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The Uruguay Round of Trade Negotiations: An Overview

Norman S. Fieleke

Vice President and Economist, Federal Reserve Bank of Boston. *Rachel Cononi provided valuable research assistance.*

It took more than seven years of haggling, but on December 15, 1993, in Geneva, Switzerland, negotiators representing 117 countries reached consensus on the contents of the Final Act of the Uruguay Round, the most comprehensive international trade agreement in history. Launched in Punta del Este, Uruguay, in 1986, the Uruguay Round of multilateral trade negotiations covered more issues and involved more countries than any previous round. Its Final Act prescribes, among other things, that tariffs on industrial products be reduced by an average of more than one-third, that trade in agricultural goods be progressively liberalized, and that a new body, the World Trade Organization, be established both to facilitate the implementation of multilateral trade agreements such as the Final Act and to serve as a forum for future negotiations.

The Final Act is a formidable document, entailing more than 26,000 pages of technical language and detail. The chief purpose of this article is to summarize and assess in nontechnical language the main results of the Uruguay Round as recorded in that Act, in the belief that comprehension of such a major trade agreement is too important to be left to the trade negotiators alone.[1] Some estimates of the consequences of the agreement for world trade and income are also presented. A subsequent article will offer an evaluation of sectoral and geographic economic impacts within the United States.

I. Liberalization of Trade in Industrial Products

Agreements to liberalize trade in industrial products include reductions in tariffs and removal of quantitative restrictions.

Tariff Reductions

The breadth of the commitments made to reduce tariffs differs among the advanced countries, the developing countries, and the four "transition" countries that participated in the Uruguay Round (the Czech Republic, Poland, Romania, and the Slovak Republic, all transiting from centrally planned to market economies). The advanced countries agreed to reduce tariffs on industrial imports amounting to 64 percent of the total value of their imports of such products; 18 percent of their industrial imports were already duty-free under commitments made prior to the Round. By comparison, the developing countries agreed to lower their tariffs on about one-third of their industrial imports, and the participating transition countries on three-quarters of theirs. Tariff reductions are to be completed by the year 2000 except for certain sensitive sectors such as textiles, for which the reductions must be completed by 2005.

The depth of the proffered tariff reductions matters as much as the breadth. Overall, the advanced countries pledged to lower their tariffs on industrial goods from an average of 6.3 percent to 3.8 percent, a reduction of 40 percent. Moreover, as reported in Table 1, the proportion of industrial imports they admit duty-free is to rise sharply, from 20 to 44 percent, while the proportion facing tariffs above 15 percent should decline somewhat, from 7 to 5 percent.

For the developing countries, the share of their industrial imports admitted free of duty is scheduled to rise slightly, from 39 to 42 percent, while the proportion encumbered by tariffs above 15 percent will diminish from 43 to 38 percent. The high share of duty-free imports is attributable primarily to the large amount of duty-free imports entering Hong Kong and Singapore.

In evaluating the tariff reductions outlined in Table 1, one should bear in mind that moderate percentage declines in high tariffs may well precipitate greater price reductions on imports, and thus greater increases in imports, than do large percentage declines in low tariffs. For instance, a 20 percent reduction in a 35 percent tariff could bring about a 5 percent drop in price (inclusive of the tariff), while a 50 percent reduction in a 4 percent tariff would be expected to cause a price decline of no more than 2 percent.[2] Thus, the decrease in the share of developing country imports facing tariffs exceeding 35 percent is worthy of note.

By the same token, the 22 percent reduction promised by the advanced countries on their imports

Table 1
Pre- and Post-Uruguay Round Tariff Profiles for Imports of Industrial Products,[a] by Country Group

Tariffs by Country Group	Imports: Billions of U.S. Dollars[b]	Imports: Percentage Distribution, Pre-UR	Post-UR
Advanced Economies			
Total	736.9	100	100
Duty-free[c]	149.5	20	44
0.1—5.0%	304.3	41	32
5.1—10.0%	176.8	24	15
10.1—15.0%	51.5	7	5
15.1—35.0%	45.1	6	4
Over 35%	9.8	1	1
Developing Economies			
Total	350.5	100	100
Duty-free[c]	137.3	39	42
0.1—5.0%	20.5	6	5
5.1—10.0%	28.1	8	10
10.1—15.0%	14.4	4	5
15.1—35.0%	96.6	28	30
Over 35%	53.6	15	8
Transition Economies			
Total	34.7	100	100
Duty-free[c]	4.6	13	16
0.1—5.0%	9.5	27	37
5.1—10.0%	9.5	27	35
10.1—15.0%	7.5	22	7
15.1—35.0%	3.4	10	4
Over 35%	0.2	0	0

[a]Excludes items for which duties are not available in *ad valorem* terms, since these items cannot be distributed by duty ranges, and also petroleum.
[b]Data are primarily for 1989 or 1989 and are for imports from sources receiving MFN or generalized system of preferences treatment, excluding imports from free trade area partners and imports under contractual preferential arrangements.
[c]Figures refer to tariff lines which were duty-free prior to the Uruguay Round, including those that were fully bound, partially bound or unbound.
Note: Detail may not add to totals shown because of rounding.
Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

[1] This article draws upon a number of sources, but relies most heavily on the following two: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994); and U.S. International Trade Commission, *The Year in Trade: Operation of the Trade Agreements Program*, 45th report (Washington, D.C.: USITC publication 2769, June 1994).

[2] In the first case, for example, a 20 percent reduction would lower the tariff from 35 percent to 28 percent. If the price without any tariff were, say, $1.00, then the price including the tariff could well fall from $1.35 to $1.28 as the tariff dropped, a price reduction of 5 percent.

of textiles and clothing—as reported in Table 2—could be expected to precipitate a somewhat larger price decline than the more prepossessing 69 percent reduction promised for wood, pulp, paper, and furniture. But most price declines caused by the advanced country industrial tariff reductions will be modest, since their pre-Uruguay Round tariffs were generally low. And once the Uruguay Round reductions have been completed, those tariffs will be negligible for several major industrial product categories, and will exceed 5 percent only for textiles and clothing, for leather, rubber, and footwear, and for transport equipment.

Some advanced countries agreed to much larger tariff reductions than others on these industrial products. As can be seen in Table 3, Japan and New Zealand ranked first and second, with average tariff reductions far greater than the smallest that were tendered. But the resulting price declines on imports should be much smaller for Japan than for New Zealand or for a number of other countries, such as Australia, Iceland, and South Africa, whose tariffs have been much higher than Japan's. Indeed, it is remarkable that so many countries with relatively high tariffs agreed to reductions nearly as great as, or more than, the average reduction of 40 percent; Australia, Canada, Iceland, and New Zealand all fall into this category. The governments of these countries may have had to overcome concerns that significantly cheaper imports would pose difficult adjustment problems for some competing domestic industries.

Table 2
Advanced Country Tariff Reductions by Major Industrial Product Group[a]

Product Category	Imports[b] (Billions of U.S. Dollars)	Tariff Averages[c] Pre-UR	Post-UR	Percent Reduction
All industrial products	736.9	6.3	3.8	40
Fish and fish products	18.5	6.1	4.5	26
Wood, pulp, paper and furniture	40.6	3.5	1.1	69
Textiles and clothing	66.4	15.5	12.1	22
Leather, rubber, footwear	31.7	8.9	7.3	18
Metals	69.4	3.7	1.4	62
Chemicals and photographic supplies	61.0	6.7	3.7	45
Transport equipment	96.3	7.5	5.8	23
Non-electric machinery	118.1	4.8	1.9	60
Electric machinery	86.0	6.6	3.5	47
Mineral products and precious stones	73.0	2.3	1.1	52
Manufactured articles n.e.s.	76.1	5.5	2.4	56

[a]Excludes petroleum products.
[b]Data are primarily for 1988 or 1989 and are for imports from sources receiving MFN or generalized system of preferences treatment, excluding imports from free trade area partners and imports under contractual preferential arrangements.
[c]Weighted by import values.
Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

While the summary statistics presented here are suggestive, they provide only rough indications of the true levels of tariff protection. To illustrate this important point, suppose that an industry buys a raw material for $1.00 and transforms it into a finished product that sells for $2.00, the same price as an identical competing import. The industry then has "added value" of $1.00 to the raw material. If a tariff of 10 percent (amounting in this case to $0.20) is then imposed on competing imports and the price rises to $2.20, the true, or "effective," tariff protection on the value added in the industry is not 10 but 20 percent ($0.20 as a percentage of $1.00).

If tariffs are also levied on items used as inputs by the industry, the computation becomes more complex. But under certain fairly general assumptions, the effective rate of protection for an industry is equal to the tariff on imports that compete with the industry's output only if that tariff is the same as the weighted average duty on the inputs. The greater the excess of that tariff over the average duty on inputs, the greater is the excess of effective protection over that tariff. One can, therefore, get some idea of the effective protection provided for manufacturing industries by comparing the tariffs on the kinds of goods they produce with the tariffs on the inputs, or unfinished components, that go into those goods.

This matter has been a major concern of developing countries striving to generate manufacturing industries capable of exporting finished products to the advanced countries. Their concern should probably be eased by the pattern of tariff reductions negotiated in the Uruguay Round. As reported in Table 4, the percentage point decrease in the average tariff levied by the advanced countries on finished product imports from developing countries will exceed the

Table 3

Advanced Country Tariff Reductions on Industrial Products,[a] by Country

Country	Imports[b] (Millions of U.S. Dollars)	Trade-Weighted Tariff Averages Pre-UR	Post-UR	Percentage Reduction
	736,947	6.3	3.8	40
Australia	25,152	20.1	12.2	39
Austria	5,768	10.5	7.1	32
Canada	28,429	9.0	4.8	47
European Union	196,801	5.7	3.6	37
Finland	4,237	5.5	3.8	31
Iceland	334	18.2	11.5	37
Japan	132,907	3.9	1.7	56
New Zealand	4,997	23.9	11.3	53
Norway	6,192	3.6	2.0	44
South Africa	14,286	24.5	17.2	30
Sweden	10,324	4.6	3.1	33
Switzerland	10,227	2.2	1.5	32
United States	297,291	5.4	3.5	35

[a]Excluding petroleum.

[b]From most-favored-nation origins. Data are primarily for 1988 or 1989 and are for imports from sources receiving MFN or generalized system of preferences treatment, excluding imports from free trade area partners and imports under contractual preferential arrangements.

Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

decreases for both semi-manufactures and raw materials, and the decrease on semi-manufactures will exceed that on raw materials. The resulting post-Uruguay Round average tariff structure of the advanced countries for these goods will therefore exhibit less "escalation" from the lower to the higher stages of processing, and may well provide a smaller degree of effective protection to those higher stages. More detailed product category data generally support this conclusion.

Removal of Quantitative Restrictions

Well before the Uruguay Round, a series of multilateral trade negotiations had succeeded in reducing tariffs to relatively low levels, especially in the advanced countries. By contrast, nontariff barriers to trade had proliferated, with the result that trade was far less free than the tariff schedules suggested. Prominent among these nontariff barriers are quantitative restrictions that place limits on the volume of goods flowing from one country to another. The Uruguay Round Final Act prescribes a major relaxation of these restrictions.

For industrial products, the most important quantitative restraints scheduled for removal are those on textiles and clothing applied under the MFA (Multifibre Arrangement). In recent years, approximately 11 percent of world trade in textiles and 35 percent of world trade in clothing have been subjected to these restrictions, which have limited the exports of 31 countries to 8 others. These MFA restraints are to be phased out in four steps, starting January 1, 1995, and ending January 1, 2005.

Other quantitative restrictions have been imposed under Article XIX of the GATT (General Agreement on Tariffs and Trade), which authorizes countries to establish such restrictions to shield their industries from serious injury from import competition. In addition, numerous similar "grey-area" restrictions have been imposed that violate certain important conditions set by Article XIX, in particular the condition that countries whose exports become restricted are entitled to receive, or take, some form of compensatory trade measure. More than 75 grey-area measures were being employed as recently as 1993, covering travel goods, electrical equipment and appliances, footwear, television sets or television tubes, machine tools, and other products.

Table 4

Change in Tariff Structure on Advanced Country Imports of Industrial Products from Developing Countries

	Raw Materials	Semi-Manufactures	Finished Products
Imports[a]			
Billions of U.S. Dollars[b]	36.7	36.5	96.5
Percent of Total	22	21	57
Tariff (Percentage)			
Pre-Uruguay Round	2.1	5.4	9.1
Post-Uruguay Round	.8	2.8	6.2
Percentage Point Reduction	1.3	2.6	2.9

[a]Excluding petroleum

[b]Data are primarily for 1988 or 1989 and are for imports from sources receiving MFN or generalized system of preferences treatment, excluding imports from free trade area partners and imports under contractual preferential arrangements.

Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

The Final Act provides for the termination of restrictions taken under Article XIX not later than eight years after the date on which they were instituted or January 1, 2000, whichever comes later; comparable restrictions introduced in the future are to be maintained no longer than eight years. In addition, grey-area restraints must be either conformed to standards of the Final Act or eliminated by January 1, 1999—except that one such restraint may be maintained by each country until December 31, 1999, provided the country whose exports are restricted agrees.

II. Liberalization of Trade in Agricultural Products

Trade in agricultural products has been subjected to more varied and extensive government intervention than trade in industrial products, and the agreements incorporated in the Final Act reflect that difference.

Tariff Reductions

While tariffs on agricultural products are not uncommon, a substantial share of agricultural products have been protected from international competition by nontariff barriers such as quantitative restrictions and bans, variable import levies, minimum import prices, and discretionary import licensing. The Final Act requires that these nontariff barriers generally be converted into tariffs estimated to afford an equivalent degree of protection—a procedure known as "tariffication." Thereafter, all advanced country tariffs on agricultural goods are to be reduced by an average of 36 percent by the year 2000, with each individual tariff declining by at least 15 percent. For developing country tariffs, the comparable average reduction is 24 percent by 2004, with each tariff declining by at least 10 percent. No agricultural tariff reductions are required on the part of developing countries considered to be "least developed."

The advanced countries account for about two-thirds of world imports of agricultural products. As indicated in Table 5, their simple (or unweighted) average tariff reductions by product group range from a low of 26 percent for dairy products to a high of 48 percent for flowers, plants, and vegetable materials as well as for the miscellaneous category, "other agricultural products." For all products collectively, the 37 percent decrease slightly exceeds the 36 percent target.

Table 5
Advanced Country Imports and Tariff Reductions on Agricultural Products

Product Category	Imports[a] (Millions of U.S. Dollars)	Percentage Reduction in Tariffs
All agricultural products	84,240	37
Coffee, tea, cocoa, mate	9,136	35
Fruits and vegetables	14,575	36
Oilseeds, fats and oils	12,584	40
Other agricultural products	15,585	48
Animals and products	9,596	32
Beverages and spirits	6,608	38
Flowers, plants, vegetable materials	1,945	48
Tobacco	3,086	36
Spices and cereal preparations	2,767	35
Sugar	1,730	30
Grains	5,310	39
Dairy products	1,317	26

[a]Data are primarily for 1988 or 1989 and are for imports from sources receiving MFN or generalized system of preferences treatment, excluding imports from free trade area partners and imports under contractual preferential arrangements.

Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

Other Liberalization Measures

In addition to the foregoing tariff reductions, the Final Act prescribes measures to ensure that agricultural products will have access to import markets up to certain minimal levels. Furthermore, negotiators agreed to make substantial reductions in both domestic and export subsidies.

The agreements on subsidies will enhance world competition in agricultural products. In the advanced countries, domestic subsidies to agricultural producers are to be lowered, with certain exceptions, by 20 percent by the year 2000 from the levels prevailing during the period 1986–88. For developing countries, the corresponding reduction is 13 percent by 2004 (although no reduction is required by the least developed). Among the subsidies exempted from these reductions are direct payments to limit production.

With respect to export subsidies, in the advanced countries budgetary outlays for such subsidies are to be decreased by 36 percent, and the quantities of subsidized exports by 21 percent, for specified products by the year 2000 from the levels prevailing between 1986 and 1990. For developing countries, the corresponding reductions are 24 percent for outlays and 14 percent for quantities by the year 2004 (with, again, no reductions required of the least developed).

These reductions are significant, but fall far short of eliminating all agricultural subsidies that impede free competition. More specifically, domestic subsidies are to decrease from \$197 billion to \$162 billion. Export subsidies, largely for wheat, beef, coarse grains, dairy products, and sugar, are to decrease from \$22.5 billion to \$14.5 billion, with one-half of the reduction attributable to the European Union.

III. Liberalization of Trade in Services

The Uruguay Round is the first multilateral trade negotiation to reach a comprehensive agreement on international trade in services, ranging over such varied activities as accounting to tourism. The agreement covers not only cross-border trade in services (such as U.S. television broadcasts to Canada), but also every other means by which services can be internationally traded, including: (1) services supplied from one territory to a consumer from another territory (such as New York hospital services to a citizen of Saudi Arabia); (2) services supplied by a person of one territory within the territory of another (such as consulting services provided by a U.S. citizen in Moscow); and (3) services supplied from an organization based in one territory to another territory through a subordinate organization abroad (such as financial services supplied by Citicorp USA through a Citicorp branch in another country).

Because service transactions have become a substantial component of world trade, their inclusion in the negotiations and the Final Act is a noteworthy feat. Cross-border trade alone in services accounts for roughly 20 percent of world trade in goods and services, and trade in services has been growing more rapidly than that in goods. The agreements on services include commitments on both general principles and specific service sectors.

The general principles, or goals, agreed for trade in services are similar to those long accepted in agreements relating to trade in goods. They include national treatment, most-favored-nation treatment, transparency, and progressive liberalization.

National treatment means that a country treats foreign services and service suppliers no less favorably than its national services and suppliers, while most-favored-nation (MFN) treatment means that a country treats services and service suppliers of a foreign country no less favorably than it treats those of any other foreign country. Transparency requires that relevant government policies on services be published. Progressive liberalization involves binding commitments on agreed liberalization measures, rendering the process of liberalization irreversible and laying the basis for future rounds of negotiation.

In addition to endorsing the foregoing general principles, each Uruguay Round participant country presented a schedule detailing its specific commitments for the various service sectors and indicating the extent to which it will apply the general principles to each sector. Among other things, the schedules limit particular barriers to trade in services—barriers such as restrictions on the number of service suppliers, on people employed, and on the total value or quantity of service transactions. All such schedules were included in the Final Act.

Because service transactions have become a substantial component of world trade, their inclusion in the negotiations and the Final Act is a noteworthy feat.

Measuring reductions in barriers to services trade is much more difficult than measuring reductions in tariffs. Typically, services barriers take the form of rather imponderable discriminatory regulations or obstacles limiting the provision of services by foreigners. Moreover, detailed, internationally comparable data on services imports are not available.

In the absence of better measures, a few statistics on the number of countries making commitments in some important sectors may convey the flavor of what was accomplished. Most such commitments "bind," or guarantee, the current degree of access for foreign suppliers, while the others enlarge that access. Thus, commitments were scheduled by 67 countries in the business services sector (embracing legal, accounting, medical, computer, management consulting, and many related business services), by 52 countries in "value-added" (as distinguished from "basic") telecommunications, and by more than 40 countries in the air transport sector. By contrast, only 13 countries—

including just 2 advanced countries—made commitments in audiovisual services, and the numerous commitments made in financial services (in banking and insurance) may be withdrawn unless further negotiations resolve disagreements in that sector by July 1, 1995.

IV. Strengthening the International Rules, Procedures, and Institutions Governing World Trade

The worth of all the foregoing commitments depends not only on those commitments and their observance, but also on rules limiting alternative forms of protection. For example, a lower tariff may be of little value to a foreign supplier if the importing country rejects many of the foreign supplier's goods for allegedly failing to meet health or safety or environmental standards. Therefore, the Final Act incorporates provisions to strengthen the rules, procedures, and institutions that have been used both (1) to limit such alternative protective devices and (2) to resolve disputes over the interpretation of the Final Act itself. Some of the matters these provisions address have already been outlined in passages discussing the MFA, grey-area restrictions, agriculture, MFN, and national treatment. This section briefly summarizes the remaining matters treated by these provisions.

Trade in Goods

With respect to trade in goods, the Final Act includes provisions strengthening the regulation of the following potential non-tariff barriers: customs valuation, preshipment inspection, rules of origin, import licensing procedures, subsidies and countervailing duty measures, antidumping procedures, technical barriers, safeguards, and sanitary and phytosanitary measures (dealing with matters such as pest and disease control and food safety). For all of these, the Final Act prescribes guidelines that subscribing governments must follow to make their policies and procedures clear (or "transparent") and predictable, with due process for affected exporters.

A noteworthy example is afforded by the provisions dealing with antidumping duties. "Dumping" of merchandise into a market by an exporter has long been considered an "unfair" trade practice, and countries have commonly reacted to it with antidumping duties if they judged their domestic industries to be seriously injured, or threatened with serious injury, by competition from the dumped goods. But antidumping measures, as employed, have often been criticized as being unfair trade practices themselves, capricious and overly zealous in nature.

Although the Final Act will not—and should not—allay all such criticism, it does make clearer the rules and procedures to be followed by governments in conducting investigations of alleged dumping and in determining whether injurious dumping has occurred. Thus, among other things, investigating governments now must provide interested trade partners with full notice of an investigation and the right to present evidence, must apply certain specified standards in determining injury, and must remove within five years any antidumping duty that is imposed unless a determination is made that, without the duty, dumping and injury would probably continue or recur.

The worth of tariff reductions and removal of quantitative restrictions depends not only on those commitments and their observance, but also on rules limiting alternative forms of protection.

Other provisions deal with certain trade-distorting requirements that countries sometimes impose on enterprises, such as requirements that an enterprise use or purchase products of domestic origin or that it limit its use or purchase of imports according to the amount of its output that is exported. Such requirements must now be eliminated by advanced countries by January 1, 1997, by developing countries by January 1, 2000, and by least developed countries by January 1, 2002.

Intellectual Property

Through such devices as patents and copyrights, governments have long endeavored to protect the ownership rights of inventors, writers, and other producers of intellectual property. However, the nature of those endeavors has varied widely from country to country, and no multilateral system of principles and rules has existed to discipline international trade in counterfeit items. Concern with this state of affairs has intensified with the growing role of intellectual property and the increasing ease with which it can be transmitted across national boundaries.

The Final Act addresses this concern. With limited exceptions, subscribers to the Act are required to treat nationals of trading partners on the same basis (the MFN principle), and also to provide for national treatment, with regard to the protection of intellectual property. Encompassed in the concept of intellectual property rights are patents, copyright and related rights (including rights for computer programs, data bases, sound recordings and films), trademarks and service marks, industrial designs, layout-design of integrated circuits, and geographical indications (including appellations of origin). Patent protection is to extend for 20 years for all inventions, whether of products or processes, in nearly all branches of technology.

Governments have long endeavored to protect the ownership rights of inventors, writers, and other producers of intellectual property, but no multilateral system of principles and rules has existed to discipline international trade in counterfeit items.

Moreover, governments must offer procedures and remedies under their domestic law by which foreign holders of intellectual property rights can effectively enforce their rights. These provisions on intellectual property are to be put into effect within transition periods of varying length—generally by January 1, 1996, by advanced economies; by January 1, 2000, by developing and transition economies; and by January 1, 2006, by the least developed economies.

Monitoring and Enforcement

In 1989 a Trade Policy Review Body (TPRB) was established on a provisional basis under the General Agreement on Tariffs and Trade and charged with monitoring, and publishing reviews of, the current trading policies of countries belonging to the GATT. Such reviews help to insure that multilateral trade agreements are observed. Under the Final Act, this review procedure, which covers all subscribing countries, acquires a permanent status.

Adherence to trade agreements cannot be ensured merely by such a review procedure. Thus, a multilateral enforcement process known as dispute settlement has long been available, and this process has been considerably strengthened under the Final Act. First, in place of the separate dispute settlement procedures used under different trade agreements in the past, the Act establishes a single system under a Dispute Settlement Body. Second, a negative consensus of that Body (a unanimous consensus *against* proceeding) is now required to halt the dispute settlement process from adjudicating a claim alleging that a trade agreement has been violated. Third, to assure the legal quality of rulings issued by the panels that adjudicate disputes, the Act provides for an Appellate Body to hear appeals of those rulings.

Once a violation has been found, the custom has been first to direct the offending country to cease and desist. However, rather than cease and desist, the country has the alternative of providing a mutually agreed concession (such as a reduction of its tariffs) to compensate for its continuing violation. If no agreement can be reached on compensation, the country bringing the complaint may be authorized to retaliate (for example, by raising its tariffs a specified amount on imports from the offending country).

The World Trade Organization

One of the chief results of the Uruguay Round is the establishment of the World Trade Organization (WTO), which replaced the legal system of the GATT. Its assigned tasks are as follows: to provide a forum for multilateral trade negotiations and a framework for implementing their results, including, first and foremost, the results of the Uruguay Round; to administer the trade policy review and dispute settlement mechanisms; and to cooperate with the International Monetary Fund and the World Bank group of agencies.

The WTO commenced operations on January 1, 1995, with 81 member countries and territories and nearly 50 more in a position to join in the near future. The initial membership accounted for more than 90 percent of international trade in goods and services. The organization is headed by a Ministerial Conference that meets at least once every two years, while a

General Council oversees its day-to-day operations. All members of the WTO are members of the Ministerial Conference and the General Council.

Each member country has one vote, and the majority required to approve a proposal depends on the issue under consideration. Thus, as already noted, a (unanimous) consensus is required to halt a dispute settlement proceeding. A three-quarters majority of WTO members is required to adopt an interpretation of the agreements on goods, services, and intellectual property. A two-thirds majority of the members may approve amendments to the agreements, except that unanimity is required for amendments that change the rights and obligations of members. Other proposals may be adopted either by consensus of those present or by simple majority of votes cast.

Plurilateral Agreements

In addition to the foregoing multilateral agreements, to which all Final Act subscribers accede, the Act includes several "plurilateral" agreements adopted by only some of the subscribers. Adherents to a plurilateral agreement are obliged to offer the benefits of the agreement to each other, but have no such obligation to non-adherents. Such agreements cover government procurement, civil aircraft, bovine meat, and certain dairy products.

Trade liberalization is undertaken not for its own sake but to improve living standards.

Most important for trade liberalization is the agreement on government procurement, which extends the scope of international competition for government contracts into the procurement of services (including construction services), procurement by public utilities, and procurement by government bodies below the central level, such as states, provinces, departments, and prefectures. Contracts below certain specified values are not covered. The basic principle is national treatment: Foreign suppliers, goods, and services must be treated no less favorably in government procurement than national suppliers, goods, and services. Thus, foreign suppliers must be given the same commercial opportunity to bid for and secure a government contract as domestic suppliers. At this writing, participants in the agreement will include Canada, the European Union, Hong Kong, Israel, Japan, (South) Korea, Norway, Switzerland, and the United States.

V. Effects on Trade and Income of Liberalizing Trade in Goods

What do all these agreements add up to? After all, trade liberalization is undertaken not for its own sake but to improve living standards. As trade barriers come down, countries will be stimulated to channel more of their resources into those activities they carry on relatively most efficiently in the world economy, thereby enlarging total exports, income, and investment. Evaluating the quantitative impact of the agreements is very difficult, however, given their breadth and the number of countries involved. The difficulty is greatest for the agreements dealing with matters other than trade in goods, partly because of the nature of the agreements (including the nature of the barriers to be relaxed) and partly because of the paucity of relevant data.

For the trade in goods, some fairly sophisticated estimates have been published, in spite of the difficulties—estimates of the effects of the agreements on both trade and income. Among the most recent and comprehensive are estimates issued by the GATT Secretariat in November, 1994, summarized here in Tables 6 to 9.[3] As all the agreed trade liberalizations should have been instituted by 2005, the estimates indicate how much greater (or, in some cases, lower) trade and income are expected to be by 2005 than they would have been if no Uruguay Round had occurred. In each table the estimated effect varies with the version of the estimating model employed or, more precisely, with the underlying assumptions about the nature of competition and returns to scale of production or about the investment of income gains. (These assumptions are spelled out in the notes to the tables.)

As reported in Table 6, by 2005 the volume of world merchandise trade is expected to be about 9 percent to 24 percent above the level it would have attained in the absence of the Uruguay Round. By far the greatest percentage gains are predicted for cloth-

[3] The estimates were derived from a computable general equilibrium model linking together: (1) industries (within economies) from lower to higher stages of processing, subject to constraints on the supply of land, labor, and capital; and (2) the economies themselves.

Table 6

Estimated Increase in Merchandise Exports by 2005 from the Liberalization of Trade in Goods, by Major Product Group

Percentage Change in Volume

Product Group or Sector	Version of the Estimating Model[a] Version 1	Version 2	Version 3	Actual Value of Exports in 1992 (Billions of U.S. Dollars)
All Merchandise[b]	8.6	9.6	23.5	2,843
Grains	4.1	4.4	4.6	24.2
Other Agricultural Products[c]	21.1	21.0	22.1	73.8
Fishery Products[c]	13.0	12.9	13.5	26.5
Forestry Products	3.7	4.1	5.6	7.7
Mining	1.6	1.8	3.1	328.4
Primary Steel	8.3	8.4	25.5	76.7
Primary Non-ferrous Metals	3.6	3.9	14.2	52.4
Fabricated Metal Products	5.3	5.4	16.0	57.2
Chemicals and Rubber	5.2	5.4	21.4	251.3
Transport Equipment	11.7	13.6	30.1	320.2
Textiles	17.5	18.6	72.5	93.9
Clothing	69.4	87.1	191.6	105.6
Other Manufactures	4.7	4.7	12.7	1,425.1

[a]Version 1 assumes perfect competition and constant returns to scale (no economies of scale). Version 2 assumes perfect competition and increasing returns to scale in industrial sectors ("external" economies of scale). Version 3 assumes monopolistic competition in industrial sectors and increasing returns to scale within firms ("internal" economies of scale). In the second and third versions of the model, all sectors but grains, other agriculture, forestry, and fishery are assumed to experience economies of scale.

[b]Excluding intra-European Union trade, and including trade in petroleum.

[c]The marginally smaller gains under the second version of the model than under the first result from the shift of resources into sectors whose production was stimulated by the introduction of increasing returns to scale.

Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

ing. In our judgment, the assumptions underlying the higher estimates (version 3) may be somewhat more realistic than the assumptions underlying the lower estimates—provided, of course, that the agreements are carried out.

In Table 7, the estimated increases in trade are allocated by major countries or country groups. China and Taiwan are listed separately from the other developing economies because Taiwan did not participate in the Uruguay Round and China's liberalization commitments were not definitive when the estimates were prepared. While the increases in trade from the liberalization are expected to be widely distributed, by far the largest percentage gains are projected for the developing and transition economies. The explanation, with reference to Table 6, is that these economies have a comparative advantage in the production of clothing, textiles, and other agricultural products, all of which should experience remarkable trade stimulation from the substantial liberalizations planned for them.

More informative than the trade gains are the income gains expected from the liberalization, outlined in Tables 8 and 9. As with Tables 6 and 7, readers can select the version of the estimating model that they think employs the most realistic assumptions. Again, our judgment inclines toward the set of assumptions that yields the highest estimate: that world income (gross product) will be perhaps $510 billion greater in 2005 than it would have been without the liberalization. By comparison, world income was estimated to be $22.3 trillion in 1990 (in 1990 dollars) by the World Bank.[4] This $510 billion gain, it should be noted, is not a one-time windfall, but an enduring increase in yearly income.

If nothing else mattered, the countries or country groups with the largest exports would experience the largest absolute gains in annual income. But other things do matter—in particular, the manner in which the various trade liberalizations interact with a country's economy. More specifically, relaxation of a country's barriers to imports and of foreign barriers to the country's exports encourage shifting of the country's resources into greater production of goods that the country turns out relatively more efficiently, in exchange for which the country can import more of the goods that it cannot produce so efficiently, the net result being an increase for the country in the total supply of goods that it desires.

Some idea of this interaction is conveyed in Table 9, which reports how much each of the three main categories of goods trade liberalization may add to annual income in the major countries or country groups by 2005. The major source of estimated income gains is the relaxation of industrial nontariff barriers—chiefly, MFA quantitative restrictions. Reduction of

[4] World Bank, *World Development Report 1992* (New York: Oxford University Press, 1992), p. 223.

Table 7

Estimated Increase in Merchandise Exports by 2005 from the Liberalization of Trade in Goods, by Major Countries or Country Groups[a]

Percentage Change in Volume

Country or Country Group	Version of the Estimating Model[b] Version 1	Version 2	Version 3	Actual Value of Exports in 1992 (Billions of U.S. Dollars)
World	8.6	9.6	23.5	2,843
Developing and Transition Economies	13.7	15.3	36.7	906.4
European Union	7.3	7.8	19.4	568.7
European Free Trade Association	3.2	3.3	6.3	226.9
United States	7.5	8.2	21.7	448.2
Japan	7.5	8.0	18.3	339.9
Canada	5.3	6.1	16.6	134.1
China	6.1	8.4	26.5	85.0
Taiwan	4.5	5.7	14.4	81.5
Australia and New Zealand	8.4	9.0	24.0	52.3

[a]Excluding intra-European Union trade, and including trade in petroleum.

[b]Version 1 assumes perfect competition and constant returns to scale (no economies of scale). Version 2 assumes perfect competition and increasing returns to scale in industrial sectors ("external" economies of scale). Version 3 assumes monopolistic competition in industrial sectors and increasing returns to scale within firms ("internal" economies of scale).

Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

industrial tariffs becomes the second largest source of income gains if economies of scale are realized in selected nonagricultural sectors, as assumed in version 3.

Removal of the MFA restraints is estimated to reduce rather than enhance the incomes of developing and transition economies, including China and Taiwan, under version 1. Having been obliged to restrict their textile and clothing exports under the MFA, these countries have received scarcity prices, which will fall as their exports of these goods expand with the termination of the MFA. Under assumptions about demand made in version 3, but not version 1, their exports of these goods will expand by more than enough to compensate for the adverse income effect of the decline in price, thus generating a net income gain.

VI. Conclusion

These few pages should have conveyed some idea of the scope, complexity, and achievements of the Uruguay Round. As with many things in life, trade negotiations are not so simple as they once were. Several decades ago, almost all trade was in goods, transported by rail, truck, or

Table 8

Estimated Increase in Annual Income in 2005 from the Liberalization of Trade in Goods, by Major Countries or Country Groups

Billions of 1990 US Dollars

Country or Country Group	Version of the Estimating Model with Static Specifications[a] Version 1	Version 2	Version 3	Version of the Estimating Model with Dynamic Specifications[a] Version 1	Version 2	Version 3
World	109	146	315	184	218	510
Developing and Transition Economies	−1.9	4.1	70.2	−.7	2.7	116.1
European Union	47.7	58.6	103.3	78.5	87.2	163.5
European Free Trade Association	10.1	13.4	23.1	17.5	18.0	33.5
United States	30.4	35.9	75.6	49.2	59.5	122.4
Japan	11.9	15.2	17.0	21.2	19.3	26.7
Canada	2.3	3.0	8.0	3.8	5.0	12.4
China	4.1	8.9	10.1	6.9	14.3	18.7
Taiwan	2.6	4.7	4.5	5.1	8.4	10.2
Australia and New Zealand	1.5	1.9	3.1	2.4	3.6	5.8

[a]Version 1 assumes perfect competition and constant returns to scale (no economies of scale). Version 2 assumes perfect competition and increasing returns to scale in industrial sectors ("external" economies of scale). Version 3 assumes monopolistic competition in industrial sectors and increasing returns to scale within firms ("internal" economies of scale). The dynamic specification assumes that a share of the income gain is saved and invested in new capital.

Note: Detail may not add to totals shown because of rounding.

Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

Table 9
Decomposition of Estimated Increases in Annual Income in 2005 from the Liberalization of Trade in Goods, by Major Countries or Country Groups
Billions of 1990 US Dollars

	Versions of the Estimating Model with the Dynamic Specification[a]							
	Version 1				Version 3			
Country or Country Group	Industrial Tariffs	Industrial Nontariff Barriers	Agri-culture	Total	Industrial Tariffs	Industrial Nontariff Barriers	Agri-culture	Total
Developing and Transition Economies	.3	−12.2	11.2	−.7	33.4	68.4	14.3	116.1
European Union	16.8	42.9	18.7	78.5	33.8	115.1	14.6	163.5
European Free Trade Association	5.5	4.2	7.7	17.5	9.8	17.7	6.0	33.5
United States	7.0	38.4	3.8	49.2	13.7	102.3	6.3	122.4
Japan	10.1	−.4	11.5	21.2	18.1	2.1	6.5	26.7
Canada	−.5	2.7	1.6	3.8	.7	10.2	1.5	12.4
China	9.5	−3.5	.8	6.9	11.6	5.4	1.7	18.7
Taiwan	5.9	−1.3	.5	5.1	7.7	2.1	.4	10.2
Australia and New Zealand	.4	.3	1.7	2.4	3.1	.6	2.1	5.8
Total	55	71	58	184	132	324	53	510
(Percent of total gain)	(30.0)	(38.7)	(31.3)		(25.9)	(63.6)	(10.5)	

[a]Version 1 assumes perfect competition and constant returns to scale. Version 3 assumes monopolistic competition and increasing returns to firm scale in selected sectors. The dynamic specification assumes that a share of the income gain is saved and invested in new capital.
Note: Detail may not add to totals shown because of rounding.
Source: General Agreement on Tariffs and Trade, "The Results of the Uruguay Round of Multilateral Trade Negotiations" (Geneva: November 1994).

ship; and government barriers impeding this trade mainly took the form of tariffs and quotas. Levels of protection were both high and relatively easy to measure, and negotiating reductions was straightforward.

Trade negotiations today are much more complex. Services and intellectual property comprise a much larger share of international commerce, and nontariff barriers, difficult to measure and sometimes even difficult to identify, account for much more of the protection provided to domestic industries. And more countries are involved in the negotiations.

In the face of these complexities, Uruguay Round negotiators made commendable progress. Not only did they agree to lower tariffs substantially, as in previous rounds of negotiations, but they also pledged major reductions in other trade-distorting measures such as quantitative restrictions and subsidies. In addition, they extended basic rules of trade conduct into areas that had escaped such discipline, such as services, as well as reducing barriers in these areas, and they materially strengthened the rules, procedures, and institutions that govern world trade. This was more than a good day's work, and the net benefit to the world could even exceed the $510 billion gain in annual income expected by 2005 from the liberalization of trade in goods alone.

References

Arnold, Bruce Gregory. 1994. *How the GATT Affects U.S. Antidumping and Countervailing-Duty Policy*. A Congressional Budget Office Study. Washington, D.C.: U.S. Government Printing Office, September.

Baldwin, Robert E. 1994. "An Economic Evaluation of the Uruguay Round Agreements." Paper prepared for the National Bureau of Economic Research, Inc., "Beyond the Uruguay Round: Environment, Competition and Regulation," Washington, D.C., October 28.

Clinton, William J. 1993. *Trade Agreements Resulting from the Uruguay Round of Multilateral Trade Negotiations*, Memorandum for the United States Trade Representative, December 15.

Economic Report of the President. 1995. Washington, D.C.: U.S. Government Printing Office, February.

General Agreement on Tariffs and Trade. 1994. "The Results of the Uruguay Round of Multilateral Trade Negotiations." Geneva: General Agreement on Tariffs and Trade, November.

International Monetary Fund. 1994. "Trade Agreement Mandates Broad Changes." *IMF Survey* (January 10), pp. 2–4.

Murphy, Louis J. 1994. "Successful Uruguay Round Launches Revitalized World Trading System." *Business America*, January, pp. 4–6.

United States International Trade Commission. 1994. *The Year in Trade 1993: Operation of the Trade Agreements Program, 45th Report*. USITC Publication 2769, Washington, D.C.: United States International Trade Commission, June.

World Bank. 1992. *World Development Report 1992*. New York: Oxford University Press.

Yeutter, Clayton. 1994. "Uruguay Round: What Was Accomplished . . . An Insider's Assessment." *International Economic Insights*, March/April, pp. 13–16.

Bank Regulatory Agreements in New England

Joe Peek and
Eric S. Rosengren

Professor of Economics, Boston College, and Visiting Economist, Federal Reserve Bank of Boston; and Vice President and Economist at the Federal Reserve Bank of Boston, respectively. *The authors thank Susan Bannon, Peggy Gilligan, Leo Hsu, Tim Lin, and Anthony Storm for providing excellent research assistance.*

New England's recovery from our most recent recession has been marked by unusually slow growth in bank lending. Total bank loans declined 30 percent from a peak in the third quarter of 1989 to a trough in the first quarter of 1993. As of the third quarter of 1994, total loans still had recovered only to 76 percent of the level attained at the peak.

Numerous recent studies have identified low bank capital ratios as a factor contributing to slow growth in loans (Bernanke and Lown 1991; Furlong 1992; Hancock and Wilcox 1992, 1993; Peek and Rosengren 1992, 1994, 1995c; Cantor and Wenninger 1993; Baer and McElravey 1994). While the correlation between weak growth in lending and low capital ratios is now well recognized, a direct link between the level of bank lending and bank regulation has been established only recently (Peek and Rosengren 1995a, 1995b, 1996).

To better understand how regulatory policy might directly influence bank lending, this article examines the ways that bank supervisors intervene when a bank's financial situation deteriorates. Bank supervisors progressively take actions intended to improve banks' prospects for overcoming financial difficulties; they also attempt to limit the exposure of deposit insurance funds to losses from failing banks. If a bank's problems are serious, or if bank management is not sufficiently responsive, regulators will impose a formal action, a legally enforceable agreement requiring a bank to take remedial measures to improve its performance. This study examines the requirements contained in these formal actions and their likely effect on bank behavior.

Among the conditions included in formal regulatory actions, capital requirements have played a key role in altering bank lending behavior. Formal actions normally require that much higher capital-to-asset ratios be attained within two years. Banks with low or no profits and an inability to obtain new capital at reasonable rates are left with only one viable option: to shrink their assets (and liabilities). Unfortunately for many small and medium-sized businesses, much of the shrinkage has occurred within banks' loan portfolios. Thus, the association between low bank capital ratios and slow bank loan growth found in previous studies may be a result of the conditions required in formal actions.

On the other hand, to be effective from a bank supervision standpoint, intervention must have an effect on bank behavior. Formal regulatory actions did alter bank behavior and the intervention occurred relatively early, in many cases well before a bank's reported capital was considered "impaired." And, while the short-term impact on banks is to reduce loans, bank-dependent borrowers may still benefit in the longer run to the extent that supervisory intervention is able to reduce the number of bank failures.[1] By leaving in place valuable historical lending relationships that would have been destroyed had the bank failed, lending to its bank-dependent customers is reduced temporarily rather than eliminated.

I. Formal Actions and the Examination Process

Bank examinations provide an opportunity for supervisors to verify that the practices and procedures instituted by the bank are consistent with safe and sound operations. As part of the verification process, bank supervisors rate the financial condition of the bank, considering the capital adequacy, asset quality, management quality, earnings potential, and liquidity of the institution (CAMEL). The composite CAMEL rating, which can range from 1 to 5, provides an assessment by examiners of the strength of a banking institution. While banks are evaluated on a case-by-case basis, those with a composite rating of 4 ("potential of failure, performance could impair viability") or 5 ("high probability of failure, critically deficient performance"), and some institutions with a CAMEL rating of 3 ("remote probability of failure, flawed performance"), normally will undergo enforcement action.

Bank examinations provide an opportunity for bank supervisors to verify that the practices and procedures instituted by the bank are consistent with safe and sound operations.

As the financial condition of a bank deteriorates, the first major supervisory action is usually the memorandum of understanding (MOU).[2] MOUs are agreements between bank supervisors and a bank detailing actions to improve deficiencies in the bank's operations. These agreements usually discuss changes necessary in management, strategic plans, credit risk assessment, interest risk assessment, capital adequacy, reserving procedures, and management information systems. The MOU offers suggestions that would likely be discussed at the end of any full exam, but it also serves to emphasize that the findings during the exam were not satisfactory. The MOU is not generally made public by the regulator, and is not legally enforceable, so it emphasizes the need for changes by bank management without the potential penalties and attention generated by more serious actions.

If bank supervisors determine that a bank's problems are more serious, they will institute a formal action. A formal action can be either a written agreement or a cease and desist order, with the latter generally viewed by both the bank and the public as the more serious. At least in New England, however, the difference appears to be associated with the primary supervisor of the bank. The Federal Deposit Insurance Corporation (FDIC) normally issues cease and desist orders and the Office of the Comptroller of the Currency (OCC) generally signs formal agreements. Both actions cover the same general areas discussed in a full bank exam or in an MOU. However, because formal actions are legally enforceable agreements with civil penalties for noncompliance, they are viewed as the most serious actions available to supervisors short of closing the bank. Formal actions are also publicly disclosed, resulting in greater public scrutiny of the problems at the bank.

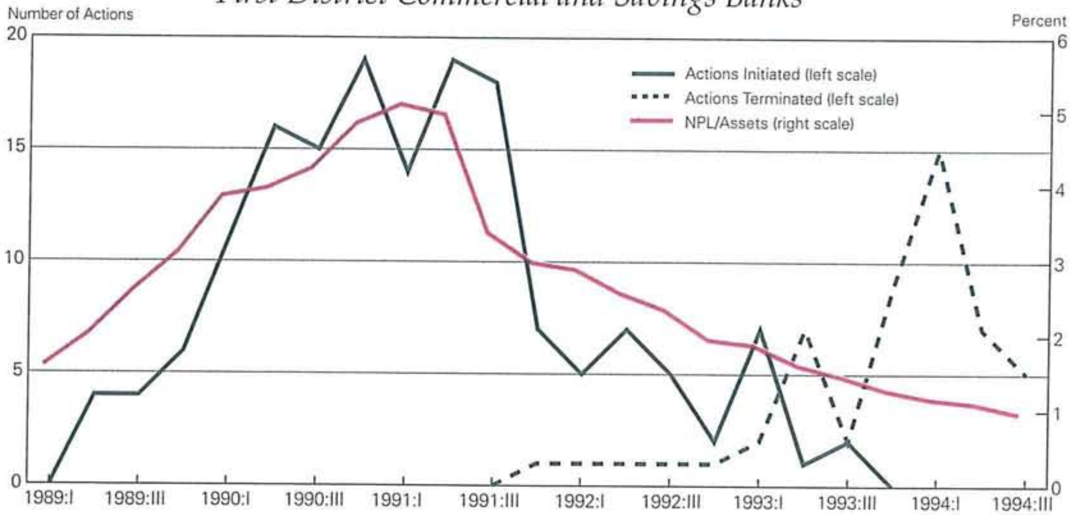
Formal actions are intended to provide supervisory intervention at a bank well before it reaches the point of failure. Figure 1 shows that the rise and

[1] While formal actions do appear to change bank behavior, no attempt is made in this study to determine whether these changes in behavior improve the survival rates of banks. That research is currently under way and will be reported in a future article.

[2] Banks with serious problems may not get an MOU because they immediately receive a formal action.

Figure 1

Enforcement Actions and Ratio of Nonperforming Loans to Assets, First District Commercial and Savings Banks



Source: Board of Governors of the Federal Reserve System, Office of the Comptroller of the Currency, Federal Deposit Insurance Corporation.

subsequent decline in new formal actions in New England closely correspond with banks' ratio of nonperforming loans to assets, where nonperforming loans are defined as the sum of loans past due 90 days or more and nonaccruing loans.[3] Both the number of new enforcement actions and the ratio of nonperforming loans to assets were low in early 1989. They then grew substantially as the New England economy deteriorated and real estate prices slumped. New enforcement actions peaked in the fourth quarter of 1990, and again in the second quarter of 1991. The ratio of nonperforming loans to assets reached a peak around the same time. Both series then dropped sharply, with the subsequent decline continuing at a more moderate pace. By 1993:III when the last formal action was imposed, the ratio of nonperforming loans to assets had returned to a level comparable to that at the beginning of 1989. Consistent with the improving health of the banking sector as reflected in these two series, supervisors began terminating enforcement actions in late 1991. They have continued to do so, with 15 enforcement actions terminated in the first quarter of 1994 alone.

Table 1 indicates the number of FDIC-insured New England banks placed under a formal action, according to the ratio of nonperforming loans to total assets, measured in the quarter in which the examination occurred that resulted in the formal action. Generally, formal actions are imposed when the nonperforming loans ratio is still relatively low: Twenty-nine banks (18 percent) had a ratio below 2 percent at the exam resulting in a formal action, and 73 banks (45 percent) had a ratio below 4 percent.

Table 1 also classifies banks with formal actions according to the size and charter of the organization. "Large" is defined as any bank with at least $300 million in assets at the time of the exam resulting in a

[3] This study dates the formal actions by the date of the examination that resulted in the formal action rather than by the date the formal action is signed. Typically, at the end of the examination, the bank knows the nature of its problems and that it will receive a formal action. During the time between the exam and the signing of the formal action, bank supervisors determine the specific conditions to be stated in the action, often in consultation with the bank's management. Thus, a bank may begin to change its behavior at the time of the exam rather than waiting for the signing of the action. Furthermore, many of the requirements of the formal action are stated as changes required relative to values at the time of the exam rather than values at the time the formal action is signed.

Table 1
Ratio of a Bank's Nonperforming Loans to Assets at the Time of an Examination Resulting in a Formal Action, New England FDIC-Insured Banks[a]

	Total		Large Commercial		Small Commercial		Large Savings		Small Savings	
Nonperforming Loans/Assets (%)	Number	Assets ($ Billions)	Number	Assets ($ Billions)	Number	Assets ($ Billions)	Number	Assets ($ Billions)	Number	Assets ($ Billions)
<2.0	29	7.0	2	2.3	17	1.6	4	2.1	6	1.0
2.0–2.5	11	6.0	3	4.7	6	.7	1	.5	1	.1
2.5–3.0	9	2.7	1	1.8	6	.7	0	0	2	.2
3.0–3.5	14	33.7	4	27.9	5	.8	3	4.7	2	.3
3.5–4.0	10	14.8	2	13.7	6	.5	1	.3	1	.2
4.0–4.5	15	6.6	0	0	5	.4	6	5.4	4	.8
4.5–5.0	12	14.1	3	11.2	7	1.0	1	1.7	1	.2
5.0–5.5	9	11.9	2	10.2	5	.5	1	1.0	1	.1
5.5–6.0	7	1.0	0	0	4	.3	1	.5	2	.2
6.0–6.5	8	3.6	1	.8	3	.4	2	2.1	2	.3
6.5–7.0	6	1.6	1	.4	2	.3	1	.8	2	.1
7.0–7.5	4	1.3	0	0	2	.2	1	.9	1	.1
7.5–8.0	5	4.1	0	0	2	.1	3	4.0	0	0
>8.0	23	8.9	4	2.0	8	.6	9	5.8	2	.4
Total Banks with Formal Actions	162	117.2	23	75.0	78	8.2	34	29.9	27	4.1

[a]This table includes all formal actions on FDIC-insured commercial and savings banks resulting from bank examinations during the period 1989:I through 1993:III in New England, defined here as the First District of the Federal Reserve System. Large banks are defined as those with assets exceeding $300 million at the time of the examination resulting in the formal action.

formal action.[4] Twenty-six percent of large savings banks received formal actions after their nonperforming loans ratio exceeded 8 percent. That was also the case for 17 percent of large commercial, 10 percent of small commercial, and 7 percent of small savings banks. At the other end of the spectrum, small banks were more than twice as likely as large banks to receive their formal actions before their nonperforming loans reached 2 percent of assets.

Because of the size mix of banks receiving formal actions, a much larger percentage of bank assets than of banks came under formal actions. Figure 2 shows that both the share of assets and the share of loans held by banks under formal actions rose from 1989:I through 1990:IV. The series then dips as the Bank of New England and its affiliates, under formal actions at the time and representing the second largest bank holding company in New England as measured by total assets, failed in 1990:IV and their assets were transferred to the FDIC. Both series then resumed their rise as additional banks came under formal actions.[5]

Table 2 shows the leverage ratios of these banks at the time of the exam resulting in a formal action. More than half of the formal actions were imposed on banks before their leverage ratios fell below 5 percent, a level deemed to indicate that a bank was "well capitalized" under the guidelines in the Federal Deposit Insurance Corporation Improvement Act (FDICIA). Thus, in many cases supervisors intervened well before a bank's capital was considered "impaired," even though the capital zones were not defined specifically until well after FDICIA. Only 23 percent of the formal actions were imposed on banks with leverage ratios below 4 percent, while 38 percent were imposed on

[4] Using the exam date to classify size has two potential problems. First, many institutions may have already undergone shrinkage prior to the exam. Second, over time the $300 million cutoff would be slightly different in real terms because of inflation, although the inflation rate was low during this period. If, instead, banks were classified according to size at the beginning of the sample period, other problems would be introduced: many institutions grew significantly as a result of mergers, and some would be classified as small even though they were quite large by the time of the exam.

[5] Total assets under enforcement actions can decline as a result of bank failures as well as declines in assets at banks under formal actions or the termination of a formal action. If all or part of the assets of a failed bank under an enforcement action are transferred to the FDIC and/or a bank not under an enforcement action, the share of assets under formal actions will record a decline.

Table 2

Leverage Ratios of Banks at Exam Resulting in a Formal Action, New England FDIC-Insured Banks[a]

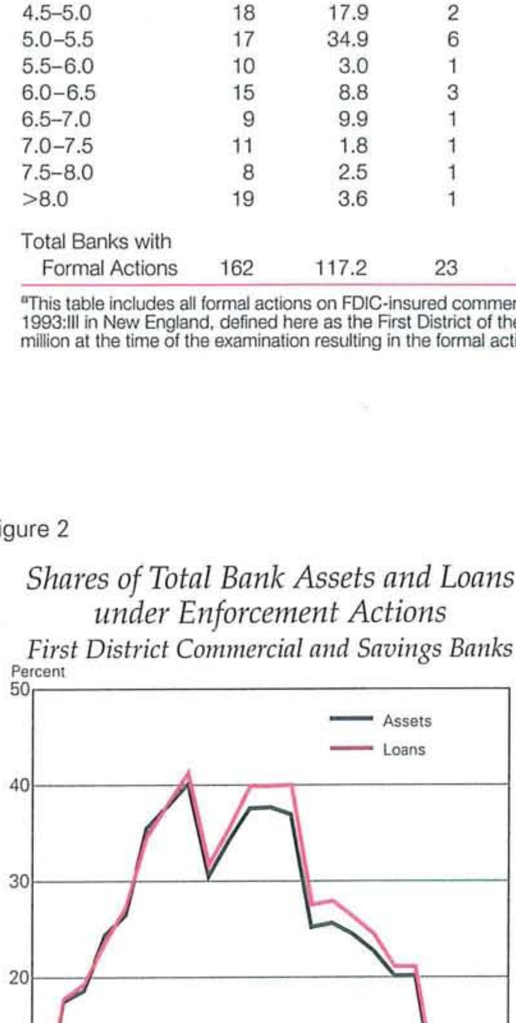
	Total		Large Commercial		Small Commercial		Large Savings		Small Savings	
Leverage Ratio	Number	Assets ($ Billions)	Number	Assets ($ Billions)	Number	Assets ($ Billions)	Number	Assets ($ Billions)	Number	Assets ($ Billions)
<4.0	38	21.6	4	11.3	16	1.5	10	7.6	8	1.2
4.0–4.5	17	13.3	3	3.8	7	1.0	5	8.3	2	.2
4.5–5.0	18	17.9	2	13.7	9	.9	5	3.1	2	.1
5.0–5.5	17	34.9	6	30.1	6	.7	1	3.4	4	.7
5.5–6.0	10	3.0	1	.5	4	.4	3	1.8	2	.3
6.0–6.5	15	8.8	3	5.7	5	.6	4	1.9	3	.6
6.5–7.0	9	9.9	1	8.7	7	.8	1	.4	0	0
7.0–7.5	11	1.8	1	.6	6	.4	1	.3	3	.5
7.5–8.0	8	2.5	1	.4	5	.4	2	1.8	0	0
>8.0	19	3.6	1	.3	13	1.4	2	1.3	3	.5
Total Banks with Formal Actions	162	117.2	23	75.0	78	8.2	34	29.9	27	4.1

[a]This table includes all formal actions on FDIC-insured commercial and savings banks resulting from bank examinations during the period 1989:I through 1993:III in New England, defined here as the First District of the Federal Reserve System. Large banks are defined as those with assets exceeding $300 million at the time of the examination resulting in the formal action.

Figure 2

Shares of Total Bank Assets and Loans under Enforcement Actions

First District Commercial and Savings Banks



Source: Board of Governors of the Federal Reserve System, Office of the Comptroller of the Currency, Federal Deposit Insurance Corporation.

banks with a leverage ratio exceeding 6 percent, a level more than twice the minimum required for the healthiest banking institutions to satisfy capital requirements and substantially above the capital deemed adequate in FDICIA.[6]

Smaller institutions were more likely than larger institutions to receive their formal actions while their leverage ratios were still relatively high. In fact, approximately 15 percent of the formal actions imposed on small savings and commercial banks occurred while their leverage ratios were still above 8 percent. Savings banks were the least well-capitalized at the time formal actions were imposed. Approximately 30 percent of the savings banks had a leverage ratio below 4 percent at the time they received a formal action.

[6] It might appear surprising that banks with leverage ratios exceeding 6 percent came under formal actions. This occurred for at least three reasons. First, formal actions may be imposed on banks with severe problems with management information systems (predominantly smaller banks), making it difficult for examiners to ascertain the true financial health of the bank, even though reported capital may be high. Second, as a consequence of their examinations, several of these banks saw their leverage ratio drop well below 6 percent after they had fully reserved for their problem loans, suggesting that their reported leverage ratio at the time of the examination was overstated. Third, some banks with leverage ratios exceeding 6 percent were subjected to a formal action at the same time as other, poorly capitalized banks within the same holding company, in order to limit transfers of assets from poorly to better capitalized affiliates.

Table 3
Conditions Contained in Formal Regulatory Actions at FDIC-Insured Commercial and Savings Banks, New England[a]

		Required Leverage Capital Target (Percent of Assets)					Increase in Loan Loss Reserve (Percent of Assets)		
Total Banks[b]	Banks with Formal Actions	<5	5–6	6	6–7	>7	≥1	<1	Increase Not Quantified
493	162	1	20	98	13	8	56	39	67

[a]This table includes all banks under formal actions resulting from examinations of FDIC-insured commercial and savings banks during the period 1989:I through 1994:I in New England, defined here as the First District of the Federal Reserve System.
[b]Measured as of 1989:I.

II. Remedial Measures in Formal Actions

Formal actions are intended to provide specific recommendations for actions by banks to prevent further deterioration in their financial condition. Many of the requirements of a formal action are qualitative rather than quantitative. These recommendations may include improved management information systems, greater oversight of credit risks, and improved reserving procedures.

For example, examiners generally sample the loan portfolio to determine whether the classification of loans by the bank is consistent with that of the examiners. Examiners categorize loans as loss, doubtful, substandard, special mention, and not criticized. Loans categorized as loss indicate that the loan is uncollectible. Loans categorized as doubtful are loans where "the collection or liquidation in full is highly questionable and unlikely." Loans categorized as substandard are "inadequately protected by the current sound worth and paying capacity of the obligor or of the collateral pledged." Loans categorized as special mention are "currently protected but are potentially weak." Loans not criticized have no clearly identified weakness. The bank's loan loss reserve is normally evaluated against the classified loans in its portfolio. If examiners determine that the amount of classified loans has been understated by the bank, they are likely to be critical of the bank's risk identification system and to require a recategorization of loans to more closely reflect their actual status as perceived by the examiners.

In addition to such general management recommendations, which frequently are the result of deficiencies found during the examination process, several specific quantitative requirements are usually stated in the formal action. By far the most common are requirements to improve capital ratios, or at least to maintain them at a particular level.

Table 3 shows the conditions included in formal regulatory actions for FDIC-insured New England banks, from the first quarter of 1989 to the third quarter of 1993. One-third of FDIC-insured commercial and savings banks in New England had formal actions. If confidential MOUs were included, the share of banks under regulatory actions would be significantly larger. Many of the 1989 and 1990 formal actions required banks to maintain a capital ratio of at least 8 percent under the old capital definitions (primary capital).[7] More recent formal actions have tied the specific targets to the leverage ratio, and, in some cases, to risk-based capital ratios. The most common capital target in these actions was a 6 percent leverage ratio. Thus, these formal regulatory actions required leverage ratios twice the minimum required by the leverage capital requirements for the strongest institutions.

If no new capital can be raised through new equity issues or through retained earnings, the bank may need to shrink dramatically. Consider a bank whose leverage ratio was 4 percent. To achieve a 6 percent leverage ratio through asset shrinkage alone, the bank's assets would have to decline by 33 percent.

Table 3 indicates that many banks were also required to increase their loan loss provisions substantially, which, in the absence of current earnings, de-

[7] The capital ratio based on the old definition of capital, referred to as primary capital, was mainly composed of equity capital, goodwill, and allowance for loan and lease losses, divided by the sum of the quarterly average of assets and the allowance for loan and lease losses minus goodwill. (See Regulation Y, appendix B, pages 58–59 for more details.)

creases their capital. Roughly 60 percent of the formal actions described in Table 3 required specific increases to the loan loss reserve. This suggests that many of these banks previously had been underreserved. At many of the institutions, the increases were large, with 56 of the formal actions requiring an increase in reserves of 1 percent or more of total assets. Raising the required capital-to-asset ratio while simultaneously requiring loan loss provisions that decrease a bank's capital amplifies the procyclical nature of the implementation of capital regulations.

III. Bank Reactions to Formal Actions

Table 4 shows how banks responded during the year following a bank examination that resulted in a formal action. The leverage ratio improved in only 42 banks (31 percent), even though 35 banks increased their equity capital (26 percent) and 111 shrank their assets (82 percent). Only 58 banks shrank their holdings of securities (43 percent), yet 123 shrank their total loans (90 percent), and 110 banks shrank their commercial and industrial loan portfolios (81 percent).

Table 5 shows the magnitude of the bank responses one year following the enforcement action. The shrinkage at most banks was dramatic (Panel A). Almost 40 percent of all FDIC-insured banks with formal actions had declines in assets of more than 10 percent within one year. And loan shrinkage was even more dramatic, with nearly 60 percent having registered declines in excess of 10 percent and 20 percent registering declines in excess of 20 percent. Of the 13 banks that increased their loans, only three had leverage ratios below 6 percent, and all four banks that increased their loans by more than 10 percent had leverage ratios above 6 percent.

Even though these banks were under pressure to raise their capital ratios, only one-quarter increased their capital and less than one-third succeeded in increasing their leverage ratio (Panel B), even with the (often dramatic) shrinkage of assets that occurred at most of these banks. Almost one-half of the sample had declines in their leverage ratio in excess of 1 percentage point. In large part, this occurred because of the widespread declines in capital, most often associated with the increased levels of loan loss reserves mandated by the formal actions, and the need to replenish loan loss reserves following loan charge-offs, many of which were required by the formal actions.

These results are consistent with results reported in Peek and Rosengren (1995b), who found that New England banks shrank as a result of formal actions. These effects were found to be statistically significant,

Table 4
FDIC-Insured Banks' Responses One Year Following a Formal Action, New England[a]

			Number of Banks Whose					
Leverage[b] Ratio	Number	Assets[b] ($ Billion)	Assets Declined	Securities Declined	Loans Declined	CI Loans Declined	Leverage Ratio Increased	Equity Increased
<4.0	26	18.4	23	14	24	18	5	1
4.0–4.5	13	9.2	13	6	13	11	6	3
4.5–5.0	17	5.4	16	5	16	13	10	9
5.0–5.5	12	3.3	9	5	12	11	4	4
5.5–6.0	9	2.5	7	6	9	7	4	2
6.0–6.5	15	8.8	12	8	14	14	4	4
6.5–7.0	8	1.2	6	2	6	6	2	3
7.0–7.5	11	1.8	8	1	9	10	3	4
7.5–8.0	8	2.5	7	4	7	8	2	2
>8.0	17	2.7	10	7	13	12	2	3
Total	136	55.7	111	58	123	110	42	35
% Total	100	100	81.6	42.6	90.4	80.9	30.9	25.7

[a]This table omits the 15 banks that either failed or were acquired during the year following their formal action and the 11 of the remaining banks that engaged in mergers or acquisitions during the year subsequent to their formal action.
[b]Measured at time of exam resulting in formal action.

even though the estimated equation included a variety of other variables to proxy for loan demand shocks, including variables to capture portfolio concentrations of the individual banks and over 100 time and location dummy variables. In addition, the loan supply constraints associated with formal regulatory actions were found to be particularly important at small banks and in lending categories likely to be dominated by borrowers dependent on bank financing.

To determine the magnitude of the effect of formal actions on this study's sample of all New England banks, the following regression taken from Peek and Rosengren (1995b) was reestimated:

$$\frac{\Delta LN_{i,t}}{A_{i,t-1}} = \alpha_1 + \left(\alpha_2 + \alpha_3 \frac{K_{i,t-1}}{A_{i,t-1}}\right) FA_{i,t} + \alpha_4 \frac{K_{i,t-1}}{A_{i,t-1}} (1 - FA_{i,t}) + \beta X_{i,t-1} + \epsilon_{i,t} \quad (1)$$

The dependent variable is the change in total loans of bank i scaled by total assets of bank i. The equation includes a dummy variable for formal actions (*FA*) with a value of one for any quarter the bank is under a formal regulatory action and zero otherwise.

Because formal actions specify a leverage ratio, usually 6 percent, that the bank is legally required to achieve, the most poorly capitalized banks have the greatest incentive to shrink. Thus, the magnitude of the effect of formal actions on the change in loans may differ across banks, in particular because it is related to a bank's beginning-of-period (end-of-previous-period) leverage ratio. Consequently, the coefficient on *FA* has been specified to be a function of the leverage ratio, with α_3 predicted to be positive. We also have included the leverage ratio for banks not under a formal action as an argument in the equation to allow for the possibility that a bank would respond by voluntarily rebuilding its capital ratio even in the absence of a formal action. That is, this specification allows one to distinguish between bank responses that are voluntary and those that are imposed by regulators. We anticipate that being below minimum capital requirements may not in itself generate a bank response to restore its capital position in the absence of formal regulatory actions, implying that $\alpha_3 > \alpha_4$.

While many of the differences across banks in the demand for loans will be ameliorated by concentrating on banks in one geographic region, Peek and Rosengren (1995b) also includes a series of classification variables intended to control for any remaining differences in loan demand shocks arising from a bank's size, its specialization in particular types of lending activities, volume of troubled loans, and bank charter type, as well as a set of dummy variables for each of the six New England states interacted with a set of quarterly time dummy variables, one for each quarter in the sample. The estimation technique is a variance components model. For a more detailed description of the estimation technique and variables, see Peek and Rosengren (1995b).

Table 5
FDIC-Insured Banks' Response One Year Following Formal Action, New England[a]

Percent Change[b]	Panel A Number of Banks: Change in Assets / Assets	Change in Loans / Loans
>20	4	2
10 to 20	5	2
5 to 10	5	1
0 to 5	11	8
−5 to 0	29	19
−10 to −5	29	27
−15 to −10	29	32
−15 to −20	13	17
−20 to −25	6	14
−25 to −30	5	9
<−30	0	5
Total	136	136

Percent Change[b]	Panel B Number of Banks: Change in Capital / Assets	Percentage Point Change in Leverage Ratio
>1	6	12
.5 to 1	7	15
0 to .5	22	15
−.5 to 0	17	18
−1 to −.5	18	11
−2 to −1	24	24
−3 to −2	14	16
−5 to −3	14	11
−10 to −5	13	11
<−10	1	3
Total	136	136

[a]This table omits the 15 banks that either failed or were acquired during the year following their formal action and the 11 of the remaining banks that engaged in mergers or acquisitions during the year subsequent to their formal action.

[b]Change from the quarter in which the exam occurred that resulted in the formal action.

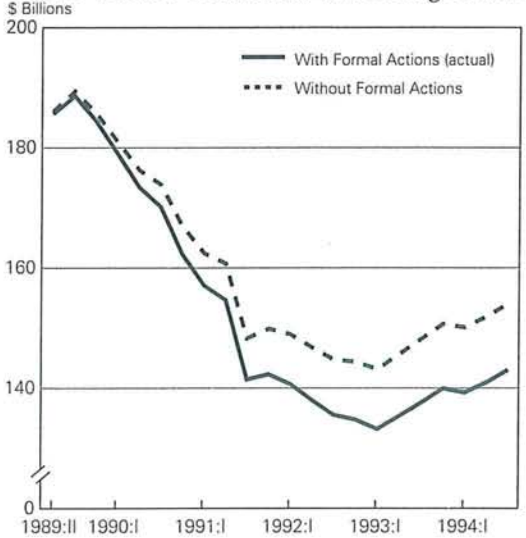
Using estimates of equation 1 for total loans on the sample of FDIC-insured New England commercial and savings banks for the period 1989:II to 1994:III, it is possible to calculate the total effect of the formal actions on bank lending. Because leverage ratios with and without formal actions have different estimated impacts, the effect of the leverage ratio also must be incorporated in order to calculate the net impact of formal actions on loan volumes. That is, it is necessary to calculate the magnitude of the effect over and above what would have occurred because of low leverage ratios in the absence of formal actions. The total effect of formal actions is thus calculated as $\alpha_2 + (\alpha_3 - \alpha_4) * K/A$ summed over all banks under formal actions.

Figure 3 shows the path of actual bank loans in New England during the 1989:II to 1994:III period, compared to the estimate of the magnitude of bank loans in the absence of formal actions. The latter path is derived by adding to actual loans the measure of the reduction in bank loans attributable to formal actions.

Figure 3

The Decline in Bank Loans with and without Formal Actions[a]

First District Commercial and Savings Banks



a Loans without formal actions are calculated as actual loans ("with formal actions") plus the imputed effect of formal actions on loan growth based on estimated coefficients from Equation 1 (see text).

Source: Board of Governors of the Federal Reserve System, Office of the Comptroller of the Currency, Federal Deposit Insurance Corporation.

The figure shows that from the peak in 1989:III to the trough in 1993:I, loans held by New England banks dropped by 30 percent. Of that $55 billion decline in bank loans, 18 percent ($10 billion) can be attributed to formal actions. The magnitude of the decline that can be attributed to formal actions indicates that these regulatory actions contributed to the credit crunch that occurred in New England during this period.

The correlation between bank capital and loan shrinkage found in earlier studies has a regulatory link, through the requirements imposed in formal actions.

As of the third quarter of 1994, 52 of the outstanding formal actions had been terminated because of the improved financial health of the banks. As Figure 1 showed, the imposition of formal actions has essentially ceased in New England and terminations are on the upswing. The combination of terminations and the failures or acquisitions of banks under formal actions left slightly less than 50 formal actions still in effect at the end of the third quarter of 1994. With at least one-third of these remaining actions terminated in late 1994 and early 1995, and with additional terminations of formal actions likely to occur over the next several quarters given the dramatic improvement in the financial conditions of New England banks, much of the restraint on bank lending arising from formal actions has been mitigated. Thus, the recent episode of the supply-induced decrease in bank lending in New England associated with formal regulatory actions now should have come to a close.

IV. Conclusion

The widespread imposition of formal regulatory actions on New England banks contributed to the decline in bank lending in that region since 1989. Formal actions that require significant improvements in bank capital ratios over periods as short as two years induced banks to shrink their loan portfolios. This study documents that the correlation between bank capital and loan shrinkage found in earlier studies has a regulatory link, through the requirements imposed in formal actions.

Such a supply-induced shrinkage in credit availability can be a serious obstacle to bank-dependent customers of troubled or failed banks. In the event that their loans are called (or their primary lender fails), these bank-dependent customers may have few, if any, alternative sources of credit in their local banking market. Because the recent banking problems were so widespread in New England, few banks were in a financial position to offset reductions in lending by more troubled institutions.

As formal actions have been, and continue to be, terminated, the regulatory impediments to an expansion of lending by New England banks will erode. Nonetheless, an understanding of how regulatory policy can affect lending and the local economy is important, if regulators are to avoid magnifying future banking cycles. While research to date has documented that regulatory actions change bank behavior, it remains an open question whether fewer banks failed as a result of the formal actions. If the formal actions prevented still more bank failures, then in the absence of such aggressive regulatory intervention, increased numbers of failures might have resulted in even greater loan shrinkage.

References

Baer, Herbert and John McElravey. 1994. "Capital Adequacy and the Growth of U.S. Banks." In C. Stone and A. Zissu, eds., *Global Risk-Based Capital Regulation: Management and Funding Strategies*, Vol. 2. Burr Ridge, IL: Dow-Jones Professionals.

Bernanke, Ben S. and Cara S. Lown. 1991. "The Credit Crunch." *Brookings Papers on Economic Activity*, No. 2, pp. 205–48.

Cantor, Richard and John Wenninger. 1993. "Perspectives on the Credit Slowdown." Federal Reserve Bank of New York *Quarterly Review*, vol. 18, Spring, pp. 3–36.

Furlong, Frederick T. 1992. "Capital Regulation and Bank Lending." Federal Reserve Bank of San Francisco *Economic Review*, No. 3, pp. 23–33.

Hancock, Diana and James A. Wilcox. 1992. "The Effects on Bank Assets of Business Conditions and Capital Shortfalls." In *Credit Markets in Transition*, Proceedings of the 28th Annual Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, May, pp. 502–20.

______. 1993. "Was There a 'Capital Crunch' in Banking? The Effects on Real Estate Lending of Business Conditions and Capital Shortfalls." *Journal of Housing Economics*, vol. 3(1), December, pp. 31–50.

Jones, David S. and Kathleen Kuester King. 1994. "The Implementation of Prompt Corrective Action: An Assessment." *Journal of Banking and Finance*, vol. 19(1), forthcoming.

Peek, Joe and Eric S. Rosengren. 1992. "The Capital Crunch in New England." *New England Economic Review*, May/June, pp. 21–31.

______. 1994. "Bank Real Estate Lending and the New England Capital Crunch." *Journal of the American Real Estate and Urban Economics Association*, vol. 22(1), pp. 33–58.

______. 1995a. "Bank Regulation and the Credit Crunch." *Journal of Banking and Finance*, vol. 19(1), forthcoming.

______. 1995b. "Banks and the Availability of Small Business Loans." Federal Reserve Bank of Boston Working Paper Series No. 95-1, January.

______. 1995c. "The Capital Crunch: Neither a Borrower Nor a Lender Be." *Journal of Money, Credit and Banking*, forthcoming.

______. 1996. "Bank Regulatory Agreements and Real Estate Lending." *Journal of the American Real Estate and Urban Economics Association*, forthcoming.

The Impact of Employer Payments for Health Insurance and Social Security on the Premium for Education and Earnings Inequality

Jane Sneddon Little

Senior Economist, Federal Reserve Bank of Boston. *The author is most grateful to Katharine Bradbury, Catherine Jew, and Stephen McNees for helpful suggestions and to Rachel Deyette for valuable research assistance.*

The trend toward increased wage and income inequality that emerged in the 1980s—with "the rich getting richer and the poor poorer"—has attracted a great deal of attention and concern. Journalists have brought the growing gap between workers on the top and bottom rungs of the earnings ladder to the public's attention,[1] while academics have sought the reasons for the change. One aspect of this phenomenon has been the growing premium for education, with the disparity between the wage and salary earnings of the least and best educated rising since 1979. Explanations generally focus on the slowing growth in the supply of college-trained workers entering the labor force as the baby boom generation has matured and, on the demand side, the widespread adoption of new technologies requiring skilled workers. However, many economists find that these explanations are not fully satisfactory. A related observation, also not fully understood, involves the increased earnings inequality among similar workers—young, male, high school graduates working full-time, year-round, for example. This rising within-group inequality occurred in the 1970s as well as the 1980s, unlike the increased between-group inequality seen only in the 1980s.

This exploratory article seeks to broaden the discussion by asking whether the rising cost of another element of compensation—employer-provided health insurance and employer payments for FICA taxes—has contributed to the growth in observed and actual inequality among workers over this period. The cost of these two benefits increased from 11 percent of total compensation in 1970 to 17 percent in 1990.[2] Because the cost of these fringe benefits looms large in comparison to the lowest wages, these employer obligations would be expected to take a relatively large bite out of the wages of workers on the bottom rung.[3] Since workers with few years of work experience or schooling also tend to earn low wages, this country's job-based system for financing health insurance and Social Security may have exaggerated the premium for education (and the growth in that premium) found when compensation is measured by wages alone. The rising cost of these benefits might also help to explain the observed increase in within-group inequality for groups defined in a variety of ways, including at the industry or plant level.

On the other hand, the share of the population covered by employer-provided health insurance has shrunk over this period as health insurance costs have soared and as the structure of employment has shifted from manufacturing, mining, and transportation (where health insurance benefits are common) to services (where they are less so). It seems quite likely, moreover, that the declining availability of employer-provided health insurance may have hit less-skilled workers particularly hard. If so, measures of the growth in between-group and within-group inequality based on wage trends would understate the real growth in compensation inequities.

The cost of employer-provided health insurance and employer payments for FICA taxes increased from 11 percent of total compensation in 1970 to 17 percent in 1990.

Although several studies have explored the impact of including health insurance benefits and worker payments for FICA on family or household income inequality,[4] discussions of the premium for education are generally based on relative wages rather than on the theoretically preferable concept of total compensation. Compensation is the preferred measure because that total is the value set by supply and demand conditions. If some component of total compensation—employer payments for health insurance, for example—rises as a share of the total, then, other things equal, real wages or other fringe benefits should fall. For this reason, using wage behavior as an indicator of changing supply and demand conditions could be misleading. Moreover, in addition to signaling imbalances in the supply of and demand for specific types of labor, an index of inequality can also serve as a gauge of economic or social equity. From this second perspective too, adding the value of health insurance and Social Security benefits to wages results in a better measure of inequalities in all forms of remuneration than wages alone.

Admittedly—and particularly from the workers' perspective—this modification improves our measure of economic equity only partially because the value of these benefits is not equal for each employee. For example, health care costs vary considerably across states, and some workers might obtain insurance through a spouse's employer. Similarly, while employers view their legally required FICA tax payments as "benefits," the amount paid for each employee has little correlation with the value of the Social Security benefits that the employee eventually receives. Moreover, all face different tax situations. Thus, individual workers might prefer higher wages in lieu of certain benefits.

Researchers have been forced to use wages in studying the premium for education because other components of total compensation have not been available in a data base linking pay with personal characteristics like age (experience) and years at school. However, starting with the March 1980 Current Population Survey, the U.S. Bureau of the Census has collected information on employer-provided insurance and employee and (because they are equal) employer contributions for Social Security. The Bureau of the Census has been publishing this information, including estimates of the value of employer-provided insurance for Census respondents, starting with the March 1988 survey.

This study uses a small part of the published and unpublished data to explore the impact of employer

[1] Indeed, a recent article on the front page of *The New York Times* (Bradsher 1995) presented recent and forthcoming research indicating that among the industrial countries the United States has the most unequal distribution of income and wealth.

[2] As a share of benefits, moreover, employer payments for group health insurance and for Social Security—Old Age, Survivors, and Disability Insurance (OASDI) and Medicare hospital insurance (HI)—jumped from 46 percent to 63 percent over the same period.

[3] Federal Insurance Contributions Act (FICA) taxes are proportional to wages only *up to* the maximum taxable earnings or wage base. This ceiling on taxable earnings results in the FICA taxes having a disproportionately small impact on the wages of workers whose earnings exceed the cutoff. The wage base for OASDI has risen from \$22,900 in 1979 to \$55,500 in 1992; the base for HI has risen from \$22,900 to \$130,200 over the same period.

[4] Data in a study titled *Measuring the Effect of Benefits and Taxes on Income and Poverty: 1979 to 1991* (U.S. Bureau of the Census 1992) show that including health insurance benefits reduces family income inequality slightly, while including worker payments for FICA increases income inequality in any given year. However, these data also indicate that including health insurance benefits in income increases the *growth* in income inequality (measured by the Gini index) between 1979 and 1992.

payments for health insurance and FICA on the observed and actual premium for education from 1979 to 1992 for males[5] working full-time and year-round.[6] It concludes that adding the cost of health insurance to wages boosts the rise in the premium for education for all males working full-time, year-round, by as much as 25 percentage points, because over this 13-year period men with relatively little education lost access to jobs with health benefits to a disproportionate extent. For all full-time male workers, moreover, adding the cost of health insurance to wages also increases the growth in inequality within narrowly defined groups.[7]

The decreased availability of jobs with health insurance has had a particularly severe impact on less-skilled workers.

By exception, for the more limited group of men with employer-provided health insurance, adding the cost of these benefits to wages reduces the observed premium for education in any given year and the growth in that premium during the 1980s,[8] as expected. Adding insurance payments to wages also tends to moderate the rise in within-group inequality for men with job-based health benefits.

In sum, then, the decreased availability of jobs with health insurance has had a particularly severe impact on less-skilled workers. As a result, the compensation of full-time male workers has actually become substantially more unequal since 1979 than the traditional measure based on wages alone indicates. The article ends with a brief consideration of the policy implications of these results.

I. The Premium for Education: The Picture to Date

According to Frank Levy and Richard Murnane's extensive review of trends in U.S. earnings levels and inequality and proposed explanations for these developments (Levy and Murnane 1992), inequality *between* groups of men defined by age and education declined slightly in the 1970s and grew in the 1980s. By contrast, inequality *within* groups defined by age and education grew steadily through both decades. Very important in explaining the decline in the education premium in the 1970s was the entry of large numbers of the relatively well-educated members of the baby boom generation into the labor force, starting in the late 1960s.[9] Between 1971 and 1979, the number of 25- to 34-year-old male college graduates in the labor force increased by 85 percent while the number of young male high school graduates rose just 13 percent. As a consequence of this influx, the premium for experience rose and the premium for a college education fell. During the 1980s, by contrast, the number of young college-educated males in the labor force grew slightly more slowly than the number of young high school graduates—perhaps because of the decline in the education premium during the 1970s and the move to a volunteer army.[10]

Table 1 shows the distribution by age and level of education for men working full-time, year-round in the two years used in this study, 1979 and 1992. In 1979 the first baby boomers were 33 years old. By 1992, the leading edge of the baby boom was just entering the 45–54 years of age category.

It is generally agreed, however, that the change in the relative supply of young college graduates does not fully explain the dramatic rise in the premium for education seen in the 1980s. Changes in the demand for skilled labor must also have been at work. Indeed, as Olivier Blanchard (1995) put it, the situation is best

[5] This exploratory study focuses on males because the increase in the education premium during the 1980s noted by other studies for both men and women was particularly pronounced for men. In addition, the issue of the changing availability of employer-provided health insurance is undoubtedly clarified by examining men since they have held a disproportionate number of jobs in the industries, like manufacturing and transportation, that have traditionally offered employer-paid health insurance.

[6] While it clearly would be preferable to have data for other components of total compensation, the employer cost of many of the excluded benefits, like vacation and sick pay, tends to be proportional to the individual worker's earnings; thus, these excluded benefits are less likely to have a disproportionate impact on the lowest wages.

[7] Including FICA payments (where coverage has increased rather than contracted) tends to reduce the growth in the premium for education slightly but increases the growth in within-group inequality.

[8] Except in the case of young, less educated workers, as will be discussed more fully below.

[9] The first cohort of the baby boom (born in 1946) graduated from high school in 1964 and from college in 1968; thus, baby boom high school graduates began entering Census tabulations of the work force in 1965 while those with college degrees typically were included as full-time workers beginning in 1969.

[10] Particularly during the Vietnam War, the existence of the draft may have given some young men an added incentive to continue their education in order to postpone or avoid military service. With the shift to a volunteer army, this added incentive to stay in school disappeared.

Table 1
Distribution of Males Working Full-Time, Year-Round, by Education and Age, 1979 and 1992
Percent

1979	25–34	35–44	45–54	Total	Memo on 25–34[a]
<High School	3.30	4.35	6.55	14.19	8.1
HS Diploma[b]	13.02	11.02	9.75	33.80	32.0
Some College	10.25	6.56	4.28	21.10	25.2
Coll Diploma[b]	8.39	4.45	3.71	16.55	20.6
Grad School	5.77	5.07	3.51	14.36	14.2
Total	40.74	31.46	27.80	100.00	100.0

1992	25–34	35–44	45–54	Total	Memo on 25–34[a]
<High School	3.08	2.70	2.46	8.25	8.5
HS Diploma[b]	12.75	11.64	8.04	32.43	35.0
Some College	9.75	10.47	6.60	26.82	26.7
Coll Diploma[b]	8.30	8.25	4.40	20.95	22.8
Grad School	2.57	4.77	4.21	11.55	7.0
Total	36.46	37.83	25.72	100.00	100.0

[a]Memo: educational mix of 25- to 34-year-old males working full-time, year-round.
[b]Because of changes in the survey questions, in 1979 men in these categories attended high school or college, respectively, for four years but did not necessarily receive a diploma. In 1992, these men received diplomas.
Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

described as "a race, over the last twenty years, between increases in relative demand for skills and increases in relative supply. In the 1970s, relative supply won; in the 1980s, relative demand won. But in both decades, the race has been fast on both sides."

Two frequently cited explanations for the rise in the demand for skilled workers include the growth in world trade with a consequent decrease in the demand for unskilled workers in the United States and the other industrialized countries, and the spread of new technologies that increase the productivity of, and thus the relative demand for, highly skilled workers. Economists still have not entirely sorted out the relative contributions of these and other explanations (like the declining importance of trade unionism) to the increased premium for education, although the majority tend to give most weight to the technology-based explanations.[11] Whatever their relative importance, however, these developments together do not appear to account for the entire change.[12]

Another important unsolved piece of the puzzle, according to Levy and Murnane, concerns the 20-year trend of rising earnings inequality within narrowly defined groups. For example, analysts have noted an increase in inequality among workers of similar age and skills even within a given industry or firm. Because "skill" is usually measured by years at school,[13] one suggested cause of this rise in within-group inequality (with the groups defined by age and years of education) is an increase in the demand for specific vocational skills or for abilities not necessarily associated with years of formal education—interactive skills like mentoring, negotiating, or supervising, for example.

Cross-country comparisons point to still another aspect of the wage gap phenomenon requiring explanation. While many OECD countries experienced a growing premium for education during the 1980s, wage dispersion increased more dramatically in the United States than in most other industrialized countries examined so far (Higgins 1994). This observation raises the role of institutional differences and their contribution to growing inequality in labor compensation.

[11] Although often treated as contending, these two explanations are not necessarily incompatible. For example, increased foreign competition may have prompted some U.S. firms' efforts to improve productivity. In addition, while some analysts argue that the rise in the premium for education in many countries in different stages of development indicates that trade pressures cannot be an important reason for the rise in inequality here in the United States, U.S. firms often respond to rising foreign competition by establishing affiliates overseas. They then export U.S. capital equipment and production methods to these affiliates. As foreign workers using these new methods become more productive, their rising wages could exhibit a growing premium for education similar to that seen in the United States. Accordingly, increased income inequality in foreign countries, including the LDCs, could be a corollary of increased inequality caused by trade pressures experienced here in this country. Finally, many observers have deemphasized the trade-based explanations by suggesting that the rise in the U.S. merchandise trade deficit has simply been too small to account for much of the growing wage gap. However, this country's rising surplus in services trade may have augmented trade's role, since increased foreign demand for U.S. business and professional services may have boosted the demand for skilled workers within the service sector at the same time that the growing merchandise deficit has helped reduce demand for low-skilled production workers in manufacturing.

[12] Brauer and Hickok (1995), for example, find that technology, trade, and shifts in product demand across industries account for just 35 to 40 percent of the widening hourly wage gap between college graduates and high school graduates or dropouts between 1979 and 1989.

[13] Of course, years at school may not be a very good measure of skill, especially since the quality of those years at school could vary considerably.

Altogether, recent reviews of the literature[14] suggest that much work remains to be done in untangling the many intertwined developments that have contributed to growing labor income inequality in recent years. This article does not attempt to assess the relative merits of the explanations already posited. Rather it explores the impact of expanding our measure of compensation to include health benefits and payroll taxes for Social Security.

II. The Impact of Including Health and Social Security Benefits

To broaden the discussion of earnings inequality, this article examines the impact of shifting from wages towards compensation by adding employer contributions for health insurance and FICA taxes to pre-tax wage and salary earnings[15] in measuring the premium for education and within-group inequality. The first step involved identifying in the Current Population Surveys conducted in 1980 and 1993 all males working full-time, year-round. These men were then classified by age (as a proxy for experience) and by years of education; a subgroup included men with employer-provided health insurance.[16]

The Premium for Education

Tables 2 and 3 show the ratios of the median annual wage and salary earnings for the members of each education group to the median for high school dropouts of the same age/experience; Table 2 provides data for males with health insurance benefits, while Table 3 covers all males. The columns labeled "W" measure the education premium in the traditional way, using annual wage and salary earnings. In the columns labeled "W+H," compensation includes employer contributions for health insurance. The tables show the results for insured men (Table 2) and for all men (Table 3) separately in order to distinguish the impact of employer payments for health insurance on wages and compensation from the impact of insurance availability.

In both tables, the ratios based on wages exhibit the premium for education noted in previous studies. Referring to Table 2, for example, in 1992, the median wage and salary earnings for 25- to 34-year-old males with a college degree and employment-based insurance were 73 percent greater than the median earnings for young men without a high school diploma. For all males, with or without employer-provided health insurance, the comparable premium was 106 percent.

The wage-based data also show the increase in the premium for education over time found in other studies. In 1979, for example, the average young man who had completed high school earned 23 percent more than the average high school dropout (see Table 3), while young men with postgraduate education earned an average 54 percent more than men without a high school diploma. By 1992, young high school graduates earned 35 percent more and young men with some years in graduate school earned 135 percent more than young high school dropouts. As the tables show, much of the total increase in the premium for education occurred at the graduate level. In 1979, the bulk of the premium accrued to college graduates; men who studied beyond college made limited additional gains. By 1992, however, the relative reward for postgraduate study had risen considerably. The shift undoubtedly relects a growing demand for men with professional degrees combined with a declining share of men holding such degrees, as shown in Table 1.[17]

Returning to Table 2, the figures in the columns labeled "W+H," with employer contributions for health insurance added to wages and salaries, also show a comparable premium for education and a

[14] In addition to Levy and Murnane, see the January 1995 issue of the Federal Reserve Bank of New York's *Economic Policy Review*, which is devoted to that Bank's November 4, 1994 colloquium on U.S. wage trends in the 1980s and early 1990s.

[15] Annual pre-tax wage and salary earnings or, for the self-employed, net earnings.

[16] The sample used in this study includes all males, aged 25 to 54, working 50 to 52 weeks and at least 35 hours every week (including the self-employed). The subsample received health insurance paid in part or in full by their own employer. (In a very small number of cases, a union may have contributed to the health insurance. For most unionized workers, however, health benefits are largely paid by the employer. Self-employed workers who are incorporated and buy health insurance are treated as employees with employer-provided health benefits; unincorporated self-employed workers who buy health insurance are considered to have other private insurance, not provided by the worker's employer.) In an attempt to isolate the impact of health benefit costs on annual wage and salary earnings, men with health insurance were restricted to those working for just one employer in the year before the survey. In other words, the restriction reflects an effort to avoid including workers who were covered by job-related health insurance for just a fraction of a year. On the other hand, some men classified as not covered by employer-provided health insurance may have been working for a firm with health benefits but may have chosen not to participate in that firm's health plan.

[17] Explanations for this decline in the share of men obtaining graduate degrees could include the impact of the draft and the Vietnam War on graduate enrollment in the 1960s. Alternatively, the data may simply reflect a growing tendency for individuals to attend graduate school after obtaining several years of work experience.

Table 2
Premium for Education as Measured by Wages and by Wages plus Employer Contributions for Health Insurance: Males Ages 25 to 54 with Health Insurance Provided by Own Employer and Working Full-Time, Year-Round for a Single Primary Employer

	1979			1992			Percent Growth in Premium		
	W	W + H	Change in Premium (Percent)	W	W + H	Change in Premium (Percent)	W	W + H	Difference (Percentage Points)
Ages 25–34									
HS Diploma[a]	1.22	1.21	−4.5	1.22	1.23	+4.5	.0	9.5	9.5
Some College	1.32	1.30	−6.3	1.41	1.36	−12.2	28.1	20.0	−8.1
Coll Diploma[a]	1.39	1.36	−7.7	1.73	1.67	−8.2	87.2	86.1	−1.1
Grad School	1.51	1.47	−7.8	2.05	1.95	−9.5	105.9	102.1	−3.8
Ages 35–44									
HS Diploma[a]	1.27	1.24	−11.1	1.38	1.35	−7.9	40.7	45.8	5.1
Some College	1.40	1.34	−15.0	1.64	1.57	−10.9	60.0	67.6	7.6
Coll Diploma[a]	1.67	1.60	−10.4	2.05	1.93	−11.4	56.7	55.0	−1.7
Grad School	1.73	1.66	−9.6	2.50	2.32	−12.0	105.5	100.0	−5.5
Ages 45–54									
HS Diploma[a]	1.20	1.19	−5.0	1.31	1.28	−9.7	55.0	47.4	−7.6
Some College	1.29	1.27	−6.9	1.54	1.49	−9.3	86.2	81.5	−4.7
Coll Diploma[a]	1.65	1.62	−4.6	1.85	1.78	−8.2	30.8	25.8	−5.0
Grad School	1.72	1.67	−6.9	2.27	2.13	−11.0	76.4	68.7	−7.7
Total									
HS Diploma[a]	1.16	1.17	+6.3	1.36	1.31	−13.9	125.0	82.4	−42.6
Some College	1.26	1.25	−3.8	1.58	1.49	−15.5	123.1	96.0	−27.1
Coll Diploma[a]	1.42	1.40	−4.8	1.90	1.77	−14.4	114.3	92.5	−21.8
Grad School	1.60	1.56	−6.7	2.35	2.23	−8.9	125.0	119.6	−5.4

Note: Premium for education is measured by the ratio of the median wages (or wages plus employer payments for benefits) for men with selected years of education and experience to the median for men of similar age and less than a high-school education. That is, the median for high school dropouts equals 1.00.

[a]Because of changes in the survey questions, in 1979 men in these categories attended high school or college, respectively, for four years but did not necessarily receive a diploma. In 1992, these men received diplomas.

Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

large increase in that premium between 1979 and 1992. However, as the third column in each year's panel indicates, measuring the premium using wages plus health benefits generally reduces the premium for education by as much as 15 percent. By exception, in 1992, measuring the education premium with wages plus health insurance raises the reward for finishing high school. This exception may reflect that men with a high school education *and* a job with health insurance benefits may be disproportionately employed at unionized facilities in the northeast quadrant of the country, where health benefits and medical costs may both be above average.

Turning to the growth in the premium for education between 1979 and 1992, the final three columns in Table 2 show that for most groups with job-based insurance this premium has risen by less over the 13 years covered when compensation includes health insurance than when wages are the only criterion. The difference reflects the fact that health insurance benefits had grown as a share of compensation between 1979 and 1992, especially for low-paid, less-skilled workers.[18]

The data in Table 3, which cover all men working full-time, whether or not they receive health insurance benefits, present a very different picture from that shown in Table 2. When the sample contains all full-time male workers, including the employer cost

[18] By exception, the growth in the premium for education is somewhat greater for young and prime age men with little education when the cost of insurance is included. This result may again reflect the concentration of men with a high school education *and* jobs with health benefits in unionized industries and in regions with relatively high health care costs.

Table 3
Premium for Education as Measured by Wages and by Wages plus Employer Contributions for Health Insurance: All Males Ages 25 to 54 Working Full-Time, Year-Round

	1979			1992			Percent Growth in Premium		
	W	W + H	Change in Premium (Percent)	W	W + H	Change in Premium (Percent)	W	W + H	Difference (Percentage Points)
Ages 25–34									
HS Diploma[a]	1.23	1.22	−4.3	1.35	1.35	.0	52.2	59.1	6.9
Some College	1.31	1.29	−6.5	1.59	1.57	−3.4	90.3	96.6	6.3
Coll Diploma[a]	1.38	1.36	−5.3	2.06	1.99	−6.6	178.9	175.0	−3.9
Grad School	1.54	1.48	−11.1	2.35	2.29	−4.4	150.0	168.8	18.8
Ages 35–44									
HS Diploma[a]	1.31	1.27	−12.9	1.48	1.46	−4.2	54.8	70.4	15.6
Some College	1.40	1.36	−10.0	1.75	1.70	−6.7	87.5	94.4	6.9
Coll Diploma[a]	1.72	1.66	−8.3	2.18	2.15	−2.5	63.9	74.2	10.3
Grad School	1.76	1.68	−10.5	2.75	2.65	−5.7	130.3	142.6	12.3
Ages 45–54									
HS Diploma[a]	1.24	1.20	−16.7	1.42	1.40	−4.8	75.0	100.0	25.0
Some College	1.31	1.28	−9.7	1.68	1.63	−7.4	119.4	125.0	5.6
Coll Diploma[a]	1.70	1.64	−8.6	1.99	1.94	−5.1	41.4	46.9	5.5
Grad School	1.75	1.70	−6.7	2.57	2.41	−10.2	109.3	101.4	−7.9
Total									
HS Diploma[a]	1.20	1.19	−5.0	1.35	1.38	+8.6	75.0	100.0	25.0
Some College	1.27	1.25	−7.4	1.60	1.62	+3.3	122.2	148.0	25.8
Coll Diploma[a]	1.40	1.40	.0	2.00	2.01	+1.0	150.0	152.5	2.5
Grad School	1.60	1.57	−5.0	2.58	2.59	+.6	163.3	178.9	15.6

Note: Premium for education is measured by the ratio of the median wages (or wages plus employer payments for benefits) for men with selected years of education and experience to the median for men of similar age and less than a high-school education. That is, the median for high school dropouts equals 1.00.

[a]Because of changes in the survey questions, in 1979 men in these categories attended high school or college, respectively, for four years but did not necessarily receive a diploma. In 1992, these men received diplomas.

Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

of health benefits generally increases the growth in the premium for education by as much as 25 percentage points. As before, adding the cost of insurance benefits to wages reduces the premium for education in any given year; however, the reduction shrinks from as much as 17 percent in 1979 to a maximum of 10 percent in 1992. Table 4 provides the explanation: for all male workers, access to jobs with health benefits declined sharply over this period, but the drop was particularly severe for men with limited education. While the share of full-time male workers with health insurance benefits fell from 87 to 70 percent between 1979 and 1992, the share of full-time male workers with less than a high school education and job-related health benefits fell from 88 percent to 54 percent. In 1979, men with no more than a high school education suffered little disadvantage in terms of access to health insurance; in 1992, they did. Clearly, the decreased availability of employer-provided health insurance has hit the least educated particularly hard. This development almost surely reflects declining employment opportunities for males with little formal education in manufacturing and in highly unionized nonmanufacturing industries, like mining and trucking, where health insurance benefits have been an important part of the compensation package. By contrast, the sectors where many unskilled workers now find jobs—retailing, personal services, and construction—have below-average insurance coverage.

Of course, men employed in jobs without health benefits are not necessarily uninsured. They may, for instance, be covered through their wife's health plan, or they may pay the entire cost of insurance themselves. Alternatively, some workers—particu-

Table 4
Share of Full-Time, Year-Round Male Workers Ages 25 to 54 with Employer-Provided Health Insurance, by Age and Years of Education, 1979 and 1992
Percent

	1979			
	25–34	35–44	45–54	Total
<High School	79.7	88.6	91.2	87.7
HS Diploma[a]	86.3	89.0	92.4	88.9
Some College	83.2	87.7	91.2	86.2
Coll Diploma[a]	82.0	90.3	89.8	86.0
Grad School	82.1	87.9	90.3	86.2
Total	83.5	88.7	91.3	87.3
	1992			
	25–34	35–44	45–54	Total
<High School	46.6	53.8	62.8	53.8
HS Diploma[a]	61.1	69.9	77.2	68.3
Some College	68.6	71.2	76.5	71.5
Coll Diploma[a]	72.1	76.8	77.9	75.2
Grad School	71.9	74.2	73.6	73.5
Total	65.2	71.2	75.2	70.0

[a]Because of changes in the survey questions, in 1979 men in these categories attended high school or college, respectively, for four years but did not necessarily receive a diploma. In 1992, these men received diplomas.

Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

larly the young and healthy—may choose to take their chances and go uninsured. Appendix Table 1 shows the health insurance status of full-time male workers with no job-related health insurance benefits in 1993. The table indicates that, even taking other sources of insurance coverage into account, working men with limited education were much more likely to be uninsured in 1993 than were men with a college degree or more. Among workers ages 35 to 44, for instance, 71 percent of those with less than a high school diploma had no insurance; the comparable number for those with some post-graduate education was 23 percent. Relatively well-educated, and presumably well-paid, men were much more likely to have insurance coverage through a wife's health plan or to have other private insurance coverage purchased out-of-pocket than were men with a high school education or less.

Inequality within Groups Defined by Age and Education

To examine the issue of inequality within groups of similar individuals, Tables 5 and 6 show the coefficients of variation, a widely used index of inequality,[19] for groups defined by age and education. Again, compensation is measured using both wages and wages plus employer payments for health insurance. As in other studies, these measures of within-group inequality increase considerably between 1979 and 1992 in almost every case. (By exception, inequality measured by wages falls slightly for young men with little schooling and for older men with graduate education. Again, the drop in inequality among less educated men probably results from the dwindling number of high-wage manufacturing jobs for workers with little education.) In any given year, moreover, adding employer payments for health insurance to wages almost always reduces the coefficient of variation (by as much as 4 percent) for men with health benefits and for all men. (The single exception is the coefficient for all young men with less than a high school education.)

As was the case for between-group inequality, adding the cost of health insurance to wages has a different impact on the growth in within-group inequality for all men than for men with health benefits. For men with job-based health insurance, the addition has mixed results (Table 5). For most groups, particularly young workers with little education and most older workers, using wages plus health benefits instead of wages reduces the growth in within-group inequality. For younger men with more than a high school education, however, using the expanded measure increases the growth in within-group inequality—presumably as the cost/quality of insurance packages available to these young workers has become increasingly variable. As premium costs soared in the 1980s, many employers felt compelled to cut the package of health services or the insurance options offered or have shifted a greater share of the premium payment onto their employees.

In contrast to the mixed results of switching from

[19] The coefficients of variation shown in Tables 5 and 6 are ratios of the standard deviation to the mean multiplied by 100. The coefficient of variation has the attribute of being scale invariant (the degree of inequality does not change when all observations are multiplied by a constant). In addition, this measure has the desirable property that it always registers a decrease in inequality when income is shifted from the higher- to the lower-income person, regardless of where in the distribution the transfer occurs.

Table 5

Coefficients of Variation for Wages and for Wages plus Employer Contributions for Health Insurance: Men Ages 25 to 54 with Employer-Provided Health Insurance and Working Full-Time, Year-Round for a Single Primary Employer

	Ages 25–34						
	1979		1992		Percent Change, 1979 to 1992		
	W	W + H	W	W + H	W	W + H	Difference (Percentage Points)
<High School	41.22	39.61	41.14	39.30	−.2	−.8	−.6
HS Diploma[a]	36.39	35.30	43.30	41.71	19.0	18.2	−.8
Some College	37.42	36.39	41.95	40.90	12.1	12.4	.3
Coll Diploma[a]	38.80	37.99	45.63	44.73	17.6	17.7	.1
Grad School	40.29	39.56	43.03	42.47	6.8	7.4	.6
	Ages 35–44						
	1979		1992		Percent Change, 1979 to 1992		
	W	W + H	W	W + H	W	W + H	Difference (Percentage Points)
<High School	41.94	40.22	48.30	46.00	15.2	14.4	−.8
HS Diploma[a]	38.22	37.08	42.26	40.59	10.6	9.5	−1.1
Some College	35.03	34.10	41.55	40.07	18.6	17.5	−1.1
Coll Diploma[a]	39.67	38.98	43.97	43.22	10.8	10.9	.1
Grad School	39.58	39.11	42.36	41.85	7.0	7.0	0
	Ages 45–54						
	1979		1992		Percent Change, 1979 to 1992		
	W	W + H	W	W + H	W	W + H	Difference (Percentage Points).
<High School	40.31	38.79	44.67	42.47	10.8	9.5	−1.3
HS Diploma[a]	37.42	36.38	41.96	40.39	12.1	11.0	−1.1
Some College	40.65	39.70	45.13	43.45	11.0	9.4	−1.6
Coll Diploma[a]	39.65	39.02	45.66	44.64	15.2	14.4	−.8
Grad School	38.46	37.93	37.42	36.97	−2.7	−2.5	.2

[a]Because of changes in the survey questions, in 1979 men in these categories attended high school or college, respectively, for four years but did not necessarily receive a diploma. In 1992, these men received diplomas.

Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

wages to wages plus health benefits in measuring the growth of within-group inequality among men with insurance, the results for all men are unambiguous (Table 6). Including the cost of health insurance increases the growth in within-group inequality for all men in all cases. The differences range from 4 to 7 percentage points for men with relatively little education to 0.6 to 1.8 percentage points for men with more than college. These results again reflect the reduced availability of health benefits, particularly for the young and unskilled, already noted.[20] In addition, broadening the focus from men with health benefits to all men changes the industrial, firm-size, and geographic mix of the sample. Firms not offering health benefits tend to be small businesses in agriculture, construction, retail trade, and personal services. Such

[20] Of course, in response to rising premium costs, a growing number of workers, particularly young workers, may have chosen to self-insure. In addition, as women's labor force participation has increased, a growing number of men may be obtaining health insurance through their wives.

Table 6

Coefficients of Variation for Wages and for Wages plus Employer Contributions for Health Insurance: All Men Ages 25 to 54 Working Full-Time, Year-Round

	1979		1992		Percent Change, 1979 to 1992		
Ages 25–34	W	W + H	W	W + H	W	W + H	Difference (Percentage Points)
<High School	42.88	41.06	48.35	49.24	12.8	19.9	7.1
HS Diploma[a]	38.22	37.03	48.84	48.62	27.8	31.3	3.5
Some College	38.99	37.82	49.83	49.29	27.8	30.3	2.5
Coll Diploma[a]	40.27	39.34	48.50	48.04	20.4	22.1	1.7
Grad School	41.81	40.93	47.89	47.61	14.5	16.3	1.8
Ages 35–44	W	W + H	W	W + H	W	W + H	Difference (Percentage Points)
<High School	43.33	41.55	54.68	54.25	26.2	30.6	4.4
HS Diploma[a]	39.71	38.51	47.97	47.14	20.8	22.4	1.6
Some College	36.26	35.28	45.17	44.54	24.6	26.2	1.6
Coll Diploma[a]	41.18	40.42	47.19	46.85	14.6	15.9	1.3
Grad School	40.68	40.14	45.39	45.13	11.6	12.4	.8
Ages 45–54	W	W + H	W	W + H	W	W + H	Difference (Percentage Points)
<High School	41.99	40.39	51.49	51.07	22.6	26.4	3.8
HS Diploma[a]	38.94	37.84	45.83	45.09	17.7	19.2	1.5
Some College	41.40	40.43	47.61	46.76	15.0	15.7	.7
Coll Diploma[a]	41.56	40.83	48.63	48.09	17.0	17.8	.8
Grad School	39.67	39.07	40.72	40.32	2.6	3.2	.6

[a]Because of changes in the survey questions, in 1979 men in these categories attended high school or college, respectively, for four years but did not necessarily receive a diploma. In 1992, these men received diplomas.

Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

firms are also more likely to be in western and southern states where wages are relatively low.

The Impact of FICA Taxes

Appendix Tables 2 and 3 show the impact of adding employer contributions for Social Security taxes (as well as health insurance) to wages on the premium for education and on within-group inequality. The tables provide data only for all male full-time, year-round workers, age 25 to 54, since most workers are subject to FICA. Although employers are legally required to make FICA tax payments for most employees, employers generally consider these payments to be part of the benefits package, and their cost clearly affects hiring decisions. From the individual worker's perspective, of course, the value of the benefit actually received may be little correlated with his own or his employer's contributions on his behalf.

As Appendix Table 2 shows, including FICA payments has only a modest marginal impact on the premium for education, compared with the impact of adding health insurance. Because the taxable wage base has risen over time, the addition tends to reduce

Table 7
Coefficients of Variation for Wages, for Wages plus Employer Payments for Health Insurance, and for Wages plus Employer Payments for Health and Social Security (FICA) Benefits: All Males Ages 25 to 54 Working Full-Time, Year-Round

1979			1992			Percentage Change, 1979 to 1992		
W	W + H	W + H + F	W	W + H	W + H + F	W	W + H	W + H + F
45.62	44.30	43.33	57.01	56.11	55.41	25.0	26.7	27.9
					Difference (Percentage Points)		1.7	2.9

Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

the growth in the education premium for younger (probably less well paid) workers and to increase it for older, better educated employees. By contrast, including employer contributions for FICA generally increases the growth in within-group inequality, particularly for older, better educated workers (Appendix Table 3).

The Increase in Total Inequality

Finally, Table 7 provides the coefficients of variation based on wages, wages plus employer contributions for health insurance, and wages plus employer contributions for health insurance and FICA for all men ages 25 to 54 without regard to age or education in 1979 and 1992. While overall inequality in both years is lower for the more comprehensive measures of compensation, adding the cost of health benefits and employer contributions for Social Security to wages increases the growth in overall inequality from 25 percent to 27 and 28 percent, respectively.

III. Policy Implications

The data reviewed indicate that as access to health insurance and the quality of insurance coverage have become increasingly uneven over the last decade, the premium for education and within-group earnings inequality measured to include the cost of benefits have grown somewhat faster than commonly recognized (up to 25 percentage points and 7 percentage points, respectively). Reduced access to health benefits between 1979 and 1992 has clearly had a disproportionately adverse impact on workers with the least education and the lowest wages. If growing earnings inequality and its impact on social cohesion are of concern, this finding underscores the need to rethink the way this country finances its health insurance and Social Security systems.

Compared to other industrial countries where health care is financed by a tax on general revenues or a tax on wages, rather than by a flat premium, the U.S. approach to financing health insurance has a disproportionately adverse impact on the wages or job quality of the lowest-paid workers. Table 2 demonstrated how the U.S. approach to health care finance has had an unfavorable impact on the wages of low-skilled, low-paid workers when access to health insurance is held constant. As Table 2 showed, for workers with health insurance benefits, the wages of the least educated rose less than their total compensation (the value ultimately determined by supply and demand) as rising health insurance costs constrained their wage growth to a disproportionate degree. Alternatively, when access to health insurance is not held constant, as in Table 3, this study's results suggest that low-wage, low-skill workers lost access to jobs with health benefits to an above-average extent.[21]

In all likelihood, then, cross-country differences in methods of financing health care help to explain why the premium for education, measured in terms of wages, has grown more in the United States than in most other industrial countries. In no other high-income country would the growing cost of health care have contributed to rising earnings inequality as it has here in the United States.

Another reason for concern about growing in-

[21] Consistent with the hypothesis that rising health insurance costs have depressed wage growth for workers with health benefits is the fact that the median annual wage and salary earnings for full-time, year-round male workers with health benefits rose 36 percent between 1979 and 1992, while the median for similar workers with no health benefits rose 71 percent.

come inequality relates to recent declines in labor force participation for prime-age men. If, as Olivier Blanchard has suggested, the supply of unskilled labor is more price-elastic than the supply of skilled men, the growing premium for education, with real wages stagnant, has probably contributed to the observed decline in labor force participation over the last decade. At current wages for high school graduates, Blanchard believes, the supply of unskilled men is likely to prove very elastic indeed. But, as is widely suspected and as this study confirms, including health insurance benefits in the compensation package only aggravates the growing discrepancies and disincentives for unskilled men to work.[22]

Accordingly, one approach to ameliorating the recent increase in worker inequality might be to rethink the way this country finances health insurance and Social Security. For example, if citizens want to keep the U.S. system of job-based health insurance, total employer and employee premium payments could be allocated on a sliding scale by earnings rather than as a flat premium that weighs most heavily on the wages or job prospects of the lowest-paid workers. If needed, the government could cover any shortfall by subsidizing low-wage workers and their employers. Alternatively, policymakers might prefer to consider financing health care through a tax on income. Such an approach would neither aggravate income inequality nor encourage employers to substitute capital for labor. In other words, health reform could contribute to reducing earnings inequality and to raising labor force participation, an issue likely to become increasingly important as the population ages.

Health reform could contribute to reducing earnings inequality and to raising labor force participation, an issue likely to become increasingly important as the population ages.

A recent World Bank study (International Bank for Reconstruction and Development 1994) makes somewhat similar recommendations concerning social security. It suggests that public social security should be financed out of general revenues rather than through a capped tax on wages. Again, the ceiling on taxable earnings aggravates inequality while the taxation of wages distorts the choice between capital and labor. Likewise, Olivier Blanchard hints that a subsidy for low-skilled workers, possibly in the form of a reduction in the payroll tax, might be desirable, but he finds such a step to be highly unlikely politically.

Whether or not U.S. policymakers decide to change this country's approach to financing its health insurance and Social Security systems, U.S. voters need to recognize that our current financing methods contribute to growing compensation inequality and, most probably, to reduced labor force participation. Similarly, researchers may want to pay more attention to institutional issues in exploring earnings trends across various sectors and times.

IV. Conclusions

In sum, then, this article indicates that the U.S. system of employer-based health insurance and a capped payroll tax to fund Social Security has distorted our traditional wage-based measures of between-group and within-group inequality and their growth. In fact, the study points out, when compensation is measured to include employer costs for health and Social Security benefits, inequality among male workers has increased more than generally recognized. Accordingly, these findings underscore the need for U.S. citizens to rethink this country's approach to financing its health insurance and Social Security systems.

[22] The data shown in Table 1 are clearly consistent with the suggestion that, as unskilled men mature, they have been dropping out of the full-time work force at an above-average pace.

Appendix Table 1

Health Insurance Status of Full-Time Male Workers Ages 25 to 54 Not Covered by a Private Plan Partially or Fully Paid by Own Employer, 1993

Percent

		25–34	35–44	45–54	All Ages
Less than high school	Job-based private plan, no employer payment	5.34	6.91	6.08	
	Other private plan in own name	2.96	7.82	8.88	
	Other private plan in other's name	9.98	11.25	14.86	
	Medicaid	6.17	1.83	3.23	
	Medicare	1.06	.42	.00	
	Champus[a]	.62	1.18	3.20	
	No coverage	73.87	70.59	63.75	
	Total	100.00	100.00	100.00	
High school diploma	Job-based private plan, no employer payment	10.29	8.62	13.27	
	Other private plan in own name	6.83	9.19	17.02	
	Other private plan in other's name	17.71	31.01	28.24	
	Medicaid	2.91	2.09	.39	
	Medicare	.11	.93	.16	
	Champus[a]	10.91	8.14	5.87	
	No coverage	51.23	40.01	35.06	
	Total	100.00	100.00	100.00	
Some college	Job-based private plan, no employer payment	9.73	10.18	10.27	
	Other private plan in own name	9.59	12.14	14.42	
	Other private plan in other's name	21.54	31.08	31.82	
	Medicaid	2.12	1.12	.23	
	Medicare	.34	.35	.42	
	Champus[a]	17.66	17.38	10.89	
	No coverage	39.02	27.74	31.95	
	Total	100.00	100.00	100.00	
College degree	Job-based private plan, no employer payment	9.34	10.61	11.81	
	Other private plan in own name	17.55	17.50	17.79	
	Other private plan in other's name	25.47	39.22	41.45	
	Medicaid	.00	.14	.00	
	Medicare	.19	.28	.39	
	Champus[a]	13.41	10.57	6.08	
	No coverage	34.04	21.67	22.48	
	Total	100.00	100.00	100.00	
Graduate work	Job-based private plan, no employer payment	10.14	8.73	12.45	
	Other private plan in own name	15.63	17.85	18.80	
	Other private plan in other's name	32.74	40.36	30.94	
	Medicaid	1.57	.00	.00	
	Medicare	1.57	.00	.00	
	Champus[a]	10.75	10.08	19.08	
	No coverage	27.61	22.99	18.73	
	Total	100.00	100.00	100.00	
Totals	Job-based private plan, no employer payment	9.28	9.18	11.09	9.65
	Other private plan in own name	8.89	12.15	15.57	11.59
	Other private plan in other's name	19.34	31.00	29.58	25.95
	Medicaid	2.72	1.24	.66	1.71
	Medicare	.39	.50	.21	.39
	Champus[a]	11.38	10.34	8.86	10.43
	No coverage	47.99	35.58	34.03	40.27
	Total	100.00	100.00	100.00	100.00

[a]Civilian Health and Medical Program for the Uniformed Services and the Veterans Administration.
Source: U.S. Bureau of the Census, *Current Population Survey*, March 1993.

Appendix Table 2

Premium for Education as Measured by Wages and by Wages plus Employer Contributions for Health Insurance and FICA: All Males Ages 25 to 54 Working Full-Time, Year-Round

	1979			1992			Percent Growth in Premium, 1979 to 1992		
	W	W + H + F	Change in Premium (Percent)	W	W + H + F	Change in Premium (Percent)	W	W + H + F	Difference (Percentage Points)
Ages 25–34									
HS Diploma[a]	1.23	1.22	−4.3	1.35	1.35	.0	52.2	59.1	+6.9
Some College	1.31	1.29	−6.5	1.59	1.55	−6.8	90.3	89.7	−.6
Coll Diploma[a]	1.38	1.37	−2.6	2.06	1.99	−6.6	178.9	167.6	−11.3
Grad School	1.54	1.49	−9.3	2.35	2.30	−3.7	150.0	165.3	+15.3
Ages 35–44									
HS Diploma[a]	1.31	1.27	−12.9	1.48	1.45	−6.2	54.8	66.7	+11.9
Some College	1.40	1.36	−10.0	1.75	1.69	−8.0	87.5	91.7	+4.2
Coll Diploma[a]	1.72	1.65	−9.7	2.18	2.14	−3.4	63.9	75.4	+11.5
Grad School	1.76	1.68	−10.5	2.75	2.59	−9.1	130.3	133.8	+3.5
Ages 45–54									
HS Diploma[a]	1.24	1.21	−12.5	1.42	1.41	−2.4	75.0	95.2	+20.2
Some College	1.31	1.27	−12.9	1.68	1.65	−4.4	119.4	140.7	+21.3
Coll Diploma[a]	1.70	1.62	−11.4	1.99	1.98	−1.0	41.4	58.1	+16.7
Grad School	1.75	1.68	−9.3	2.57	2.42	−9.6	109.3	108.8	−.5
Total									
HS Diploma[a]	1.20	1.19	−5.0	1.35	1.38	+8.6	75.0	100.0	+25.0
Some College	1.27	1.25	−7.4	1.60	1.62	+3.3	122.2	148.0	+25.8
Coll Diploma[a]	1.40	1.39	−2.5	2.00	1.99	−1.0	150.0	153.8	+3.8
Grad School	1.60	1.57	−5.0	2.58	2.55	−1.9	163.3	171.9	+8.6

Note: Premium for education is measured by the ratio of the median wages (or wages plus employer payments for benefits) for men with selected years of education and experience to the median for men of similar age and less than a high-school education. That is, the median for high school dropouts equals 1.00.

[a]Because of changes in the survey questions, in 1979 men in these categories attended high school or college, respectively, for four years but did not necessarily receive a diploma. In 1992, these men received diplomas.

Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

Appendix Table 3

Coefficients of Variation for Wages and for Wages plus Employer Payments for Health Insurance and Social Security: All Men Ages 25 to 34 Working Full-Time, Year-Round

	Ages 25–34						
	1979		1992		Percent Change, 1979 to 1992		
	W	W + H + F	W	W + H + F	W	W + H + F	Difference (Percentage Points)
<High School	42.88	40.92	48.35	49.01	12.8	19.8	7.0
HS Diploma[a]	38.22	36.56	48.84	48.38	27.8	32.3	4.5
Some College	38.99	37.15	49.83	48.92	27.8	31.7	3.9
Coll Diploma[a]	40.27	38.44	48.50	47.43	20.4	23.4	3.0
Grad School	41.81	39.89	47.89	46.87	14.5	17.5	3.0
	Ages 35–44						
	1979		1992		Percent Change, 1979 to 1992		
	W	W + H + F	W	W + H + F	W	W + H + F	Difference (Percentage Points)
<High School	43.33	40.99	54.68	53.76	26.2	31.2	5.0
HS Diploma[a]	39.71	37.69	47.97	46.83	20.8	24.3	3.5
Some College	36.26	34.49	45.17	44.12	24.6	27.9	3.3
Coll Diploma[a]	41.18	39.27	47.19	46.17	14.6	17.6	3.0
Grad School	40.68	39.07	45.39	44.42	11.6	13.7	2.1
	Ages 45–54						
	1979		1992		Percent Change, 1979 to 1992		
	W	W + H + F	W	W + H + F	W	W + H + F	Difference (Percentage Points)
<High School	41.99	39.79	51.49	51.10	22.6	28.4	5.8
HS Diploma[a]	38.94	37.11	45.83	44.66	17.7	20.3	2.6
Some College	41.40	39.46	47.61	46.19	15.0	17.1	2.1
Coll Diploma[a]	41.56	39.72	48.63	47.32	17.0	19.1	2.1
Grad School	39.67	38.20	40.72	39.39	2.6	3.1	.5

[a]Because of changes in the survey questions, in 1979 men in these categories attended high school or college, respectively, for four years but did not necessarily receive a diploma. In 1992, these men received diplomas.

Source: Based on data from the U.S. Bureau of the Census, *Current Population Survey*, March 1980 and March 1993.

References

Blanchard, Olivier. 1995. "Macroeconomic Implications of Shifts in the Relative Demand for Skills." Federal Reserve Bank of New York *Economic Policy Review*, January, pp. 48–53.

Borjas, George J. and Valery A. Ramey. 1993. *Foreign Competition, Market Power, and Wage Inequality: Theory and Evidence*. Cambridge, MA., National Bureau of Economic Research Working Paper No. 4556.

Bound, John and George Johnson. 1995. "What Are the Causes of Rising Wage Inequality in the United States?" Federal Reserve Bank of New York *Economic Policy Review*, January, pp. 9–17.

Bradsher, Keith. 1995. "Gap in Wealth in U.S. Called Widest in West." *The New York Times*, April 17, p. A1.

Brauer, David and Susan Hickok. 1995. "Explaining the Growing Inequality in Wages Across Skill Levels." Federal Reserve Bank of New York *Economic Policy Review*, January, pp. 61–75.

Federal Reserve Bank of New York. 1995. "Colloquium on U.S. Wage Trends in the 1980s." Frederic S. Mishkin, ed. *Economic Policy Review*, January, entire issue.

Fieleke, Norman S. 1994. "Is Global Competition Making the Poor Even Poorer?" *New England Economic Review*, November/December, pp. 3–16.

Green, Gordon, John Coder and Paul Ryscavage. 1992. "International Comparisons of Earnings Inequality for Men in the 1980s." In U.S. Bureau of the Census, *Studies in the Distribution of Income*, Current Population Reports, Consumer Income, P60-183, pp. 51–60.

Grubb, W. Norton and Robert H. Wilson. 1992. "Trends in Wage and Salary Inequality, 1967–88." *Monthly Labor Review*, June, pp. 23–39.

Higgins, Matthew. 1994. "Wage Trends Abroad: The Role of Trade, Technology and Labor Market Institutions." Federal Reserve Bank of New York, mimeo, November.

International Bank for Reconstruction and Development. 1994. *Averting the Old Age Crisis: Policies to Protect the Old and Promote Growth* (A World Bank Policy Research Report), New York: Oxford University Press.

Lawrence, Robert Z. 1995. "U.S. Wage Trends in the 1980s: The Role of International Factors." Federal Reserve Bank of New York *Economic Policy Review*, January, pp. 18–25.

Levy, Frank and Richard J. Murnane. 1992. "U.S. Earnings Levels and Earnings Inequality: a Review of Recent Trends and Proposed Explanations." *Journal of Economic Literature*, Vol. XXX (September), pp. 1333–81.

Nelson, Charles T. 1994. "Levels of and Changes in the Distribution of U.S. Income." In *The Changing Distribution of Income in an Open U.S. Economy*, edited by Jeffrey H. Bergstrand, Thomas F. Cosimano, John W. Houck and Richard G. Sheehan. New York: North-Holland, pp. 40–63.

Pierce, Brooks and Finis Welch. 1994. "Dimensions of Inequality in Labor Income." In *The Changing Distribution of Income in an Open U.S. Economy*, edited by Jeffrey H. Bergstrand, Thomas F. Cosimano, John W. Houck and Richard G. Sheehan. New York: North-Holland, pp. 145–79.

Ryscavage, Paul, Gordon Green and Edward Welniak. 1992. "The Impact of Demographic, Social, and Economic Change on the Distribution of Income." In U.S. Bureau of the Census, *Studies in the Distribution of Income*, Current Population Reports, Consumer Income, P60-183, pp. 11–30.

U.S. Bureau of the Census. 1992. *Measuring the Effect of Benefits and Taxes on Income and Poverty: 1979 to 1991*. Current Population Reports, Consumer Income, Series P-60, No. 182-RD.

Differences Across First District Banks in Operational Efficiency

Robert Tannenwald

Senior Economist, Federal Reserve Bank of Boston. *The author thanks Allen N. Berger at the Board of Governors of the Federal Reserve System, Loretta Mester at the Philadelphia Fed, and colleagues at the Boston Fed for their helpful suggestions. Rachel Cononi and Leslie Eydenberg provided able research assistance.*

Economists devoted little attention to differences across banks in operational efficiency until about 15 years ago, when banks began to fail with increasing frequency. Some economists (for example, Bennett 1986, Davis 1986, Kaufman 1991) attributed the rising failure rate in part to intensified competitive pressures generated by deregulation and technological innovation. According to this view, stiffer competition disciplined inefficient institutions viable only in a simpler, more protected environment. If this hypothesis is correct, and a significant number of banks are still inefficiently managed, then further deregulation and technological change could "shake up and shake out" the banking industry. Concern over this possibility has spurred efforts to estimate the dispersion among banks in operational efficiency.

Using data from 1985 through 1993, this study evaluates the extent to which operational efficiency—efficiency in the use of inputs—varies within the First Federal Reserve District. This type of efficiency, often referred to as "X efficiency," is one of three types. The other two are economies of scale (efficiency from operating at optimal size) and economies of scope (efficiency from optimal diversification of outputs). Economists have generally found few economies of scale or scope in banking.[1]

This study relies on methodologies developed and applied by other economists who have examined X efficiency in banking. Unlike most other studies that have addressed this issue, however, this study focuses on dispersion in efficiency within a region rather than the nation as a whole.[2] This subnational focus is appropriate because the characteristics of an efficient bank may differ by region. For example, an operational strategy that may be efficient in the Midwest may not be efficient in the East, where institutional, legal, and regulatory environments are different (Evanoff and Israilevich 1991). Furthermore, some banking markets may be national, others regional or local. Consequently, while a bank in Massachusetts may be inefficient relative to one in Missouri, the two banks may not compete with each other in any market. In evaluating a bank's ability to withstand increased competitive pressure, one should compare the bank's operational efficiency with that of its most efficient competitors. In some markets, such as those for lending to mid-sized businesses, the competitors of Massachusetts banks are limited mostly to New England institutions (see Dunham 1986 and Tannenwald 1994).

The article begins with a discussion of the problems inherent in measuring variation among banks in X efficiency. It goes on to describe the principal strategies that economists have devised to resolve these dilemmas. The methodologies used in this study are then presented, along with empirical results. The next section interprets these results and critiques the study's methodologies. The final section summarizes and draws policy conclusions.

Unlike most studies that have examined X efficiency in banking, this study focuses on dispersion in efficiency within a region rather than the nation as a whole.

The study finds substantial dispersion in X efficiency among First District banks. The characteristics of this dispersion have changed over time, however. Differences in X efficiency between the most and least efficiently managed banks have widened. The least efficient banks have fallen further and further below prevailing efficiency standards. By contrast, differences between the most efficiently managed banks and banks exhibiting an average degree of efficiency have narrowed. One interpretation of this narrowing gap is that the difficulties experienced by the District's banks during the late 1980s and early 1990s taught the majority of bank managers a painful but effective lesson on the importance of managing inputs efficiently.

However, the article points out several anomalies in the empirical results that raise doubts about the validity of the methodologies commonly used in measuring X efficiency in banking. Consequently, the article concludes that measures of bank efficiency need further development before one can rely on them with confidence.

I. Problems Inherent in the Measurement of Bank Efficiency

Efficiency is the ratio of a system's effective or useful output to its total input. In order to evaluate the efficiency of a machine or a business, one must identify and measure its inputs and outputs and determine its minimum input/output ratio. Engineers are usually able to satisfy these requirements in measuring the efficiency of a machine. For example, the fuel efficiency of an automobile is measured by the number of miles traveled per gallon of fuel consumed. Given the characteristics of the automobile, the fuel utilized, and the environment in which the vehicle operates, engineers can deduce the maximum possible number of miles per gallon from laws of mechanics and physics.

Measuring the efficiency of a bank is more difficult for several reasons. First, a bank's inputs and outputs are hard to identify; indeed, they can be one and the same. For example, demand and retail time and savings deposits are inputs in that they are important sources of funds used to finance loans. At the same time, according to a national survey (Board of Governors 1992), almost one-half of the operating expenses incurred by U.S. commercial banks are devoted to servicing checking and savings accounts, functions viewed by depositors as outputs.

Second, like many businesses, banks have several inputs and outputs whose quantities are difficult to compare. Banks provide loans, checking accounts, and savings accounts; manage custodial accounts; lease equipment; underwrite securities; and provide a host of other financial services. In so doing, they utilize labor, land, machinery and equipment, and deposits. Since the measures used to gauge the volume of these outputs and inputs are not comparable, analysts of bank efficiency measure total bank output and input in terms of their monetary value. Monetary values, however, reflect price as well as quantity.

Third, the minimum input/output ratio that a particular bank *could* achieve is difficult to determine objectively. No laws of bank operations exist, parallel to laws of mechanics and physics, to enable an expert to deduce a bank's maximum attainable performance ("best practice"). Rather, economists must infer best

[1] See Evanoff and Israilevich (1991), Clark (1988), and Mester (1987) for surveys of studies estimating economies of scale and scope in banking. More recent estimates can be found in Mester (1994a and 1994b) and Berger and Humphrey (1991).

[2] The only other study of dispersion in X efficiency within a region is Mester's study for the Third District (Mester 1994a and 1994b).

Table 1
Dispersion in X Efficiency among First District Banks, Measured in Terms of Interquartile Differences in Average Total Cost (ATC)[a]

	1985 to 1989		
Mean ATC, by ATC Quartile	Banks with Total Assets Less than $100 Million	Banks with Total Assets between $100 Million and $300 Million	Banks with Total Assets Greater than $300 Million
First ATC Quartile (Lowest Cost)	.078	.078	.082
Fourth ATC Quartile (Highest Cost)	.102	.100	.109
Percentage Difference between Mean ATC of First and Fourth ATC Quartiles[b]	31%	28%	33%
	1990 to 1993		
Mean ATC, by ATC Quartile	Banks with Total Assets Less than $100 Million	Banks with Total Assets between $100 Million and $300 Million	Banks with Total Assets Greater than $300 Million
First ATC Quartile (Lowest Cost)	.072	.069	.073
Fourth ATC Quartile (Highest Cost)	.121	.107	.122
Percentage Difference between Mean ATC of First and Fourth ATC Quartiles[b]	68%	55%	67%

[a]Average total cost (ATC) = ratio of total cost to total assets. Total cost includes interest on time certificates of deposit of $100,000 or more; interest on other deposits; interest on deposits in foreign offices, Edge Act and Agreement subsidiaries, and in International Banking Facilities (IBFs); expense of federal funds purchased and securities sold under agreements to repurchase in domestic offices of the bank money; interest on mortgage indebtedness and obligations under capitalized leases; interest on notes and debentures subordinated to deposits; salaries and employee benefits; expenses of premises and fixed assets; and other noninterest expense.

[b]{(Mean ATC, Fourth Quartile − Mean ATC, First Quartile)/Mean ATC, First Quartile} * 100

Source: Federal Insurance Deposit Corporation, *Reports on Condition and Income*, and author's calculations.

practice by observing the input/output ratios of actual banks.

Precisely how to infer best practice is unclear. One cannot simply pick banks with the highest value of output per dollar of input, because this ratio is partially determined by factors other than efficiency, such as output mix and input and output prices. Banks with a low input/output ratio may have access to unusually cheap labor and office space or specialize in types of loans that are especially inexpensive to originate. The method used to identify efficient banks must control for such factors. The problem is comparable to the need to control for differences in speed, temperature, weight, and road conditions in determining the maximum possible fuel efficiency of an automobile.

As an illustration of the problem, suppose that best practice banks in the First District were identified as those with a relatively low ratio of total cost to total assets, or average total costs (ATC). One could divide the District's banks into size groups, rank banks within each size group in order of increasing ATC, divide each group into ATC quartiles, and designate banks exhibiting best practice as those in the first (lowest) ATC quartile. To estimate the difference between best practice and worst practice, one could compare the mean ATCs for the first and fourth quartiles. Table 1 shows such comparisons for three size groups and two time periods, 1985 to 1989 and 1990 to 1993. The revealed interquartile differences are large, especially in the later time period. Among large banks (those with more than $300 million in assets), the mean ATC for the fourth quartile was 67 percent higher than the mean ATC for the first quartile in the 1990 to 1993 period.

This difference could reflect factors other than X efficiency, such as differences in the price of inputs. Large banks in the fourth ATC quartile paid an average interest rate of 6.0 percent on small time and savings deposits during the 1990 to 1993 period. The comparable average interest rate for the first quartile was only 3.7 percent. Large fourth-quartile banks paid an average interest rate of 9.4 percent on purchased funds, while their first-quartile counterparts paid an average rate of only 4.8 percent. These large differences in the price of funds, not differences in X efficiency, may have been responsible for the interquartile difference in average ATC among large banks between 1990 and 1993.

II. Alternative Methods of Determining "Best Practice"

The three most prevalent methods for identifying best practice are the data envelopment analysis approach (DEA), the stochastic econometric frontier approach (SEFA), and the thick frontier approach (TFA).[3]

Data Envelopment Analysis Approach (DEA)

Under this approach, a sample of banks is, in effect, divided into subsamples that produce the same level and mix of outputs and face similar input prices.[4] In each subsample, the bank that incurs the lowest total cost is deemed to exemplify best practice for that subsample. The best practice banks form an efficiency frontier that "envelops" other banks in the sample and can be used to evaluate a bank's X efficiency.

A simplified hypothetical example, limited to a sample of banks producing only one output and using only one input, is presented in Figure 1. Each point on line AA* represents the bank using the least amount of input at its level of output. Banks lying within the AA* frontier are X inefficient; their degree of inefficiency is measured by their distance from the frontier.

The DEA approach makes no attempt to distinguish between banks that are on the frontier because they are truly the most efficient and those whose total costs are depressed by other factors not held constant by sample stratification. As a result, the approach tends to produce upwardly biased estimates of dispersion in X efficiency. Other approaches attempt to eliminate such bias in their estimates of the efficiency frontier.

Stochastic Econometric Frontier Approach (SEFA)

In this approach, regression techniques are used to estimate a model in which total cost is assumed to be a function of several variables, including input prices and the level and mix of outputs. A graphic version of a simple cost model, in which total cost varies only with the level of a single output, is shown in Figure 2. Banks' predicted total costs, given their level of output, forms line BB*.

According to SEFA, the cost model is assumed to represent best practice. Consequently, if the model controlled perfectly for all cost determinants except X efficiency, a bank whose observed cost equaled its predicted value would exhibit best practice. A bank's relative X efficiency could be measured by the degree to which its actual cost exceeded its predicted value. By assumption, a bank's actual cost could not be less than its predicted value.

In fact, some cost determinants other than X efficiency cannot be controlled for because they are unknown or impossible to measure. The SEFA approach assumes that these cost determinants generate random errors in prediction, distributed according to a normal or bell-shaped curve. By contrast, errors generated by X efficiency are assumed to be distributed according to a one-sided "half-normal" pattern.[5] Given the different statistical properties of these two distributions, one can distinguish deviations of actual from predicted cost attributable to X efficiency from those attributable to other factors. Critics of the SEFA approach present empirical evidence suggesting that predictive errors attributable to variation in X efficiency are not in fact distributed according to a half-normal pattern. (See, for example, Berger and Humphrey 1991.)

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[3] See Evanoff and Israilevich (1991); Berger (1993); Berger, Hunter, and Timme (1993); and Mester (1994a and 1994b) for other descriptions and comparisons of these approaches.

A fourth, recently developed approach to the measurement of X efficiencies in financial institutions is the "distribution-free" approach, developed by Berger (1993). According to this approach, a cost function is estimated for a sample of financial institutions for each of several years. (For example, Berger and Humphrey (1991) estimate such a function for a constant nationwide sample of bank holding companies each year between 1980 and 1990.) Each bank holding company's average residual over the entire time period is then compared with the comparable average residual for each bank holding company within its peer group. The bank holding company with the lowest average residual is considered to exhibit best practice for the peer group. The key assumption implicit in this approach is that random error averages out over time.

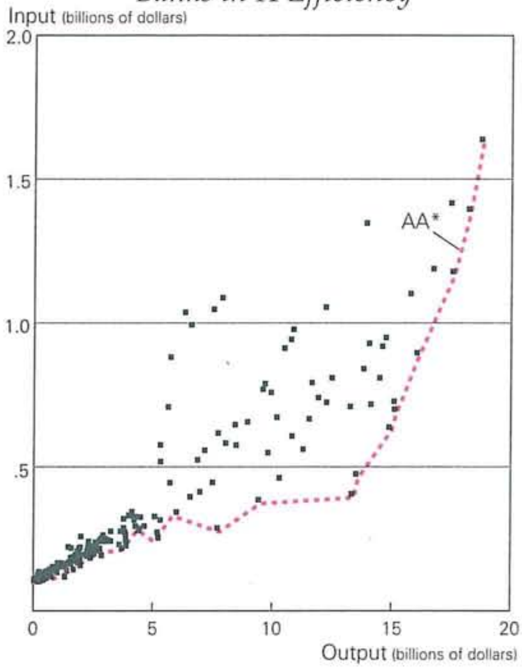
Yet another approach, recently applied by Akhavein, Swamy, and Taubman (1994), is capable of estimating a unique efficiency frontier for each bank in a sample. The approach is based on a general fixed-coefficients profit function that relaxes many of the arbitrary assumptions required in other approaches.

[4] Although output prices should also be controlled for, prices of most banking outputs are difficult to observe. For example, in making loans, banks often tailor the terms of each loan to the characteristics of the borrower, such as profitability, size, and volume of debt outstanding. The terms of each loan involve many variables, such as interest rate, maturity, down payment, and collateral, so that measuring the price of any particular type of loan is extremely difficult.

[5] Most observations in a half-normal distribution are clustered at or near one extreme value. The further one moves away from this extreme, the lower the probability of finding an observation. A detailed description of the statistical properties of a half-normal distribution is presented in Mester (1994a and 1994b).

Figure 1

The Data Envelopment Analysis Approach to Analyzing Differences across Banks in X Efficiency

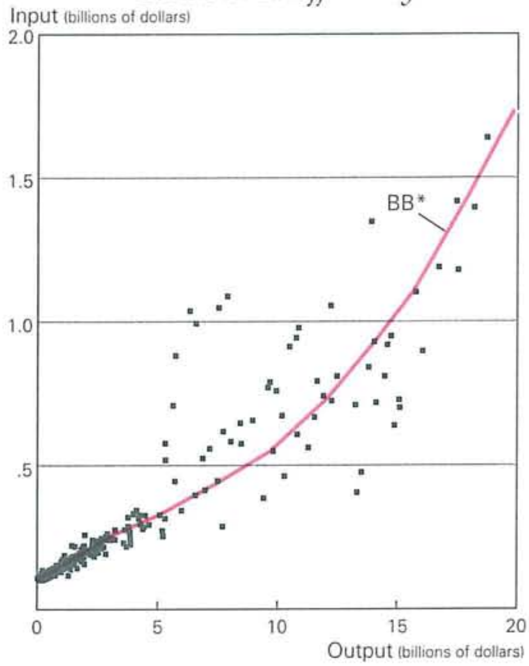


Note: The observations in this figure consist of a pooled cross-section time series sample of First District commercial banks spanning the years 1985 through1993. The cross-sectional sample from each year includes all Bank Insurance Fund (BIF)-insured banks domiciled within the First District in that year except 1) banks created de novo within the previous two years or operating in less than seven of the ten years from 1984 through 1993; 2) banks whose deposits-to-assets ratio was less than 0.15; and 3) banks whose total output exceeded $20 billion. The rationale for exclusions 1) and 2) is given in Section III of the text. Banks with more than $20 billion in annual output were distant outliers. The vertical axis measures a composite input consisting of the sum of employee compensation, expense of fixed assets, interest expense of small time and savings deposits, and interest expense of all purchased funds. The horizontal axis measures a composite output consisting of demand deposits, small time and savings deposits, real estate loans, commercial and industrial loans, and consumer installment loans. The total number of observations (1,315) appears much smaller than the actual number because so many of them are clustered in the lower left corner of the figure.

Source: Federal Deposit Insurance Corporation, *Reports on Income and Condition*, and author's calculations.

Figure 2

The Stochastic Econometric Frontier Approach to Analyzing Differences across Banks in X Efficiency



Note and Source: See Figure 1.

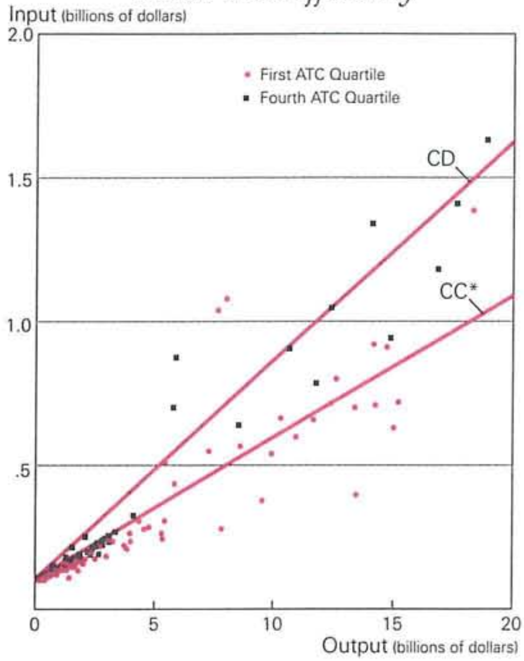
The Thick Frontier Approach (TFA)

The thick frontier approach, pioneered by Berger and Humphrey (1991), borrows elements from both DEA and SEFA. Like SEFA, TFA embraces the assumption that deviations of actual from predicted total cost are attributable to random error as well as X efficiency. Like DEA, TFA assumes that best practice is exhibited by a subset of banks. Specifically, TFA assumes that, on average, banks with relatively low average cost (total cost/total assets) set the standard for operational efficiency against which other banks should be measured. Practitioners of TFA have usually identified low-average-cost banks as those in the lowest average-cost quartile within their size group. TFA defines best practice by estimating a total cost function from a subsample limited to these banks. Although observed total costs within this sample still deviate from their predicted values, these deviations are assumed to result solely from random error.

TFA is illustrated in Figure 3. CC* is a total cost function fitted to the observed total cost of banks in the lowest average-cost quartile in their size groups, represented by circles. Among these low-cost banks, few exhibit total costs that exactly equal their pre-

Figure 3

The Thick Frontier Approach to Analyzing Differences across Banks in X Efficiency



Note and Source: See Figure 1.

dicted values (in other words, fall on line CC*). Predictive errors are assumed to be random. Thus, banks below and above CC* are not assumed to be "superefficient" and "inefficient," respectively; rather, their deviations are attributed exclusively to random error. The term "thick frontier" comes from TFA's usage of all the low-average-cost firms to identify best practice, including those with observed total costs above and below predicted values.

For comparative purposes, a total cost function estimated for banks in the highest average cost quartile in their size group (represented by squares in Figure 3) is also drawn in Figure 3. This fitted line, CD, represents worst practice. As explained in the next section, a comparison of the two functions reveals the degree to which banks within a given sample vary in X efficiency.[6]

III. Methodology and Results

This study uses two of the widely used standard methodologies described above to measure variation in X efficiency among First District banks between 1985 and 1993. TFA is used to estimate the difference in X efficiency between the District's "best practice" and "worst practice" banks. Estimates are performed for two time periods, 1985 to 1989 and 1990 to 1993. A hybrid of TFA and SEFA is used to estimate the difference in X efficiency between the District's best practice and average practice banks for each year between 1985 and 1993. (Sample sizes are too small to permit annual estimation of the range of efficiency between best and worst practice institutions.)

Both sets of estimates utilize the categorization of inputs and outputs in the study by Bauer, Berger, and Humphrey (1993). Four inputs and five outputs are identified. Inputs include labor, land and physical capital, interest paid for purchased funds, and interest paid on demand and retail time deposits. The five outputs include three types of loans and two types of deposits. The loan categories are real estate, commercial and industrial (including construction and land development), and consumer. The deposit categories are demand deposits and retail time and savings.

The sample of banks in each year includes all Bank Insurance Fund (BIF)-insured banks domiciled within the First District with the following exceptions: 1) Banks created de novo within the previous two years or operating in fewer than seven of the ten years from 1984 through 1993. In general, banks incur atypical start-up costs in the first several years of their existence that are difficult to control for. 2) Banks whose deposits-to-assets ratio was less than 0.15. Since these institutions either are trust companies or function like them, factors affecting their total costs are different from those influencing the total costs of banks.

Use of Cost Functions to Compare Dispersion in X Efficiency: 1985 to 1989 and 1990 to 1993

As explained in the previous section, the numerous studies that have used the TFA approach determine best practice by estimating a cost function from a sample of banks ranking low in average cost compared to other banks of similar size. Next, these

[6] TFA does not permit one to estimate the relative X efficiency of a particular bank because, within the lowest and highest ATC quartiles, differences in X efficiency are assumed away.

Table 2
Difference between Best Practice and Worst Practice Banks, First District, by Size Group
Percent of Average Total Cost

	Banks with Total Assets Less than $100 Million	Banks with Total Assets between $100 Million and $300 Million	Banks with Total Assets Greater than $300 Million
1985 to 1989	25	7	21
1990 to 1993	45	34	51

Note: Figures are the estimated percentage increase in total costs that best practice banks would experience if their x efficiency deteriorated to worst practice. See Appendix for methodological details.
Source: Federal Insurance Deposit Corporation, *Reports on Condition and Income*, and author's calculations.

studies determine worst practice by estimating the same function from a sample of institutions ranking high in average cost compared to other banks of similar size. Then, the studies estimate how much a representative best practice bank would raise its predicted total cost by downgrading its X efficiency to worst practice. This is accomplished by comparing the bank's total cost predicted from the best practice model with that predicted from the worst practice model.

In order to implement this strategy, two samples of banks were created by pooling data for 1985 through 1989 and for 1990 through 1993, respectively. Banks in each pooled data set were divided into three size groups and, within each size group, into ATC quartiles, just as they were in the comparisons presented in Table 1. All banks ranking in the lowest quartile within their size group were assumed to exhibit best practice, all banks ranking in the highest quartile to exhibit worst practice.

In most studies following the TFA approach, translog cost models are estimated for the best practice and worst practice subsamples, respectively. In translog cost models, explanatory variables interact in complex ways to influence total cost. The influence of each variable is assumed to depend on both its own value and that of each other cost determinant included in the model. For example, according to the translog form, the impact of an additional dollar of real estate loans on total cost partially depends on the volume of each of the outputs because diversification of output can affect economies of scope. The impact of an increase in real estate loans is also assumed to depend in part on the cost of labor (as well as the cost of other inputs), since the provision of real estate loans may be more or less labor-intensive than that of other outputs.

In a translog cost function, total cost is also partially determined by the square of each cost factor. Inclusion of squared terms reflects the assumption that the relationship between a given cost determinant and total cost may be nonlinear, that is, it may vary with the determinant's value. For example, as a bank's loan portfolio expands, it may experience decreasing average cost because of economies of scale. At some point, diseconomies of scale set in, causing average cost to increase with further loan growth. Many relationships between outputs and costs follow this "U-shaped" pattern.

Some economists (for example, Mitchell and Onvural 1992 and McAllister and McManus 1993) have questioned whether translog functions accurately reflect how input prices, output mix, and other factors interact to determine a bank's total cost. These economists are particularly skeptical of the accuracy of translog cost functions when they are estimated from samples of banks exhibiting wide variation in values of cost determinants. Despite these limitations, this study follows the common practice of using the translog form.

The estimated translog cost models (described in the Appendix and presented in Appendix Tables 1 and 2) were used to evaluate "X efficiency gaps"—percentage increases in average total cost that representative best practice banks would suffer if their X efficiency deteriorated to worst practice.[7] The results of this evaluation are presented in Table 2. A comparison of Table 2 with Table 1 yields at least one noteworthy difference and one similarity. For each

[7] For each size group, the representative best practice bank possessed the mean value among banks in the lowest ATC quartile for each variable in the cost function.

size group in each time period, the efficiency gap reported in Table 2 is smaller than the comparable ATC interquartile difference reported in Table 1. Thus, controlling for factors other than efficiency narrows the interquartile gaps. As in Table 1, interquartile differences are narrower during the 1985 to 1989 period, when the efficiency gap ranged between 7 percent and 25 percent, than during the 1990 to 1993 period, when they ranged between 34 percent and 51 percent.[8]

Estimates of Annual Efficiency Gaps between Best Practice and Average Practice

Given the limitations of available data, the ability to evaluate dispersion in X efficiency on an annual basis is more limited than over the longer time periods used for Table 2. Consequently, differences between best practice and average practice were estimated for each year instead of differences between best practice and worst practice. In order to measure differences between best practice and worst practice, one must be able to estimate cost functions from 25-percent subsamples of First District banks. As alluded to in the previous section, the population of First District banks is too small to support such quartile-specific estimates on a year-by-year basis.

As noted above, annual differences between best practice and average practice were estimated with a hybrid of the standard SEFA and TFA methodologies employed by other economists. As in SEFA, a translog cost function was estimated with banks drawn from all ATC quartiles. However, contrary to standard SEFA methodology, the estimated cost function was not assumed to represent best practice. The predictive errors attributable to all variables not included in the cost model, including X efficiency, were assumed to be random and, therefore, to have an expected value of zero. Consequently, the cost model provided estimates of what each bank's total cost would be under the assumption that it exhibits average practice.

It was assumed, as in the TFA approach, that banks in the lowest ATC quartile in their size group exhibit best practice. An ATC dummy variable was included in the cost model, assigned a value of 1 if a bank was in the lowest ATC quartile and 0 if it was not. The coefficient on this dummy variable indicates by what percentage a bank would increase its total cost if its level of X efficiency deteriorated from best practice to average practice.

The estimated coefficients on the ATC dummies for the years 1985 through 1993, expressed in percentage terms, range from −4 percent (1991 and 1993) to −14 percent (1986) (Figure 4 and Appendix Table 2). This range includes the −8 percent point estimate made by Mester (1994a and 1994b) for Third District Banks in 1992. The coefficients tend to get smaller over time, suggesting that differences between best practice and average practice in the First District narrowed over the 1985 to 1993 period. The difference, −4 percent, is statistically significant in 1991 and insignificant in 1993. This trend contrasts with the widening gap over the same time period between best practice and worst practice (Table 2).

IV. Interpretation of Results

Two interpretations of these diverging trends are offered here. According to one, these trends reflect a "shake-up and shakeout" of New England's banking industry, in which increasing deregulation and cyclical shocks have compelled most institutions to manage their inputs more efficiently, while some have been too burdened by problem loans to do so. According to the other interpretation, these diverging trends are spurious empirical results reflecting flaws in estimation procedures.

The "Shake-Up and Shakeout" Interpretation

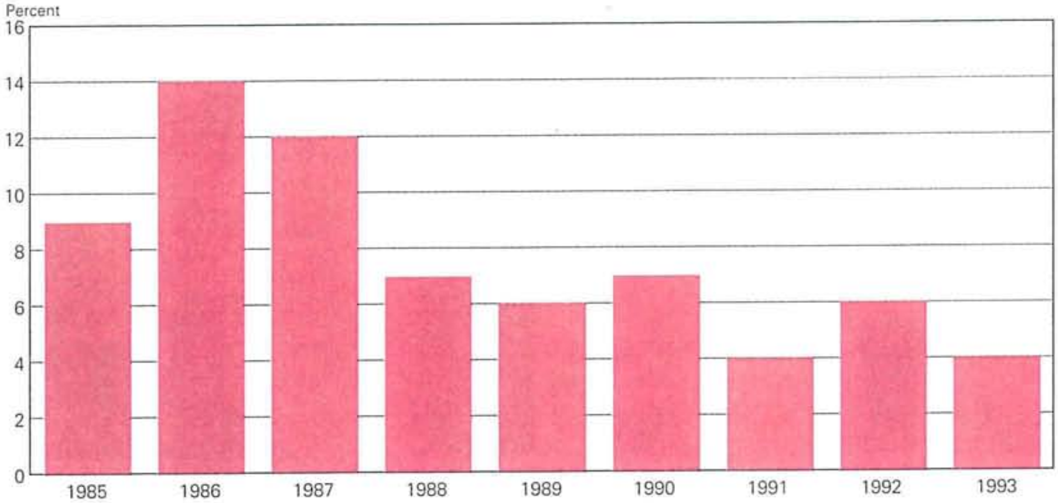
The results presented in the previous section are consistent with the theory that deregulation and severe financial stress have compelled First District banks as a whole to manage their inputs more efficiently. From 1978 through 1982, several federal laws broadened the competitive interface between banks and other financial institutions.[9] In addition, the New

[8] The 7 percent estimate for the efficiency gap among First District banks in the $100 million to $300 million range is considerably narrower than the comparable gap found by Bauer, Berger, and Humphrey (1993) in the United States for 1985 to 1988, using TFA. Precise comparisons with their findings are difficult because they used eight size groups instead of three. They found efficiency gaps for this four-year period averaging 21 percent in the $100 million to $200 million asset range, and 19 percent for the $200 million to $300 million range. Their estimated efficiency gaps for banks in the $300 million to $10 billion range were similar to the 21 percent reported in Table 2 for First District banks in the $300 million plus group. They found much larger efficiency gaps (well over 40 percent) for banks with total assets exceeding $10 billion.

[9] For example, the Financial Institutions Regulatory and Interest Rate Control Act of 1978, the International Banking Act of 1978, the Depository Institutions Deregulation and Monetary Control Act of 1980, and the Garn–St Germain Depository Institutions Act of 1982. See Spong (1994) for an overview of U.S. bank regulatory policy.

Figure 4

X Efficiency Gaps: Best Practice vs. Average Practice, 1985 to 1993, First District Commercial Banks



Note: Figures indicate percentage increase in total costs that best-practice banks would experience if their x efficiency deteriorated to average practice. They are identical to the coefficients on the ATC dummy variable in the cost function presented in Appendix Table 1.

Source: Federal Deposit Insurance Corporation, *Reports on Income and Condition*, and author's calculations.

England states passed interstate banking bills over the course of the 1980s that increased the geographic dispersion of bank holding companies.[10] In theory, intensified competitive pressures created by these various deregulatory measures could have forced First District banks to become more X efficient. The full impact of these pressures may not have been felt until the late 1980s, after banks had sufficient time to adjust to their less regulated environment. This theory is consistent with the narrowing gap between best practice and average practice between 1985 and 1993.

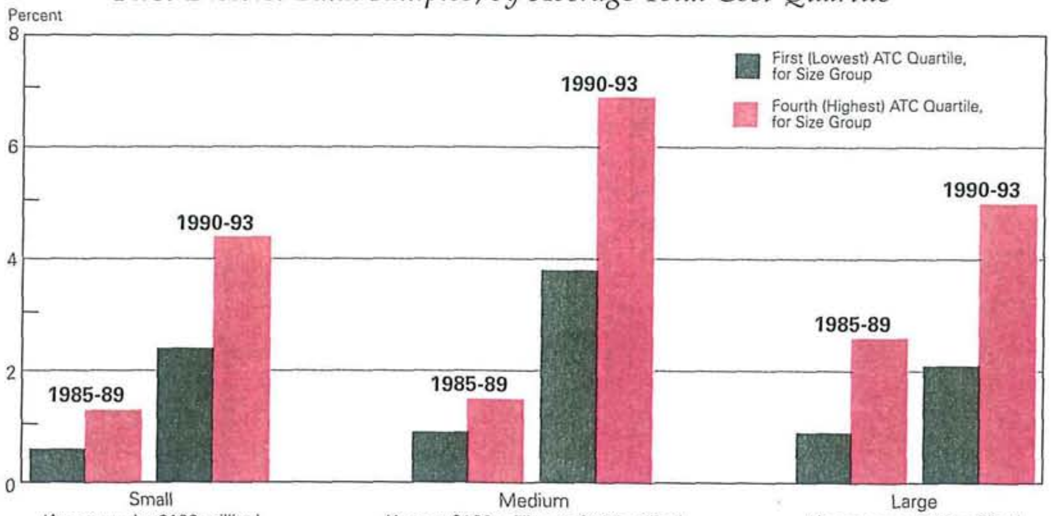
In addition, New England's banking industry was subject to severe financial stress during the late 1980s and early 1990s. As a result, many banks experienced a sharp rise in their ratio of nonperforming loans to total assets. This shock theoretically could have provided an additional incentive for the average bank to enhance X efficiency. Those institutions experiencing the sharpest deterioration in their loan portfolios, however, generally were subject to the most severe regulatory discipline and therefore cut their lending more sharply than the banking industry as a whole. They were compelled to allocate staff and to hire consultants to cope with their financial problems, with little or no additional output to show for it. In theory, these requirements could have caused their X efficiency to decline relative to best practice. Thus, while increasingly intense competition and financial stress may have induced the majority of banks to become more X efficient, the same factors may have so damaged some banks that they could not become more efficient. Instead, these institutions were forced to cut output and to cope with their acute financial difficulties, sacrificing X efficiency in the process.

Consistent with this theory is the correlation between the rising incidence of problem loans and the widening gap in mean ATC between the first and fourth ATC quartiles, demonstrated in Figure 5. In all three size categories, and in both the 1985 to 1989 and 1990 to 1993 time periods, nonperforming loans as a percentage of total assets is larger for the highest ATC quartile than for the lowest ATC quartile. The difference in this percentage between ATC quartiles is significantly larger in the later time period for all three size groups.

[10] These changes in interstate banking laws and regulations within the region are discussed in Syron (1984) and Dunham and Syron (1984).

Figure 5

Nonperforming Loans as a Percentage of Total Assets, First District Bank Samples, by Average Total Cost Quartile



Source: Federal Deposit Insurance Corporation, *Reports on Income and Condition*, and author's calculations.

The "Spurious Results" Interpretation

The trends reported in Figure 4 and Appendix Tables 1 and 2, although consistent with the "shake-up and shakeout" theory, may be spurious. Several troubling characteristics of the annual estimated cost models displayed in Appendix Table 2 raise doubts about the trends' statistical validity. First, the coefficients on several variables fluctuate widely from year to year. For example, as shown in Row 4, the coefficient on the volume of small time and savings deposits (LDTS) plummets from 0.966 in 1987 to −1.010 in 1988, climbs to −0.395 in 1989, climbs further to 0.010 in 1990, falls back sharply to −0.820 and −0.853 in 1991 and 1992, respectively, and then plummets to −3.575 in 1993. Several of the coefficients on other variables in the cost function exhibit extreme intertemporal volatility, as do the coefficients estimated from pooled cross-section time series data for 1985 to 1989 and 1990 to 1993 (Appendix Table 1). Such volatility is difficult to explain and therefore casts doubt on the accuracy of the estimated coefficients.[11]

Another disturbing characteristic of the coefficients is their sensitivity to slight changes in data samples. As stated in Section III, all banks not present for at least seven years between 1984 and 1993, de novo banks, and banks with a ratio of deposits to assets of less than 0.15 were excluded from the samples used to estimate the cost functions. In each year, a few banks had a ratio of deposits to assets of less than 0.15 but met the other two criteria for inclusion. When these banks were included in the samples, the estimates of the coefficient on the ATC dummy variable changed dramatically and the tendency of the coefficient's absolute value to fall over time vanished. Such sensitivity to slight changes in sample definition

[11] The intertemporal volatility of the coefficients may be symptomatic of the biases inherent in the translog functional form, mentioned in Section III of the text.

The intertemporal volatility of the coefficients is not the same as the total elasticities of cost with respect to cost determinants. Each determinant appears in several different terms in the cost function: a linear term, a squared term, and several interaction terms. In the theory, intertemporal variation in the coefficients on some terms could offset the variation in the coefficients on others, resulting in little variation over time in the total impact of each determinant.

To explore this possibility, the total elasticity of total cost with respect to each of the five outputs in the model was evaluated at the mean value for each output, using the annual cost model estimates. The results, presented in the Appendix, suggest a substantial amount of year-to-year variation in total cost elasticities with respect to various outputs.

Table 3

Percentage of Banks in the Lowest-Cost ATC Quartile Two Years in a Row, 1985 to 1993

Pairs of Consecutive Years (1)	Number of Banks in Sample Present in Both Years of Pair (2)	Banks in Lowest-Cost ATC Quartile for Their Size Group Present in Both Years of Pair, as a Percentage of Banks in Lowest-Cost ATC Quartile in First Year of Pair (3)
1985–86	173	20.2
1986–87	176	28.4
1987–88	178	30.3
1988–89	178	23.6
1989–90	178	21.3
1990–91	151	18.5
1991–92	136	21.3
1992–93	128	39.1

Note: Calculations reported in column (3) are based on banks present in both years of pair.
Source: Federal Deposit Insurance Corporation, *Reports on Condition and Income*, and author's calculations.

suggests problems with the underlying data, the cost function, or both.

An especially troubling indication of methodological problems is the large year-to-year variation in the identity of banks in the lowest-cost ATC quartile for each size group. According to the thick frontier approach, banks possessing this characteristic are assumed to exhibit best practice. Given this assumption, one would expect the identity of best practice banks to exhibit some intertemporal stability. At a minimum, one would expect at least one-half of all banks in the lowest-cost ATC quartile for their size group in a given year to be in the lowest-cost ATC quartile for their size group in the following year. According to Table 3, however, the average annual rate of turnover in banks ranking in the lowest-cost ATC quartile for their size group far exceeds 0.5. Column 1 lists all pairs of consecutive years during the sample period, 1985 to 1993. Column 2 reports the number of banks present in the sample in both years. Column 3 reports, for this subsample, the percentage of all banks in the lowest-cost ATC quartile for their size group in the first year of the pair of years that is also in the lowest-cost ATC quartile for their size group in the second year. For example, in 1985–86, 20 percent of the banks present in both 1985 and 1986 and in the lowest-cost ATC quartile for their size group in 1985 were also in the lowest ATC quartile for their size group in 1986. This percentage varies between 19 percent and 40 percent, suggesting turnover rates roughly between 0.6 and 0.8.

V. Summary and Conclusions

Measures of dispersion among banks in X efficiency have many potential applications. They can assist in the identification of banks vulnerable to competitive pressures generated by further deregulation and technological change. In so doing they can help regulators choose where to channel their scarce resources, especially those devoted to improving bank management. They can assist in the evaluation of potential efficiency gains or losses resulting from bank mergers.[12]

This article develops estimates of the dispersion in X efficiency among First District banks between 1985 and 1993. It shows evidence that, over time, the average First District bank has realized an increasing percentage of its potential X efficiency. In 1993, the last year studied, the gap between best practice and average practice banks within the District was statistically insignificant. By contrast, the gap in efficiency between the most and least efficient banks has widened considerably, suggesting the presence of a group of banks quite vulnerable to further competitive pressure. The advent of unlimited interstate branching could be a source of such pressure in the near future.

However, methods for estimating interbank differences in X efficiency are still in the developmental stage. The cost functions at the heart of these efficiency estimates are unstable over time, casting doubt on their accuracy. Key assumptions underpinning some of these methods are not supported by empirical evidence. Estimates of differences among banks in X efficiency need further refinement before they can be used confidently as public policy indicators.

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[12] This potential application of measures of X efficiency has already been demonstrated in several studies. See Wall, Srinivasan, Narayanan, and Takeda (1994) for such a study and a review of previous such studies.

References

Akhavein, Jalal D., P.A.V.B. Swamy and Stephen B. Taubman. 1994. *A General Method of Deriving the Efficiencies of Banks from a Profit Function*. Working Paper. Philadelphia, PA: The Wharton Financial Institutions Center, University of Pennsylvania.

Bauer, S.E., A.N. Berger and D. B. Humphrey. 1993. "Efficiency and Productivity Growth in U.S. Banking." In H.O. Fried, C.A.K. Lovell and S.S. Schmidt, eds. *The Measurement of Productive Efficiency: Techniques and Applications*, pp. 386–413. Oxford: Oxford University Press.

Bennett, Paul. 1986. "Weaker Bank Earnings: Trend or Cycle?" In *Recent Trends in Commercial Banking Profitability*, pp. 73–86. New York: Federal Reserve Bank of New York.

Berger, A.N. 1993. " 'Distribution Free' Estimates of Efficiency in the U.S. Banking Industry and Tests of the Standard Distributional Assumptions." *The Journal of Productivity Analysis*, vol. 4, pp. 261–92.

Berger, A.N. and D.B. Humphrey. 1991. "The Dominance of Inefficiencies over Scale and Product Mix Economies in Banking." *Journal of Monetary Economics*, vol. 28, pp. 117–48.

Berger, A.N., W.C. Hunter and S.G. Timme. 1993. "The Efficiency of Financial Institutions: A Review and Preview of Research Past, Present, and Future." *Journal of Banking and Finance*, vol. 17, pp. 221–49.

Board of Governors of the Federal Reserve System. 1992. *Functional Cost Analysis*. Washington, D.C.

Clark, J.A. 1988. "Economies of Scale and Scope at Depository Financial Institutions: A Review of the Literature." *Economic Review*, Federal Reserve Bank of Kansas City, September/October, pp. 16–33.

Davis, Richard G. 1986. "Introduction." In *Recent Trends in Commercial Banking Profitability*, pp. 1–7. New York, NY: Federal Reserve Bank of New York.

Dunham, Constance R. 1986. "Regional Banking Competition." *New England Economic Review*, Federal Reserve Bank of Boston, July/August, pp. 3–19.

Dunham, Constance R. and Richard F. Syron. 1984. "Interstate Banking: the Drive to Consolidate." *New England Economic Review*, May/June, pp. 11–28.

Evanoff, Douglas D. and Philip R. Israilevich. 1991. "Productive Efficiency in Banking." *Economic Perspectives*, Federal Reserve Bank of Chicago, July/August, pp. 11–32.

Kaufman, George G. 1991. *The Diminishing Role of Commercial Banking in the U.S. Economy*. Working Paper 1991-11. Chicago, IL: Federal Reserve Bank of Chicago.

McAllister, Patrick H. and Douglas McManus. 1993. "Resolving the Scale Efficiency Puzzle in Banking." *Journal of Banking and Finance*, vol. 17, pp. 389–405.

Mester, Loretta J. 1987. "Efficient Production of Financial Services: Scale and Scope Economies." *Business Review*, Federal Reserve Bank of Philadelphia, January/February, pp. 15–25.

______. 1994a. *Efficiency of Banks in the Third Federal Reserve District*. Working Paper No. 94-1. Philadelphia, PA: Federal Reserve Bank of Philadelphia. December.

______. 1994b. "How Efficient Are Third District Banks?" *Business Review*, Federal Reserve Bank of Philadelphia, January/February, pp. 3–18.

Mitchell K. and N. M. Onvural. 1992. "Economies of Scale and Scope at Large Commercial Banks: Evidence from the Fourier Flexible Function Form." Working Paper, North Carolina State University, Raleigh.

Spong, Kenneth. 1994. *Banking Regulation: Its Purposes, Implementation, and Effects*. 4th edition. Kansas City, MO: Federal Reserve Bank of Kansas City.

Syron, Richard F. 1984. "The 'New England Experiment' in Interstate Banking." *New England Economic Review*, Federal Reserve Bank of Boston, March/April, pp. 5–17.

Tannenwald, Robert. 1994. "The Geographic Boundaries of Middle Lending Markets." *New England Economic Review*, Federal Reserve Bank of Boston, July/August, pp. 45–63.

Varian, Hal R. 1993. *Microeconomic Analysis*. 3rd edition, New York: W.W. Norton Co.

Wall, Larry D., Aruna Srinivasan, Rajesh Narayanan and Carolyn Takeda. 1994. *Ownership Structure and Efficiency Gains from Bank Mergers*. Processed. Atlanta, GA: Federal Reserve Bank of Atlanta, October.

Appendix

Translog Cost Model

The formal translog cost model estimated in this study (Appendix Tables 1 and 2) can be written as:

$$lnTC = \alpha + \sum_{i=1}^{5}\beta_i \, lnY_i + 1/2 \sum_{i=1}^{5}\sum_{j=1}^{5}\delta_{ij} \, lnY_i \, lnY_j$$

$$+ \sum_{k=1}^{4}\gamma_k \, lnP_k + 1/2 \sum_{k=1}^{4}\sum_{n=1}^{4}\gamma_{kn} \, lnP_k \, lnP_n$$

$$+ \sum_{i=1}^{5}\sum_{k=1}^{4}\rho_{ik} \, lnY_i \, lnP_k + \epsilon \qquad (1)$$

$$S_k = \alpha_k + \sum_{n=1}^{4}\gamma_{kn} lnP_n + \sum_{i=1}^{5}\rho_{ik} \, lnY_i + \Psi_k, \quad k = 1,2,3,4 \qquad (2)$$

where:

- TC = real total cost (interest and operating costs deflated by the GNP deflator). As is standard in banking studies, cost figures do not include loan losses. They are instead effectively treated as a decline in revenue, since the rates charged on loans include premia to cover the expected value of these losses;
- Y_i = real value of output i: 1) demand deposits, 2) small time and savings deposits, 3) real estate loans, 4) commercial and industrial loans, and 5) installment loans;
- P_k = real price of input k: 1) labor, 2) physical capital, 3) interest rate on small time and savings deposits, and 4) interest rate on purchased funds;
- S_k = cost share of input k, which equals $\partial lnTC/\partial lnP_k$ from equation (1) plus an error term;
- ϵ, Ψ_k = error terms.

The standard symmetry and linear homogeneity in input price restrictions are imposed in estimation, as are the Shephard's Lemma cross-equation restrictions. One of the share equations is dropped to avoid singularity. Estimates of the parameters for the share equations are available from the author upon request.

Methodology for Computing Difference between Best Practice and Worst Practice Banks, as Reported in Table 2

Following the methodology of Berger (1993), the differences reported in Table 2 for each time period were computed according to the following formula:

$$\text{INEFF} = (AC^{Q4} - AC^{Q4*})/AC^{Q4}$$

AC^{Q4} was calculated in the following manner: 1) the average values of all cost determinants in the cost model were computed for banks in the lowest average cost (ATC) quartile; 2) using the model estimated with the lowest ATC quartile data, total cost was estimated for a hypothetical bank exhibiting these average values for the cost determinants; 3) this total cost estimate was divided by the average value for total assets for lowest quartile banks, to arrive at predicted ATC for the hypothetical low AC bank.

AC^{Q4*} was calculated in the same manner, except estimated total cost was derived from the cost model estimated from the highest ATC quartile.

Analysis of Total Impact of Output Variables on Total Cost

As mentioned in footnote 11, simulations were performed to evaluate the elasticity of total cost with respect to each of the five outputs in the cost model at the output's mean value. For each of the five outputs in each year, the observation with the mean value for that output was identified. It was then assumed that the value of that output increased by 10 percent. The resulting percentage increases in predicted cost, based on the annual estimated cost functions (Appendix Table 2), were divided by 10 to arrive at the estimated elasticities. The results are reported in Appendix Table 3. Note the sharp, difficult-to-explain jumps in the cost elasticity with respect to demand deposits from 1988 to 1989, consumer installment loans from 1992 to 1993, and small time and savings deposits from 1991 to 1992 and from 1992 to 1993.

Appendix Table 1

Total Cost Function, Estimated from Pooled, Cross-Section Time Series Data, 1985–89 and 1990–93[a]

Line	Variable[b]	Definition	First ATC Quartile 1985–1989 Coefficient	First ATC Quartile 1985–1989 Standard Error	First ATC Quartile 1990–1993 Coefficient	First ATC Quartile 1990–1993 Standard Error	Fourth ATC Quartile 1985–1989 Coefficient	Fourth ATC Quartile 1985–1989 Standard Error	Fourth ATC Quartile 1990–1993 Coefficient	Fourth ATC Quartile 1990–1993 Standard Error
1	INTERCEPT		−7.688931	.435160**	−2.417944	1.015545*	−2.739171	.593205**	.242356	.783426
	Output Variables:									
2	LDDD	Demand deposits	.031399	.113486	.876433	.226216**	.600413	.137288**	.276690	.102950**
3	LDTS	Small time & savings deposits	1.475004	.158898**	.309359	.367604	.730481	.237018**	2.201001	.232851**
4	LDRE	Real estate loans	−.284770	.083589**	−.261039	.173051	−.039043	.170376	−2.099448	.175245**
5	LDCI	Commercial & industrial loans[c]	.096250	.056879	−.305873	.139975*	−.549310	.145005**	.797676	.153188**
6	LDIN	Consumer installment loans	−.246265	.096940*	.289798	.212053	−.028881	.121908	−.430759	.139782**
	Factor Price Variables:									
7	LW1	Price of labor[d]	−.287748	.048815**	−.311337	.072206**	.030809	.059419	−.107262	.083997
8	LW2NE	Price of capital[e]	1.399268	.072455**	.734793	.085243**	.792558	.083455**	.138539	.109650
9	LW3	Price of small time and savings deposits[f]	−.474727	.054225**	.246831	.071944**	−.371273	.071572**	.297317	.094263**
10	LW4	Price of purchased funds[g]	−.273586	.062815**	−.340573	.083470**	.095811	.064687	.342812	.090721**
	Interaction Terms:									
11	DDDD	(LDDD×LDDD)/2	.235639	.019736**	.210973	.056195**	.017054	.006277**	.004439	.004075
12	DDTS	(LDDD×LDTS)/2	−.087717	.052741	.137036	.088951	−.100440	.039013*	−.105303	.034312**
13	DDRE	(LDDD×LDRE)/2	−.105514	.030255**	−.301139	.071142**	−.031826	.031241	−.218577	.035509**
14	DDCI	(LDDD×LDCI)/2	−.035724	.028537	−.074710	.062607	.101471	.036067**	.337200	.038867**
15	DDIN	(LDDD×LDIN)/2	−.135842	.031018**	−.170975	.049162**	.019657	.023017	−.107050	.010039**
16	TSTS	(LDTS×LDTS)/2	−.145665	.019116**	−.293619	.058397**	−.054308	.027460*	−.129617	.021965**
17	TSRE	(LDTS×LDRE)/2	.341397	.025262**	.345778	.082747**	−.030698	.061845	.124290	.020594**
18	TSCI	(LDTS×LDCI)/2	−.055175	.034624	.177107	.096191	.221418	.064775**	−.023768	.035442
19	TSIN	(LDTS×LDIN)/2	.152935	.045862**	−.050227	.116522	.082090	.029389**	.160587	.023006**
20	RERE	(LDRE×LDRE)/2	−.063056	.005944**	.051941	.048491	.142312	.032883**	.238423	.019002**
21	RECI	(LDRE×LDCI)/2	.014861	.019962	−.093891	.068919	−.144734	.027459**	−.165670	.017746**
22	REIN	(LDRE×LDIN)/2	−.154927	.031624**	.066934	.051399	−.052956	.033788	−.002082	.013623
23	CICI	(LDCI×LDCI)/2	−.000365	.002662	.009272	.009403	−.021485	.034377	−.062210	.011555**
24	CIIN	(LDCI×LDIN)/2	.065707	.022943**	−.035913	.039374	−.063982	.031467*	.000373	.011317
25	ININ	(LDIN×LDIN)/2	.001038	.012279	.058217	.025190*	−.022805	.017905	−.002048	.008361
26	W1W1	(LW1×LW1)/2	.085582	.010453**	.045132	.009722**	.033019	.010248**	.088821	.012061**
27	W1DD	LW1×LDDD	.068195	.005991**	.046690	.010115**	.028703	.003758**	.030465	.004931**
28	W1TS	LW1×LDTS	−.079940	.008153**	−.065353	.015619**	−.021053	.006667**	−.020084	.008362*
29	W1RE	LW1×LDRE	−.016636	.002994**	−.013646	.005306*	−.027532	.005002**	−.041824	.006123**
30	W1CI	LW1×LDCI	.002697	.002379	.012062	.003474**	.006420	.004943	.005475	.005160
31	W1IN	LW1×LDIN	.011903	.005268*	.007600	.006491	−.013931	.004916**	−.005047	.004514
32	W2NEW2NE	(LW2NE×LW2NE)/2	−.104211	.010985**	−.109397	.010538**	−.091988	.012531**	−.047605	.015441**
33	W2NEDD	LW2NE×LDDD	−.118682	.006527**	−.135239	.010609**	−.042559	.005514**	−.037353	.006519**

Appendix Table 1 continued

Total Cost Function, Estimated from Pooled, Cross-Section Time Series Data, 1985–89 and 1990–93[a]

			First ATC Quartile				Fourth ATC Quartile			
			1985–1989		1990–1993		1985–1989		1990–1993	
Line	Variable[b]	Definition	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
34	W2NETS	LW2NE×LDTS	.020375	.008758*	.078589	.016267**	−.041561	.009530**	−.007667	.010669
35	W2NERE	LW2NE×LDRE	.020560	.003227**	.001701	.005558	.033664	.007300**	.054622	.007852**
36	W2NECI	LW2NE×LDCI	.000399	.002566	.006060	.003649	−.007250	.007216	−.007152	.006589
37	W2NEIN	LW2NE×LDIN	.039037	.005709**	.015688	.006813*	.027383	.007157**	−.011003	.005886
38	W3W3	(LW3×LW3)/2	.006825	.009459	.071183	.008114**	−.006181	.011621	.035926	.014406*
39	W3DD	LW3×LDDD	.015468	.007585*	.034258	.011404**	−.008204	.005964	−.011533	.007691
40	W3TS	LW3×LDTS	.088903	.010091**	.039905	.017925*	.064858	.010300**	.020676	.012417
41	W3RE	LW3×LDRE	−.007830	.003804*	.005517	.005998	.007527	.007928	.005196	.009116
42	W3CI	LW3×LDCI	−.003105	.003049	−.020449	.003978**	−.005467	.007835	−.000198	.007737
43	W3IN	LW3×LDIN	−.043067	.006374**	−.014957	.007465*	.003477	.007705	.026071	.006812**
44	W4W4	(LW4×LW4)/2	−.072243	.018040**	−.216562	.012637**	−.174553	.030836**	.016782	.013341
45	W4DD	LW4×LDDD	−.013833	.028505	.060135	.042656	.151961	.026964**	−.131672	.020484**
46	W4TS	LW4×LDTS	.106709	.036102**	−.199818	.071397**	−.142365	.043322**	.182103	.026829**
47	W4RE	LW4×LDRE	−.034205	.011054**	.172209	.055651**	.097839	.032084**	−.223630	.028637**
48	W4CI	LW4×LDCI	.006172	.013975	−.030529	.011479**	−.040065	.026280	.259198	.028899**
49	W4IN	LW4×LDIN	−.061396	.021400**	.001153	.028434	−.076316	.026412**	−.087291	.028791**
50	W1W2NE	(LW1×LW2NE)/2	.046016	.005825**	.100970	.005828**	.079195	.007015**	.087266	.007167**
51	W1W3	(LW1×LW3)/2	−.118908	.008478**	−.087607	.008174**	−.057579	.010490**	−.015831	.012272
52	W1W4	(LW1×LW4)/2	.012751	.005370*	.011836	.007416	.037324	.007390**	.016290	.009305
53	W2NEW3	(LW2NE×LW3)/2	.083989	.010218**	−.018444	.009493	.006196	.011699	−.067309	.012521**
54	W2NEW4	(LW2NE×LW4)/2	−.030435	.005772**	−.020352	.008082*	−.095086	.010856**	−.056254	.011497**
55	W3W4	(LW3×LW4)/2	.001039	.006503	.016137	.008452	.016045	.011157	.033776	.013253*
		R-Square	.9991		.9976		.9971		.9981	
		Observations	214		152		211		154	

*Significant at the .05 level or greater.

**Significant at the .01 level or greater.

[a]The dependent variable is total cost defined as the sum of employee compensation, expense of fixed assets, interest expense of small time and savings deposits, and interest expense of all purchased funds.

[b]All variables are in natural log form and have been deflated by the Boston Consumer Price Index (annual).

[c]Includes construction and land and farmland loans.

[d]Price of labor is defined as employee compensation divided by the number of full-time employees.

[e]Price of capital is defined as the value of non-residential office space divided by the square footage of non-residential office space, multiplied by 1,000.

[f]Price of small time and savings deposits is defined as interest expense on small time and savings deposits divided by small time and savings deposits.

[g]Price of purchased funds is defined as interest expense of federal funds purchased and securities sold, time certificates of deposit of $100,000 or more, demand notes issued to the U.S. Treasury on other borrowed money, and deposits in foreign offices divided by the stock of federal funds purchased and securities sold, time certificates of deposit of $100,000 or more, demand notes issued to the U.S. Treasury on other borrowed money, and deposits in foreign offices.

Note: The division of several of the interaction terms by 2, although counterintuitive, is a characteristic of a cost function derived from a translog production function. See Varian (1993) for a formal derivation.

Source: U.S. Bureau of Labor Statistics; FW Dodge Division, McGraw-Hill, Inc., *Dodge Construction Potentials Bulletin*; Federal Deposit Insurance Corporation, *Reports on Condition and Income*; and author's calculations.

Appendix Table 2

Estimated Total Cost Functions, 1985 through 1993, Annual Data[a]

Line	Variable[b]	Definition	1985 Coefficient	1985 Standard Error	1986 Coefficient	1986 Standard Error	1987 Coefficient	1987 Standard Error	1988 Coefficient	1988 Standard Error	1989 Coefficient	1989 Standard Error
1	Q	Lowest average total cost dummy variable	−.088234	.017278**	−.135761	.015280**	−.122548	.015046**	−.066129	.014967**	−.064024	.014262**
2	INTERCEPT		−6.285675	.694998**	−8.085702	.701716**	−4.777063	.715260**	−2.669158	.878994**	−1.553787	.686011*
	Output Variables:											
3	LDDD	Demand deposits	.820573	.152089**	.050892	.130553	.775379	.186618**	.450070	.210608*	.629440	.194766**
4	LDTS	Small time & savings deposits	1.594516	.273504**	1.568488	.203796**	.965896	.160444**	−1.009896	.322820**	−.394831	.256854
5	LDRE	Real estate loans	−.473943	.156009**	−.004174	.143998	.135174	.112679	.483476	.140249**	.593105	.134626**
6	LDCI	Commercial & industrial loans[c]	−.410284	.152338**	−.164831	.069945*	−.445574	.129025**	.625560	.181512**	−.109468	.120931
7	LDIN	Consumer installment loans	−.456364	.174712*	−.177418	.178972	−.557707	.172635**	.281770	.174488	.050592	.153067
	Factor Price Variables:											
8	LW1	Price of labor[d]	−.069614	.068807	.020401	.068377	.185615	.084069*	.138329	.072471	.211487	.070176**
9	LW2NE	Price of capital[e]	.969905	.099497**	1.021682	.100133**	.684118	.128749**	.604218	.134727**	.413370	.098483**
10	LW3	Price of small time and savings deposits[f]	−.369697	.084262**	−.572411	.076459**	−.322830	.083859**	−.622062	.088606**	−.171619	.081828*
11	LW4	Price of purchased funds[g]	−.061189	.085516	.060656	.091279	−.093806	.112533	.759030	.183784**	.093525	.085090
	Interaction Terms:											
12	DDDD	(LDDD×LDDD)/2	.255217	.033050**	.030033	.014470*	.001562	.005237	.002851	.005861	.002171	.005767
13	DDTS	(LDDD×LDTS)/2	−.402646	.067460**	−.008556	.043866	−.185117	.051228**	.019333	.061265	.043229	.050825
14	DDRE	(LDDD×LDRE)/2	−.151291	.022606**	.088103	.046848	−.117266	.038908**	−.202004	.035545**	−.251086	.033391**
15	DDCI	(LDDD×LDCI)/2	.041853	.037392	−.008460	.027011	.306330	.034498**	.202459	.037252**	.255778	.031310**
16	DDIN	(LDDD×LDIN)/2	.021250	.063896	−.009597	.029151	.044553	.022746	−.007841	.025755	−.079763	.024636**
17	TSTS	(LDTS×LDTS)/2	−.063228	.037044	−.028431	.028733	.029664	.022495	−.027319	.032348	−.039303	.020574
18	TSRE	(LDTS×LDRE)/2	.327448	.059767**	−.147098	.063757*	−.055408	.041094	.154449	.048941**	.235143	.032373**
19	TSCI	(LDTS×LDCI)/2	.034600	.055053	−.015008	.042575	−.059705	.048295	−.080713	.052295	−.137591	.042059**
20	TSIN	(LDTS×LDIN)/2	.105960	.048035*	.070916	.083878	.185542	.036250**	.096944	.037373*	.118457	.031670**
21	RERE	(LDRE×LDRE)/2	−.081513	.019022**	.055862	.019669**	.065890	.015942**	.053137	.030718	.052386	.015009**
22	RECI	(LDRE×LDCI)/2	.044098	.015732**	−.032488	.016458	−.029443	.020889	−.070904	.035332*	−.049224	.017506**
23	REIN	(LDRE×LDIN)/2	−.050596	.043776	.002377	.049531	.101536	.039931*	−.033788	.040260	−.126515	.019148**
24	CICI	(LDCI×LDCI)/2	−.030871	.012470*	.023742	.005786**	.013178	.015361	.018279	.019567	.006086	.005269
25	CIIN	(LDCI×LDIN)/2	.029324	.047689	.059813	.023956*	−.191023	.041487**	−.077936	.033852*	−.008428	.023440
26	ININ	(LDIN×LDIN)/2	−.059766	.023807*	−.070019	.024958**	−.067102	.018489**	−.006659	.022044	.025497	.017832
27	W1W1	(LW1×LW1)/2	.065996	.012474**	.056736	.012774**	.024218	.015915	.074776	.013137**	−.013710	.011082
28	W1DD	LW1×LDDD	.043763	.004916**	.025599	.004832**	.021128	.005209**	.026932	.004601**	.022444	.004507**
29	W1TS	LW1×LDTS	.002595	.007997	.024452	.008604**	.017209	.009748	−.035006	.008425**	−.028999	.007822**
30	W1RE	LW1×LDRE	−.032890	.003595**	−.040262	.003950**	−.028313	.005638**	−.020171	.005156**	−.012668	.004296**
31	W1C1	LW1×LDCI	−.009379	.003805*	.009014	.002773**	−.007557	.005163	.003607	.005288	.004906	.003410
32	W1IN	LW1×LDIN	−.018766	.007205*	−.028169	.007237**	−.014917	.006891*	.005482	.005718	−.003386	.005211
33	W2NEW2NE	(LW2NE×LW2NE)/2	−.060504	.016073**	−.030233	.016020	−.021135	.019723	.074408	.024918**	−.048402	.013922**

Appendix Table 2 continued

Estimated Total Cost Functions, 1985 through 1993, Annual Data[a]

Line	Variable[b]	Definition	1985 Coefficient	1985 Standard Error	1986 Coefficient	1986 Standard Error	1987 Coefficient	1987 Standard Error	1988 Coefficient	1988 Standard Error	1989 Coefficient	1989 Standard Error
34	W2NEDD	LW2NE×LDDD	−.089840	.006512**	−.044386	.006484**	−.041255	.007133**	−.035616	.006401**	−.038524	.006742**
35	W2NETS	LW2NE×LDTS	−.058555	.009895**	−.073670	.011027**	−.060489	.012538**	−.009122	.011488	−.018219	.011560
36	W2NERE	LW2NE×LDRE	.057442	.004642**	.046662	.005231**	.035591	.007644**	.025434	.007145**	.012556	.006409
37	W2NECI	LW2NE×LDCI	−.006371	.005015	.000344	.003655	.001986	.007026	−.017524	.007354*	.006429	.005072
38	W2NEIN	LW2NE×LDIN	.075916	.009338**	.039994	.009763**	.034371	.009044**	.009505	.007877	.004300	.007720
39	W3W3	(LW3×LW3)/2	−.022196	.014751	−.060199	.012707**	−.015371	.013895	−.048763	.013558**	−.005995	.012308
40	W3DD	LW3×LDDD	.018726	.006649**	−.002595	.005276	.005679	.005796	−.008571	.006492	−.001589	.007796
41	W3TS	LW3×LDTS	.053235	.010187**	.049583	.009234**	.045812	.010377**	.057554	.011537**	.055255	.013459**
42	W3RE	LW3×LDRE	−.011143	.004763*	.002079	.004299	−.002747	.006266	−.000896	.007269	−.001569	.007513
43	W3CI	LW3×LDCI	.014817	.005193**	−.008140	.003026**	.005807	.005762	.009078	.007430	−.010186	.005921
44	W3IN	LW3×LDIN	−.038289	.009439**	−.002178	.007881	−.012230	.007306	−.008305	.007845	.008838	.008878
45	W4W4	(LW4×LW4)/2	−.163431	.035315**	−.156798	.028155**	−.180233	.042888**	−.155428	.055615**	−.048409	.025661
46	W4DD	LW4×LDDD	.065579	.035441	.157308	.026883**	.220631	.044201**	.118683	.055172*	.107484	.048973*
47	W4TS	LW4×LDTS	−.031905	.053694	−.219897	.036850**	−.186634	.040827**	−.578142	.137102**	−.239169	.070839**
48	W4RE	LW4×LDRE	.000658	.014114	.048209	.011889**	.134446	.027021**	.187017	.067435**	.176733	.025387**
49	W4CI	LW4×LDCI	−.040884	.030143	.030141	.014820*	−.108994	.022434**	.173468	.039455**	.027380	.026053
50	W4IN	LW4×LDIN	.004034	.059054	−.012413	.041800	−.059602	.041273	.094214	.053919	−.071604	.038025
51	W1W2NE	(LW1×LW2NE)/2	.031644	.009931**	.012257	.009906	.033113	.009590**	−.012625	.010931	.093929	.007044**
52	W1W3	(LW1×LW3)/2	−.078156	.012522**	−.059560	.012347**	−.032737	.015013*	−.062130	.012009**	−.007604	.010678
53	W1W4	(LW1×LW4)/2	.040681	.009341**	.040745	.008959**	.052024	.008267**	.005598	.011137	.068085	.008856**
54	W2NEW3	(LW2NE×LW3)/2	.066130	.014737**	.067371	.015495**	.017331	.017988	.084183	.015904**	−.061687	.011374**
55	W2NEW4	(LW2NE×LW4)/2	−.091564	.012317**	−.085845	.012016**	−.098691	.011129**	−.060557	.015672**	−.080349	.013151**
56	W3W4	(LW3×LW4)/2	.021456	.012308	.014998	.009526	.020105	.008967*	.040818	.014782**	−.024694	.014273
		R-Square	.9975		.9979		.9978		.9975		.9978	
		Observations	173		176		177		179		182	

Appendix Table 2 continued

Estimated Total Cost Functions, 1985 through 1993, Annual Data[a]

Line	Variable[b]	Definition	1990 Coefficient	1990 Standard Error	1991 Coefficient	1991 Standard Error	1992 Coefficient	1992 Standard Error	1993 Coefficient	1993 Standard Error
1	Q	Lowest average total cost dummy variable	−.068997	.013741**	−.043448	.015990**	−.059684	.018924**	−.036306	.021999
2	INTERCEPT		−.748082	.648064	−.489340	.684615	−.281838	.880114	−4.755886	1.289112**
	Output Variables:									
3	LDDD	Demand deposits	.045503	.151201	.192089	.129884	.656033	.179967**	.557617	.204695**
4	LDTS	Small time & savings deposits	.009599	.215478	−.820308	.208502**	−.852535	.242043**	−3.575209	.570827**
5	LDRE	Real estate loans	.642559	.129970**	.609869	.138355**	.117245	.147129	−2.644577	.236153**
6	LDCI	Commercial & industrial loans[c]	−.397316	.124502**	−.030446	.113177	.115122	.132588	−.395634	.158664*
7	LDIN	Consumer installment loans	.328220	.164892*	.694437	.141483**	.641608	.164858**	.024405	.207168
	Factor Price Variables:									
8	LW1	Price of labor[d]	.148715	.073965*	−.024186	.077300	.037533	.082059	−.248337	.103067*
9	LW2NE	Price of capital[e]	.336451	.101737**	.439741	.110382**	.449154	.120736**	.661014	.109901**
10	LW3	Price of small time and savings deposits[f]	.204825	.077652**	.022491	.090489	.062106	.098373	.211241	.102603*
11	LW4	Price of purchased funds[g]	−.379981	.095036**	.123907	.115326	−.097585	.131608	−.247837	.130252
	Interaction Terms:									
12	DDDD	(LDDD×LDDD)/2	.020514	.003727**	.014419	.004514**	.012626	.005907*	−.014460	.006682*
13	DDTS	(LDDD×LDTS)/2	.311361	.047001**	.028965	.047027	.031482	.045755	.227882	.062343**
14	DDRE	(LDDD×LDRE)/2	−.272805	.035119**	−.062256	.025047*	−.163414	.030996**	−.472020	.048091**
15	DDCI	(LDDD×LDCI)/2	.014686	.029354	.004522	.029194	.049197	.040423	.196397	.051271**
16	DDIN	(LDDD×LDIN)/2	−.133637	.020178**	.013000	.023723	.017256	.026322	.000471	.031541
17	TSTS	(LDTS×LDTS)/2	−.136998	.016990**	−.090230	.019642**	−.030466	.030099	−.152629	.048529**
18	TSRE	(LDTS×LDRE)/2	.233261	.035281**	.120436	.020181**	.312487	.028552**	.208148	.048450**
19	TSCI	(LDTS×LDCI)/2	.068044	.050389	.210735	.039140**	.097376	.052354	.078201	.068712
20	TSIN	(LDTS×LDIN)/2	−.028174	.034585	.098438	.034263**	.029153	.043254	−.186578	.084481*
21	RERE	(LDRE×LDRE)/2	.062456	.018270**	.089573	.016893**	−.043189	.022312	.127143	.043235**
22	RECI	(LDRE×LDCI)/2	−.106189	.022581**	−.160992	.023778**	−.026448	.026389	−.075687	.046968
23	REIN	(LDRE×LDIN)/2	−.109124	.019946**	.162370	.027131**	−.154784	.036571**	.129912	.050882*
24	CICI	(LDCI×LDCI)/2	.018912	.003923**	.003893	.004109	.028214	.005956**	.003899	.010438
25	CIIN	(LDCI×LDIN)/2	.022578	.024332	−.090479	.018250**	−.192304	.023039**	−.106726	.018964**
26	ININ	(LDIN×LDIN)/2	.083081	.010927**	.029436	.011590*	.066401	.013281**	.055501	.021601*
27	W1W1	(LW1×LW1)/2	−.015858	.012183	.012844	.012794	−.011263	.011570	.078889	.013967**
28	W1DD	LW1×LDDD	.022794	.004350**	.020940	.005094**	.019438	.005697**	.015181	.006091*
29	W1TS	LW1×LDTS	−.020438	.008165*	−.004513	.009396	−.018925	.010788	−.021372	.013401
30	W1RE	LW1×LDRE	−.022340	.004566**	−.036534	.004978**	−.027025	.005684**	−.034566	.007863**
31	W1C1	LW1×LDCI	.001405	.003442	.005253	.003781	.005427	.004232	.017227	.004645**
32	W1IN	LW1×LDIN	.002583	.004597	.004797	.004672	.009111	.005360	−.000841	.006487
33	W2NEW2NE	(LW2NE×LW2NE)/2	−.047115	.014200**	−.074514	.016487**	−.051169	.017031**	−.092201	.014545**

Appendix Table 2 continued

Estimated Total Cost Functions, 1985 through 1993, Annual Data[a]

Line	Variable[b]	Definition	1990 Coefficient	1990 Standard Error	1991 Coefficient	1991 Standard Error	1992 Coefficient	1992 Standard Error	1993 Coefficient	1993 Standard Error
34	W2NEDD	LW2NE×LDDD	−.033032	.006412**	−.023691	.006659**	−.032104	.006664**	−.033583	.005750**
35	W2NETS	LW2NE×LDTS	−.039239	.011607**	−.043873	.011604**	−.021498	.012311	−.031124	.012484*
36	W2NERE	LW2NE×LDRE	.030422	.006603**	.038610	.006309**	.040793	.006553**	.059242	.007291**
37	W2NECI	LW2NE×LDCI	.011773	.004954*	.010587	.004818*	−.003320	.004866	−.011427	.004342*
38	W2NEIN	LW2NE×LDIN	−.000396	.006590	−.014377	.006006*	−.016496	.006234**	−.005570	.006070
39	W3W3	(LW3×LW3)/2	.044443	.012570**	−.024293	.017682	−.023242	.014560	.025328	.015055
40	W3DD	LW3×LDDD	−.003905	.006668	−.011516	.007078	−.004970	.007762	.005352	.007419
41	W3TS	LW3×LDTS	.062656	.012315**	.044503	.012554**	.050413	.014487**	.046252	.016334**
42	W3RE	LW3×LDRE	−.002781	.007047	.005123	.006848	−.003328	.007630	−.007122	.009547
43	W3CI	LW3×LDCI	−.013236	.005273*	−.014800	.005197**	−.006094	.005765	−.013491	.005658
44	W3IN	LW3×LDIN	.003858	.006885	.013953	.006328*	.006502	.007279	.012082	.007899
45	W4W4	(LW4×LW4)/2	−.060473	.023165*	−.173519	.044259**	−.077872	.041060	−1.288E-05	.035087
46	W4DD	LW4×LDDD	−.042398	.037741	.054621	.030215	.074791	.054349	−.020768	.062123
47	W4TS	LW4×LDTS	.056065	.044894	−.293065	.052808**	−.016287	.081000	.716109	.112858**
48	W4RE	LW4×LDRE	.155863	.028170**	.197301	.029182**	.006706	.036810	−.589564	.082297**
49	W4CI	LW4×LDCI	−.077799	.029807*	.009498	.023824	.062454	.019220**	.044434	.023741
50	W4IN	LW4×LDIN	−.091975	.045605*	.042724	.040918	−.123512	.040847**	−.142696	.036326**
51	W1W2NE	(LW1×LW2NE)/2	.101562	.006515**	.098144	.006869**	.087983	.007459**	.067501	.007971**
52	W1W3	(LW1×LW3)/2	−.002681	.011529	.009524	.012375	−.047291	.011985**	−.082455	.012188**
53	W1W4	(LW1×LW4)/2	.055422	.007647**	.026861	.009912**	.027967	.010267**	−.009707	.012076
54	W2NEW3	(LW2NE×LW3)/2	−.100904	.012102**	−.079209	.012961**	−.033038	.013690*	.009875	.012116
55	W2NEW4	(LW2NE×LW4)/2	−.054202	.010126**	−.093591	.012835**	−.059711	.012171**	−.066571	.011623**
56	W3W4	(LW3×LW4)/2	.001815	.010751	.024042	.013549	.020264	.013967	.083896	.014589**
		R-Square	.9976		.9981		.9976		.9971	
		Observations	184		158		141		132	

*Significant at the .05 level or greater.

**Significant at the .01 level or greater.

[a]The dependent variable is total cost defined as the sum of employee compensation, expense of fixed assets, interest expense of small time and savings deposits, and interest expense of all purchased funds.

[b]All variables except lowest average total cost dummy variable are in natural log form and have been deflated by the Boston Consumer Price Index (annual).

[c]Includes construction and land and farmland loans.

[d]Price of labor is defined as employee compensation divided by the number of full-time employees.

[e]Price of capital is defined as the value of non-residential office space divided by the square footage of non-residential office space, multiplied by 1,000.

[f]Price of small time and savings deposits is defined as interest expense on small time and savings deposits divided by small time and savings deposits.

[g]Price of purchased funds is defined as interest expense of federal funds purchased and securities sold, time certificates of deposit of $100,000 or more, demand notes issued to the U.S. Treasury on other borrowed money, and deposits in foreign offices divided by the stock of federal funds purchased and securities sold, time certificates of deposit of $100,000 or more, demand notes issued to the U.S. Treasury on other borrowed money, and deposits in foreign offices.

Note: The division of several of the interaction terms by 2, although counterintuitive, is a characteristic of a cost function derived from a translog production function. See Varian (1993) for a formal derivation.

Source: U.S. Bureau of Labor Statistics; FW Dodge Division, McGraw-Hill, Inc., *Dodge Construction Potentials Bulletin*; Federal Deposit Insurance Corporation, *Reports on Condition and Income*; and author's calculations.

Appendix Table 3
Elasticity of Total Cost with Respect to Each of Five Outputs, Evaluated at Output Mean

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Real Estate Loans	−.1	0	0	.1	0	0	.2	0	−.2
Demand Deposits	.1	.1	0	.1	.6	0	.1	0	−.1
Small Time and Savings Deposits	1.1	.9	.9	.9	1	.7	.6	.9	1.3
Commercial and Industrial Loans	0	0	0	−.1	.2	.1	.1	0	0
Consumer Installment Loans	−.1	−.1	0	0	0	.2	0	.1	1

Note: See appendix text for methodological details.
Source: Same as for Appendix Tables 1 and 2.

Appendix

Translog Cost Model

The formal translog cost model estimated in this study (Appendix Tables 1 and 2) can be written as:

$$lnTC = \alpha + \sum_{i=1}^{5}\beta_i \, lnY_i + 1/2 \sum_{i=1}^{5}\sum_{j=1}^{5}\delta_{ij} \, lnY_i \, lnY_j$$

$$+ \sum_{k=1}^{4}\gamma_k \, lnP_k + 1/2 \sum_{k=1}^{4}\sum_{n=1}^{4}\gamma_{kn} \, lnP_k \, lnP_n$$

$$+ \sum_{i=1}^{5}\sum_{k=1}^{4}\rho_{ik} \, lnY_i \, lnP_k + \epsilon \qquad (1)$$

$$S_k = \alpha_k + \sum_{n=1}^{4}\gamma_{kn} lnP_n + \sum_{i=1}^{5}\rho_{ik} \, lnY_i + \Psi_k, \quad k = 1, 2, 3, 4 \qquad (2)$$

where:

- TC = real total cost (interest and operating costs deflated by the GNP deflator). As is standard in banking studies, cost figures do not include loan losses. They are instead effectively treated as a decline in revenue, since the rates charged on loans include premia to cover the expected value of these losses;
- Y_i = real value of output i: 1) demand deposits, 2) small time and savings deposits, 3) real estate loans, 4) commercial and industrial loans, and 5) installment loans;
- P_k = real price of input k: 1) labor, 2) physical capital, 3) interest rate on small time and savings deposits, and 4) interest rate on purchased funds;
- S_k = cost share of input k, which equals $\partial lnTC/\partial lnP_k$ from equation (1) plus an error term;
- ϵ, Ψ_k = error terms.

The standard symmetry and linear homogeneity in input price restrictions are imposed in estimation, as are the Shephard's Lemma cross-equation restrictions. One of the share equations is dropped to avoid singularity. Estimates of the parameters for the share equations are available from the author upon request.

Methodology for Computing Difference between Best Practice and Worst Practice Banks, as Reported in Table 2

Following the methodology of Berger (1993), the differences reported in Table 2 for each time period were computed according to the following formula:

$$\text{INEFF} = (AC^{Q4} - AC^{Q4*})/AC^{Q4}$$

AC^{Q4} was calculated in the following manner: 1) the average values of all cost determinants in the cost model were computed for banks in the lowest average cost (ATC) quartile; 2) using the model estimated with the lowest ATC quartile data, total cost was estimated for a hypothetical bank exhibiting these average values for the cost determinants; 3) this total cost estimate was divided by the average value for total assets for lowest quartile banks, to arrive at predicted ATC for the hypothetical low AC bank.

AC^{Q4*} was calculated in the same manner, except estimated total cost was derived from the cost model estimated from the highest ATC quartile.

Analysis of Total Impact of Output Variables on Total Cost

As mentioned in footnote 11, simulations were performed to evaluate the elasticity of total cost with respect to each of the five outputs in the cost model at the output's mean value. For each of the five outputs in each year, the observation with the mean value for that output was identified. It was then assumed that the value of that output increased by 10 percent. The resulting percentage increases in predicted cost, based on the annual estimated cost functions (Appendix Table 2), were divided by 10 to arrive at the estimated elasticities. The results are reported in Appendix Table 3. Note the sharp, difficult-to-explain jumps in the cost elasticity with respect to demand deposits from 1988 to 1989, consumer installment loans from 1992 to 1993, and small time and savings deposits from 1991 to 1992 and from 1992 to 1993.

Appendix Table 1

Total Cost Function, Estimated from Pooled, Cross-Section Time Series Data, 1985–89 and 1990–93[a]

Line	Variable[b]	Definition	First ATC Quartile				Fourth ATC Quartile			
			1985–1989		1990–1993		1985–1989		1990–1993	
			Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
1	INTERCEPT		−7.688931	.435160**	−2.417944	1.015545*	−2.739171	.593205**	.242356	.783426
	Output Variables:									
2	LDDD	Demand deposits	.031399	.113486	.876433	.226216**	.600413	.137288**	.276690	.102950**
3	LDTS	Small time & savings deposits	1.475004	.158898**	.309359	.367604	.730481	.237018**	2.201001	.232851**
4	LDRE	Real estate loans	−.284770	.083589**	−.261039	.173051	−.039043	.170376	−2.099448	.175245**
5	LDCI	Commercial & industrial loans[c]	.096250	.056879	−.305873	.139975*	−.549310	.145005**	.797676	.153188**
6	LDIN	Consumer installment loans	−.246265	.096940*	.289798	.212053	−.028881	.121908	−.430759	.139782**
	Factor Price Variables:									
7	LW1	Price of labor[d]	−.287748	.048815**	−.311337	.072206**	.030809	.059419	−.107262	.083997
8	LW2NE	Price of capital[e]	1.399268	.072455**	.734793	.085243**	.792558	.083455**	.138539	.109650
9	LW3	Price of small time and savings deposits[f]	−.474727	.054225**	.246831	.071944**	−.371273	.071572**	.297317	.094263**
10	LW4	Price of purchased funds[g]	−.273586	.062815**	−.340573	.083470**	.095811	.064687	.342812	.090721**
	Interaction Terms:									
11	DDDD	(LDDD×LDDD)/2	.235639	.019736**	.210973	.056195**	.017054	.006277**	.004439	.004075
12	DDTS	(LDDD×LDTS)/2	−.087717	.052741	.137036	.088951	−.100440	.039013*	−.105303	.034312**
13	DDRE	(LDDD×LDRE)/2	−.105514	.030255**	−.301139	.071142**	−.031826	.031241	−.218577	.035509**
14	DDCI	(LDDD×LDCI)/2	−.035724	.028537	−.074710	.062607	.101471	.036067**	.337200	.038867**
15	DDIN	(LDDD×LDIN)/2	−.135842	.031018**	−.170975	.049162**	.019657	.023017	−.107050	.010039**
16	TSTS	(LDTS×LDTS)/2	−.145665	.019116**	−.293619	.058397**	−.054308	.027460*	−.129617	.021965**
17	TSRE	(LDTS×LDRE)/2	.341397	.025262**	.345778	.082747**	−.030698	.061845	.124290	.020594**
18	TSCI	(LDTS×LDCI)/2	−.055175	.034624	.177107	.096191	.221418	.064775**	−.023768	.035442
19	TSIN	(LDTS×LDIN)/2	.152935	.045862**	−.050227	.116522	.082090	.029389**	.160587	.023006**
20	RERE	(LDRE×LDRE)/2	−.063056	.005944**	.051941	.048491	.142312	.032883**	.238423	.019002**
21	RECI	(LDRE×LDCI)/2	.014861	.019962	−.093891	.068919	−.144734	.027459**	−.165670	.017746**
22	REIN	(LDRE×LDIN)/2	−.154927	.031624**	.066934	.051399	−.052956	.033788	−.002082	.013623
23	CICI	(LDCI×LDCI)/2	−.000365	.002662	.009272	.009403	−.021485	.034377	−.062210	.011555**
24	CIIN	(LDCI×LDIN)/2	.065707	.022943**	−.035913	.039374	−.063982	.031467*	.000373	.011317
25	ININ	(LDIN×LDIN)/2	.001038	.012279	.058217	.025190*	−.022805	.017905	−.002048	.008361
26	W1W1	(LW1×LW1)/2	.085582	.010453**	.045132	.009722**	.033019	.010248**	.088821	.012061**
27	W1DD	LW1×LDDD	.068195	.005991**	.046690	.010115**	.028703	.003758**	.030465	.004931**
28	W1TS	LW1×LDTS	−.079940	.008153**	−.065353	.015619**	−.021053	.006667**	−.020084	.008362*
29	W1RE	LW1×LDRE	−.016636	.002994**	−.013646	.005306*	−.027532	.005002**	−.041824	.006123**
30	W1CI	LW1×LDCI	.002697	.002379	.012062	.003474**	.006420	.004943	.005475	.005160
31	W1IN	LW1×LDIN	.011903	.005268*	.007600	.006491	−.013931	.004916**	−.005047	.004514
32	W2NEW2NE	(LW2NE×LW2NE)/2	−.104211	.010985**	−.109397	.010538**	−.091988	.012531**	−.047605	.015441**
33	W2NEDD	LW2NE×LDDD	−.118682	.006527**	−.135239	.010609**	−.042559	.005514**	−.037353	.006519**

Appendix Table 1 continued

Total Cost Function, Estimated from Pooled, Cross-Section Time Series Data, 1985–89 and 1990–93[a]

Line	Variable[b]	Definition	First ATC Quartile 1985–1989 Coefficient	First ATC Quartile 1985–1989 Standard Error	First ATC Quartile 1990–1993 Coefficient	First ATC Quartile 1990–1993 Standard Error	Fourth ATC Quartile 1985–1989 Coefficient	Fourth ATC Quartile 1985–1989 Standard Error	Fourth ATC Quartile 1990–1993 Coefficient	Fourth ATC Quartile 1990–1993 Standard Error
34	W2NETS	LW2NE×LDTS	.020375	.008758*	.078589	.016267**	−.041561	.009530**	−.007667	.010669
35	W2NERE	LW2NE×LDRE	.020560	.003227**	.001701	.005558	.033664	.007300**	.054622	.007852**
36	W2NECI	LW2NE×LDCI	.000399	.002566	.006060	.003649	−.007250	.007216	−.007152	.006589
37	W2NEIN	LW2NE×LDIN	.039037	.005709**	.015688	.006813*	.027383	.007157**	−.011003	.005886
38	W3W3	(LW3×LW3)/2	.006825	.009459	.071183	.008114**	−.006181	.011621	.035926	.014406*
39	W3DD	LW3×LDDD	.015468	.007585*	.034258	.011404**	−.008204	.005964	−.011533	.007691
40	W3TS	LW3×LDTS	.088903	.010091**	.039905	.017925*	.064858	.010300**	.020676	.012417
41	W3RE	LW3×LDRE	−.007830	.003804*	.005517	.005998	.007527	.007928	.005196	.009116
42	W3CI	LW3×LDCI	−.003105	.003049	−.020449	.003978**	−.005467	.007835	−.000198	.007737
43	W3IN	LW3×LDIN	−.043067	.006374**	−.014957	.007465*	.003477	.007705	.026071	.006812**
44	W4W4	(LW4×LW4)/2	−.072243	.018040**	−.216562	.012637**	−.174553	.030836**	.016782	.013341
45	W4DD	LW4×LDDD	−.013833	.028505	.060135	.042656	.151961	.026964**	−.131672	.020484**
46	W4TS	LW4×LDTS	.106709	.036102**	−.199818	.071397**	−.142365	.043322**	.182103	.026829**
47	W4RE	LW4×LDRE	−.034205	.011054**	.172209	.055651**	.097839	.032084**	−.223630	.028637**
48	W4CI	LW4×LDCI	.006172	.013975	−.030529	.011479**	−.040065	.026280	.259198	.028899**
49	W4IN	LW4×LDIN	−.061396	.021400**	.001153	.028434	−.076316	.026412**	−.087291	.028791**
50	W1W2NE	(LW1×LW2NE)/2	.046016	.005825**	.100970	.005828**	.079195	.007015**	.087266	.007167**
51	W1W3	(LW1×LW3)/2	−.118908	.008478**	−.087607	.008174**	−.057579	.010490**	−.015831	.012272
52	W1W4	(LW1×LW4)/2	.012751	.005370*	.011836	.007416	.037324	.007390**	.016290	.009305
53	W2NEW3	(LW2NE×LW3)/2	.083989	.010218**	−.018444	.009493	.006196	.011699	−.067309	.012521**
54	W2NEW4	(LW2NE×LW4)/2	−.030435	.005772**	−.020352	.008082*	−.095086	.010856**	−.056254	.011497**
55	W3W4	(LW3×LW4)/2	.001039	.006503	.016137	.008452	.016045	.011157	.033776	.013253*
		R-Square	.9991		.9976		.9971		.9981	
		Observations	214		152		211		154	

*Significant at the .05 level or greater.

**Significant at the .01 level or greater.

[a]The dependent variable is total cost defined as the sum of employee compensation, expense of fixed assets, interest expense of small time and savings deposits, and interest expense of all purchased funds.

[b]All variables are in natural log form and have been deflated by the Boston Consumer Price Index (annual).

[c]Includes construction and land and farmland loans.

[d]Price of labor is defined as employee compensation divided by the number of full-time employees.

[e]Price of capital is defined as the value of non-residential office space divided by the square footage of non-residential office space, multiplied by 1,000.

[f]Price of small time and savings deposits is defined as interest expense on small time and savings deposits divided by small time and savings deposits.

[g]Price of purchased funds is defined as interest expense of federal funds purchased and securities sold, time certificates of deposit of $100,000 or more, demand notes issued to the U.S. Treasury on other borrowed money, and deposits in foreign offices divided by the stock of federal funds purchased and securities sold, time certificates of deposit of $100,000 or more, demand notes issued to the U.S. Treasury on other borrowed money, and deposits in foreign offices.

Note: The division of several of the interaction terms by 2, although counterintuitive, is a characteristic of a cost function derived from a translog production function. See Varian (1993) for a formal derivation.

Source: U.S. Bureau of Labor Statistics; FW Dodge Division, McGraw-Hill, Inc., *Dodge Construction Potentials Bulletin*; Federal Deposit Insurance Corporation, *Reports on Condition and Income*; and author's calculations.

Appendix Table 2
Estimated Total Cost Functions, 1985 through 1993, Annual Data[a]

Line	Variable[b]	Definition	1985 Coefficient	1985 Standard Error	1986 Coefficient	1986 Standard Error	1987 Coefficient	1987 Standard Error	1988 Coefficient	1988 Standard Error	1989 Coefficient	1989 Standard Error
1	Q	Lowest average total cost dummy variable	−.088234	.017278**	−.135761	.015280**	−.122548	.015046**	−.066129	.014967**	−.064024	.014262**
2	INTERCEPT		−6.285675	.694998**	−8.085702	.701716**	−4.777063	.715260**	−2.669158	.878994**	−1.553787	.686011*
	Output Variables:											
3	LDDD	Demand deposits	.820573	.152089**	.050892	.130553	.775379	.186618**	.450070	.210608*	.629440	.194766**
4	LDTS	Small time & savings deposits	1.594516	.273504**	1.568488	.203796**	.965896	.160444**	−1.009896	.322820**	−.394831	.256854
5	LDRE	Real estate loans	−.473943	.156009**	−.004174	.143998	.135174	.112679	.483476	.140249**	.593105	.134626**
6	LDCI	Commercial & industrial loans[c]	−.410284	.152338**	−.164831	.069945*	−.445574	.129025**	.625560	.181512**	−.109468	.120931
7	LDIN	Consumer installment loans	−.456364	.174712*	−.177418	.178972	−.557707	.172635**	.281770	.174488	.050592	.153067
	Factor Price Variables:											
8	LW1	Price of labor[d]	−.069614	.068807	.020401	.068377	.185615	.084069*	.138329	.072471	.211487	.070176**
9	LW2NE	Price of capital[e]	.969905	.099497**	1.021682	.100133**	.684118	.128749**	.604218	.134727**	.413370	.098483**
10	LW3	Price of small time and savings deposits[f]	−.369697	.084262**	−.572411	.076459**	−.322830	.083859**	−.622062	.088606**	−.171619	.081828*
11	LW4	Price of purchased funds[g]	−.061189	.085516	.060656	.091279	−.093806	.112533	.759030	.183784**	.093525	.085090
	Interaction Terms:											
12	DDDD	(LDDD×LDDD)/2	.255217	.033050**	.030033	.014470*	.001562	.005237	.002851	.005861	.002171	.005767
13	DDTS	(LDDD×LDTS)/2	−.402646	.067460**	−.008556	.043866	−.185117	.051228**	.019333	.061265	.043229	.050825
14	DDRE	(LDDD×LDRE)/2	−.151291	.022606**	.088103	.046848	−.117266	.038908**	−.202004	.035545**	−.251086	.033391**
15	DDCI	(LDDD×LDCI)/2	.041853	.037392	−.008460	.027011	.306330	.034498**	.202459	.037252**	.255778	.031310**
16	DDIN	(LDDD×LDIN)/2	.021250	.063896	−.009597	.029151	.044553	.022746	−.007841	.025755	−.079763	.024636**
17	TSTS	(LDTS×LDTS)/2	−.063228	.037044	−.028431	.028733	.029664	.022495	−.027319	.032348	−.039303	.020574
18	TSRE	(LDTS×LDRE)/2	.327448	.059767**	−.147098	.063757*	−.055408	.041094	.154449	.048941**	.235143	.032373**
19	TSCI	(LDTS×LDCI)/2	.034600	.055053	−.015008	.042575	−.059705	.048295	−.080713	.052295	−.137591	.042059**
20	TSIN	(LDTS×LDIN)/2	.105960	.048035*	.070916	.083878	.185542	.036250**	.096944	.037373*	.118457	.031670**
21	RERE	(LDRE×LDRE)/2	−.081513	.019022**	.055862	.019669**	.065890	.015942**	.053137	.030718	.052386	.015009**
22	RECI	(LDRE×LDCI)/2	.044098	.015732**	−.032488	.016458	−.029443	.020889	−.070904	.035332*	−.049224	.017506**
23	REIN	(LDRE×LDIN)/2	−.050596	.043776	.002377	.049531	.101536	.039931*	−.033788	.040260	−.126515	.019148**
24	CICI	(LDCI×LDCI)/2	−.030871	.012470*	.023742	.005786**	.013178	.015361	.018279	.019567	.006086	.005269
25	CIIN	(LDCI×LDIN)/2	.029324	.047689	.059813	.023956*	−.191023	.041487**	−.077936	.033852*	−.008428	.023440
26	ININ	(LDIN×LDIN)/2	−.059766	.023807*	−.070019	.024958**	−.067102	.018489**	−.006659	.022044	.025497	.017832
27	W1W1	(LW1×LW1)/2	.065996	.012474**	.056736	.012774**	.024218	.015915	.074776	.013137**	−.013710	.011082
28	W1DD	LW1×LDDD	.043763	.004916**	.025599	.004832**	.021128	.005209**	.026932	.004601**	.022444	.004507**
29	W1TS	LW1×LDTS	.002595	.007997	.024452	.008604**	.017209	.009748	−.035006	.008425**	−.028999	.007822**
30	W1RE	LW1×LDRE	−.032890	.003595**	−.040262	.003950**	−.028313	.005638**	−.020171	.005156**	−.012668	.004296**
31	W1C1	LW1×LDCI	−.009379	.003805*	.009014	.002773**	−.007557	.005163	.003607	.005288	.004906	.003410
32	W1IN	LW1×LDIN	−.018766	.007205*	−.028169	.007237**	−.014917	.006891*	.005482	.005718	−.003386	.005211
33	W2NEW2NE	(LW2NE×LW2NE)/2	−.060504	.016073**	−.030233	.016020	−.021135	.019723	.074408	.024918**	−.048402	.013922**

Appendix Table 2 continued

Estimated Total Cost Functions, 1985 through 1993, Annual Data[a]

Line	Variable[b]	Definition	1985 Coefficient	1985 Standard Error	1986 Coefficient	1986 Standard Error	1987 Coefficient	1987 Standard Error	1988 Coefficient	1988 Standard Error	1989 Coefficient	1989 Standard Error
34	W2NEDD	LW2NE×LDDD	−.089840	.006512**	−.044386	.006484**	−.041255	.007133**	−.035616	.006401**	−.038524	.006742**
35	W2NETS	LW2NE×LDTS	−.058555	.009895**	−.073670	.011027**	−.060489	.012538**	−.009122	.011488	−.018219	.011560
36	W2NERE	LW2NE×LDRE	.057442	.004642**	.046662	.005231**	.035591	.007644**	.025434	.007145**	.012556	.006409
37	W2NECI	LW2NE×LDCI	−.006371	.005015	.000344	.003655	.001986	.007026	−.017524	.007354*	.006429	.005072
38	W2NEIN	LW2NE×LDIN	.075916	.009338**	.039994	.009763**	.034371	.009044**	.009505	.007877	.004300	.007720
39	W3W3	(LW3×LW3)/2	−.022196	.014751	−.060199	.012707**	−.015371	.013895	−.048763	.013558**	−.005995	.012308
40	W3DD	LW3×LDDD	.018726	.006649**	−.002595	.005276	.005679	.005796	−.008571	.006492	−.001589	.007796
41	W3TS	LW3×LDTS	.053235	.010187**	.049583	.009234**	.045812	.010377**	.057554	.011537**	.055255	.013459**
42	W3RE	LW3×LDRE	−.011143	.004763*	.002079	.004299	−.002747	.006266	−.000896	.007269	−.001569	.007513
43	W3CI	LW3×LDCI	.014817	.005193**	−.008140	.003026**	.005807	.005762	.009078	.007430	−.010186	.005921
44	W3IN	LW3×LDIN	−.038289	.009439**	−.002178	.007881	−.012230	.007306	−.008305	.007845	.008838	.008878
45	W4W4	(LW4×LW4)/2	−.163431	.035315**	−.156798	.028155**	−.180233	.042888**	−.155428	.055615**	−.048409	.025661
46	W4DD	LW4×LDDD	.065579	.035441	.157308	.026883**	.220631	.044201**	.118683	.055172*	.107484	.048973*
47	W4TS	LW4×LDTS	−.031905	.053694	−.219897	.036850**	−.186634	.040827**	−.578142	.137102**	−.239169	.070839**
48	W4RE	LW4×LDRE	.000658	.014114	.048209	.011889**	.134446	.027021**	.187017	.067435**	.176733	.025387**
49	W4CI	LW4×LDCI	−.040884	.030143	.030141	.014820*	−.108994	.022434**	.173468	.039455**	.027380	.026053
50	W4IN	LW4×LDIN	.004034	.059054	−.012413	.041800	−.059602	.041273	.094214	.053919	−.071604	.038025
51	W1W2NE	(LW1×LW2NE)/2	.031644	.009931**	.012257	.009906	.033113	.009590**	−.012625	.010931	.093929	.007044**
52	W1W3	(LW1×LW3)/2	−.078156	.012522**	−.059560	.012347**	−.032737	.015013*	−.062130	.012009**	−.007604	.010678
53	W1W4	(LW1×LW4)/2	.040681	.009341**	.040745	.008959**	.052024	.008267**	.005598	.011137	.068085	.008856**
54	W2NEW3	(LW2NE×LW3)/2	.066130	.014737**	.067371	.015495**	.017331	.017988	.084183	.015904**	−.061687	.011374**
55	W2NEW4	(LW2NE×LW4)/2	−.091564	.012317**	−.085845	.012016**	−.098691	.011129**	−.060557	.015672**	−.080349	.013151**
56	W3W4	(LW3×LW4)/2	.021456	.012308	.014998	.009526	.020105	.008967*	.040818	.014782**	−.024694	.014273
		R-Square	.9975		.9979		.9978		.9975		.9978	
		Observations	173		176		177		179		182	

Appendix Table 2 continued

Estimated Total Cost Functions, 1985 through 1993, Annual Data[a]

Line	Variable[b]	Definition	1990 Coefficient	1990 Standard Error	1991 Coefficient	1991 Standard Error	1992 Coefficient	1992 Standard Error	1993 Coefficient	1993 Standard Error
1	Q	Lowest average total cost dummy variable	−.068997	.013741**	−.043448	.015990**	−.059684	.018924**	−.036306	.021999
2	INTERCEPT		−.748082	.648064	−.489340	.684615	−.281838	.880114	−4.755886	1.289112**
	Output Variables:									
3	LDDD	Demand deposits	.045503	.151201	.192089	.129884	.656033	.179967**	.557617	.204695**
4	LDTS	Small time & savings deposits	.009599	.215478	−.820308	.208502**	−.852535	.242043**	−3.575209	.570827**
5	LDRE	Real estate loans	.642559	.129970**	.609869	.138355**	.117245	.147129	−2.644577	.236153**
6	LDCI	Commercial & industrial loans[c]	−.397316	.124502**	−.030446	.113177	.115122	.132588	−.395634	.158664*
7	LDIN	Consumer installment loans	.328220	.164892*	.694437	.141483**	.641608	.164858**	.024405	.207168
	Factor Price Variables:									
8	LW1	Price of labor[d]	.148715	.073965*	−.024186	.077300	.037533	.082059	−.248337	.103067*
9	LW2NE	Price of capital[e]	.336451	.101737**	.439741	.110382**	.449154	.120736**	.661014	.109901**
10	LW3	Price of small time and savings deposits[f]	.204825	.077652**	.022491	.090489	.062106	.098373	.211241	.102603*
11	LW4	Price of purchased funds[g]	−.379981	.095036**	.123907	.115326	−.097585	.131608	−.247837	.130252
	Interaction Terms:									
12	DDDD	(LDDD×LDDD)/2	.020514	.003727**	.014419	.004514**	.012626	.005907*	−.014460	.006682*
13	DDTS	(LDDD×LDTS)/2	.311361	.047001**	.028965	.047027	.031482	.045755	.227882	.062343**
14	DDRE	(LDDD×LDRE)/2	−.272805	.035119**	−.062256	.025047*	−.163414	.030996**	−.472020	.048091**
15	DDCI	(LDDD×LDCI)/2	.014686	.029354	.004522	.029194	.049197	.040423	.196397	.051271**
16	DDIN	(LDDD×LDIN)/2	−.133637	.020178**	.013000	.023723	.017256	.026322	.000471	.031541
17	TSTS	(LDTS×LDTS)/2	−.136998	.016990**	−.090230	.019642**	−.030466	.030099	−.152629	.048529**
18	TSRE	(LDTS×LDRE)/2	.233261	.035281**	.120436	.020181**	.312487	.028552**	.208148	.048450**
19	TSCI	(LDTS×LDCI)/2	.068044	.050389	.210735	.039140**	.097376	.052354	.078201	.068712
20	TSIN	(LDTS×LDIN)/2	−.028174	.034585	.098438	.034263**	.029153	.043254	−.186578	.084481*
21	RERE	(LDRE×LDRE)/2	.062456	.018270**	.089573	.016893**	−.043189	.022312	.127143	.043235**
22	RECI	(LDRE×LDCI)/2	−.106189	.022581**	−.160992	.023778**	−.026448	.026389	−.075687	.046968
23	REIN	(LDRE×LDIN)/2	−.109124	.019946**	.162370	.027131**	−.154784	.036571**	.129912	.050882*
24	CICI	(LDCI×LDCI)/2	.018912	.003923**	.003893	.004109	.028214	.005956**	.003899	.010438
25	CIIN	(LDCI×LDIN)/2	.022578	.024332	−.090479	.018250**	−.192304	.023039**	−.106726	.018964**
26	ININ	(LDIN×LDIN)/2	.083081	.010927**	.029436	.011590*	.066401	.013281**	.055501	.021601*
27	W1W1	(LW1×LW1)/2	−.015858	.012183	.012844	.012794	−.011263	.011570	.078889	.013967**
28	W1DD	LW1×LDDD	.022794	.004350**	.020940	.005094**	.019438	.005697**	.015181	.006091*
29	W1TS	LW1×LDTS	−.020438	.008165*	−.004513	.009396	−.018925	.010788	−.021372	.013401
30	W1RE	LW1×LDRE	−.022340	.004566**	−.036534	.004978**	−.027025	.005684**	−.034566	.007863**
31	W1C1	LW1×LDCI	.001405	.003442	.005253	.003781	.005427	.004232	.017227	.004645**
32	W1IN	LW1×LDIN	.002583	.004597	.004797	.004672	.009111	.005360	−.000841	.006487
33	W2NEW2NE	(LW2NE×LW2NE)/2	−.047115	.014200**	−.074514	.016487**	−.051169	.017031**	−.092201	.014545**

Appendix Table 2 continued

Estimated Total Cost Functions, 1985 through 1993, Annual Data[a]

Line	Variable[b]	Definition	1990 Coefficient	1990 Standard Error	1991 Coefficient	1991 Standard Error	1992 Coefficient	1992 Standard Error	1993 Coefficient	1993 Standard Error
34	W2NEDD	LW2NE×LDDD	−.033032	.006412**	−.023691	.006659**	−.032104	.006664**	−.033583	.005750**
35	W2NETS	LW2NE×LDTS	−.039239	.011607**	−.043873	.011604**	−.021498	.012311	−.031124	.012484*
36	W2NERE	LW2NE×LDRE	.030422	.006603**	.038610	.006309**	.040793	.006553**	.059242	.007291**
37	W2NECI	LW2NE×LDCI	.011773	.004954*	.010587	.004818*	−.003320	.004866	−.011427	.004342*
38	W2NEIN	LW2NE×LDIN	−.000396	.006590	−.014377	.006006*	−.016496	.006234**	−.005570	.006070
39	W3W3	(LW3×LW3)/2	.044443	.012570**	−.024293	.017682	−.023242	.014560	.025328	.015055
40	W3DD	LW3×LDDD	−.003905	.006668	−.011516	.007078	−.004970	.007762	.005352	.007419
41	W3TS	LW3×LDTS	.062656	.012315**	.044503	.012554**	.050413	.014487**	.046252	.016334**
42	W3RE	LW3×LDRE	−.002781	.007047	.005123	.006848	−.003328	.007630	−.007122	.009547
43	W3CI	LW3×LDCI	−.013236	.005273*	−.014800	.005197**	−.006094	.005765	−.013491	.005658
44	W3IN	LW3×LDIN	.003858	.006885	.013953	.006328*	.006502	.007279	.012082	.007899
45	W4W4	(LW4×LW4)/2	−.060473	.023165*	−.173519	.044259**	−.077872	.041060	−1.288E-05	.035087
46	W4DD	LW4×LDDD	−.042398	.037741	.054621	.030215	.074791	.054349	−.020768	.062123
47	W4TS	LW4×LDTS	.056065	.044894	−.293065	.052808**	−.016287	.081000	.716109	.112858**
48	W4RE	LW4×LDRE	.155863	.028170**	.197301	.029182**	.006706	.036810	−.589564	.082297**
49	W4CI	LW4×LDCI	−.077799	.029807*	.009498	.023824	.062454	.019220**	.044434	.023741
50	W4IN	LW4×LDIN	−.091975	.045605*	.042724	.040918	−.123512	.040847**	−.142696	.036326**
51	W1W2NE	(LW1×LW2NE)/2	.101562	.006515**	.098144	.006869**	.087983	.007459**	.067501	.007971**
52	W1W3	(LW1×LW3)/2	−.002681	.011529	.009524	.012375	−.047291	.011985**	−.082455	.012188**
53	W1W4	(LW1×LW4)/2	.055422	.007647**	.026861	.009912**	.027967	.010267**	−.009707	.012076
54	W2NEW3	(LW2NE×LW3)/2	−.100904	.012102**	−.079209	.012961**	−.033038	.013690*	.009875	.012116
55	W2NEW4	(LW2NE×LW4)/2	−.054202	.010126**	−.093591	.012835**	−.059711	.012171**	−.066571	.011623**
56	W3W4	(LW3×LW4)/2	.001815	.010751	.024042	.013549	.020264	.013967	.083896	.014589**
		R-Square	.9976		.9981		.9976		.9971	
		Observations	184		158		141		132	

*Significant at the .05 level or greater.

**Significant at the .01 level or greater.

[a]The dependent variable is total cost defined as the sum of employee compensation, expense of fixed assets, interest expense of small time and savings deposits, and interest expense of all purchased funds.

[b]All variables except lowest average total cost dummy variable are in natural log form and have been deflated by the Boston Consumer Price Index (annual).

[c]Includes construction and land and farmland loans.

[d]Price of labor is defined as employee compensation divided by the number of full-time employees.

[e]Price of capital is defined as the value of non-residential office space divided by the square footage of non-residential office space, multiplied by 1,000.

[f]Price of small time and savings deposits is defined as interest expense on small time and savings deposits divided by small time and savings deposits.

[g]Price of purchased funds is defined as interest expense of federal funds purchased and securities sold, time certificates of deposit of $100,000 or more, demand notes issued to the U.S. Treasury on other borrowed money, and deposits in foreign offices divided by the stock of federal funds purchased and securities sold, time certificates of deposit of $100,000 or more, demand notes issued to the U.S. Treasury on other borrowed money, and deposits in foreign offices.

Note: The division of several of the interaction terms by 2, although counterintuitive, is a characteristic of a cost function derived from a translog production function. See Varian (1993) for a formal derivation.

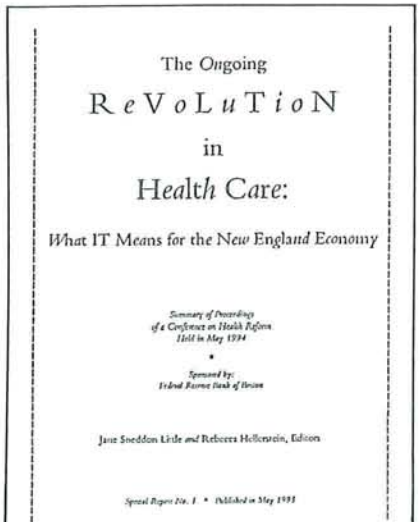
Source: U.S. Bureau of Labor Statistics; FW Dodge Division, McGraw-Hill, Inc., *Dodge Construction Potentials Bulletin*; Federal Deposit Insurance Corporation, *Reports on Condition and Income*; and author's calculations.

Appendix Table 3
Elasticity of Total Cost with Respect to Each of Five Outputs, Evaluated at Output Mean

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Real Estate Loans	−.1	0	0	.1	0	0	.2	0	−.2
Demand Deposits	.1	.1	0	.1	.6	0	.1	0	−.1
Small Time and Savings Deposits	1.1	.9	.9	.9	1	.7	.6	.9	1.3
Commercial and Industrial Loans	0	0	0	−.1	.2	.1	.1	0	0
Consumer Installment Loans	−.1	−.1	0	0	0	.2	0	.1	1

Note: See appendix text for methodological details.
Source: Same as for Appendix Tables 1 and 2.

Special Report



The Ongoing

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in

Health Care:

What IT Means for the New England Economy

Summary of Proceedings
of a Conference on Health Reform
Held in May 1994

•

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Because of the significant public and private sector reforms sweeping the health care industry and the importance of that industry to New England, the Federal Reserve Bank of Boston held a one-day conference on *The Ongoing Revolution in Health Care: What It Means for the New England Economy* on May 3, 1994. This forum gathered highly respected members of the academic, medical, government, and corporate communities to explore such issues as the requirements for and consequences of market-based health care, the impact of mergers within the health services and health insurance industries, and the consequences of reform for the region's medical research community. This special report provides a summary of the participants' remarks. The discussion remains a useful contribution to the ongoing debate on health reform.

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