, including but not limited to the NBER Digest and Reporter, shall be consistent with the object stated in paragraph 1. They shall contain a specific disclaimer noting that they have not passed through the review procedures required in this resolution. The Executive Committee of the Board is charged with the review of all such publications from time to time.

7. NBER working papers and manuscripts distributed on the Bureau’s web site are not deemed to be publications for the purpose of this resolution, but they shall be consistent with the object stated in paragraph 1. Working papers shall contain a specific disclaimer noting that they have not passed through the review procedures required in this resolution. The NBER’s web site shall contain a similar disclaimer. The President shall establish an internal review process to ensure that the working papers and the web site do not contain policy recommendations, and shall report annually to the Board on this process and any concerns raised in connection with it.

8. Unless otherwise determined by the Board or exempted by the terms of paragraphs 6 and 7, a copy of this resolution shall be printed in each NBER publication as described in paragraph 2 above.
This volume is dedicated to Ralph Gomory for his encouragement of scientific analysis of the job market for scientists and engineers and his contribution to economic analysis of technology, international trade, and firm and industry competitiveness.
Contents

Acknowledgment xi

Introduction 1
Richard B. Freeman and Hal Salzman

1. The Engineering Labor Market:
   An Overview of Recent Trends 11
Daniel Kuehn and Hal Salzman

I. ENGINEERING EDUCATION

2. Career Plans of Undergraduate Engineering
   Students: Characteristics and Contexts 49
   Shannon K. Gilmartin, anthony lising antonio,
   Samantha R. Brunhaver, Helen L. Chen,
   and Sheri D. Sheppard

3. Engineering Educational Opportunity:
   Impacts of 1970s and 1980s Policies to
   Increase the Share of Black College
   Graduates with a Major in Engineering
   or Computer Science 87
   Catherine J. Weinberger

4. Bridging the Gaps between Engineering
   Education and Practice 129
   Samantha R. Brunhaver, Russell F. Korte,
   Stephen R. Barley, and Sheri D. Sheppard
II. Engineering and Innovation

5. The Effects of Scientists and Engineers on Productivity and Earnings at the Establishment Where They Work
   Erling Barth, James C. Davis, Richard B. Freeman, and Andrew J. Wang
   167

6. What Goes On under the Hood? How Engineers Innovate in the Automotive Supply Chain
   Susan Helper and Jennifer Kuan
   193

III. Engineers and Labor Markets

7. The Influence of Licensing Engineers on Their Labor Market
   Yoon Sun Hur, Morris M. Kleiner, and Yingchun Wang
   217

8. Dynamics of Engineering Labor Markets: Petroleum Engineering Demand and Responsive Supply
   Leonard Lynn, Hal Salzman, and Daniel Kuehn
   243

9. Bridge to Permanent Immigration or Temporary Labor? The H-1B Visa Program Is a Source of Both
   Ron Hira
   263

Contributors 285
Author Index 287
Subject Index 293
We gratefully acknowledge funding from the Alfred P. Sloan Foundation.