Statement of Richard Schmalensee, Ph.D.
To the Australian Energy Regulator

July 29, 2022

Introduction

I am Howard W. Johnson Professor of Management, Emeritus and Professor of Economics, Emeritus at the Massachusetts Institute of Technology (MIT). I served as Dean of the MIT Sloan School of Management from 1998 through 2007 and as a Member of the U.S. President's Council of Economic Advisers from 1989 through 1991.

My various books and articles have been cited more than 38,000 times in the academic literature.[1] I am a Fellow of the Econometric Society, a Member of the American Academy of Arts and Sciences, and the 2012 Distinguished Fellow of the Industrial Organization Society. I have served on the Executive Committee of the American Economic Association and serve on the Executive Committee of the Board of the National Bureau of Economic Research. A copy of my Curriculum Vitae is an appendix to this statement.

I have been asked by ENA to evaluate Dr. Martin Lally's (2021) characterization of Schmalensee (1989) and its implications. Specifically, I have been asked to answer two questions:

1. Do you agree with the characterization of Schmalensee (1989) that appears in Lally (2021)?
2. If an economic regulator seeks to reach "*an unbiased estimate of the expected efficient return, consistent with the relevant risks involved in providing regulated network services*" to be applied over a defined regulatory period, does Schmalensee (1989) have any implications for the way that return should be estimated?

[1] Google Scholar, visited 7/22/2022. Schmalensee (1989), which is the focus of this Statement, contributed 78 of those citations; to my knowledge none of them have been critical.

The short answer to both questions is "No!" I consider these questions in order in more detail after providing an overview of Schmalensee (1989) and the related literature.

Overview of Schmalensee (1989)

Schmalensee (1989) was concerned with the effects of depreciation methods on accounting rates of return of regulated firms, taking as given regulators' determination of the allowed cost of capital. It was inspired by work, notably Fisher-McGowan (1983), showing that for two unregulated firms with the same fundamental economic rate of return, different depreciation methods could induce dramatically different accounting rates of return. Only in the very special case of so-called economic depreciation, first discovered by Hotelling (1925), will economic and accounting rates of return always be equal.

A brief overview of this work is useful to set the stage for Schmalensee (1989).[2] Consider an unregulated asset with an initial cost of I, a lifetime of T periods, and market-determined net cash flow X_t in period t, for $t = 1,\ldots,T$. As what follows should make clear, a period here and below is simply the interval over which net cash flow is measured and depreciation is assessed. If the investment's net present value is zero using ρ as the discount rate, ρ is the **economic rate of return** on the investment:[3]

$$NPV_U = -I + \sum_{t=1}^{T} \frac{X_t}{(1+\rho)^t} = 0. \tag{1}$$

[2] I provide a similar overview in Schmalensee (1989a, pp. 962-964) in continuous time. Throughout the relevant literature and Schmalensee (1989) there is no explicit treatment of risk, though in the real world a firm's cost of capital is affected by its risk.

[3] If the X_t change sign, it is possible for equation (1) to be satisfied by more than one value of ρ, but this rarely occurs in practice.

The attractiveness of an asset (or of a firm that is a bundle of assets) to a perfectly informed investor depends on its fundamental economic rate of return relative to the relevant market-determined cost of capital for investments of similar riskiness.

To consider the accounting rates of return computed for this asset, let B_t be its book value at the start of period t and let D_t be depreciation charged in period t:

$$B_i = I - \sum_{t=1}^{i-1} D_t = \sum_{t=i}^{T} D_t, \quad i = 1,...,T. \tag{2}$$

(This equation with i=1 implies that the D_i sum to I.) The asset's **accounting rates of return** are given by

$$r_t = \frac{X_t - D_t}{B_t}, \quad t = 1,...,T. \tag{3}$$

Comparing equations (1) and (3), one might think that accounting rates of return, which could vary over time, could never provide a reliable measure of the underlying economic rate of return. However, Hotelling (1925) showed that the r_t will all equal ρ if and only if the depreciation schedule is such that B_t is always equal to the NPV of the investment's future net cash flows, using ρ as the discount rate. As Fisher-McGowan (1983) stress, this bears little resemblance to actual accounting depreciation methodology,[4] so that in practice accounting rates of return – for individual assets or firms that are collections of assets – can diverge dramatically from the underlying economic rates of return.

In the 1980s I regularly taught the economics Ph.D. course on public utility regulation at MIT, and Frank Fisher was a colleague (and my former dissertation advisor). Having worked through the literature just described, I wondered when, if ever, the accounting rates of return of

[4] In Schmalensee (1989a, p. 964), I did show that if the X_t and the B_t both decline exponentially at the same rate, accounting and economic rates of return will always be equal. But this is a very special case, which has been generally ignored in the literature.

regulated firms provided a reliable measure of their underlying economic rates of return, with which regulators and investors are primarily concerned. The fundamental difference between the two contexts is that the regulator-determined allowed cost of capital, which I will denote as ρ, determines the net cash flows the regulated firm is permitted to earn, while in the unregulated context the market-determined net cash flows determine the economic rate of return.

Suppose initially that the regulator sets a constant **allowed rate of return,** ρ, for the life of the asset described above. In practice, regulators generally attempt to set allowed rates of return to match investors' market-determined required rates of return, but *nothing in Schmalensee (1989) depends on how the allowed rates of return are determined*. Suppose also that in every period there is perfect price regulation, i.e., the regulator requires that the firm's accounting rate of return, given by equation (3), equal ρ. Then one can solve (3) for the regulation-permitted net cash flows:

$$X_t = \rho B_t + D_t, \quad t = 1,...,T. \tag{4}$$

The fundamental result proven in Schmalensee (1989) is that the *NPV* of this regulated investment, computed using the regulator-determined allowed rate of return as the discount rate as in standard economic rate of return calculations, is always zero regardless of how depreciation is assessed:

$$NPV_R = -I + \sum_{t=1}^{T} \frac{X_t}{(1+\rho)^t} = -I + \sum_{t=1}^{T} \frac{\rho B_t + D_t}{(1+\rho)^t} = 0. \tag{5}$$

That is, if the regulator determines *in any way whatever* that the regulated firm should earn an economic rate of return of ρ, and it requires the firm's accounting rate of return always to be ρ, the firm will in fact earn an economic rate of return equal to ρ. That is, the *NPV=0* principle, as I understand it is called in Australia, will be satisfied.

In stark contrast to the unregulated case, the method of depreciation is completely irrelevant. The level of ρ is not irrelevant in any fundamental sense, of course: the higher the value chosen by regulators, the more profitable the regulated firm is allowed to be and, on average, the higher the prices paid by its customers. On the other hand, if ρ is set below the firm's actual, market-determined cost of capital, the firm will not meet investors' expectations and will have difficulty financing similar investments in the future.

When I showed a draft of Schmalensee (1989) to my MIT colleague Stewart Myers, he pointed me to a much earlier paper of his in which he had asserted the same basic result, though without proof:

> If a regulatory commission decides to allow a return R, and adjusts the utility's prices frequently enough that the utility always earns R on a book basis, then the utility will always earn the same true return R. (Myers 1972, note 38).

Myers (1972) clearly asserts that this statement is true for *any* regulator-determined R, and he implicitly asserts that it is true regardless of how depreciation is computed. This is perfectly consistent with Schmalensee (1989). The only mention of periodicity in Myers' assertion is the requirement that "the utility *always* earns R on a book basis," where *always* must mean whenever depreciation is charged and the accounting ("book basis") rate of return is computed.[5]

My 1989 paper basically generalized this assertion to permit the regulator to set a different allowed rate of return for each period of the project's lifetime and provided a proof. Because both Dr. Lally (2021) and the AER (2022) consider two-period examples, it is worth presenting the two-period special case from Schmalensee (1989). Suppose the regulator somehow sets allowed rates of return ρ_1 in period 1 and ρ_2 in period 2. Then under the

[5] Indeed, as I point out in note 4 in Schmalensee (1989), this fundamental result holds if depreciation is assessed and the accounting rate of return is computed continuously, and the regulator-determined allowed cost of capital may also vary continuously.

assumption of perfect price regulation, so that accounting rates of return equal allowed rates of return in each period, equation (2) in Schmalensee (1989) becomes

$$(6) \qquad NPV_R = -I + \frac{X_1}{(1+\rho_1)} + \frac{X_2}{(1+\rho_1)(1+\rho_2)} = -I + \frac{\rho_1 I + D_1}{(1+\rho_1)} + \frac{\rho_2(I-D_1)+(I-D_1)}{(1+\rho_1)(1+\rho_2)} = 0.$$

To prove that this *NPV=0* result is true in this special case for *any* values of ρ_1, ρ_2, and D_1, simply multiply both sides by $(1+\rho_1)(1+\rho_2)$ and collect terms involving I and D_1.

If capital market conditions make it appropriate to set the allowed rate of return in period 2 equal to ρ_2, it is appropriate to use that rate to discount period 2's end-of-period returns back to the start of that period. It is then appropriate to use the allowed rate of return in period 1, ρ_1, to discount those discounted returns, along with period 1's end-of-period returns back to period zero.

Moreover, this NPV=0 result holds even if ρ_2 is unknown at the beginning of the first period. All that is required is that it is known that the regulator will set the allowed return equal to ρ_2 (the market-determined required return) whatever that turns out to be.

Because of Myers (1972) and several other earlier statements of the assertion that depreciation doesn't matter under perfect price regulation, which I rather grandly labelled *The Invariance Proposition*, Schmalensee (1989) only claimed to be an expository note.

Dr. Lally's (2021) Mischaracterization of Schmalensee (1989)

Let me now turn to the first question that ENA has asked me to address: whether or not I agree with the characterization of Schmalensee (1989) that appears in Lally (2021). Dr. Lally (2021, p. 7) asserts that:

> A fundamental requirement of regulation is the NPV=0 principle, i.e., at the time a firm invests in regulated activities, the present value of its future cash flows must be equal to its initial investment. Schmalensee (1989) shows that satisfying this principle requires that, at the commencement of each regulatory cycle (when

> the allowed cost of capital is set), the term to which the allowed cost of capital relates matches the term of the regulatory cycle.[6]

Dr. Lally does not show how this conclusion follows from the analysis in Schmalensee (1989). Instead he introduces a rather different two-period model to support it, and AER (2022) presents two different two-period models to support the same conclusion. As I discuss below, all are fundamentally inconsistent with the model presented in Schmalensee (1989) and summarized above.

In fact, Dr. Lally's characterization of Schmalensee (1989) is almost exactly backwards. Schmalensee (1989) shows that the *NPV=0* principle will be satisfied for *any* choices of allowed rates of return as long as accounting rates of return in each period are constrained by price regulation to equal the corresponding allowed rates of return. Of course, it is universally understood that to avoid granting rents to regulated firms while still maintaining adequate investment incentives, the regulator should set allowed rates of return to match the rates that investors require. There is no serious discussion in Schmalensee (1989) about how that should be done: I was not then nor am I now an expert in applied corporate finance, and, in particular, I have no opinion on how the AER should determine the actual, market-based costs of capital of the firms it regulates.

What is perhaps most odd about Dr. Lally's characterization of Schmalensee (1989) is the assertion that it shows that "the term to which the allowed cost of capital relates matches the term of the regulatory cycle." It is a general principle that the allowed cost of capital should be an estimate of the relevant efficient expected return demanded by investors. I have no idea why Dr. Lally thinks that Schmalensee (1989) implies that

[6] He makes the same assertion in Lally (2004, p. 18). He doesn't support this assertion using the Schmalensee (1989) framework there either.

this estimate must depend precisely on how often it is computed. Schmalensee (1989) is agnostic about how investors might go about determining their required return. Schmalensee (1989) certainly does not "show" that the term of the allowed return must match the term of the regulatory cycle. Efficient regulation generally requires that the allowed rate of return must be consistent with the return required by investors – however they determine it.

It is my understanding, for instance, that the AER will shortly develop a framework for determining allowed rates of return and will revise that framework every four years. I also understand that it will use that framework to make annual changes in allowed rates of return. It is not clear to me why Dr. Lally says that bonds with five-year maturities rather than one-year maturities should be used in this process – or why, as a general matter, investors should care how frequently allowed rates of return are computed.

The two-period analysis in Lally (2021, pp. 7-8), in which each period is one year, begins by assuming, in the notation above, that ρ_2 is set at the start of period 2. He then asserts that the discounted value of period 2's revenues at the start of that period is given by

$$V_1 = \frac{\rho_2(I - D_1) + (I - D_1)}{(1 + r_2)}, \tag{7}$$

where r_2 is "the one-year cost of equity prevailing at time 1". He goes on to compute the value of the regulated asset at time zero:

$$V_0 = \frac{[\rho_1 I + D_1] + E(V_1)}{(1 + r_1)} = \frac{\rho_1 I + D_1}{(1 + r_1)} + \frac{\rho_2(I - D_1) + (I - D_1)}{(1 + r_1)(1 + r_2)}, \tag{8}$$

where r_1 is "the one-year cost of equity prevailing at time [zero]." He does not explain why the *r*'s, which do not appear in Schmalensee (1989), are the appropriate discount rates rather than, as in Schmalensee (1989) and equation (6), above, the estimated market costs of capital, the ρs.

In an amazing bit of sleight of hand, Dr. Lally then asserts that in order for V_0 to equal *I,* so that $NPV=0$ is satisfied, the ρs must be set equal to the *r*s. He does not note that replacing the *r*s with the ρs, as in equation (6) above from Schmalensee (1989), accomplishes the same thing in a much more logical fashion.

The AER (2022) offers two defenses of the same Lally proposition. The first (pp. 103-104) essentially starts from the first equality in equation (8) and assumes an all-equity firm. It argues that the ρs should be set so that $V_0=I$ and $NPV=0$ is satisfied. It is being assumed, however that r_1, the expected return on equity in period 1, is unaffected by regulatory decisions and that it may accordingly differ from the firm's market-determined cost of capital in that period. I have no idea how this assumption can be defended.

The AER's second defense (pp. 109-110) uses a two-period numerical example, the core of which can be explained using the notation and framework adopted here. The hypothesis is that the first period allowed rate of return, ρ_1, is set equal to the firm's long-term cost of capital, the economic rate of return that investors require, as assessed at time zero. At the start of period 2, the regulator decides that the long-term cost of capital has changed to ρ_2, and the allowed rate of return is adjusted accordingly. In the notation above, the AER advances the following equation for V_0 under these assumptions:

$$V_0 = \frac{\rho_1 I + D_1}{(1+\rho_1)} + \frac{\rho_2 (I - D_1) + (I - D_1)}{(1+\rho_1)^2}. \tag{9}$$

Comparing equations (6) and (9), the difference is that the cost of capital as assessed in period 1 is assumed by the AER to discount cash flows during period 2 even though, by hypothesis it has changed between the two periods. I have no idea how this assumption can be defended either.

What Schmalensee (1989) Does *Not* Imply

Let me now turn to the second question that ENA has asked me to answer:

> If an economic regulator seeks to reach "*an unbiased estimate of the expected efficient return, consistent with the relevant risks involved in providing regulated network services*" to be applied over a defined regulatory period, does Schmalensee (1989) have any implications for the way that return should be estimated?

As noted at the outset of this Statement, the answer is "No!" Even after a rather careful review of Schmalensee (1989), I cannot understand how Dr. Lally arrived at his view of what that paper implies for real-world determination of regulated firms' allowed rates of return. Fundamentally, Schmalensee (1989) takes the regulator-determined allowed rates of return as exogenous; the proof of *The Invariance Proposition* does not depend in any way on how the allowed rates of return are determined. The few places where determination of the allowed rates of return via the cost of capital is mentioned briefly in passing in Schmalensee (1989) have no implications for the decision-making of the AER or of any other regulatory agency. Schmalensee (1989) is an essay in economic theory, not a paper on estimating firms' cost of capital in practice.

Schmalensee (1989) deals with a very idealized world without risk, competition, or taxes. It is asserted (p. 294) that "[u]nder certainty, [the period t cost of capital] is just the one-period interest rate in period t" – implicitly the riskless rate for a year or some shorter period. This is obviously correct in very abstract theory but completely irrelevant for long-term investments in the real world: neither Dr. Lally nor anyone else to my knowledge has argued that regulated firms' operate under certainty or that costs of capital are equal to short-term risk-free rates.

There is a brief discussion (p. 296) of a "weak defense" for the use of the *T*-period long rate in assessing the cost of capital at the outset, once and for all, for an asset lasting *T* periods, on the grounds that the long rate reflects expected future short rates. While that "weak defense" is qualified in note 7, it is not rejected.

Finally, in a discussion of uncertainty, Schmalensee (1989, p. 297) contemplates a world in which the regulator agrees to compute the cost of capital in each future period and to set each future period's allowed rate of return equal to that cost of capital. From the point of view of time zero, future values of ρ are stochastic, but it is argued that the market value of the utility asset is then certain (since promises are kept), while the market value of a bond is stochastic when future short-term interest rates are uncertain. While this discussion may be of some (modest) theoretical interest, it has few if any implications for the world in which we live.

Summary

Dr. Lally (2021) cites Schmalensee (1989) for the proposition that the NPV=0 condition is satisfied only if the regulator sets allowed rates of return in one particular way. Dr. Lally is simply wrong. Schmalensee (1989) shows that, properly computed, NPV=0 holds *however* the allowed rates of return are determined. Economic efficiency of course, requires that the allowed rate of return is always commensurate with the return that investors require.

Schmalensee (1989) proves one theoretical result, *The Invariance Proposition*, in which the regulated firm's allowed rates of return are taken as exogenous. Neither that result nor any of the less formal discussions in the paper have any implications for how the AER or any other regulator should attempt to produce "an unbiased estimate of the expected efficient return, consistent with the relevant risks involved in providing the regulated network services." At the most abstract level, the regulatory task is conceptually a simple one – determine the return that

market investors require and set each period's allowed rate of return and accounting rate of return to match it. Of course, the current debate at the AER indicates that this conceptually simple task is generally complex in practice.

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Myers, S. C., (1972), "The application of finance theory to public utility rate cases," *Bell Journal of Economics*, 3 (Spring), 58-97.

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Appendix: Professor Schmalensee's Curriculum Vitae

EDUCATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
S.B., Economics, Politics and Science, 1965
Ph.D., Economics, 1970

EMPLOYMENT

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

2012-	Howard W. Johnson Professor of Management, Emeritus, and Professor of Economics, Emeritus
2007-12	Howard W. Johnson Professor of Management
2001-07	John C Head III Dean, MIT Sloan School of Management
1998-00	Dean, MIT Sloan School of Management (Interim, July-October 1998)
1996-98	Deputy Dean, MIT Sloan School of Management
1991-99, 2008-12	Director, MIT Center for Energy and Environmental Policy Research
1988-99	Gordon Y Billard Professor of Management
1986-12	Professor, Department of Economics
1979-12	Professor, MIT Sloan School of Management
1977-79	Associate Professor, MIT Sloan School of Management
1970	Assistant Professor, MIT Sloan School of Management (Spring)
1967-69	Instructor, MIT Sloan School of Management

PRESIDENT'S COUNCIL OF ECONOMIC ADVISERS

1989-91	Member
1967	Junior Staff Economist (Summer)

UNIVERSITY OF CALIFORNIA, SAN DIEGO

1974-77	Associate Professor, Department of Economics
1970-74	Assistant Professor, Department of Economics

VISITING APPOINTMENTS

2008	Executive in Residence, Rady School of Management; U. of California, San Diego (Winter)
2007	Distinguished Visiting Scholar, Tuck School of Business, Dartmouth College (Fall)
1985-86	Visiting Professor, Harvard Business School
1985	Visiting Professor, CORE, University of Louvain, Belgium (Spring)
1980-81	Visiting Scholar, Department of Economics, Harvard University
1973-74	Visiting Associate Professor and Research Fellow, Department of Economics, University of Louvain, Belgium

EDITORIAL SERVICE

Editor in Chief, 2005-08; Chairman, Editorial Advisory Board, 2008-: *Competition Policy International*
Editorial Board: *Journal of Economics and Management Strategy*, 1992-98
Associate Editor: *Journal of Economic Perspectives*, 1992-98
Associate Editor: *International Journal of Industrial Organization*, 1982-89
Board of Editors: *American Economic Review*, 1982-86
Founding Editor, 1978-89; Co-Editor, 1989-: MIT Press Series, *Regulation of Economic Activity*
Associate Editor, 1977-81; Board of Editors, 1981-89: *Journal of Industrial Economics*

PROFESSIONAL ASSOCIATIONS

American Economic Association: Committee on Government Relations, 2009-12; Executive Committee, 1993-95; Budget Committee, 1993-95; Nominating Committee, 1987; Advisory Committee on Meetings Program, 1986, 1989, 1994
Econometric Society: Chair, Local Arrangements Committee, 1985 World Congress; Chair, Program Committee, 1980 North American Fall Meeting; Program Committee, 1980 World Congress
Second World Congress of Environmental Economists, Program Committee, 2002

CONSULTATING AND GOVERNMENT SERVICE (SELECTED):

Global Economics Group, Director, 2011-
National Climate Assessment Development & Advisory Committee, 2011-14
LECG, LLC: Director, 2004-2011
National Academies/National Research Council: Panel on Transportation and a Sustainable Environment, 1994-97; Committee on National Statistics, 1998-2001; Panel on Cost-of-Living Indexes, 1999-2001; Coordinating Committee on the Transition to Sustainability, 2000-2001; Committee on America's Climate Choices, 2008-2011; Committee for a Study of Freight Rail Transportation and Regulation (Chair), 2014-15; Committee on the Social Cost of Carbon, 2015-16.
U.S. Environmental Protection Agency: Environmental Economics Advisory Committee, 1992-96, 1998; Clean Air Act Compliance Analysis Council, 1992-98, Chairman 1992-96
Antitrust Division, U.S. Department of Justice, consultant, 1991-92 (1992 Merger Guidelines)
NERA Economic Consulting: Special Consultant 1981-89, 1991-2004
Bureau of Economics, U.S. Federal Trade Commission: consultant, 1972-81 (Antitrust Policy)

AWARDS AND OTHER PROFESSIONAL ACTIVITIES (SELECTED):

Asia School of Business, Board of Governors, 2015- (Co-Chair 2015-18)
Associate Scholar, Harvard Environmental Economics Program, 2013-2018
Director, National Bureau of Economic Research, 2013- (Executive Committee 2018-)
Chicago Booth IGM Economic Experts Panel, 2012-
Distinguished Fellow, Industrial Organization Society, 2012
John Kuszczek Memorial Lecture, Bank of Canada, 2011
Energy Board Member, Bipartisan Policy Center, 2011-13
Stackelberg Lecture, University of Milan, Bicocca, 2010
Keynote Speaker, World Congress of Environmental and Resource Economists, 2010
Resources for the Future, Director 2009-18, Board Chair 2014-18, Chair Emeritus 2018-
Master Class, Rafael del Pino Foundation, Madrid, 2009
Carpenter Lecture, Babson College, 2008
J.-J. Laffont Lecture, CRESSE Summer School, Greece, 2008
Member, National Commission on Energy Policy, 2006-2010
Director, International Data Group, 2004-2017
European Investment Bank Lecture, European University Institute, Florence, 2002
Director, MFS Investment Management, 2002-2004
Advisory Council, Tsinghua School of Economics and Management, 2001-07
Fathauer Lecture in Political Economy, University of Arizona, 2000
Director, International Securities Exchange, 2000-2009
Member, International Academy of Management, 1998-
Member, American Academy of Arts and Sciences, 1995-
Edward A. Hewett Prize, American Association for the Advancement of Slavic Studies (with P.L. Joskow and N. Tsukanova), 1995
Revista de Análisis Económico Lecture, Econometric Society Latin American Meeting, 1994
Director, MIT Press, 1994-2007

Research Associate: National Bureau of Economic Research, 1992-2013
Director: Long Island Lighting Company, 1992-98
Donald Gilbert Memorial Lecture, University of Rochester, 1992
American Council for Capital Formation Center for Policy Research: Board of Directors, 1991-2010; Environmental Policy Fellow, 1997-98
Fellow, Econometric Society, 1982-
Invited Speaker, Econometric Society World Congress, 1980

PUBLICATIONS

INDUSTRIAL ORGANIZATION

"Multi-Sided Platforms" (with D.S. Evans), In *The New Palgrave Dictionary of Economics,* Palgrave Macmillan (eds.), Palgrave Macmillan, London, 2017.

Matchmakers (with D.S. Evans), Boston: Harvard Business School Press, 2016. French and Korean editions 2017, Chinese and Japanese editions 2018, Vietnamese edition 2019.

"Pricing the Razor: A Note on Two-Part Tariffs," *International Journal of Industrial Organization*, 42 (September 2015): 19-22.

"An Instant Classic: Rochet & Tirole, Platform Competition in Two-Sided Markets," *CPI Journal,* 10:2 (Autumn 2014): 175-180.

"'On a level with Dentists?' Reflections on the Evolution of Industrial Organization." *Review of Industrial Organization*, 41 (November 2012): 157-79.

"Why is Platform Pricing Generally Highly Skewed?" *Review of Network Economics*, 10 (December 2011), Issue 4, Article 1, 11 pages.

"Jeffrey Rohlfs' 1974 Model of Facebook: An Introduction," *Competition Policy International*, 7 (Spring 2011): 301-12.

"Failure to Launch: Critical Mass in Platform Businesses" (with D.S. Evans), *Review of Network Economics*, 9 (December 2010), Issue 4, Article 1 (26 pages).

"Comment on "Pharmaceutical Price Discrimination and Social Welfare" (by Frank R. Lichtenberg)," *Capitalism and Society*, 5 (2010), Issue 1, Article 5. DOI: 10.2202/1932-0213.1067. Available at: http://www.bepress.com/cas/vol5/iss1/art5

"Innovation and Evolution of the Payments Industry" (with D.S. Evans). In *Moving Money* (R.E. Litan and M.N. Baily, eds.), Washington: Brookings Institution, 2009, pp. 36-76.

"Standard-Setting, Innovation Specialists, and Competition Policy," *Journal of Industrial Economics*, 57 (September 2009): 526-52.

"New Risks, New Products, and New Regulations: Insurance for the 21st Century," *ICFAI Journal of Risk and Insurance*, 4 (July 2007): 7-18.

"Pick your Pricing" (with D.S. Evans). *Chief Executive*, July/August 2007.

Catalyst Code (with D.S. Evans), Boston: Harvard Business School Press, 2007. Korean edition, 2008; Polish edition, 2010; Chinese edition, 2011.

"El Debate Sobre las Tasas de Intercambio: Una Visión de Conjunto" (with D.S. Evans). *Papeles de Economia Española*, Número Extraordinario, 2006, pp. 2-17.

Invisible Engines: How Software Platforms Drive Innovation and Create Value (with D.S. Evans and A. Hagiu), Cambridge: MIT Press, 2006. Korean edition, 2008; Chinese edition, 2010.

"A Survey of the Economic Role of Software Platforms in Computer-Based Industries," *CESIfo Economic Studies*, 51 (2005): 189-224. (Reprinted, with minor changes, as "Software Platforms." In *Industrial Organization and the Digital Economy* (G. Illig and M. Peitz, eds.). Cambridge: MIT Press, 2006, pp. 31-70.)

"Payment Systems and Interchange Fees," *Journal of Industrial Economics*, 50 (June 2002): 103-122.

Paying with Plastic: The Digital Revolution in Buying and Borrowing (with D.S. Evans), Cambridge: MIT Press, 1999. Second edition, 2005; Chinese edition, 2006; Korean edition, 2011.

"Comment on 'Competition, Information, and Development,' by Jean-Jacques Laffont." In *Annual Bank Conference on Development Economics 1998* (B. Pleskovic and J.E. Stiglitz, eds.), Washington: The World Bank, 1999, pp. 262-266.

"Privatization in Russia: What Should Be a Firm?" (with P.L. Joskow). *International Journal of the Economics of Business*, 2 (1995): 297-327. Reprinted in *Transaction Cost Economics: Recent Developments* (C. Menard, ed.), Brookfield, VT: Edward Elgar, 1997, pp. 86-126.

Review of R. Wilson, *Nonlinear Pricing*. *Journal of Political Economy*, 102 (December 1994): 1288-1291.

The Economics of the Payment Card Industry (with D.S. Evans). Cambridge: National Economic Research Associates, Inc., 1993.

"Sunk Cost and Market Structure: A Review Article." *Journal of Industrial Economics*, 40 (June 1992): 125-134.

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