

Tie-in Sales and Banks

John A. Weinberg

A bank is a multiproduct firm. While its products can be grouped into two broad categories, credit and deposit services, each of these categories comprises many distinct products. In addition to these “traditional banking services,”¹ some banks, either directly or through affiliated companies, offer a wider array of financial services. A continuing trend toward deregulation is likely to further expand the set of activities and markets open to banking organizations.

Some of the services offered by banks are sold to distinct sets of buyers. On the other hand, there are broad classes of bank clientele who regularly obtain multiple services. A business firm’s relationship with a bank, for instance, may include deposit and cash management services as well as regular extensions of credit. The typical household is also a user of multiple bank services.

It is not uncommon for a multiproduct firm to undertake joint marketing efforts. The costs incurred to generate sales for the various products sold cannot always be neatly allocated across products. Such joint actions might occur in all aspects of marketing. A seller might, for instance, seek to develop a single brand identity for a variety of products so that expenditures on promotion of the brand might enhance the sales of all the products. Joint efforts might also show up in the pricing of products. For instance, a seller might give discounts on one product that are contingent on the buyer’s purchase of some other product from the same seller. Or a seller might choose to sell two products only as a bundle, not separately. It is this sort of tying, or bundling of products, that has attracted a fair amount of attention in discussions of the law and economics of antitrust.

■ The author thanks Tom Humphrey, Tony Kuprianov, Jeff Lacker, and Ned Prescott for comments on an earlier draft. The views expressed in this article are the author’s and do not necessarily represent the views of the Federal Reserve Bank of Richmond or the Federal Reserve System.

¹ In the context of the body of legislation and regulations discussed in this article, the phrase “traditional banking services” refers specifically to loans, discounts, deposits, and trust services.

If tying is to raise concerns from an antitrust point of view, it must be that the firm engaged in the practice has some amount of market power. This article examines tying as a use of market power, with the goal of understanding and evaluating restrictions that banks face with regard to such pricing behavior. After reviewing those restrictions and comparing them to the broader antitrust treatment of tying, the article focuses on a particular motivation for tied sales; this pricing strategy can facilitate price discrimination among diverse buyers. This focus suggests that the welfare implications of tying can be ambiguous and that public policy and antitrust law should approach the practice on a case-by-case basis.

1. THE LEGAL TREATMENT OF TYING

In antitrust legislation and case history, the tied sale of multiple products has been attacked as an attempt by a seller with a monopoly position in one market to extend its power into a second market.² Specifically, section 3 of the Clayton Antitrust Act makes it unlawful for a seller to make a sale on the condition that the buyer refrain from dealing with the seller's competitors. This section has been interpreted as a prohibition on tying contracts. For instance, in 1936 the Supreme Court found that IBM violated the Clayton Act by requiring that lessees of its punch-card tabulating machines purchase only punch cards supplied by IBM.

The legal treatment of allegedly anticompetitive practices typically takes one of two forms. A particular practice might be treated as per se illegal. In such a case, violation of the law is established simply by a demonstration that the practice in question took place. It is also possible for the legality of a practice to depend on the particular circumstances in the case at hand. In such instances, a "rule of reason" is said to apply. The Court's language in the 1936 IBM decision strongly suggested that the Clayton Act intended for tying to be treated as per se illegal.

The uncertainty in the treatment of tying, as in many antitrust issues, revolves around the interpretation of statutes stating that a given practice is illegal if its use may "tend to lessen competition or create a monopoly." Such phrases, found in most antitrust legislation and in the relevant banking legislation, leave it to the courts to determine if a given practice can only be anticompetitive or if there may be other, legitimate, reasons for sellers to engage in the practice. In the general antitrust case history on tying arrangements, there has been a movement over time from a treatment of the practice as per se illegal (or nearly so) toward a rule-of-reason approach.

While the Clayton Act's prohibition of tying has not been applied to banks, the Bank Holding Company Act's (BHCA) 1970 amendments extended a

² A description of the legislative and case history are found in Seplaki (1982).

similar prohibition to banking organizations.³ This restriction, contained in section 106 of the amended BHCA, was introduced in an environment in which banks were being given the power to expand into new activities; Congress therefore may well have been reacting to a fear that banks would use restrictive contracts to monopolize new markets.⁴

The prohibition of tying arrangements in the BHCA is quite stringent. While there are some broad classes of exemptions, little room is left for considering the specific conditions arising in a case that does not fall into one of those broad classes.⁵ For instance, there is, in general, no consideration given to the competitive conditions prevailing in the markets for the products involved. In other words, the BHCA rules seem to treat tying as a practice that is per se illegal, so that the legal rules governing tying by banks are at least as rigid as the more general rules contained in the Clayton Act.⁶

The Federal Reserve Board has recently expanded the set of exemptions. In 1995, the Board allowed bank and nonbank subsidiaries of bank holding companies to offer discounts to customers maintaining minimum combined balances across the affiliates' products. More recently, the Board has allowed banks to require some credit card customers to maintain deposit balances at affiliated thrifts.⁷ There remain, however, broad classes of activities to which a strict prohibition of tying still applies. This is particularly true of the tying of a bank's product to a nonbanking product of the bank's affiliate.

The treatment of tying as an anticompetitive practice is based on the idea that a seller with monopoly power in one market can leverage that power into an advantaged position in a second market (one in which it faces competition). In this scenario, the good for which the seller is a monopolist is referred to as the tying good, while the other good, for which there are competing sellers, is the tied good. The seller, then, might make a discount on the tying good available only to those buyers who also purchase the tied good from him.⁸ His position as a monopoly seller of the tying good enables him to charge a premium for the tied good. In this manner, the seller gives up some of his monopoly profits in exchange for being able to earn greater-than-competitive profits in the second market.

³ While the 1970 amendments referred to tying by banks, the same restrictions have been applied to BHCs and their nonbank subsidiaries and to non-BHC affiliated depository institutions as well.

⁴ Shull (1993) makes this point with reference to the legislative history.

⁵ Section 106 allows tie-ins when both products are "traditional banking products" offered by a bank (as opposed to nonbank affiliates within a holding company).

⁶ This comparison is made by Shull (1993).

⁷ *American Banker*, April 15, 1996.

⁸ It is worth noting that the selling of two goods only as a bundle can be seen as an extreme case of tying, in which the tying good is only available to those who buy the tied good and the prices of the two goods are not quoted separately.

An extreme form of the leverage argument holds that, through a strategic use of tying arrangements, a seller can deter potential entrants from even trying to compete in the market for the tied good. In this view, tying is not just a use of monopoly position in one market but is, further, a way of creating a monopoly position in another market. This extreme form of leverage is referred to as foreclosure.

If leverage or foreclosure were the only possible motivations for tying provisions, then per se illegality of the practice would be justified. A great deal of commentary on tying, however, has identified a number of other possible motivations. For instance, a seller may profitably make use of tying the sale of two products that are complements in production or consumption. Two goods are complements in production if the marginal cost of producing one good is less if the other good is produced by the same firm. There is complementarity in consumption between two goods if a buyer's willingness to pay for one good is enhanced by the consumption of the other.⁹

When there are complementarities between two products, the monopolist seller of one product has a natural advantage over competitors of the other product. It is not clear that the seller needs to use a tying arrangement to benefit from that advantage. Complementarities will allow the seller to be a more aggressive competitor in the nonmonopoly market, even if the two products are priced independently. Hence, complementarities alone may not be enough to justify tying arrangements. On the other hand, if the seller enjoys cost complementarities from providing two goods to a particular buyer, then bundled sales of the two products may be the best way for the firm to realize the potential cost savings.

Another justification for tying is that it allows the seller to price discriminate among the buyers of the monopolized product. By offering different prices for customers who buy different combinations of goods, a seller can separate buyers according to their demand characteristics in a way that might not be possible with independent pricing of all goods. This discrimination allows the seller to increase profits by extracting greater revenue from those buyers who are most willing and able to pay. When tying is used to facilitate price discrimination, its overall effect is typically to reduce the economic efficiency cost of monopoly power. This conclusion derives from the fact that tying two products tends to increase the quantity sold of the monopolized (or more monopolized) product. Consequently, the justification for an absolute rule against such practices is weakened, even in the absence of obvious cost or demand complementarities.

⁹ White (1995) provides a discussion of tying by banks when their products are linked by demand-side complementarities.

The next section presents a discussion of tying as price discrimination by a multiproduct monopolist. The following sections then discuss the effect of introducing competition for one of the products and the implications of interpreting the monopolized product as a banking product. The banking product chosen for this discussion is small business lending. This may be one area of operation in which some banks continue to exercise market power sufficient to raise questions about the possible competitive effects of tying. It is also an area in which some have expressed concern about the effects of continuing consolidation in the banking industry. For instance, Berger, Kashyap, and Scalise (1995) have suggested that one effect of consolidation will be a decline in the availability of credit to small business borrowers. One implication of such a decline might be that certain lenders would enjoy increased market power over their small business borrowers. If so, questions concerning how banks use what market power they might possess would become increasingly important.

A last reason to focus on small business lending is that what little private litigation there has been under the BHCA's restrictions on tying has almost exclusively involved small business lending.¹⁰ In most of this litigation, the courts have found no violation of anti-tying statutes, often because both the tying and tied products were "traditional banking products." Such a case fits into the broad exemption allowed by the rules. One might question, however, whether there is any meaningful economic difference between traditional banking products and others. Possibly one is more likely to find demand and cost complementarities among banking products. For products more remotely related, perhaps some other motivation is more likely. The above discussion focuses on two possibilities: the extension of market power or price discrimination. These two motivations have very different implications for the effects of tying on overall economic welfare.

2. TYING BY A MULTIPRODUCT MONOPOLIST

Questions concerning the possible anticompetitive effects of tying or bundling clearly require an analytical framework that includes a theory of interfirm competition. To the extent that tying is primarily a tool for price discrimination, however, a model of competition is not necessary for understanding the basic mechanics of the practice. To this end, this section presents a model of a seller that is a monopolist in two markets. This model follows the analysis first developed in Adams and Yellen (1976).

The monopolist in this model faces an array of potential customers who are differentiated in terms of the value that they place on the two products. Specifically, if the goods are labeled a and b , a typical buyer places a value of v_a and v_b on the consumption of the goods. Each buyer consumes at most

¹⁰ See Shull (1993).

one unit of each good. Hence, if an individual buys both goods, that individual enjoys net utility of $v_a + v_b - e$, where e is the total expenditure made purchasing the two goods. If the goods are priced independently, then $e = p_a + p_b$, while if they are sold as a bundle, e is the price of the bundle.

Each potential buyer is represented by a pair of valuations (v_a, v_b) . Hence, the population as a whole is characterized by a cumulative distribution function $F(v_a, v_b)$, giving the fraction of potential buyers who have valuations for both products that are less than the specified values (v_a, v_b) . Treating one good in isolation, the *marginal* distribution of buyers' valuations of good a is denoted by $F_a(v_a)$. This function gives the fraction of the population whose valuation of product a is less than the specified value. The marginal distribution, $F_b(v_b)$ has a similar definition.

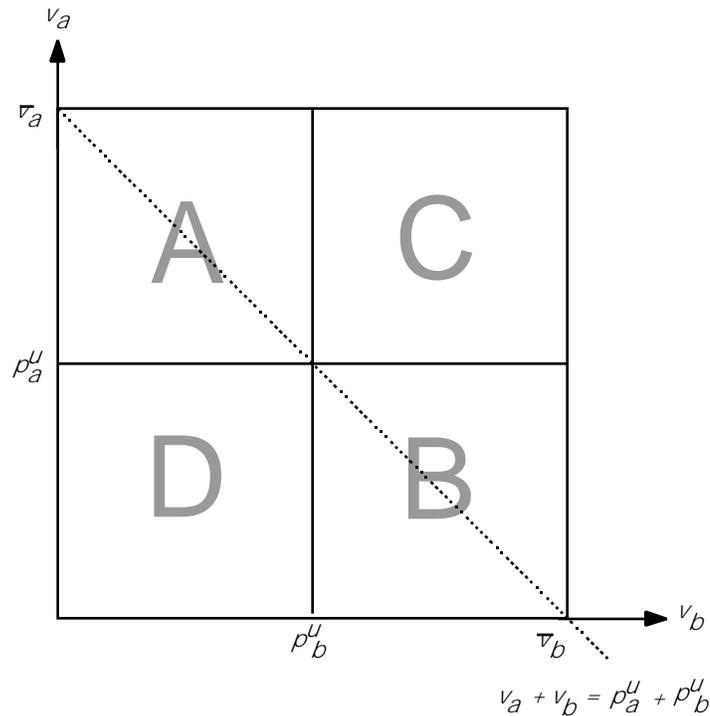
One possible simple assumption about these distributions is that v_a and v_b are uniformly and independently distributed on the interval from 0 to 1. Uniformity means that the fraction of buyers who place a value on product a of at least v is equal to $1 - v$, for all v between 0 and 1 (and similarly for product b). Independence means that this distribution of v_a is the same for any given level of v_b .

The distribution of buyers' valuations plays a central role in determining the relative values to the seller of alternative pricing strategies. In fact, as Adams and Yellen demonstrated, general results are difficult to obtain. Some broad insights about the use of bundled pricing can be obtained without making specific assumptions about the distribution of valuations, while the simple assumption of independent, uniform distributions may also be useful in thinking about the basic problem facing the seller.

Suppose first that the seller prices the two products separately. For each good, the seller faces a downward sloping demand curve given by the marginal distribution of buyer valuations. At a price of p_a , the firm will sell product a to all buyers with $v_a \geq p_a$. There are $N(1 - F_a(p_a))$ such buyers, where N is the total number of potential buyers. Hence, as price rises, sales fall. In the case of the uniform distribution, the relationship between sales, x_a , and price is simply $x_a = (1 - p_a)N$.

Facing these demand curves, the seller sets a profit-maximizing price for each product. Assume that the marginal cost of producing a unit of each product is zero, so that the profit-maximizing price for each product is simply that which maximizes revenue.¹¹ These *unbundled prices*, denoted by $p_i^u (i = a, b)$, effectively divide the population of buyers into four groups, as depicted in Figure 1. Each buyer's identification is a (v_a, v_b) pair, with the maximum value of $v_a(v_b)$ given by $\bar{v}_a(\bar{v}_b)$. The box labeled A in Figure 1 contains all buyers

¹¹ An equivalent assumption is that the lowest possible buyer's valuation for each product is at least as great as its marginal cost of production.

Figure 1 Independent Pricing and Pure Bundling

Independent pricing by a two-product monopolist divides the market into those that buy a only (A), b only (B), both goods (C), and neither good (D). Pure bundling divides the market along the (dashed) diagonal. Those above the diagonal buy the bundle, and those below do not.

for whom $v_a \geq p_a^u$ and $v_b \leq p_b^u$. All of these buyers purchase only product a . Similarly, box B contains the valuations of all buyers who purchase only product b . Box C gives the buyers who purchase both products, while box D gives those who purchase nothing.

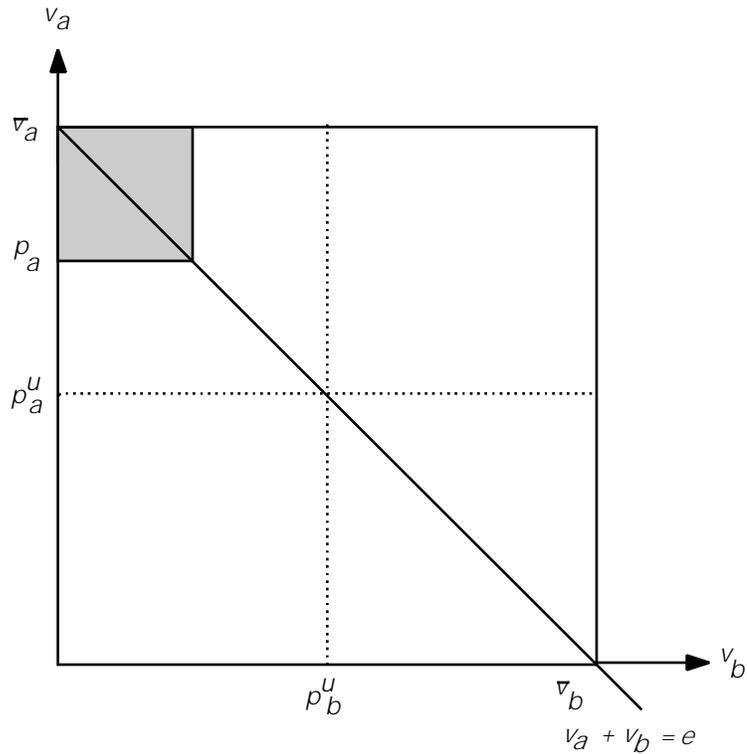
If instead of selling the products separately the seller decides to offer them only as a bundle, the population of buyers divides into two groups: those who buy the bundle and those who do not. The boundary between these two groups is made up of all buyers for whom $v_a + v_b = e$. Such an equation would be represented by a line with a slope of minus 1, as shown by the dashed line in Figure 1. This is the line for which $e = p_a^u + p_b^u$. With this price for the bundle, all buyers with valuation pairs to the northeast of the dashed line buy the bundle, while those to the southwest do not.

Figure 1 is drawn for the special case of independent, uniform distributions. In this case, each of the four areas (A,B,C,D) represents the same number of buyers. This special case also has the property that the dashed line cuts areas A and B in half. Under these particular conditions, the revenue generated by selling the goods independently at prices p_a^u and p_b^u is identical to that generated by selling only bundles at the price $e = p_a^u + p_b^u$. To see this, note that in switching from separate to bundled pricing revenue collected from area C is unaffected. In area A, half the buyers switch from buying only a at price p_a^u to buying nothing, and the other half switches from buying only a to buying both for the bundled price. Given the symmetry in this special case, the lost sales of good b are exactly offset by the increased sales of good a . The effect on area B parallels that on area A.

The equivalence of the revenues under the two pricing practices in Figure 1 demonstrates that bundled pricing is at least as profitable as independent pricing, since p_a^u and p_b^u are the revenue maximizing independent prices. This comparison, however, does not establish that $e = p_a^u + p_b^u$ is the optimal bundled price; bundling may be strictly preferred. In fact, if one considers a more general class of pricing practices, then the seller can certainly do better than independent pricing. In particular, the seller can set both the price for the bundle of goods (e) and the prices for the goods sold separately (p_a and p_b). Note that this mixed pricing policy is distinct from independent pricing only if $e < p_a + p_b$. Otherwise, buying the bundle is never preferred to buying the goods separately. To see that profits can be increased by a mixed pricing policy, suppose the seller leaves the price of the bundle at $e'' = p_a^u + p_b^u$ and sets a price for good a alone just below \bar{v}_a . The effects of this mix of prices are shown in Figure 2. Sales of the bundle are the same as in the bundled pricing case of Figure 1, except for the shaded box at the top left-hand corner. This box gives the valuations of buyers who purchase only good a at price p_a . All other buyers above the diagonal purchase the bundle.

Given the symmetry of the case depicted in Figures 1 and 2, the buyers of a alone can be divided into two groups of equal size. Those above the diagonal would buy the bundle if a were not separately available, while those below the diagonal would otherwise buy nothing. On sales to the former, the seller loses revenue of e'' and gains revenue of p_a (per buyer). On the latter, the seller gains p_a . Since there are the same number of buyers in each group, the net change in revenues is proportional to $2p_a - e''$. This change is positive under the assumptions of this case. Setting a high separate price for product b can generate a similar gain.

The mixed pricing strategy described above is very close to observed tying practices, as they are usually described. The seller makes product a available at the relatively low price of p_a^u , but only if the buyer also purchases b for p_b^u . Otherwise the buyer must pay the higher price for a . This is a profitable strategy, because it allows the seller to extract different revenues from buyers,

Figure 2 A Tied Discount for Good *a*

Buyers in the shaded box in the upper left-hand corner buy only product *a* at price p_a . All other buyers above the diagonal buy the bundle at price $e = p_a^u + p_b^u$.

based on their valuations. In other words, it allows the seller to more finely sort buyers according to their willingness to pay.

While the analysis of the special case depicted in Figures 1 and 2 demonstrates the nature of the gains that a monopolist can generate by selling two products jointly, it is hard to draw general conclusions from the specialized assumptions regarding costs and the distributions of buyers' valuations. Indeed, Adams and Yellen provide examples in which pure bundling is more profitable than independent pricing and other examples in which the reverse is true.

The literature that has followed Adams and Yellen, as surveyed by Varian (1989), has produced some more general conclusions. For instance, a mixed strategy, like the one described in Figure 2, will be more profitable than independent pricing if the valuation distributions of the two products are independent.

Note also that mixed bundling is always preferred to pure bundling, as the latter is a special case of the former.

The two figures show by example how the profit-maximizing independent prices for two goods might be improved upon by some form of joint pricing. The figures do not show the profit-maximizing bundled pricing configuration (pure or mixed). The typical optimal pricing structure will include prices for the goods purchased separately that are no lower than the independent monopoly prices and a price for the bundle that is no greater than the sum of the independent monopoly prices. Such a pricing structure rewards those buyers with relatively high valuations for both products and imposes a high price on those with a high valuation of one product and a low valuation of the other. Hence, bundling benefits the seller and some consumers while hurting other consumers. The sum of all buyers' consumer surplus and the seller's profit is typically increased by (mixed) bundling relative to independent pricing.¹² Hence, bundling reduces the dead-weight loss from market power.

3. TYING AND COMPETITION

The above discussion shows that a seller with monopoly power in the markets for two goods can benefit from a pricing strategy that gives preference to buyers who purchase both products. This gain to the seller is independent of any effect of the pricing practice on competition, actual or potential. The concerns that have led to legal restrictions on tied pricing arise from the possibility of such competitive effects. Can the monopolist seller of one product foreclose the market for another product to competitors by tying the sale of the two products together? The answer to this question appears to depend on the nature of the competition in the second market.

As a first approach to the problem of tying in the presence of competition, suppose that one of the markets, that for product b , is perfectly competitive. That is, suppose that there is a perfectly elastic supply of product b at the price $p_b = c_b$, where c_b is the (constant) marginal cost of producing the good. The monopolist seller of product a can choose to participate as well in the competitive market. If the monopolist sells both goods and prices them independently, then the population of buyers is divided as in Figure 3. Buyers with $v_a \geq p_a^u$ purchase good a , while those with $v_b \geq c_b$ purchase good b . Some fraction of the latter sales goes to the monopolist, but he earns no profits on this competitively priced good. Assuming, as before, that the marginal cost of producing product a is zero, the monopolist's profits are equal to the revenues from selling a .

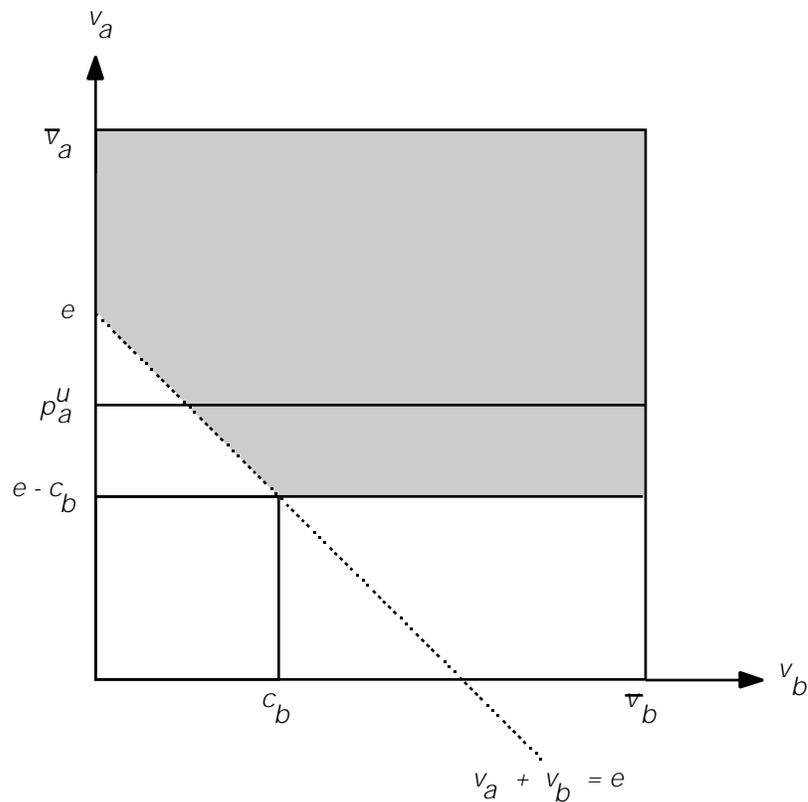
¹² The consumer surplus enjoyed by a buyer who purchases only good $a(b)$ is

$$v_a - p_a(v_b - p_b),$$

while one who buys the bundle receives surplus of $v_a + v_b - e$.

If the monopolist offers the two goods only as a bundle for a price of e , he can guarantee his market for b by forcing anyone seeking good a to also obtain b . Can he profit by doing so? Buyers will prefer the bundle to buying nothing if $v_a + v_b \geq e$. They will prefer the bundle to buying only b at its competitive price if $v_a + v_b - e \geq v_b - c_b$, or $v_a \geq e - c_b$. The sales resulting from a particular value of e are given by the area above the shaded area in Figure 3. For each unit of the bundle sold at price e , the monopolist earns net revenues of $e - c_b$. The total net revenues from these sales, then, can be no greater than the net revenue from selling a alone at a price $e - c_b$. The latter earns

Figure 3 Tying by a Product a Monopolist when Market b is Perfectly Competitive



All buyers in the shaded area buy the bundle at price e . Buyers below the shaded area and to the right of c_b buy product b at the competitive price c_b .

the same net revenue per sale, but on a larger volume of sales. Since the price p_a^u maximizes revenues (and profits) from selling a alone, the monopolist cannot increase profits by tying the sale of two goods when there is a competitive market for the tied good b .

A perfectly competitive market leaves no buyers unserved for whom the value of the product exceeds its cost. Hence, the seller of the monopolized good has no room to price discriminate among buyers according to the mix of willingness to pay for the two goods. If, instead, the market for product b is characterized by imperfect competition, the monopolist seller of product a may find tying to be a profitable pricing strategy. Here, the monopolist's optimal strategy depends on the price set by the competitors in market b . Suppose this price is $p_b > c_b$. The monopolist's problem is essentially the same as that depicted in Figures 1 and 2. Given the price p_b , the seller can act as a monopolist toward the set of buyers with $v_b < p_b$ and $v_a < \bar{v}_a$. Hence, it is certainly possible that, given a competitor's price, the seller's optimal response is to tie the sale of the two products.

Of course, the actual pricing structure chosen by the monopolist is the result of the strategic interaction between that firm and its competitors in the market for product b . If product b is homogeneous across sellers, then the resulting equilibrium price may be no different from the perfectly competitive price. For tying to be valuable to the monopolist, competition in the market for the tied good must be such that, in equilibrium, competitors' prices exceed marginal cost.

Whinston (1990) examines a model in which the market for the tied good is a duopoly, with the two sellers' products being imperfect substitutes. In that setting, tying can be profitable for the reasons outlined above; the tying seller acts as a multiproduct monopolist on the market for the tying product and the residual market for the tied product, given the competitor's actions. Whinston shows further that, in the presence of fixed costs, tying can reduce the competitor's prospective profits and thereby induce the competitor to withdraw from the market.

Whinston's market preemption result comes close to the concerns that seem to have motivated the antitrust treatment of tying; monopolists might be able to extend their monopoly power into new markets by reducing the profit opportunities of their rivals. Even here, however, the consequences of tying for overall economic welfare are ambiguous. Market preemption is a side-effect of the seller's desire to price discriminate among heterogeneous buyers.¹³ This

¹³ Whinston identifies conditions under which preemption of a rival's market opportunities does operate independently from the price discrimination effects of tying. This case requires that the monopolist be able to precommit (before the rival incurs fixed costs of entering the market) to offering the goods only as a bundle. Absent the price discrimination benefits, the seller would break that commitment if given a chance.

price discrimination, as above, has a tendency to be welfare-enhancing since it typically increases total sales of the products. Working against the price discrimination effect may be the effect of reducing the output of rivals in the market for the tied good. Certainly tying produces gains for some buyers and sellers and losses for others, but the overall effect cannot be determined in general.

Note that the two products in the model can be given the interpretation of the same good at different points in time. Under this interpretation, “tying” may appear as the use of a long-term contract by a seller with initial market power to deter entry by future potential competitors. As with the general case of tying with imperfect competition, this arrangement has both a competitive effect and a price discrimination effect; offering long-term arrangements together with unbundled “spot” prices at each point in time allows the seller to discriminate among buyers with differing patterns of preferences for the good over time.

4. TYING BY A BANK WITH LENDING AS THE TYING GOOD

Banks engage in many types of joint pricing or bundling of products. Depositors who maintain a minimum balance might receive free checking or other services at reduced or no fee. A borrower might be asked to keep compensating balances on deposit at the bank. Many such practices might be driven primarily by cost complementarities between the products. For instance, the probability of incurring the costs of dealing with a check drawn on an account with insufficient funds is lower the greater the balance is in an account. It is also possible that such practices achieve a certain amount of price discrimination. Recall, however, that price discrimination is a way in which sellers increase their gains from monopoly power. This use of market power is quite different from that envisioned by the market foreclosure view, under which power in one market is used to create power in a second market. In both of these views, however, tying is an activity undertaken by a seller with market power.

The adoption of tying restrictions in the 1970 BHCA amendments was a response to a concern that the granting of expanded powers to banks would enable them to gain an unfair advantage in the new markets they entered. This advantage would come from the ability of banks to tie new products to products in their traditional markets, in which they were shielded from competition by an array of legal restrictions. Since that time, however, financial innovation and deregulation have eroded the advantaged position and power over prices enjoyed by banks in many of the markets in which they participate.¹⁴

¹⁴ The changes experienced by banking are surveyed in Berger, Kashyap, and Scalise (1995).

One area in which banks may continue to hold market power is in small business lending. Changes in the financial system over the last few decades have opened new options and sources of funds to larger firms. Small firms, however, have remained relatively bank-dependent. Small business lending, then, might be a product for which the price discrimination effects of tying are potentially significant.

To treat one of the products in the model presented above as the extension of credit, some slight modification is necessary. Specifically, suppose that there is a set of potential borrowers, each of whom seeks a loan of a fixed size, say \$1. With a probability of ϕ , a borrower successfully produces revenues to repay the loan. Otherwise, the borrower produces nothing and defaults on the loan. For simplicity, suppose that all borrowers have the same probability of success, ϕ , but that they differ in the revenue they will generate if successful. This revenue, y , is distributed between 0 and \bar{y} .

A monopolist lender in this market would set a loan price, R (payment due outside of default), to maximize profits given its cost of funds, r . This lender faces a downward sloping demand curve for credit, since for any price, R , all borrowers with $y \geq R$ will seek loans.

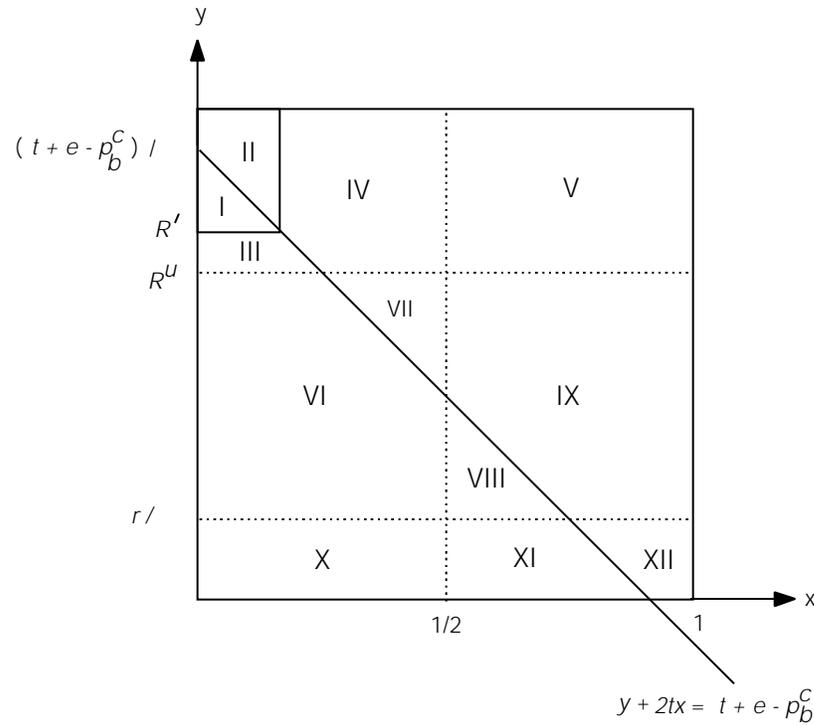
To analyze the effect of tying between credit and a second product, assume that the lender is one of two providers of product b and that this product is differentiated across sellers. Product differentiation allows a precise specification of the product b demand that the lender faces, given the other firm's price. Specifically, one can imagine that the two sellers are located at the endpoints of a line interval. The lender is located at point 1 and the rival at point 0. This spatial differentiation can have literal geographic interpretation; the sellers' stores are at two different locations. Alternatively, the differentiation can be in terms of some characteristic of the product. In either case, assume that a consumer's preferences between the two varieties of product b is given by the consumer's location on the same line interval (between zero and one).

A buyer located at point x incurs a cost of $t(1-x)$ when obtaining product b from the lender and a cost of tx in obtaining the product from the other seller. Hence, the net value to a buyer purchasing from the lender at a price of p_b is $v^* - t(1-x) - p_b \equiv w_b(x, p_b)$. If, instead, the same buyer buys from the competitor at a price of p_b^c , the net value is $(v^* - tx - p_b^c) \equiv w_b^c(x, p_b^c)$.

In Figure 4, credit takes the place of product a from the earlier figures. Accordingly, the vertical axis measures y , the revenue generated by a successful borrower. The horizontal axis gives a borrower/consumer's location with regard to product b ; buyers further (horizontally) from the origin have a greater relative preference for the lender's variety of product b .

The monopolist lender's optimal unbundled price of credit is denoted R^u , while the competitive price is r/ϕ . Both the lender and a competitor sell product b . The competitor's price is set at p_b^c , in response to which the lender sets an

Figure 4 Tying the Extension of Credit to the Sale of a Differentiated Product



With independent pricing, $p_b^u = p_b^c$, and each consumer buys product b from the closest seller. Therefore, all buyers with $x > 1/2$ buy from the lender, while those with $x < 1/2$ buy from the competitor. Loans are made to all with $y > R^u$. With a tied discount for credit, buyers in IV, V, VII, IX, and XII obtain the bundle at price e . All others buy b from the competitor, with those in I and II obtaining unbundled loans at price R' .

unbundled price of p_b^u .¹⁵ Given these prices, all buyers with $w_b(x, p_b^u) \geq w_b^c(x, p_b^c)$ buy b from the lender, while all others buy from the competitor.¹⁶ Given prices p_b^u and p_b^c , all buyers with $x \geq 1/2 + (p_b^u - p_b^c)/2t$ purchase from

¹⁵ As mentioned earlier, fixing the competitor's price abstracts from the form of strategic interaction in market b . Although the actual price levels depend crucially on this interaction, many of the qualitative characteristics of tied pricing are independent of the equilibrium level of prices.

¹⁶ This section includes the additional assumption that v^* is big enough (and/or t is small enough) that all buyers purchase product b from someone.

the lender, and those with x below this level purchase from the competitor. In the credit market, all buyers with $y \geq R^u$ take out loans.

The division of the market with unbundled pricing, as shown in Figure 4, reflects the (unique) symmetric price equilibrium in the market for product b ($p_b^u = p_b^c$). Accordingly, all buyers with $x \leq (\geq) 1/2$ buy from the lender (competitor). With unbundled pricing, loans go to all buyers in the areas with the following labels in Figure 4: I, II, III, IV, V. Buyers in areas I, II, III, IV, VI, VII and X purchase b from the competitor, while those in V, VIII, IX, XI, and XII purchase from the lender.

The lender can tie the extension of credit to sales of product b by setting two loan prices, R' and $R^T < R'$, and making the lower price available only to borrowers who purchase b at the price p_b^T . In comparing the option of buying the tied products to other options, it is often useful to focus on the expected total payment, $e = \phi R^T + p_b^T$. The bundle has net value to a particular buyer of $\phi y + v^* - t(1-x) - e$. Buyers have two other options, beside buying the bundle at price e . A buyer can purchase b from the competitor and either not obtain credit, or borrow at the unbundled price of R' .¹⁷ With no credit, such a buyer earns net value of $w_b^c(x, p_b^c)$, and with credit, the buyer's net value is $w_b^c(x, p_b^c) + \phi y - \phi R'$.

Buying the bundle at price e is the most preferred option for all buyers with $x \geq 1/2 + (e - p_b^c - \phi y)/2t$ and $x \geq 1/2 + (e - p_b^c - \phi R')/2t$. These buyers are all those in areas IV, V, VII, IX, and XII in Figure 4. All others buy b from the competitor, while those in areas I and II also receive unbundled credit.

Figure 4 assumes that the competitor's price for product b does not depend on whether the lender is tying or pricing independently. While the figure is drawn to capture equilibrium when the lender prices independently, the competitor's pricing behavior is likely to be different when the lender offers a bundle instead. Rather than showing an equilibrium in this case, the figure shows how the lender's adoption of a tied pricing strategy affects buyers' decisions for a particular price of the competitor's product. The equilibrium, however, would share the important qualitative characteristics of Figure 4.

While the actual prices chosen depend on demand and cost conditions as well as on strategic considerations, the figure is drawn to capture some general tendencies. Foremost among these is that sales of the tying good (credit in the present case) tend to be higher than under independent pricing. Added extensions of credit are represented by the areas VII, IX, and XII. On the other hand, loans that would be made under independent pricing but are not made under tied pricing are represented by area III.¹⁸

¹⁷ Again, the maintained assumption is that preference parameters are such that all buyers purchase product b .

¹⁸ Note that equating areas to sales assumes a more-or-less uniform distribution of buyer characteristic pairs (y, x) .

As is typically the case, tying tends to increase the overall welfare (surplus) of borrowers with high credit quality who also place a high value on the tied product. Customers who place a high value on one product and a low value on the other see their well-being decline from tying. This is true, in particular, of those who obtain credit at the high, unbundled price (areas I and II). As discussed above, the effect of tying on overall economic welfare is difficult to determine, since these effects depend on the strategic interaction among the sellers of the tied good.

In Figure 4, an important aspect of the effect of tying is the distribution between the two rivals of sales of product b . With unbundled pricing, this market is divided evenly, with the marginal buyer (who is just indifferent between the two sellers) located at $x = 1/2$. This division of buyers minimizes the total “transportation” costs in the market, where buyer x ’s transportation cost is $t(1 - x)$ if buying from the lender and tx if buying from the competitor. With the market divided at $1/2$, each buyer goes to the “closest” seller. Tying introduces a distortion into this market. In Figure 4, buyers in areas IV and VII obtain b from the lender, even though they are “closer” to the other seller. Similarly, buyers in areas VIII and XI incur extra transportation costs in buying b from the competitor. Hence, while tying may result in an increase in total extensions of credit, reducing the social cost of monopoly power in the credit market, this positive effect may be offset by the increased transportation costs in the market for the tied good.

Tying has some interesting implications for the allocation of credit. Note first that there are some creditworthy borrowers who do not receive loans. These borrowers appear in areas III, VI, and VIII. Many of these borrowers, however, also would not receive loans under independent pricing. This limitation on the extension of credit is merely the result of the assumed market power in the loan market. Indeed, there are also borrowers (areas VII, IX, and XII) who are excluded under independent pricing but not under tying. This set may even include borrowers who are not creditworthy when loan terms are considered in isolation from the rest of the customer relationship (area XII). Borrowers for whom $y < r/\phi$ would not receive loans if credit were independently and competitively priced; these are borrowers from whom maximum expected return is less than the cost of funds. Nevertheless, these borrowers’ willingness to pay for product b is high enough to make it profitable for the lender to maintain a multiproduct relationship with them.

An outsider, viewing the credit decisions made by the bank in isolation from the rest of the bank’s customer relationships, might conclude that the bank was making unsound loans. Even worse, the bank appears to be making some unprofitable loans while profitable opportunities are left on the table. Such a view, however, would be misleading, because it does not evaluate the bank’s activities as a whole. In a multiproduct business, the isolated evaluation of parts of the product line can give a distorted view of the whole.

How might the analysis of tying by a bank change if one recognizes banks' unique status as issuers of liabilities insured by the government? In terms of Figure 4, one might simply interpret deposit insurance as a subsidization of the lender's cost of funds, r . While it is true that tying results in a riskier loan portfolio, those risks should not necessarily be of concern to the deposit insurer. From the point of view of the safety and soundness of the entire bank, the increased risks in the loan portfolio may be offset by increased profits in the sale of the tied good.

5. CONCLUSION

The U.S. banking industry is in the midst of a period of dramatic change. Interstate banking is likely to give further impetus to the ongoing trend toward consolidation. Some have expressed the concern that this trend will work to the disadvantage of the most bank-dependent class of borrowers, small businesses. If this fear is justified, it must in part be so because consolidation will increase the market power enjoyed by at least some banks with regard to their small business borrowers. One step that might prevent such a decline in credit might be to ease the restrictions that banks face on the joint marketing of "bank" and "nonbank" products. When such joint marketing takes the form of tied pricing, its effect is often to expand sales of the products over which sellers enjoy market power.

When tying is used as a means of practicing price discrimination, it serves as a method by which businesses seek to maximize the benefits from whatever natural (comparative) advantage they may have over competitors. The statement holds true when tying is used to take advantage of cost or demand complementarities between products. On the other hand, the antitrust concern with tying is that it could be used by a seller with a natural advantage in one market to create an unnatural advantage in another market. It is only in this last case that tying increases the social cost of monopoly power. A broad restriction on banks' ability to jointly market multiple products will certainly prevent uses of tying that have anticompetitive effects as well as many that do not. An alternative approach is to grant banks broad discretion in their entry into new markets, with anticompetitive practices to be guarded against by litigation on a case-by-case basis. This approach would make the treatment of tying by banks consistent with the modern antitrust perspective on such practices.

REFERENCES

- Adams, William James, and Janet L. Yellen. "Commodity Bundling and the Burden of Monopoly," *Quarterly Journal of Economics*, vol. 90 (August 1976), pp. 475–98.
- Berger, Allen N., Anil K Kashyap, and Joseph M. Scalise. "The Transformation of the U.S. Banking Industry: What a Long, Strange Trip It's Been," *Brookings Papers on Economic Activity*, 2:1995, pp. 55–218.
- Seplaki, Les. *Antitrust and the Economics of the Market*. New York: Harcourt Brace Jovanovic, Inc., 1982.
- Shull, Bernard. "Tying and Other Conditional Agreements under Section 106 of the Bank Holding Company Act: A Reconsideration," *The Antitrust Bulletin*, vol. 38 (Winter 1993), pp. 859–86.
- Varian, Hal R. "Price Discrimination," in Richard Schmalensee and Robert D. Willig, eds., *Handbook of Industrial Organization*. Amsterdam: North-Holland, 1989.
- Whinston, Michael D. "Tying, Foreclosure, and Exclusion," *American Economic Review*, vol. 80 (September 1990), pp. 837–59.
- White, Lawrence J. "Tying, Banking, and Antitrust: It's Time for a Change," *Contemporary Economic Policy*, vol. 13 (October 1995), pp. 26–35.

Sterilized Foreign Exchange Intervention: The Fed Debate in the 1960s

Robert L. Hetzel

In early 1962, the Federal Reserve System (the Fed) began to buy and sell foreign currency. The decision to intervene in foreign exchange markets was controversial and generated considerable internal debate. The debate involved the fundamental issue of the Fed's independence from the Treasury. The Treasury has primary responsibility for official foreign exchange operations in the United States. Hence, participation with the Treasury in foreign exchange operations could jeopardize Fed independence. Moreover, the Federal Reserve Act safeguards this independence by requiring that acquisition of Treasury debt by the Fed be done in the open market, that is, at the Fed's discretion rather than at the behest of the Treasury. The practice of acquiring foreign exchange directly from the Treasury in support of the Treasury's operations could erode that safeguard.

Former Secretary of the Treasury George Shultz (Shultz and Dam 1978, p. 9) stated flatly, ". . . the Fed takes direction from the President, through the Treasury Department, on international monetary affairs." Stephen Axilrod (Burk 1992, p. 41), formerly Staff Director for Monetary and Financial Policy at the Board of Governors, noted

. . . there is a deep distinction in the U.S. (unlike the U.K.) between international and domestic monetary policy: the Fed is totally and utterly independent when making a domestic monetary policy decision; not only is there no clearance with the Treasury—to attempt it would cause a constitutional crisis. The international arena is more complicated: here the Fed's independence is unknown and has not been fully tested, but in practice it is limited. The Treasury controls international finance.

■ The opinions expressed herein are the author's and do not necessarily represent those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

The debate also dealt with whether the Federal Reserve Act authorized the Fed to transact in foreign exchange. This article reviews the debate and briefly addresses subsequent developments. As background, the article begins with a brief historical overview of the Bretton Woods system and the Treasury's Exchange Stabilization Fund.

1. BRETTON WOODS

In 1962, the United States was part of the Bretton Woods system. That international monetary arrangement attempted to recreate key parts of the gold standard, which had collapsed in the Depression. Member countries other than the United States pegged their currencies to the dollar. The United States agreed to maintain convertibility of the dollar to gold at the rate of \$35 per ounce. As required by the Federal Reserve Act, before 1968 Federal Reserve notes were collateralized in part by gold.

If the United States ran a balance of payments deficit and lost enough gold, the Fed would have to contract the money stock. According to the classical view of the gold standard, a reduction in the money stock would reduce the price level and make U.S. goods cheaper to foreigners, who would increase their purchases of U.S. goods. The resulting decline in the external deficit would end the gold outflow. Under the Bretton Woods system, as under the classical gold standard, the price level was supposed to adjust to achieve balance in the country's external accounts.

By early 1959, the currencies of the countries in the European Economic Community had become fully convertible into the dollar (for current account transactions). (This review draws on Coombs [1976], Roosa [1967], and Solomon [1982].) These countries, however, established exchange rates that overvalued the dollar (made U.S. goods too expensive). Consequently, the United States ran a significant, persistent balance of payments deficit. Foreign central banks financed part of the U.S. payments deficit by accumulating dollars, and foreign investors financed part of it by willingly holding dollar assets. However, between 1959 and 1961, the U.S. Treasury had to finance the remainder of the deficit through sales of gold to foreign central banks. Countries relying on the United States for defense (Germany, Japan, and Italy) refrained from gold purchases. Other countries (like Belgium, the Netherlands, and Great Britain) were fearful of being caught with a devalued dollar in their portfolios and enforced the Bretton Woods discipline by asking the U.S. Treasury for gold. By the end of 1960, U.S. gold losses had become front-page news in papers like *The New York Times*.

In the early 1960s, monetary policymakers walked a tightrope requiring them to balance internal and external objectives. The 1960 recession pushed U.S. short-term interest rates below those in Europe. That difference in rates

spurred a capital outflow, widened the payments deficit, and aggravated the loss of the Treasury's gold reserve. While in the middle of the 1960 presidential campaign, the country faced both a domestic recession and a balance of payments deficit, each requiring conflicting policy responses.

In 1954, Britain had reopened the London gold market. By 1960, it had acquired a status comparable to the long-term bond market of today. Quotations for the price of gold were a "barometer of confidence in both the gold-dollar parity and the Bretton Woods system generally" (Coombs 1976, p. 14). Through most of the 1950s, sales of gold by South Africa and the Soviet Union had kept the free market price at \$35 per ounce. In 1960, however, the concern arose in Europe that a Democrat might win the U.S. presidency and pursue expansionary domestic policies.

On October 20, 1960, the London gold price suddenly shot up from close to \$35 an ounce to \$40 an ounce. That created an arbitrage opportunity for foreign central banks willing to sell gold in London and replace it by asking the U.S. Treasury for gold. The Treasury decided to maintain the \$35 price of gold in the London market with gold sales. On October 31, 1960, candidate John Kennedy promised that if elected he would maintain convertibility at the \$35 parity. Later as the President, in his February 6, 1961, message on the balance of payments, he promised that the \$35 price of gold was "immutable." The immediate crisis passed, but the drain of gold continued as Kennedy took office in January 1961, and the position of the dollar remained precarious.

The Federal Open Market Committee (FOMC) *Minutes* in 1961 reveal a persistent concern over the U.S. balance of payments deficit, offset by a concern for unemployment. For example, the *Minutes* (Board of Governors 1961, pp. 935–36) paraphrase one governor:

Mr. Mitchell noted that the Chairman of the Council of Economic Advisers had said recently that if unemployment did not decline, it would be up to the Administration to create jobs. However, he (Mr. Mitchell) felt that it would be better if the private economy could be persuaded to create jobs. Monetary policy should do whatever it could to make this possible. . . . Foreigners wanted to know how this country was going to get its payments position into balance, but he did not feel that anyone in this country knew the answer to this question. As he saw it, the Federal Reserve could do just one thing about the balance-of-payments problem. It could encourage foreigners to leave their money in this country by making interest rates competitive with those in key European countries. In his opinion, however, carrying this policy much farther than it had been carried in recent months would be too high a price to pay at the moment, considering the importance of a somewhat lower level of interest rates to stimulate the domestic economy.

In 1961, the FOMC raised interest rates twice out of a concern for the external deficit. At the October 24, 1961, meeting, the FOMC raised bill rates from about $2\frac{1}{4}$ to $2\frac{1}{2}$ percent. New York Fed President Hayes, who as vice

chairman presided over the meeting in the absence of Chairman Martin, commented (Board of Governors 1961, pp. 897–98)

That at least a goodly number of those around the table had expressed some concern about the international problem and had recognized that there was perhaps something the System could do to help, in a minor way, to show that it was aware of the problem, without doing danger to the domestic economy.

Governor Mills expressed the general sentiment for an increase in rates at the December 19 meeting (Board of Governors 1961, p. 1079):

Patently, time is of the essence in reorienting the existing monetary and credit policy in the direction of moderate restraint. . . . What I consider as having been an unpardonable delay in pursuing that objective has permitted distrust in the exchange value of the U.S. dollar to grow and will consequently vitiate counteroffensive interest rate efforts to stem the loss of gold from this country. Reliance on collective central bank and International Monetary Fund actions to protect the U.S. dollar should have been reserved for secondary emergency application and not suggested for continuing use, in that public notice of resort to these media will be regarded by cynical investors as acts of desperation and not as curatives to temporary problems of international currency imbalances.

Initially, Chairman Martin urged postponement of a rise in rates, but he then relented (Board of Governors 1961, pp. 1089–90 and 1136):

He questioned whether the situation had really come to the point where a significant change of policy was required. . . . He would hope that the System would not get itself in the position, following the increase in the maximum permissible interest rates on time and savings deposits, of being charged with causing the commercial bank prime rate to be increased at this particular juncture. [The Board of Governors had decided to raise the Reg Q ceiling on deposits held for one year or more from 3 to 4 percent, effective January 1, 1962.]

Following additional discussion, Chairman Martin restated his conception of the consensus of the meeting. As he saw it, the consensus was along the lines of concentrating on a bill rate in the upper part of the range of $2\frac{1}{2}$ - $2\frac{3}{4}$ percent.

The external deficit kept the FOMC from lowering market rates in July 1962 in response to weakness in economic activity. The bill rate, however, only began to rise significantly in June 1963 when it first reached 3 percent.

With monetary policy basically immobilized because of weakness in the domestic economy, the United States was left with only ad hoc measures to deal with the balance of payments deficit. In 1961, it reduced the duty-free allowance on goods purchased abroad by American tourists from \$500 to \$100. The United States moved to limit the demand for its gold stocks by making it illegal for Americans to buy gold abroad. In 1962, it set up the London Gold Pool among central banks to curb central bank free market purchases

of gold. The U.S. government asked Germany to pay more of the expense of maintaining U.S. troops in Germany.

The Treasury issued bonds denominated in foreign currencies, named Roosa bonds after Treasury Under Secretary Robert Roosa, to obtain foreign currency to purchase dollars. The Treasury and the Fed also began Operation Twist, whereby the Fed began to hold longer-term securities, and the Treasury began to issue mainly shorter-term securities. The resulting decrease in the supply of longer-term securities relative to shorter-term securities was supposed to lower longer-term interest rates relative to shorter-term interest rates. The idea was to encourage both domestic investment and short-term capital inflows. Although the balance of payments exercised some influence on monetary policy, the FOMC was unwilling to subordinate domestic to external considerations.

2. THE EXCHANGE STABILIZATION FUND

In 1961, the Exchange Stabilization Fund (ESF) of the U.S. Treasury began to intervene in the foreign exchange markets. Its ability to intervene, however, was limited by its resources. In 1934, Congress had created the ESF with the Gold Reserve Act. Congress capitalized it with \$2 billion of the profits created by that Act's revaluation of gold from \$20.67 to \$35.00 per ounce. It put the ESF under the control of the Treasury and authorized it to intervene in the foreign exchange markets to stabilize the value of the dollar. In 1945, the Bretton Woods Agreements Act transferred \$1.8 billion of the ESF's capital to the International Monetary Fund (IMF). The ESF, therefore, was left with \$200 million in its capital account and no alternative funding sources apart from money appropriated by Congress (see Todd [1991, 1992]). However, over the years, the ESF had earned profits through its purchases and sales of gold. It invested these profits in domestic and foreign securities. With the income from those securities, by June 30, 1961, it had accumulated about \$336 million in assets. (Figures on the balance sheet of the ESF come from U.S. Treasury *Annual Reports*.)

By 1962 the ESF had committed much of its resources through provision of foreign aid, especially to Latin American countries. In 1960, it had acquired Argentine pesos. In May 1961, the ESF agreed to exchange up to \$70 million dollars for Brazilian cruzeiros (U.S. Treasury 1961, p. 369). On January 1, 1962, the ESF entered into an exchange agreement with Mexico for \$75 million, and in the middle of 1962 it entered into a swap agreement with the Philippines (U.S. Treasury 1963, p. 57).¹

¹ At times, the ESF obtained the foreign exchange needed to purchase dollars in the foreign exchange market by borrowing from foreign central banks through an arrangement called a "swap." At other times, when the ESF needed dollars, in an arrangement called "warehousing," it would organize a trade with the foreign exchange in the Fed's inventory in return for dollars. The appendix explains the details of these two kinds of transactions.

Because so much of its resources were tied up, the ESF intervened mainly in the forward markets. In that way, it would only need foreign exchange if it had to close out a position at a loss. "Reference was made to the extent of operations of the ESF in the forward market, as opposed to spot transactions, and Mr. Coombs [manager of the New York Fed's foreign exchange desk] said the basic reason was that the ESF was short of money" (Board of Governors 1962, p. 169). The dollar often traded at a large discount in the forward market. The Treasury entered into commitments to furnish foreign currencies in the future in order to reduce this discount. In doing so, it hoped to encourage individuals to hold dollar-denominated assets by reassuring them that the dollar would not depreciate in value.

In March 1961, the British pound weakened while the German mark and Dutch guilder strengthened. Germany and the Netherlands revalued their currencies by 5 percent.² Because many in the foreign exchange markets believed that a 10 percent revaluation would be required to eliminate the German balance of payments surplus, capital continued to flow into Germany. In forward markets, the mark commanded a 4 percent premium.

German exporters . . . hedged by borrowing dollars . . . and converting these dollars into deutsche marks immediately, counting on the future dollar receipts to repay the dollar loans on maturity. Activities of this nature significantly increased the volume of dollars being offered on the exchange market, compelling the German Bundesbank to acquire dollars in huge amounts. . . . U.S. authorities were confronted with the possibility that the Germans would have to purchase gold in order to prevent a further drop in their already low gold/dollar ratio (U.S. Treasury 1962a, p. 3; Foreign 1962).

By the end of June, the ESF had entered into forward contracts agreeing to deliver more than \$250 million deutsche marks for dollars in the future. Fortunately, the Treasury was able to unwind these positions without putting pressure on the dollar in the summer because the Berlin Wall crisis produced a weakening of the deutsche mark.

The Berlin crisis, however, produced capital flight to Switzerland, and the Swiss franc commanded a premium of 1½ percent in the forward market. Starting in July, the ESF began to sell Swiss francs forward to Swiss commercial banks, which then became willing to hold the dollars instead of turning them over to the Swiss National Bank. If the Swiss National Bank had been forced to purchase the dollars, it would have been under pressure to use them to buy gold from the Treasury. Toward the end of 1961, the Italian lira became the strongest European currency, and the Italian central bank came under pressure

² The following discussion draws on a memo (U.S. Treasury 1962a; Foreign 1962) that "Secretary Dillon promised Chairman Martin we would furnish to the Board of Governors." The memo summarizes a letter from Robert Knight, Treasury General Counsel, to Ralph Young, Adviser to the Board of Governors, February 9, 1962.

to exchange the dollars it was accumulating for gold. In an attempt to encourage Italian commercial banks to hold dollars rather than turn them over to the central bank, the ESF entered into \$200 million in forward contracts. The forward commitments of the ESF in lira and Swiss francs amounted to \$346.6 million in early 1962.

Forward commitments, however, carried the risk of loss if the dollar did not appreciate. Given the risk exposure due to the size of its forward commitments, the Treasury felt that the ESF had insufficient cash on hand. To provide it with additional cash, the Treasury wanted the Fed to buy the ESF's foreign currencies such as the deutsche mark. The ESF could then acquire the lira and Swiss francs it needed to meet its forward commitments without having to incur the ire of other central banks by dumping their currencies on the market in return for lira and Swiss francs.

A Treasury memo (Foreign 1962; U.S. Treasury 1962b, p. 2) noted

Total resources of the Fund at the present time amount to about \$340 million. Against these resources there are outstanding \$222 million in Exchange Stabilization agreements with Latin American countries, and some additional agreements may be made from time to time. The free resources of the Stabilization Fund are consequently quite small. . . . Spot holdings of foreign exchange now amount to about \$100 million These spot holdings must in general be thought of as providing backing for outstanding forward exchange contracts (currently about \$340 million equivalent). The entrance of the Federal Reserve System into foreign exchange operations will therefore provide particularly needed resources.

As Charles Coombs (1976, p. 71) put it later, “. . . the money-creating authority, the Federal [Reserve] could rise to almost any financial emergency, whereas the Treasury was confined, in the absence of new Congressional appropriations, to the existing \$330 million resources of its Stabilization Fund.”

3. LOOKING TO THE FED

On June 27, 1961, Ralph Young, Adviser to the Board of Governors, distributed to FOMC members a memo proposing that the Fed become involved in the coordinated foreign exchange intervention started by other central banks in response to the March sterling crisis. When the pound sterling had weakened, the Bank of England used its dollar reserves to buy pounds. The resulting outflow of dollars ended up at other European central banks. Although those banks recycled the dollars by lending them to the Bank of England, the U.S. Treasury was concerned that the banks might use the dollars to buy gold from the United States. To safeguard against such an event, Young recommended that the Fed open swap lines with other central banks as a way of acquiring

foreign exchange to buy dollars if necessary.³ He also recommended that the Fed stand ready to replenish the ESF's dollar holdings by purchasing its foreign exchange through a procedure later termed "warehousing."⁴

Young's (1961, p. 8; Foreign 1961) memo stated

The assets of the Stabilization Fund cannot, without Congressional action, be increased beyond the present amount of about \$360 million. Part of this amount is immobilized under present exchange agreements with Latin American countries. The rest is not sufficient to cope with the swings in holdings of foreign exchange . . . in periods of disturbed exchange market conditions.

Chairman Martin first raised the issue of foreign exchange intervention at an FOMC meeting on September 12, 1961. He let William Treiber, first vice president of the New York Fed, take the lead. Treiber (Board of Governors 1961, pp. 798–99) noted the weakness in the dollar and the ESF's lack of resources:

[The ESF's] present size is about \$ $\frac{1}{3}$ billion, of which a large amount is already tied up by stabilization agreements with certain Latin American countries. The scope of acquisition of hard currencies by the Fund is probably not much over \$100 million. While the Treasury may eventually ask the Congress to authorize an increase in the resources of the Fund, I understand that in any case the Treasury would welcome Federal Reserve acquisition of foreign exchange as a helpful supplement. . . . Abrupt declines of the dollar to the floor of the foreign exchanges have excited speculation as to possible changes in currency parities . . . an adequate supply of the major foreign currencies . . . [would] restrain a snowballing of speculative anticipations.

Young noted that the Treasury would like the Fed to become involved in foreign exchange intervention so that it could use the ESF's funds for other purposes:

Mr. Young pointed out . . . that the Treasury has other jobs in connection with the Stabilization Fund. That was one of the reasons why the funds available for the particular kinds of operations under discussion were so limited. He gathered that the Treasury might be happy if it were left free to use the Stabilization Fund for the other things with which it had to deal (p. 815).

Carl Allen (Board of Governors 1961), president of the Chicago Fed, began a discussion of the legality of Fed intervention in foreign exchange markets

³ As explained in Appendix A, in a swap the Fed or the ESF places dollar deposits with a foreign central bank, which in return places deposits in its currency with the Fed. Appendix A explains how the foreign exchange acquired through swaps was used to insure foreign central banks against loss of value of their dollar holdings in the event of a devaluation of the dollar. In this way, the United States persuaded foreign central banks not to purchase gold.

⁴ As explained in Appendix A, with warehousing the Fed credits the Treasury's deposits with the Fed in exchange for foreign exchange held by the ESF.

and Karl Bopp, president of the Philadelphia Fed, raised the issue of whether the Fed could retain its independence while working with the Treasury:

Just because a thing was legal, that did not mean that he [Allen] would always want to do it. On the legality of the proposed operations, however, he did have a question . . . whether it seemed clear that it would be legal for the System to undertake such operations (p. 801).

. . . The Chairman then turned to Mr. Hackley [Board Counsel], who commented that legal questions had, of course, been raised in the past. Nearly 30 years ago, as indicated in Mr. Young's memorandum, the Board took a position, which it did not publish, that would seem to preclude the implementation of the program such as suggested. However, for reasons that did not need to be gone into today, he felt that the Board could well reinterpret the law in a somewhat different manner, and in his view such a step would be desirable. . . . Chairman Martin then stated that he had mentioned this subject informally—not formally—to the Chairmen of the Senate and House Banking and Currency Committees. . . . It would not be fair to say that the Committee Chairmen had given any clearance of any kind (p. 802).

The Chairman went on to comment. . . . There was a very real point . . . that the primary direction must come from the Treasury and that anything done by the Federal Reserve must be coordinated with the Treasury. . . . Everyone . . . ought to keep in mind what the framework was. Also, before entering into any such operations, the System ought to do as the memorandum from Mr. Young suggested; namely, take the matter up formally with the Chairmen of the Banking and Currency Committees (p. 803).

Mr. Bopp said that as nearly as he could recall . . . one reason for its [ESF's] creation was dissatisfaction with the idea of the Federal Reserve handling foreign exchange operations. . . . Through the Stabilization Fund . . . the Treasury was to have the authority in case of any conflict. . . . In the longer run, he noted, a possible conflict could develop between Treasury policy and Federal Reserve policy in this area. This was a thing to keep in mind . . . the sense in which the Treasury could direct Federal Reserve operations in this field even though Federal Reserve funds were used (p. 804). . . . Mr. Bopp then commented that he was sympathetic to the approach suggested in Mr. Young's memorandum (p. 805).

Governor Robertson [Board Vice Chairman] was especially skeptical:

Mr. Robertson said . . . while he would not want to argue that the proposed operations would be illegal, he thought that the point was highly questionable (p. 805). . . . It seemed to him this whole problem was not fundamentally the problem of the Federal Reserve, but rather of the Treasury. If so, Federal Reserve operations of the kind suggested might be construed as bailing out the Treasury. . . . Accordingly, before any operations were undertaken, he felt that the Congress should have a chance to take a look, at least through the Banking and Currency Committees, to see whether it was felt that the Federal Reserve had the power to proceed. . . . In other countries there was a much closer relationship between the central bank and the executive branch of the Government than in this country. . . . While this problem [weakness of

the dollar] did exist, he would not want to see the Federal Reserve take the position that it could construe the statute [Section 14 of the Federal Reserve Act] in any way it wished (p. 806).

FOMC members then raised a variety of questions:

Mr. Swan [president of the San Francisco Fed] noticed . . . that the Stabilization Fund had certain amounts committed under existing stabilization agreements with Latin American countries, whereas presumably Federal Reserve operation would not involve such uses of funds (p. 808). . . . Mr. Wayne [president of the Richmond Fed] said . . . he would feel much more comfortable if the Federal Reserve had an official commitment from the Congress that operations of the kind under consideration were clearly within its power (p. 809). . . . Mr. Allen said . . . he had some doubt about the legality of Federal Reserve operations. . . . He was inclined to think that the intent of Congress had been . . . to have the Stabilization Fund do this job (p. 810).

4. BACKGROUND TO THE DEBATE

The Federal Reserve Act does not explicitly authorize the Fed to influence the value of the dollar by intervening in the foreign exchange market or to acquire foreign exchange for that purpose by swapping deposits with foreign central banks (establish swap lines). It also does not explicitly authorize the Fed to acquire foreign exchange from the Treasury (warehousing). This omission of powers undoubtedly reflected the adherence of the authors of the Federal Reserve Act to the two dominant assumptions of their era: the discipline of the gold standard and the real bills doctrine. Adherence to the gold standard (continued in the Bretton Woods system) required that the Fed raise the discount rate in response to gold outflows. It seems unlikely that the authors of the Federal Reserve Act would have authorized actions designed to avoid this discipline. Also, according to the real bills doctrine, a central bank should extend credit only through discounting commercial bills (bills of exchange), that is, on the basis of debt arising from the financing of real productive activity. Again, it seems unlikely that the authors of the Federal Reserve Act would have authorized deposit creation for U.S. and foreign governments in return for direct asset sales. (Foreign central banks were typically under direct government control.)

Section 14 of the Federal Reserve Act states “Any Federal reserve bank may . . . purchase and sell in the open market, at home or abroad, either from or to domestic or foreign banks, firms, corporations, or individuals, cable transfers and bankers’ acceptances and bills of exchange.” Given the existence of the gold standard and the acceptance of the real bills philosophy at the time of the writing of the Federal Reserve Act, the simplest understanding of the power to buy and sell foreign exchange (cable transfers in the language of the Federal Reserve Act) would be as a power facilitating transaction abroad by the Fed

in gold or bankers' acceptances and bills of exchange. H. Parker Willis (1926, p. 488), who drafted the Federal Reserve Act for Carter Glass, discussed the intention of this part of the Federal Reserve Act. He wrote that the power to deal in cable transfers facilitated the ability of Reserve Banks to purchase gold abroad. These foreign gold purchases could be used to supplement the domestic stockpiles of the Reserve Banks. Such purchases could also be used to avoid unnecessary trans-Atlantic movements of gold. For example, a Reserve Bank could use its holdings of gold in London to meet the needs of an individual in London wanting to exchange dollars for gold and thus avoid the need for shipment of gold from New York.

The Federal Reserve Bank of New York had opened swap lines in the 1920s with foreign central banks desiring to make their currencies convertible.⁵ In 1932, however, Carter Glass, senator from Virginia and author of the Federal Reserve Act, denounced on the Senate floor those swap lines as inconsistent with the Federal Reserve Act. As a consequence, in the Banking Act of 1933, Congress added language to the Federal Reserve Act giving the Board of Governors the power to prevent the New York Fed from dealing directly with foreign banks. “. . . the Board subsequently (in 1933 and 1934) construed section 14(e) as limiting foreign accounts to the purchase of bills of exchange” (U.S. Congress 1962, p. 147).

5. DEBATING FED FOREIGN EXCHANGE INTERVENTION

At the request of Chairman Martin, Board Counsel Howard Hackley wrote a memorandum outlining a legal basis for Fed participation in foreign exchange operations. The FOMC discussed the memo at its December 5, 1961, meeting. (The full memorandum is reprinted in U.S. Congress [1962]. Appendix B summarizes the legal arguments of the memorandum.)

President Swan had already expressed his doubts in a November 30, 1961, letter to Ralph Young (Foreign 1961). He argued that the memo was a “shaky foundation for proceeding with a full-blown operation” because “the real bills doctrine of the 1914 law” made it doubtful that the Federal Reserve Act would authorize opening foreign accounts for purposes other than buying bills of exchange. Most FOMC members shared the sentiments expressed by George Clay (Board of Governors 1961, p. 1035), president of the Kansas City Fed:

⁵ Coombs (1976, p. 75) said of the swap arrangements he was discussing with other central banks in January 1962, “Such swaps of one currency for another, with a forward contract to reverse the transaction, say 90 days hence, had long been a standard trading instrument in the foreign exchange markets. Moreover, back in 1925, the New York Federal [Reserve Bank] under Governor Strong had arranged with the Bank of England a similar swap arrangement of \$200 million of United States gold against sterling.”

Mr. Clay went on to say that he had a basic feeling against Government agencies taking unto themselves authorities that had never been specifically granted. . . . He felt that Congress should be given an opportunity, and in fact urged, to assign this authority to the agency that in its wisdom it would choose.

Governor King (Board of Governors 1961, p. 1043) commented:

He did not think the Federal Reserve was the proper place for these operations if they were to be conducted. Instead, he felt that a political agency or body would be the proper place to lodge the responsibility. As he had heard it said on various occasions, if the System should get into politics at any stage it could founder.

President Bopp (Board of Governors 1961, p. 1046) stated:

Like others who had spoken, he was concerned about the legal basis for System operations in foreign currencies. The legal authority was not based on specific provisions of the law but rather on a construction of the statutes. . . . In a democratic process it was important . . . to have specific authorization.

President Bryan (Board of Governors 1961, pp. 1048–49) of the Atlanta Fed urged the FOMC to concentrate on maintaining convertibility through the appropriate domestic policies. “Sometimes . . . a great deal more harm can be done, with good intentions, by intervening to save the patient some pain than by letting him realize he is sick.”

Governor Robertson (Board of Governors 1961, pp. 1037–42) argued that sterilized foreign exchange intervention by the Fed was bad law, bad politics, and bad economics:

It does not follow that the power to maintain foreign accounts—basically an incidental power—can be regarded as an authorization to exercise the broad policy functions contemplated by the instant proposal. In other words, even if foreign accounts may be maintained in connection with functions other than dealing in bills of exchange, these must be functions that are authorized by the Federal Reserve Act. *Nowhere in the Act can authority be found for the stabilization function that is the core of this proposal* (italics in original).

Even if its legality were to be assumed, I think the proposed action would be highly questionable because it is inconsistent with explicit Congressional authority. . . . Purchasing foreign exchange from the Stabilization Fund whenever that fund has been used up *or* by operating in the same field on its own . . . could be interpreted as circumventing the will of Congress by making available more dollars for the purpose of “stabilizing the exchange value of the dollar” than Congress contemplated. . . . Such a function [selling foreign exchange] . . . involves very sensitive international diplomatic relationships, with which the Federal Reserve is not in the best position to cope. The function would seem to be more appropriately one for the Treasury (which Congress has already designated to handle the problem).

Federal Reserve operations in foreign currencies . . . would merely camouflage the difficulty, which is one of dealing with the balance of payments

problem. . . . If the amount of that fund [the ESF] is insufficient, then the Treasury should request Congress to expand the fund. . . . There are no gimmicks by which the position of the dollar can be maintained in the world. It would be unwise to resort to devices designed to hide the real problems and assuage their symptomatic effects. . . . The United States must practice what it has long preached about the need for monetary and fiscal discipline.

6. THE DECISION TO INTERVENE

The main defenders of Fed involvement in the foreign exchange markets were Governor Balderston, Charles Coombs, and President Hayes of the New York Fed. Balderston (Board of Governors 1961, p. 1058) argued that the Fed should intervene in the foreign exchange market because “it was so close to the function carried on by the Open Market Committee in domestic affairs.” Coombs (Board of Governors 1961, p. 1052) argued that “speculative pressures could boil up within a matter of minutes in the exchange market. . . . It would be desirable to have the resources to deal with such periodic emergencies, so that exchange operations could resist speculative trends before they had gone too far.” Hayes (Board of Governors 1961, p. 1054) argued that, since the ESF was not in a position to intervene in foreign exchange markets, the Fed should do so.

As to the roles of the Treasury and Federal Reserve, some of those who commented had suggested that the Stabilization Fund was set up for this kind of purpose. Actually, however, the Fund had been used for a lot of other purposes. It had been used to assist United States foreign policy in relation to various weaker currencies that needed shoring up, as a kind of State Department activity.

In a poll conducted by Chairman Martin, thirteen of the eighteen FOMC participants registered the opinion that “legislation is desirable” before beginning to intervene in the foreign exchange market. (The poll is recorded in the notes of Richmond’s President Wayne and are in the Richmond Fed archives for the December 5, 1961, FOMC meeting.) One of the five in favor of intervention, Governor Mills, expressed reservations. “He had no great faith that operations of this kind could be conducted successfully or without serious danger to the independent status of the Federal Reserve System.” Another of the five in favor, Delos Johns, president of the St. Louis Fed, believed the FOMC should seek enabling congressional legislation at the same time it proceeded. Chairman Martin ended the meeting by saying that he would explore the matter of legislation with the Treasury and report back to the Committee at its next meeting.

At the December 19, 1961, FOMC meeting, Chairman Martin, supported by President Hayes, asked the Committee’s permission to discuss a working

relationship with the Treasury for foreign exchange intervention.⁶ Most members agreed that Chairman Martin should continue discussions with the Treasury, but agreed with President Deming of the Minneapolis Fed “that he would regard operations in foreign currencies as a proper activity for the central bank if statutory clarification could be obtained” (Board of Governors 1962, p. 1151).

At the January 9, 1962, FOMC meeting, Chairman Martin asked Hackley to report to the FOMC on his discussions with the Treasury’s general counsel, Robert Knight. Hackley noted that the Treasury’s general counsel and the Attorney General concurred with his opinion. He also noted that the Treasury opposed seeking legislation for three reasons (Board of Governors 1962, p. 61):

The international situation was very tender. . . . If there were discussions on the Hill, they might be agitating to the markets. Second . . . it might be better to seek such legislation after the Open Market Committee had some experience in order to determine what its problems and limitations were. . . . Third, there was a range of ideas on the Hill with regard to the Federal Reserve System. . . . Legislation, if sought, might become a vehicle for adding various amendments the nature of which could not be foretold.

Chairman Martin said that he had conferred with the Secretary of the Treasury, and they agreed that “regarding the question of seeking legislation . . . there were real problems involved.” Martin suggested that he confer with the chairmen of the House and Senate Banking Committees. “If the Committee Chairmen . . . should feel strongly that the introduction of legislation would cause a great deal of stir, it might be better not to embark on that course” (Board of Governors 1962, p. 63). Governor King then commented

The Federal Reserve was being asked to go a little too far in the name of cooperation. As he understood it, the Treasury was suggesting that it might not favor legislation because of apprehension as to the outcome (p. 63).

The Committee then authorized Chairman Martin to confer with the chairmen of the congressional banking committees.

At the January 23, 1962, meeting Chairman Martin reported to the FOMC “on the general problem of obtaining legislation that would clarify the Committee’s authority to conduct foreign currency operations.” Although the *Minutes* do not explain why, Chairman Martin no longer considered legislation an option. The *Minutes* note then that the FOMC had a roundtable discussion. They record a reference to the opinions of the Committee’s and Treasury’s general

⁶ On December 18 the Secretary of the Treasury had sent a letter to Chairman Martin asking for prompt resolution of the issue of FOMC involvement in foreign exchange intervention and offering the advice of the Treasury’s legal staff. “I realize that the Committee might be hesitant to embark on operations in which it has not engaged since the establishment of the Stabilization Fund under the Gold Reserve Act of 1934. If the Committee should be interested in the opinion of the Treasury’s General Counsel . . . the Treasury’s legal staff will be ready to cooperate with yours” (Board of Governors 1961, p. 1146).

counsels that the “System’s existing statutory authority, although in some respects limiting, did provide a general sanction for Committee operations,” but otherwise state only that “differing viewpoints were expressed.” The *Minutes* (Board of Governors 1962, pp. 111–12) then state

In bringing the discussion to a head, it was moved by Mr. Balderston and seconded by Mr. Hayes that the Committee go on record at this session as favoring in principle the Committee’s initiation on an experimental basis of a program of foreign currency operations; that Mr. Young, the Committee’s Secretary, and Mr. Coombs, Vice President in charge of foreign operations of the New York Federal Reserve Bank, be authorized to explore for the Committee with the Treasury the needed guidelines for actual operations . . . and further that Chairman Martin be authorized to refer to this development in his statement and testimony before the Joint Economic Committee scheduled for January 30, 1962.

Ten of the twelve voting FOMC members voted in favor and two (Governors Robertson and Mitchell) dissented.

At its February 13, 1962, meeting, the FOMC discussed the issue of “the needed guidelines for actual operation.” The exchange was charged because it dealt with the issue of Fed independence. Because foreign exchange intervention involved U.S. relations with foreign governments, many FOMC members were afraid that the Fed would inevitably become a junior member to the Treasury. Earlier, in a November 30, 1961, letter to Ralph Young, President Fulton of the Cleveland Fed (Foreign 1961) had written

There is a danger that if the System takes on the functions of the executive, it will end up as a captive of the executive branch of the government. . . . It might be safer for the Congress to designate the Treasury Department as the principal locus of responsibility for exchange operations. . . . This approach . . . would not rely on a tenuous Treasury-Federal Reserve “accord,” which might not endure with different personalities and under different conditions. For another thing, Congress would retain its traditional control over the purse strings.

At the February 13 meeting, Governor King argued for explicit assurance that the Fed could refuse to finance the activities of the ESF (Board of Governors 1962, pp. 175–77):

Mr. King raised a question with respect to the comment made earlier by Mr. Young that there would be no specific rules at the outset on relationships between the Treasury and the Federal Reserve, the thought being that these might evolve out of experience. He asked whether it might not be better to have such rules.

In response, Mr. Young expressed the view that no general rule was needed. . . . He did not think that the Treasury would be apt to come to the System with the idea of selling from the Stabilization Fund unless something happened in the development of the over-all program of foreign currency

operations that would make it seem desirable, from the Treasury's standpoint, to get unloaded. There could always be that development. For example, an underdeveloped country might need temporary help and there would be no way to arrange it except to give a commitment from the Stabilization Fund. In that event, the Treasury might need to convert some of its resources.

Mr. Robertson inquired as to the advantages seen—aside from the Federal Reserve's "unlimited pocketbook"—in having two agencies operating in this field instead of one, and Mr. Coombs replied that he did not think there were any. . . . He [President Swan] asked whether it was not possible that the Federal Reserve would just be in the role of supplying funds to the Treasury rather than conducting foreign currency operations.

[Chairman Martin] considered it difficult to sit down and attempt to draw up such principles while the Federal Reserve was in the process of learning.

Chairman Martin then advanced a proposal that the Board of Governors, not the full FOMC, have responsibility for foreign exchange intervention. Hackley explained the proposal, which he had advanced in a memo dated February 8, 1962: "He [Hackley] did feel that in at least some respects this approach might be more defensible from a legal standpoint" (Board of Governors 1962, p. 177). The New York Fed and many other regional banks, however, objected to being excluded. Most FOMC members felt that exclusion of the regional banks would weaken the federal character of the System:

[Governor] Shepardson said that . . . either approach involved an interpretation of the law that was rather nebulous. . . . On the assumption that the original proposal would be legally supportable . . . participation of the entire Open Market Committee would be desirable from the standpoint of System unity (Board of Governors 1962, p. 186).

As part of this discussion, Chairman Martin recommended that decisions about foreign exchange intervention be made by a subcommittee consisting of the Chairman and Vice Chairman of the FOMC and the Vice Chairman of the Board of Governors. Earlier, Delos Johns (Board of Governors 1961, p. 1051), president of the St. Louis Fed, had opposed such a delegation of authority:

He had real doubt about the power of the Committee to delegate its responsibilities. That was an old question. . . . He was not quite satisfied by the argument that a subcommittee that supervised the operations was not making policy. The executive committee was abolished because the Committee became convinced that it was not confining its activities to administration and instead was actually making policy. This is almost inevitably the result, he suggested, when delegations of authority are made to a small group.⁷

⁷ Prior to 1955, only the Executive Committee (consisting of the Fed chairman, two governors, the president of the New York Fed, and one other regional Bank president) met regularly to make monetary policy. The full FOMC met only four times a year, with two of those meetings separated by only a weekend.

There was, however, no real opposition to delegating to a small subcommittee authority over operations in the foreign exchange markets. Any other arrangement appeared impractical.

Chairman Martin then asked for approval of guidelines for initiating foreign currency purchases. Although the Board staff had circulated on December 12, 1961 (Foreign 1961), a draft of congressional legislation that would give the Federal Reserve explicit authority to transact in foreign exchange, Martin (Board of Governors 1962, p. 193) argued

There were those . . . who felt that the law was not sufficiently clear. It might be desirable to seek legislation in this area at some time, but at the moment he doubted whether it would be feasible, with so little experience, to determine what kind of legislation was needed. . . . The availability of those decisions [Hackley's memorandum and the opinions of the Treasury's general counsel and the Attorney General], along with a lack of System experience in foreign currency operations, would handicap the System if it tried to get legislation. The System would be asked what kind of additional legislation it needed, and the Congress probably would not want to put itself in the position of approving something if the Federal Reserve was not clear about its wishes in the matter.

In the words of Coombs (1976, p. 72), the FOMC then "somewhat apprehensively approved on February 13, 1962, the undertaking of market operations in foreign currencies."

At the March 6, 1962, FOMC meeting, discussion again centered around the issue of whether the Fed, by participating in foreign exchange operations, would be taking orders from the Treasury. The Treasury had two immediate problems. First, a number of foreign governments, especially France, wanted gold for their dollars. The problem was acute:

Mr. Coombs reiterated that a number of European central banks holding large amounts of dollars had been deliberately refraining from taking gold. If any bank should come in for a large amount of gold, an "every man for himself" proposition could possibly develop (Board of Governors 1962, p. 273).

On February 28, in a telephone poll, the FOMC had approved entering into a swap arrangement with France.⁸ Among the seven governors, King and Robertson had dissented and Mitchell had abstained.

The Treasury's second problem was that the ESF needed dollars so it could buy Swiss francs to meet its forward commitments:

Mr. Mitchell inquired of Mr. Coombs whether a purchase by the System of marks from the Stabilization Fund might not be the kind of operation that would leave the System open to the charge of bailing out the Stabilization Fund. . . . At times . . . the Federal Reserve had been dominated by the

⁸ See the discussion in the appendix in the memo of Ralph Young, dated October 17, 1963, on using swaps to offer foreign central banks protection against dollar devaluation.

Treasury, so there was always a problem of maintaining a kind of arms-length relationship. On the present occasion, the objectives of the Treasury and the Federal Reserve tended to coincide, but a different situation could possibly develop (Board of Governors 1962, pp. 277 and 280).

Reference was made by Mr. Thomas [Board economist] to the fact that the Federal Reserve could not purchase U.S. government securities directly from the Treasury. . . . Mr. Hackley [said] that the law clearly indicates that direct purchases of U.S. government securities from the Treasury are not open market transactions. As to foreign currency operations, he had come to the conclusion, however, that in this sense the Stabilization Fund was a part of the open market (Board of Governors 1962, pp. 279 and 283).

After Coombs noted that “the Stabilization Fund was strained to the utmost at this moment” (Board of Governors 1962, p. 285), the Committee voted to buy marks from the ESF.

7. CONGRESSIONAL ANNOUNCEMENT

On February 27 and 28, 1962, the House Committee on Banking and Currency held hearings on legislation (U.S. Congress 1962) to increase the resources of the IMF. Chairman Martin (U.S. Congress 1962, pp. 91–92) used these hearings to announce that the Federal Reserve had become involved in foreign exchange intervention:

The Federal Reserve has recently acquired small amounts of several convertible currencies widely used in international transactions from the Treasury Stabilization Fund and has opened accounts with several European reserve banks. . . . While in time it may be desirable to recommend amendment of the Federal Reserve Act to provide greater flexibility than we now have under the act in carrying out these operations, it would be impractical to request such legislation before operating experience under existing authority has provided a clear guide as to the need for it.

Rep. Reuss (U.S. Congress 1962, pp. 102 and 140) criticized the use of the “nearly unlimited money creative powers of the system” to intervene in the foreign exchange markets:

Much of the operation that you are doing . . . seems to me to duplicate the foreign exchange stabilization operation that the Secretary of the Treasury has very properly undertaken pursuant to the Gold Reserve Act of 1934. To me this is a tremendous power you have taken upon yourself, and I must serve notice on you right now that I consider this an usurpation of the powers of Congress. . . . You come in here and tell us that you propose to go off on, if I may say so, a frolic of your own, involving unspecified sums without the slightest statutory guidance.

Chairman Martin (U.S. Congress 1962, p. 140) challenged Rep. Reuss’ representation. “Now, you may disagree as a lawyer with the lawyers for the

Federal Reserve Board as to our existing authority on this, Mr. Reuss. But as I reiterate, our lawyers said we had the authority, the Treasury counsel concurred, and the Attorney General concurred with them.” Copies of the Hackley Memorandum, the opinion of the Treasury’s general counsel and the concurrence of the Attorney General were provided to the Committee at its request and published in the hearing record.⁹

8. CONCLUDING COMMENTS

From the time of the first swap arrangement with France for \$50 million in 1962 to the closing of the gold window in August 1971, Fed swap lines grew to \$11.7 billion. The entrance of the Fed into the foreign exchange markets initially produced considerable internal debate. On the one hand, Coombs (1962, p. 469) considered foreign exchange intervention to be integral to maintaining the international monetary order. “[W]hen the exchange markets become seriously unsettled by political or other economic uncertainties, normally beneficial speculation may quickly become transformed into a perverse, and sometimes even sinister, force.” On the other hand, Governor Robertson (Board of Governors 1962, p. 185) was critical:

⁹ The Fed’s conduct of foreign exchange operations has continued to be the subject of much discussion in the years since the internal FOMC debate chronicled in this article. In commenting on an earlier draft of this article, members of the Board of Governors’ staff suggested that the following additional information be included for completeness:

Since 1962, Congress has reviewed the foreign currency operations of the Federal Reserve in hearings on related issues. The Hackley Memorandum was published a second time in a 1973 hearing record of the House Banking Committee on the Par Value Modification Act of 1972. In addition, the *Annual Reports* of the Board have described and provided data on the Federal Reserve’s foreign currency operations, and the Federal Reserve Bank of New York has submitted quarterly reports to Congress on Treasury and Federal Reserve foreign currency operations. Although Congress can properly be considered to have been fully aware of these published materials, it has not acted to restrict the authority of the Federal Reserve to engage in these operations.

In fact, Congress has recognized and facilitated the Federal Reserve’s foreign currency operations by amending a related provision of the Federal Reserve Act to permit the investment of foreign exchange obtained through those operations. In 1980, Congress amended Section 14(b)(1) of the Act to grant Reserve Banks the authority to invest foreign exchange in “short-term foreign government securities.” The provision was enacted as part of the Monetary Control Act of 1980 in response to a long-standing request from the Board. Its enactment demonstrated congressional awareness and suggested tacit acceptance of the Federal Reserve’s foreign currency operations.

Finally, in 1989 and 1990 the Federal Reserve conducted a comprehensive study and review of System foreign exchange operations. This material was discussed and reviewed by the FOMC at its meeting on March 27, 1990. All aspects of the operations, including the policy and legal basis of such operations, were thoroughly examined. After consideration of the material, the FOMC voted in favor of increasing the limits on the System’s holding of foreign currencies and on the amount of eligible foreign currencies the System was willing to warehouse for the Treasury and the ESF. The discussion and the votes were reported in the published FOMC minutes. Three members dissented from these decisions. Two of the dissenters cited concerns about the absence of definitive congressional intent in this area but only in reference to the warehousing increase.

Mr. Robertson recalled that he had opposed the whole program of operations in foreign currencies on legal, practical, and policy grounds because it had seemed to him that the only basis for the entrance of the Federal Reserve into this field would be to supplement the resources of the Stabilization Fund and because the program was being undertaken without specific congressional approval.

The place of the Federal Reserve System within the U.S. government is different from the place of central banks in other countries because the U.S. government is different. The U.S. government is characterized by a division of powers, with fiscal policy assigned to Congress. As discussed in Appendix A and Broadus and Goodfriend (1995), the sterilized foreign exchange intervention and warehousing practiced by the Fed since the early 1960s constitute fiscal policy, not monetary policy. That fact raises fundamental issues about the Fed's operations in the foreign exchange markets. Policymakers vigorously debated many of these issues when the Fed first became involved in the foreign exchange markets in the early 1960s. Those debates remain helpful today in assessing the proper role of the Federal Reserve System.

APPENDIX A: SWAPS AND WAREHOUSING

The Fed can obtain the foreign exchange it requires to buy dollars in the foreign exchange market through a swap of currencies with another central bank. In a swap, the Fed agrees to establish dollar deposits on its books for the German Bundesbank in exchange for the Bundesbank establishing mark deposits for the Fed. At the same time, the Fed agrees via a forward transaction to reexchange the same amount of marks for the Bundesbank's dollars at a given date in the future. Before the breakdown of the Bretton Woods system of fixed exchange rates, the United States used swaps to provide cover for the dollar holdings of foreign central banks. That is, as a consequence of maintaining the fixed exchange rate with the dollar, the Bundesbank might have to buy dollars it did not want to hold. It would have liked to exchange them for gold at the U.S. Treasury, but the Treasury did not want to deplete its stockpile of gold.

The U.S. Treasury could persuade the Bundesbank to hold the unwanted dollars by guaranteeing the Bundesbank against loss in case of a devaluation of the dollar. The Treasury did so by having the Fed take marks acquired by the latter in a swap transaction and use them to buy dollars from the Bundesbank. Counting the dollars in its swap account, the Bundesbank ended up with the same amount of dollars as before the swap, but more of the dollars it did hold were protected against devaluation. The reason is that if the Bundesbank

decided not to renew the swap agreement, it could just exchange at the old exchange rate its dollars at the Fed for the marks in the Fed's deposit at the Bundesbank. The Fed, however, since it had used its marks to buy the Bundesbank's dollars, would have to go into the market to buy the marks. (In practice, the Treasury always protected the Fed from loss in buying the necessary foreign exchange.)

Ralph Young (1963; Swap), Director of the Board's Division of International Finance, provided the following explanation:

Foreign monetary authorities were increasingly unwilling to hold additional dollar claims on an uncovered basis. . . . When the System draws foreign currencies for temporary use under a swap arrangement, the foreign central bank comes into additional dollar holdings that are covered against exchange risk in an amount corresponding to the System's drawing. As the System uses the currencies that it has drawn . . . through a direct sale against dollars with the foreign monetary authority, the *uncovered* dollar holdings of the foreign monetary authority are reduced . . . by a corresponding amount. In this way, although the foreign central bank in question ends up holding the same amount of total liquid dollar assets that it would have held in the absence of the swap drawing . . . its *uncovered* dollar holdings can be held down to the amount that . . . it is content to hold. And in this way, gold sales by the U.S. Treasury are avoided (*italics in original*).

After the breakdown of the fixed parities of the Bretton Woods system in the early 1970s, the Fed began using the foreign exchange acquired in swap transactions to intervene directly in the foreign exchange markets in response to weakness in the external value of the dollar. At that time, swaps assumed their more modern function of attempting to influence market psychology. Charles Coombs (Board of Governors 1971), Manager of the System foreign exchange account, and Fed Chairman Arthur Burns (Board of Governors 1972), respectively, expressed the change:

Mr. Coombs remarked that the rationale of the swap network rested on two main considerations. First, the network enabled the System to shield the Treasury gold stock and other reserve assets by providing the alternative of an exchange guarantee to foreign central banks having dollars they wished to convert. . . . That part of the rationale had now fallen away, since the decision of August 15 [1971, closing the gold window] had made the dollar inconvertible into gold or other reserve assets (p. 1101). . . . More generally, the swap network had come to be regarded in the market as the very symbol of central bank cooperation (p. 1102).

By demonstrating that the United States was prepared to cooperate with other nations . . . such operations [in the foreign exchange markets] could have a major impact on market psychology (pp. 734–35).

Swaps constitute a fiscal policy, not a monetary policy, action. (See Goodfriend and King [1988] on monetary and fiscal policy.) Consider a swap line with Mexico that involves the acquisition of peso deposits by the Fed in return

for dollar deposits at the Mexican central bank. If the Mexican central bank tries to prop up the value of its currency by using its dollar deposits to buy pesos on the foreign exchanges, the U.S. monetary base increases. The Fed will sterilize this increase in the base by selling U.S. Treasury securities out of its portfolio. As a result, the Fed's portfolio will come to include fewer U.S. assets and more peso assets. Because the monetary base ends up unchanged, the Fed has not undertaken a monetary policy action. Neither the U.S. money stock nor interest rates changes. However, when the Fed sells Treasury securities, the supply of U.S. Treasury securities in the hands of the public increases. The effect is the same as though the Treasury had lent money to Mexico by selling Treasury securities to the general public. The Fed has undertaken a fiscal policy action.

Warehousing is one way the Treasury obtains funds for either intervening in the foreign exchange market or lending to a foreign government. It also involves a fiscal policy action by the Fed (Goodfriend 1994). With warehousing, the Fed puts dollars into a deposit account of the U.S. Treasury in return for assets denominated in foreign currencies from the Treasury. At the same time, the Fed and the Treasury agree to reverse the transaction at a future date. Warehousing is equivalent to a repurchase agreement in which the Fed makes a loan to the Treasury using the foreign assets as collateral. When the Treasury uses the dollars it has gained to intervene in the foreign exchange market, the Fed offsets the resulting increase in the monetary base by selling a Treasury security. As above, government debt in the hands of the public increases. It is as if the Treasury issued debt to obtain dollars with which to buy foreign exchange.

If the Fed provides a loan to Mexico via a swap or to the Treasury via warehousing, the measured federal government deficit does not rise because for accounting purposes the Fed is assumed to be part of the private sector. What is relevant for fiscal policy, however, is government debt in the hands of the taxpaying public. If the Fed acquires an additional government security, it will return the interest it receives to the Treasury. Interest paid on the debt is a wash. In contrast, if the private sector acquires an additional government security, the U.S. government must come up with additional funds to pay the interest. Swap lines and warehousing that finance sterilized foreign exchange intervention are fiscal policy actions because they increase the debt that taxpayers must fund.¹⁰

Because of the separation of powers at the federal level that characterizes the U.S. framework of government, the involvement by the Fed in fiscal policy raises a number of issues. The U.S. Constitution assigns the major decisions

¹⁰ The additional interest the Treasury owes because of the increase in its debt outstanding can be offset by the interest gained on the acquisition of a foreign asset. The redistribution of assets, however, is still fiscal policy. With warehousing or a swap, the Fed has extended credit to the Treasury or a foreign government, but has not changed the monetary base.

about fiscal policy to Congress. When the Fed undertakes a fiscal policy action, it is off-budget; that is, it is not subject to the regular congressional budget process. For further discussion, see Broaddus and Goodfriend (1995).

APPENDIX B: THE HACKLEY MEMORANDUM

The Hackley Memorandum outlining a legal basis for transactions by the Fed in the foreign exchange market dealt with the three ways the Fed acquires foreign exchange: (1) directly from the Treasury in return for crediting the dollar deposits of the Treasury at the Federal Reserve; (2) directly from foreign central banks in exchange for dollar deposits placed with those banks; and (3) in the open market in exchange for dollar deposits at private banks.

In his memo, Hackley pointed to the language of Section 14 of the Federal Reserve Act, which lists transacting in foreign exchange (cable transfers) as an express power.¹¹ (“Any Federal reserve bank may . . . purchase and sell in the open market, at home or abroad, either from or to domestic or foreign banks, firms, corporations, or individuals, cable transfers and banker’s acceptances and bills of exchange.”) He argued that not only does this language allow the Fed to intervene in the foreign exchange market but also to acquire foreign exchange directly from the Treasury. In taking this position, Hackley made two assertions: “Within the meaning of . . . Section 14,” the United States (the Treasury) is a “corporation” and Federal Reserve purchases of foreign exchange “from the Stabilization Fund may reasonably be regarded as ‘open market’ purchases.” He defended the first assertion by reference to Chief Justice Marshall’s definition of a “corporation” in the *Dartmouth College* case as “an artificial being, invisible, intangible and existing only in contemplation of law” (U.S. Congress 1962, p. 149).

He defended the second assertion by arguing that the Treasury is part of “the open market” for purposes of transacting in foreign exchange, but not for transacting in government debt because the Treasury does not issue the foreign exchange, but it does issue debt (U.S. Congress 1962, p. 149):

By the Banking Act of 1935, Congress prohibited such purchases of Government obligations except in the “open market.” . . . It seems clear, however, that this limitation on direct purchases of Government obligations was intended to prevent the Federal Reserve System from lending its resources to the Treasury in a manner that might be inconsistent with the System’s monetary and credit

¹¹ The discussion of Section 14 in the section of this article entitled “Background to the Debate” dealt with intent or purpose. Hackley’s discussion deals exclusively with powers. The purpose of granting someone a license to drive a car may be to allow him to drive to the store. The power to drive the car, however, is different from the motivation for granting the power.

responsibilities. These considerations, of course, are not applicable to purchases of cable transfers from the Treasury. In other words, an “open market” in cable transfers may be regarded as embracing any person with whom a Reserve bank may feel free to deal, including the United States Treasury, which is a part of that market; whereas an “open market” in Government obligations may be regarded as excluding the United States Treasury, which issues such obligations and consequently is *not* part of that market. . . . On balance, it is my opinion that a Reserve bank’s purchases of cable transfers from the Stabilization Fund may be regarded as “open market” purchases from a “domestic corporation.”

In outlining a legal basis for swap transactions with foreign central banks, Hackley (U.S. Congress 1962, p. 149) turned to paragraph (e) of Section 14, “Foreign Correspondents and Agencies:”

Every Federal reserve bank shall have power . . . with the consent or upon the order and direction of the Board of Governors . . . to open and maintain accounts in foreign countries, appoint correspondents, and establish agencies in such countries wheresoever it may be deemed best for the purpose of purchasing, selling, and collecting bills of exchange . . . (or acceptances) arising out of actual commercial transactions which have not more than ninety days to run.

Interpretation of this language turns on the qualifying language “wheresoever it may be deemed best.” An interpretation consistent with the real bills doctrine is that this language allows the Fed only “to open and maintain accounts in foreign countries . . . for the purpose of purchasing, selling, and collecting bills of exchange.”

Hackley, however, argued that the wheresoever clause does not limit the Fed’s authority to open accounts in foreign countries as a way of engaging in swaps.¹² In defending this position, Hackley (U.S. Congress 1962, p. 146) first argued that the language does not unambiguously limit the opening of accounts just to dealing in bills of exchange:

. . . perhaps the strongest argument for the more liberal construction of the statute may be based upon the ambiguous nature of the phrase “wheresoever it may be deemed best.” . . . It does not expressly require such accounts . . . to be utilized *only* for the purpose of buying and selling bills of exchange. It is susceptible of the construction that such accounts may be opened wherever geographically it may be reasonably contemplated that they *might* be used at some time for such purpose but that they need not be limited to that purpose (italics in original).

¹² Hackley said later in commenting on the legality of swap arrangements with the Bank of England, “There was no express authority in the [Federal Reserve] Act for the Federal Reserve to extend credits to foreign banks, although such an action might be justified under the authority for the Federal Reserve Banks to open accounts with foreign banks” (Board of Governors 1967, p. 1244).

Hackley then notes that Section 14(e) concludes by stating that once “any such account has been opened . . . by a Federal reserve bank . . . any other Federal reserve bank may . . . carry on . . . any transaction authorized in this section.” That is, foreign deposit accounts can be used for any purpose, not just transacting in bills of exchange.

REFERENCES

- Board of Governors of the Federal Reserve System. *Annual Report*, 1993.
- . *Minutes of Federal Open Market Committee*, 1961, 1962, 1967, 1971, and 1972.
- Broaddus, J. Alfred, Jr., and Marvin Goodfriend. “Foreign Exchange Operations and the Federal Reserve.” Federal Reserve Bank of Richmond *Annual Report*, 1995.
- Burk, Kathleen, and Alec Cairncross. *Goodbye, Great Britain: The 1976 IMF Crisis*. New Haven: Yale University Press, 1992.
- Coombs, Charles A. *The Arena of International Finance*. New York: John Wiley & Sons, 1976.
- . “Treasury and Federal Reserve Foreign Exchange Operations, March 1961–August 1962,” in U.S. Treasury *Annual Report*, 1962.
- “Foreign Currency Memos, 1961 and 1962.” Federal Reserve Bank of Richmond archives.
- Goodfriend, Marvin. “Why We Need an ‘Accord’ for Federal Reserve Credit Policy,” *Journal of Money, Credit, and Banking*, vol. 26 (August 1994), pp. 572–80.
- , and Robert G. King. “Financial Deregulation, Monetary Policy, and Central Banking,” Federal Reserve Bank of Richmond *Economic Review*, vol. 74 (May/June 1988), pp. 3–22.
- Roosa, Robert V. *The Dollar and World Liquidity*. New York: Random House, 1967.
- Shultz, George P., and Kenneth Dam. *Economic Policy Beyond the Headlines*. New York: W. W. Norton & Company, 1978.
- Solomon, Robert. *The International Monetary System, 1945–1981*. New York: Harper & Row, 1982.
- “Swap Arrangements between the System and Foreign Central Banks, 1962–1963.” Federal Reserve Bank of Richmond archives.

- Todd, Walker F. "Disorderly Markets: The Law, History, and Economics of the Exchange Stabilization Fund and U.S. Foreign Exchange Market Intervention," in George G. Kaufman, ed., *Research in Financial Services: Private and Public Policy*, Vol. 4. Greenwich, Conn.: JAI Press, 1992.
- _____. "Disorderly Markets: A Fresh Look at the Law, History, and Economics of the Exchange Stabilization Fund (ESF) and United States Foreign Exchange Market Intervention." Mimeo, Federal Reserve Bank of Cleveland, February 1, 1991.
- U.S. Congress, House of Representatives, Committee on Banking and Currency. "Bretton Woods Agreements Act Amendment." Hearings, 87 Cong. 2 Sess. Washington: Government Printing Office, 1962.
- U.S. Treasury. "Treasury Experience in the Foreign Exchange Markets." Treasury memorandum, February 9, 1962a.
- _____. "Treasury Memorandum on Treasury and Federal Reserve Foreign Currency Operations and Policies—Relationships and Coordination," February 6, 1962b.
- _____. *Annual Report*, 1961 and 1963.
- Willis, H. Parker. *Federal Reserve Banking Practice*. New York: D. Appleton and Company, 1926.
- Young, Ralph A. "Rationale of the System's Swap Arrangements." Board of Governors memorandum, October 17, 1963.
- _____. "Federal Reserve Holdings of Foreign Currencies." Board of Governors memorandum, June 26, 1961.

Limits on Interest Rate Rules in the IS Model

William Kerr and Robert G. King

Many central banks have long used a short-term nominal interest rate as the main instrument through which monetary policy actions are implemented. Some monetary authorities have even viewed their main job as managing nominal interest rates, by using an interest rate rule for monetary policy. It is therefore important to understand the consequences of such monetary policies for the behavior of aggregate economic activity.

Over the past several decades, accordingly, there has been a substantial amount of research on interest rate rules.¹ This literature finds that the feasibility and desirability of interest rate rules depends on the structure of the model used to approximate macroeconomic reality. In the standard textbook Keynesian macroeconomic model, there are few limits: almost any interest rate

■ Kerr is a recent graduate of the University of Virginia, with bachelor's degrees in system engineering and economics. King is A. W. Robertson Professor of Economics at the University of Virginia, consultant to the research department of the Federal Reserve Bank of Richmond, and a research associate of the National Bureau of Economic Research. The authors have received substantial help on this article from Justin Fang of the University of Pennsylvania. The specific expectational IS schedule used in this article was suggested by Bennett McCallum (1995). We thank Ben Bernanke, Michael Dotsey, Marvin Goodfriend, Thomas Humphrey, Jeffrey Lacker, Eric Leeper, Bennett McCallum, Michael Woodford, and seminar participants at the Federal Reserve Banks of Philadelphia and Richmond for helpful comments. The views expressed are those of the authors and do not necessarily reflect those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

¹ This literature is voluminous, but may be usefully divided into four main groups. First, there is work with small analytical models with an "IS-LM" structure, including Sargent and Wallace (1975), McCallum (1981), Goodfriend (1987), and Boyd and Dotsey (1994). Second, there are simulation studies of econometric models, including the Henderson and McKibbin (1993) and Taylor (1993) work with larger models and the Fuhrer and Moore (1995) work with a smaller one. Third, there are theoretical analyses of dynamic optimizing models, including work by Leeper (1991), Sims (1994), and Woodford (1994). Finally, there are also some simulation studies of dynamic optimizing models, including work by Kim (1996).

policy can be used, including some that make the interest rate exogenously determined by the monetary authority. In fully articulated macroeconomic models in which agents have dynamic choice problems and rational expectations, there are much more stringent limits on interest rate rules. Most basically, if it is assumed that the monetary policy authority attempts to set the nominal interest rate without reference to the state of the economy, then it may be impossible for a researcher to determine a unique macroeconomic equilibrium within his model.

Why are such sharply different answers about the limits to interest rate rules given by these two model-building approaches? It is hard to reach an answer to this question in part because the modeling strategies are themselves so sharply different. The standard textbook model contains a small number of behavioral relations—an IS schedule, an LM schedule, a Phillips curve or aggregate supply schedule, etc.—that are directly specified. The standard fully articulated model contains a much larger number of relations—efficiency conditions of firms and households, resource constraints, etc.—that implicitly restrict the economy's equilibrium. Thus, for example, in a fully articulated model, the IS schedule is not directly specified. Rather, it is an outcome of the consumption-savings decisions of households, the investment decisions of firms, and the aggregate constraint on sources and uses of output.

Accordingly, in this article, we employ a series of macroeconomic models to shed light on how aspects of model structure influence the limits on interest rate rules. In particular, we show that a simple respecification of the IS schedule, which we call the expectational IS schedule, makes the textbook model generate the same limits on interest rate rules as the fully articulated models. We then use this simple model to study the design of interest rate rules with nominal anchors.² If the monetary authority adjusts the interest rate in response to deviations of the price level from a target path, then there is a unique equilibrium under a wide range of parameter choices: all that is required is that the authority raise the nominal rate when the price level is above the target path and lower it when the price level is below the target path. By contrast, if the monetary authority responds to deviations of the inflation rate from a target path, then a much more aggressive pattern is needed: the monetary authority must make the nominal rate rise by more than one-for-one with the inflation rate.³ Our results on interest rate rules with nominal anchors are preserved when we further extend the model to include the influence of expectations on aggregate supply.

² An important recent strain of literature concerns the interaction of monetary policy and fiscal policy when the central bank is following an interest rate rule, including work by Leeper (1991), Sims (1994) and Woodford (1994). The current article abstracts from consideration of fiscal policy.

³ Our results are broadly in accord with those of Leeper (1991) in a fully articulated model.

1. INTEREST RATE RULES IN THE TEXTBOOK MODEL

In the textbook IS-LM model with a fixed price level, it is easy to implement monetary policy by use of an interest rate instrument and, indeed, with a pure interest rate rule which specifies the actions of the monetary authority entirely in terms of the interest rate. Under such a rule, the monetary sector simply serves to determine the quantity of nominal money, given the interest rate determined by the monetary authority and the level of output determined by macroeconomic equilibrium. Accordingly, as in the title of this article, one may describe the analysis as being conducted within the “IS model” rather than in the “IS-LM model.”

In this section, we first study the fixed-price IS model’s operation under a simple interest rate rule and rederive the familiar result discussed above. We then extend the IS model to consider sustained inflation by adding a Phillips curve and a Fisher equation. Our main finding carries over to the extended model: in versions of the textbook model, pure interest rate rules are admissible descriptions of monetary policy.

Specification of a Pure Interest Rate Rule

We assume that the “pure interest rate rule” for monetary policy takes the form

$$R_t = \underline{R} + x_t, \quad (1)$$

where the nominal interest rate R_t contains a constant average level \underline{R} . (Throughout the article, we use a subscript t to denote the level of the variable at date t of our discrete time analysis and an underbar to denote the level of the variable in the initial stationary position). There are also exogenous stochastic components to interest rate policy, x_t , that evolve according to

$$x_t = \rho x_{t-1} + \varepsilon_t, \quad (2)$$

with ε_t being a series of independently and identically distributed random variables and ρ being a parameter that governs the persistence of the stochastic components of monetary policy. Such pure interest rate rules contrast with alternative interest rate rules in which the level of the nominal interest rate depends on the current state of the economy, as considered, for example, by Poole (1970) and McCallum (1981).

The Standard IS Curve and the Determination of Output

In many discussions concerning the influence of monetary disturbances on real activity, particularly over short periods, it is conventional to view output as determined by aggregate demand and the price level as predetermined. In such discussions, aggregate demand is governed by specifications closely related to the standard IS function used in this article,

$$y_t - \underline{y} = -s[r_t - \underline{r}], \quad (3)$$

where y denotes the log-level of output and r denotes the real rate of interest. The parameter s governs the slope of the IS schedule as conventionally drawn in (y, r) space: the slope is s^{-1} so that a larger value of s corresponds to a flatter IS curve. It is conventional to view the IS curve as fairly steep (small s), so that large changes in real interest rates are necessary to produce relatively small changes in real output.

With fixed prices, as in the famous model of Hicks (1937), nominal and real interest rates are the same ($R_t = r_t$). Thus, one can use the interest rate rule and the IS curve to determine real activity. Algebraically, the result is

$$y_t - \underline{y} = -s[(\underline{R} - \underline{r}) + x_t]. \quad (4)$$

A higher rate of interest leads to a decline in the level of output with an “interest rate multiplier” of s .⁴

Poole (1970) studies the optimal choice of the monetary policy instrument in an IS-LM framework with a fixed price level; he finds that it is optimal for the monetary authority to use an interest rate instrument if there are predominant shocks to money demand. Given that many central bankers perceive great instability in money demand, Poole’s analytical result is frequently used to buttress arguments for casting monetary policy in terms of pure interest rate rules. From this standpoint it is notable that in the model of this section—which we view as an abstraction of a way in which monetary policy is frequently discussed—the monetary sector is an afterthought to monetary policy analysis. The familiar “LM” schedule, which we have not as yet specified, serves only to determine the quantity of money given the price level, real income, and the nominal interest rate.

Inflation and Inflationary Expectations

During the 1950s and 1960s, the simple IS model proved inappropriate for thinking about sustained inflation, so the modern textbook presentation now includes additional features. First, a Phillips curve (or aggregate supply schedule) is introduced that makes inflation depend on the gap between actual and capacity output. We write this specification as

$$\pi_t = \psi(y_t - \underline{y}), \quad (5)$$

where the inflation rate π is defined as the change in log price level, $\pi_t \equiv P_t - P_{t-1}$. The parameter ψ governs the amount of inflation (π) that arises from a given level of excess demand. Second, the Fisher equation is used to describe the relationship between the real interest rate (r_t) and the nominal interest rate (R_t),

$$R_t = r_t + E_t \pi_{t+1}, \quad (6)$$

⁴ Many macroeconomists would prefer a long-term interest rate in the IS curve, rather than a short-term one, but we are concentrating on developing the textbook model in which this distinction is seldom made explicit.

where the expected rate of inflation is $E_t\pi_{t+1}$. Throughout the article, we use the notation $E_t z_{t+s}$ to denote the date t expectation of any variable z at date $t + s$.

To study the effects of these two modifications for the determination of output, we must solve for a reduced form (general equilibrium) equation that describes the links between output, expected future output, and the nominal interest rate. Closely related to the standard IS schedule, this specification is

$$y_t - \underline{y} = -s[(\underline{R} - \underline{r}) + x_t] + s\psi[E_t y_{t+1} - \underline{y}]. \quad (7)$$

This general equilibrium locus implies that there is a difference between temporary and permanent variations in interest rates. Holding $E_t y_{t+1}$ constant at \underline{y} , as is appropriate for temporary variations, we have the standard IS curve determination of output as above. With $E_t y_{t+1} = y_t$, which is appropriate for permanent disturbances, an alternative general equilibrium schedule arises which is “flatter” in (y, R) space than the conventional specification. This “flattening” reflects the following chain of effects. When variations in output are expected to occur in the future, they will be accompanied by inflation because of the positive Phillips curve link between inflation and output. With the consequent higher expected inflation at date t , the real interest rate will be lower and aggregate demand will be higher at a particular nominal interest rate.

Thus, “policy multipliers” depend on what one assumes about the adjustment of inflation expectations. If expectations do not adjust, the effects of increasing the nominal interest rate are given by $\frac{\Delta y}{\Delta R} = -s$ and $\frac{\Delta \pi}{\Delta R} = -s\psi$, whereas the effects if expectations do adjust are $\frac{\Delta y}{\Delta R} = -s/[1 - s\psi]$ and $\frac{\Delta \pi}{\Delta R} = -s\psi/[1 - s\psi]$. At the short-run horizons that the IS model is usually thought of as describing best, the conventional view is that there is a steep IS curve (small s) and a flat Phillips curve (small ψ) so that the denominator of the preceding expressions is positive. Notably, then, the output and inflation effects of a change in the interest rate are of larger magnitude if there is an adjustment of expectations than if there is not. For example, a rise in the nominal interest rate reduces output and inflation directly. If the interest rate change is permanent (or at least highly persistent), the resulting deflation will come to be expected, which in turn further raises the real interest rate and reduces the level of output.

There are two additional points that are worth making about this extended model. First, when the Phillips curve and Fisher equations are added to the basic Keynesian setup, one continues to have a model in which the monetary sector is an afterthought. Under an interest rate policy, one can use the LM equation to determine the effects of policy changes on the stock of money, but one need not employ it for any other purpose. Second, higher nominal interest rates lead to higher real interest rates, even in the long run. In fact, because there is expected deflation which arises from a permanent increase in

the nominal interest rate, the real interest rate rises by more than one-for-one with the nominal rate.⁵

Rational Expectations in the Textbook Model

There has been much controversy surrounding the introduction of rational expectations into macroeconomic models. However, in this section, we find that there are relatively minor qualitative implications within the model that has been developed so far. In particular, a monetary authority can conduct an unrestricted pure interest rate policy so long as we have the conventional parameter values implying $s\psi < 1$. In the rational expectations solution, output and inflation depend on the entire expected future path of the policy-determined nominal interest rate, but there is a “discounting” of sorts which makes far-future values less important than near-future ones.

To determine the rational expectations solution for the standard Keynesian model that incorporates an IS curve (3), a Phillips curve (5), and the Fisher equation (6), we solve these three equations to produce an expectational difference equation in the inflation rate,

$$\pi_t = -s\psi[(R_t - r) - E_t\pi_{t+1}], \quad (8)$$

which links the current inflation rate π_t to the current nominal interest rate and the expected future inflation rate.⁶ Substituting out for π_{t+1} using an updated version of this expression, we are led to a forward-looking description of current inflation as related to the expected future path of interest rates and a future value of the inflation rate,

$$\begin{aligned} \pi_t = & -s\psi(R_t - r) - (s\psi)^2 E_t(R_{t+1} - r) \dots \\ & - (s\psi)^n E_t(R_{t+n-1} - r) + (s\psi)^n E_t\pi_{t+n}. \end{aligned} \quad (9)$$

For short-run analysis, the conventional assumption is that there is a steep IS curve (small s) because goods demand is not too sensitive to interest rates and a flat Phillips curve (small ψ) because prices are not too responsive to aggregate demand. Taken together, these conditions imply that $s\psi < 1$ and that there is substantial “discounting” of future interest rate variations and of the “terminal inflation rate” $E_t\pi_{t+n}$: the values of the exogenous variable R and endogenous variable π that are far away matter much less than those nearby. In particular, as we look further and further out into the future, the value of long-term inflation, $E_t\pi_{t+n}$, exerts a less and less important influence on current inflation.

⁵ This implication is not a particularly desirable one empirically, and it is one of the factors that leads us to develop the models in subsequent sections.

⁶ Alternatively, we could have worked with the difference equation in output (7), since the Phillips curve links output and inflation, but (8) will be more useful to us later when we modify our models to include price level and inflation targets.

Using this conventional set of parameter values and making the standard rational expectations solution assumption that the inflation process does not contain explosive “bubble components,” the monetary authority can employ any pure nominal interest rate rule.⁷ Using the assumed form of the pure interest rate policy rule, (1) and (2), the inflation rate is

$$\pi_t = -s\psi \left[\frac{1}{1-s\psi} (\underline{R} - \underline{r}) + \frac{1}{1-s\psi} x_t \right]. \quad (10)$$

Thus, a solution exists for a wide range of persistence parameters in the policy rule (all $\rho < (s\psi)^{-1}$). Notably, it exists for $\rho = 1$, in which variations in the random component of interest rates are permanent and the “policy multipliers” are equal to those discussed in the previous subsection.⁸

2. EXPECTATIONS AND THE IS SCHEDULE

Developments in macroeconomics over the last two decades suggest the importance of modifying the IS schedule to include a dependence of current output on expected future output. In this section, we introduce such an “expectational IS schedule” into the model and find that there are important limits on interest rate rules. We conclude that one *cannot* or *should not* use a pure interest rate rule, i.e., one without a response to the state of the economy.

Modifying the IS Schedule

Recent work on consumption and investment choices by purposeful firms and households suggests that forecasts of the future enter importantly into these decisions. These theories suggest that the conventional IS schedule (3) should be replaced by an alternative, expectational IS schedule (EIS schedule) of the form

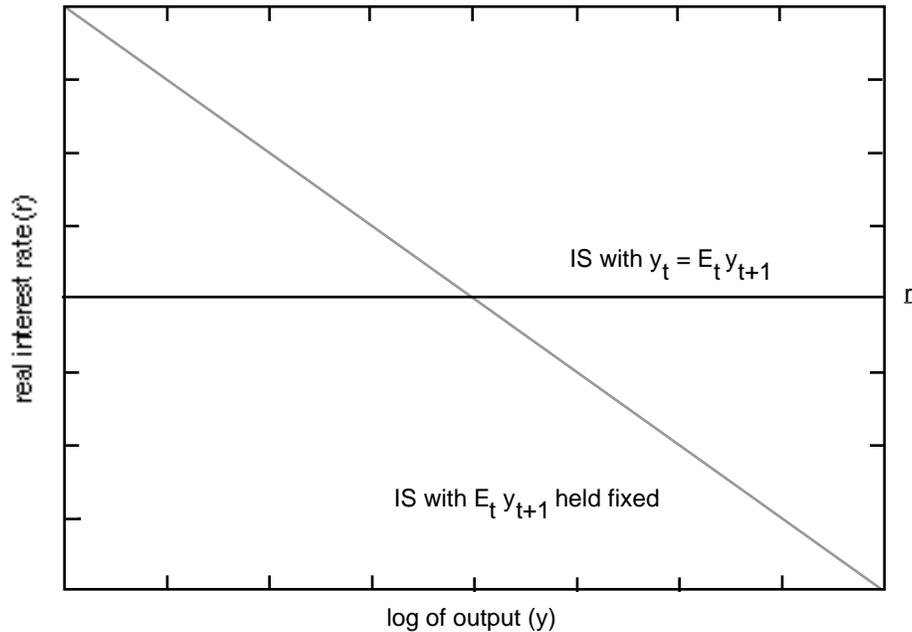
$$y_t - E_t y_{t+1} = -s(r_t - \underline{r}). \quad (11)$$

Figure 1 draws this schedule in (y, r) space, i.e., we graph

$$r_t = \underline{r} - \frac{1}{s}(y_t - E_t y_{t+1}).$$

⁷ More precisely, we require that the policy rule must result in a finite inflation rate, i.e., $|\pi_t| = |s\psi [\sum_{j=0}^{\infty} (s\psi)^j E_t(R_{t+j} - \underline{r})]| < \infty$. Since $s\psi < 1$, this requirement is consistent with a wide class of driving processes as discussed in the appendix.

⁸ With $s\psi \geq 1$, there is a very different situation, as we can see from looking at (9): future interest rates are more important than the current interest rate, and the terminal rate of inflation exerts a major influence on current inflation. Long-term expectations hence play a very important role in the determination of current inflation. In this situation, there is substantial controversy about the existence and uniqueness of a rational expectations equilibrium, which we survey in the appendix and discuss further in the next section of the article.

Figure 1 The Expectational IS Schedule

In this figure, expectations about future output are an important shift factor in the position of the conventionally defined IS schedule.

The expectational IS schedule thus emphasizes the distinction between temporary and permanent movements in real output for the level of the real interest rate. If a disturbance is temporary (so that we hold expected future output constant, say at $E_t y_{t+1} = \underline{y}$), then the linkage between the real rate and output is identical to that indicated by the conventional IS schedule of the previous section. However, if variations in output are expected to be permanent, with $E_t y_{t+1} = y_t$, then the IS schedule is effectively horizontal, i.e., $r_t = \bar{r}$ is compatible with any level of output. Thus, the EIS schedule is compatible with the traditional view that there is little long-run relationship between the level of the real interest rate and the level of real activity. It is also consistent with Friedman's (1968a) suggestion that there is a natural real rate of interest (\bar{r}) which places constraints on the policies that a monetary authority may pursue.⁹

⁹ In this sense, it is consistent with the long-run restrictions frequently built into real business cycle models and other modern, quantitative business cycle models that have temporary monetary nonneutralities (as surveyed in King and Watson [1996]).

To think about why this specification is a plausible one, let us begin with consumption, which is the major component of aggregate demand (roughly two-thirds in the United States). The modern literature on consumption derives from Friedman's (1957) construction of the "permanent income" model, which stresses the role of expected future income in consumption decisions. More specifically, modern consumption theory employs an Euler equation which may be written as

$$\sigma(E_t c_{t+1} - c_t) = (r_t - \underline{r}), \quad (12)$$

where c is the logarithm of consumption at date t , and σ is the elasticity of marginal utility of a representative consumer.¹⁰ Thus, for the consumption part of aggregate demand, modern macroeconomic theory suggests a specification that links the *change* in consumption to the real interest rate, not one that links the level of consumption to the real interest rate. McCallum (1995) suggests that (12) rationalizes the use of (11). He also indicates that the incorporation of government purchases of goods and services would simply involve a shift-term in this expression.

Investment is another major component of aggregate demand, which can also lead to an expectational IS specification in the following way.¹¹ For example, consider a firm with a constant-returns-to-scale production function, whose level of output is thus determined by the demand for its product. If the desired capital-output ratio is relatively constant over time, then variations in investment are also governed by anticipated changes in output. Thus, consumption and investment theory suggest the importance of including expected future output as a positive determinant of aggregate demand. We will consequently employ the expectational IS function as a stand-in for a more complete specification of dynamic consumption and investment choice.

Implications for Pure Interest Rate Rules

There are striking implications of this modification for the nature of output and interest rate linkages or, equivalently, inflation and interest rate linkages. Combining the expectational IS schedule (11), the Phillips curve (5), and the Fisher equation (6), we obtain

$$y_t - \underline{y} = -s[(\underline{R} - \underline{r}) + x_t] + (1 + s\psi)(E_t y_{t+1} - \underline{y}). \quad (13)$$

The key point is that expected future output has a greater than one-for-one effect on current output independent of the values of the parameters s and ψ .

¹⁰ See the surveys by Hall (1989) and Abel (1990) for overviews of the modern approach to consumption. In these settings, the natural real interest rate, \underline{r} , would be determined by the rate of time preference, the real growth rate of the economy, and the extent of intertemporal substitutions.

¹¹ In critiquing the traditional IS-LM model, King (1993) argues that a forward-looking rational expectations investment accelerator is a major feature of modern quantitative macroeconomic models that is left out of the traditional IS specification.

This restriction to a greater than one-for-one effect is sharply different from that which derives from the traditional IS model and the Fisher equation, i.e., from the less than one-for-one effect found in (7) above.

One way of summarizing this change is by saying that the general equilibrium locus governing *permanent variations* in output and the real interest rate becomes upward-sloping in (y, R) space, not downward-sloping. Thus, when we assume that $E_t y_{t+1} = \underline{y}$, we have the conventional linkage from the nominal rate to output. However, when we assume that $E_t y_{t+1} = y_t$, then we find that there is a positive, rather than negative, linkage. Interpreted in this manner, (13) indicates that a permanent lowering of the nominal interest rate will give rise to a permanent decline in the level of output. This reversal of sign involves two structural elements: (i) the horizontal “long-run” IS specification of Figure 1 and (ii) the positive dependence on expected future output that derives from the combination of the Phillips curve and the Fisher equation.

The central challenge for our analysis is that this model’s version of the general equilibrium under an interest rate rule obeys the unconventional case for rational expectations theory that we described in the previous section, irrespective of our stance on parameter values. The reduced-form inflation equation for our economy, which is similar to (8), may be readily derived as¹²

$$(1 + s\psi)E_t\pi_{t+1} - \pi_t = s\psi(R_t - \underline{r}) = s\psi[(\underline{R} - \underline{r}) + x_t]. \quad (14)$$

Based on our earlier discussion and the internal logic of rational expectations models, it is natural to iterate this expression forward. When we do so, we find that

$$\begin{aligned} \pi_t = & -s\psi[(R_t - \underline{r}) + (1 + s\psi)E_t(R_{t+1} - \underline{r}) + \dots \\ & + (1 + s\psi)^n E_t(R_{t+n} - \underline{r})] + (1 + s\psi)^{n+1} E_t\pi_{t+n+1}. \end{aligned} \quad (15)$$

As we look further and further out into the future, the value of long-term inflation, $E_t\pi_{t+n+1}$, exerts a more and more important influence on current inflation. With the EIS function, therefore, it is always the case that there is an important dependence of current outcomes on long-term expectations. One interpretation of this is that public confidence about the long-run path of inflation is very important for the short-run behavior of inflation.

Macroeconomic theorists who have considered the solution of rational expectations models in this situation have not reached a consensus on how to proceed. One direction is provided by McCallum (1983), who recommends

¹² The ingredients of this derivation are as follows. The Phillips curve specification of our economy states that $\pi_t = \psi(y_t - \underline{y})$. Updating this expression and taking additional expectations, we find that $E_t\pi_{t+1} = \psi(E_t y_{t+1} - \underline{y})$. Combining these two expressions with the expectational IS function (11), we find that $E_t\pi_{t+1} - \pi_t = \psi(E_t y_{t+1} - y_t) = s\psi(r_t - \underline{r})$. Using the Fisher equation together with this result, we find the result reported in the text.

forward-looking solutions which emphasize fundamentals in ways that are similar to the standard solution of the previous section. Another direction is provided by the work of Farmer (1991) and Woodford (1986), which recommends the use of a backward-looking form. These authors stress that such solutions may also include the influences of nonfundamental shocks. In the appendix, we discuss the technical aspects of these alternative approaches in more detail, but we focus here on the key features that are relevant to thinking about limits on interest rate rules. We find that the forward-looking approach suggests that no stable equilibrium exists if the interest rate is held fixed at an arbitrary value or governed by a pure rule. We also find that the backward-looking approach suggests that many stable equilibria exist, including some in which nonfundamental sources of uncertainty influence macroeconomic activity.

Forward-Looking Equilibria

One important class of rational expectations equilibrium solutions stresses the forward-looking nature of expectations, so that it can be viewed as an extension of the solutions considered in the previous section. These solutions depend on the “fundamental” driving processes, which in our case come from the interest rate rule. McCallum (1983) has proposed that macroeconomists focus on such solutions; he also explains that these are “minimum state variable” or “bubble free” solutions to (14) and provides an algorithm for finding these solutions in a class of macroeconomic models.

In this case, the inflation solution depends only on the current interest rate under the policy rule (1) and (2). To obtain an empirically useful solution using this method, we must circumscribe the interest rate rule so that the limiting sum in the solution for the inflation rate in (15) is finite as we look further and further ahead.¹³ In the current context, this means that the monetary authority must (i) equate the nominal and real interest rate on average (setting $\bar{R} - \bar{r} = 0$ in (10) and (ii) substantially restrict the amount of persistence (requiring $\rho < (1 + s\psi)^{-1}$). These two conditions can be understood if we return to (15), which requires that $\pi_t = -s\psi[(R_t - \bar{r}) + \dots + (1 + s\psi)^n E_t(R_{t+n} - \bar{r})] + (1 + s\psi)^{n+1} E_t \pi_{t+n+1}$. First, the average long-run value of inflation must be zero or otherwise the terms like $(1 + s\psi)^{n+1} E_t \pi_{t+n+1}$ will cause the current inflation rate to be positive or negative infinity. Second, the stochastic variations in the interest rate must be sufficiently temporary that there is a finite sum $(R_t - \bar{r}) + (1 + s\psi)E_t(R_{t+1} - \bar{r}) + \dots + (1 + s\psi)^n E_t(R_{t+n} - \bar{r}) = x_t + (1 + s\psi)\rho x_t + \dots + (1 + s\psi)^n \rho^n x_t$ as n is made arbitrarily large.

How do these requirements translate into restrictions on interest rate rules in practice? Our view is that the second of these requirements is not too important, since there will always be finite inflation rate equilibria for any finite-order

¹³ Flood and Garber (1980) call this condition “process consistency.”

moving-average process. (As explained further in the appendix, such solutions always exist because the limiting sum is always finite if one looks only a finite number of periods ahead). However, we think that the first requirement (that $\bar{R} - \bar{r} = 0$) is much more problematic: it means that the average expected inflation rate must be zero. This requirement constitutes a strong limitation on pure interest rate rules. Further, it is implausible to us that a monetary authority could actually satisfy this condition, given the uncertainty that is attached to the level of \bar{r} .¹⁴ If the condition is not satisfied, however, there does not exist a rational expectations equilibrium under an interest rate rule if one restricts attention to minimum state variable equilibria.

Backward-Looking Equilibria

Other macroeconomists like Farmer (1991) and Woodford (1986) have argued that (14) leads to empirically interesting solutions in which inflation depends on nonfundamental factors, such as sunspots, but does so in a stationary manner. In particular, working along the lines of these authors, we find that any inflation process of the form

$$\pi_t = \left(\frac{1}{1 + s\psi} \right) \pi_{t-1} + \left(\frac{s\psi}{1 + s\psi} \right) (R_{t-1} - \bar{r}) + \zeta_t \quad (16)$$

is a rational expectations equilibrium consistent with (14).¹⁵ In this expression, ζ_t is an arbitrary random variable that is unpredictable using date $t - 1$ information. Such a “backward-looking” solution is generally nonexplosive, and interest rates are a stationary stochastic process.¹⁶

There are three points to be made about such equilibria. First, there may be a very different linkage from interest rates to inflation and output in such equilibria than suggested by the standard IS model of Section 1. A change in the nominal interest rate at date t will have no effect on inflation and output at date t if it does not alter ζ_t : inflation may be predetermined relative to interest rate policy rather than responding immediately to it. Second, a permanent increase in the nominal interest rate at date t will lead ultimately to a permanent *increase* in inflation and output, rather than to the decrease described in the

¹⁴ One measure of this uncertainty is provided by the controversy over Fama’s (1975) test of the link between inflation and nominal interest rates, which assumed that the ex ante real interest rate was constant. In a critique of Fama’s analysis, Nelson and Schwert (1977) argued compellingly that there was sufficient unforecastable variability in inflation that it was impossible to tell from a lengthy data set whether the real rate was constant or evolved according to a random walk.

¹⁵ It can be confirmed that this is a rational expectations solution by simply updating it one period and taking conditional expectations, a process which results in (8).

¹⁶ By *generally*, we mean that it is stationary as long as we assume that $s\psi > 0$, as used throughout this paper.

previous section of the article.¹⁷ Third, if there are effects of interest rate changes on output and inflation within a period, then these may be completely unpredictable to the monetary authority since ζ_t is arbitrary: ζ_t can therefore depend on $R_t - E_{t-1}R_t$. We could, for example, see outcomes which took the form

$$\pi_t = \left(\frac{1}{1 + s\psi} \right) \pi_{t-1} + \left(\frac{s\psi}{1 + s\psi} \right) (R_{t-1} - \underline{r}) + \zeta_t (R_t - E_{t-1}R_t),$$

so that the short-term relationship between inflation (output) and interest rate shocks was random in magnitude and sign.

Combining the Cases: Limits on Pure Interest Rate Rules

Thus, depending on what one admits as a rational expectations equilibrium in this case, there may be very different outcomes; but either case suggests important limits on pure interest rate rules.

With forward-looking equilibria that depend entirely on fundamentals, there may well be no equilibrium for pure interest rate rules, since it is implausible that the monetary authority can exactly maintain a zero gap between the average nominal rate and the average real rate ($\underline{R} - \underline{r} = 0$) due to uncertainty about \underline{r} . However, if one can maintain this zero gap, there are some additional limits on the driving processes for autonomous interest rate movements. Thus, for the autoregressive case in (2), interest rate policies cannot be “too persistent” in the sense that we must require $\rho(1 + s\psi) < 1$.

With backward-looking equilibria, there is a bewildering array of possible outcomes. In some of these, inflation depends only on fundamentals, but the short-term relationship between inflation and interest rates is essentially arbitrary. In others, nonfundamental sources of uncertainty are important determinants of macroeconomic activity. If such an equilibrium were observed in an actual economy, then there would be a very firm basis for the monetarist claim that interest rate rules lead to excess volatility in macroeconomic activity, even though there would be a very different mechanism than the one that typically has been suggested. That is, the sequence of random shocks ζ_t amounts to an entirely avoidable set of shocks to real macroeconomic activity (since, via the Phillips curve, inflation and output are tightly linked, $\pi_t = \psi(y_t - \underline{y})$).¹⁸ While feasible, pure interest rate rules appear very undesirable in this situation.

Under either description of equilibrium, the limits on the feasibility and desirability of interest rate rules arise because individuals’ beliefs about

¹⁷ That is, there is a sense in which this Keynesian model produces neoclassical conclusions in response to interest rate shocks with a backward-looking equilibrium.

¹⁸ This policy effect is formally similar to one that Schmitt-Grohe and Uribe (1995) describe for balanced budget financing. Perhaps these changes in expectations could be the “inflation scares” that Goodfriend (1993) suggests are important determinants of macroeconomic activity during certain subperiods of the post-war interval.

long-term inflation receive very large weight in determination of the current price level. Inflation psychology exerts a dominant influence on actual inflation if a pure interest rate rule is used.

3. INTEREST RATE RULES WITH NOMINAL ANCHORS

In this section, building on the prior analyses of Parkin (1978) and McCallum (1981), we study the effects of appending a “nominal anchor” to the model of the previous section, which was comprised of the expectational IS specification, the Phillips curve, and the Fisher equation. Such policies can work to stabilize long-term expectations, eliminating the difficulties that we encountered above. We look at two rules that are policy-relevant alternatives in the United States and other countries.

The first of these rules, which we call *price-level targeting*, specifies that the monetary authority sets the interest rate so as to partially respond to deviations of the current price level from a target path \underline{P}_t , while retaining some independent variation in the interest rate x_t . We view the target price level path as having the form $\underline{P}_t = \underline{P}_0 + \underline{\pi}_t$, but more complicated stochastic versions are also possible. In this section, we shall view x_t as an arbitrary sequence of numbers and in later sections we will view it as a zero mean stochastic process. The interest rate rule therefore is written as

$$R_t = \underline{R} + f(P_t - \underline{P}_t) + x_t, \quad (17)$$

where the parameter f governs the extent to which the interest rate varies in response to deviations of the current price level from its target path.

The second of these rules, which we call *inflation targeting*, specifies that the monetary authority sets the interest rate so as to partially respond to deviations of the inflation rate from a target path $\underline{\pi}_t$, while retaining some independent variation in the interest rate. Algebraically, the rule is

$$R_t = \underline{R} + g(\pi_t - \underline{\pi}_t) + x_t. \quad (18)$$

We explore these target schemes for two reasons. First, they are relevant to current policy debate in the United States and other countries. Second, they each can be implemented without knowledge of the money demand function, just as pure interest rate rules could in the basic IS model.¹⁹

The difference between these two policies involves the extent of “base drift” in the nominal anchor, i.e., they differ in terms of whether the central

¹⁹ This latter rule is related to proposals by Taylor (1993). It is also close to (but not exactly equal to) the widely held view that the Federal Reserve must raise the real rate of interest in response to increases in inflation to maintain the target rate of inflation (such an alternative rule would be written as $R_t = \underline{R} + g(E_t\pi_{t+1} - \underline{\pi}) + x_t$).

bank is presumed to eliminate the effects of past gaps between the actual and the target price level.²⁰ In each case, for analytical simplicity, we assume that the central bank can observe the current price level without error at the time it sets the interest rate.

Inflation Targets with an Interest Rate Rule

It is relatively easy to use (14) to characterize the conditions under which an interest rate rule can implement an inflation target without introducing a multiplicity of equilibria. To analyze this case, we replace R_t in (14) with its value under the interest rate rule, which is $R_t = \underline{R} + g(\pi_t - \underline{\pi}) + x_t$. The result is

$$(1 + s\psi)E_t(\pi_{t+1} - \underline{\pi}) - (1 + s\psi g)(\pi_t - \underline{\pi}) = s\psi[x_t + (\underline{R} - \underline{\pi} - \underline{r})].$$

It is clear that there is a unique solution of the standard form if and only if $g > 1$. This solution is

$$\pi_t - \underline{\pi} = -\left(\frac{s\psi}{1 + s\psi g}\right) \left\{ \sum_{j=0}^{\infty} \left(\frac{1 + s\psi}{1 + s\psi g}\right)^j [E_t x_{t+j} + (\underline{R} - \underline{\pi} - \underline{r})] \right\}. \quad (19)$$

Thus, to have the inflation rate average to $\underline{\pi}$ we must impose $(\underline{R} - \underline{\pi} - \underline{r}) = 0$ and use the fact that the unconditional expected value of each of the terms $E_t x_{t+j}$ is zero. However, if the equilibrium real interest rate were unknown by the monetary authority, as is plausibly the case, then there would simply be an average rate of inflation that differed from the target level persistently. In particular and in contrast to the analysis of “pure” interest rate rules above, there would not be any difficulty with the existence of rational expectations equilibrium. That is, the form of the interest rate rule means that there is a “discounted” influence of future inflation in (19); the central bank has assured that the exact state of long-term inflation expectations is unimportant for current inflation by the form of its interest rate rule.²¹

Price-Level Targets with an Interest Rate Rule

There is a somewhat more complicated solution when an interest rate rule is used to target the price level. However, this solution embodies the very intuitive result that an interest rate rule leads to a conventional, unique, forward-looking

²⁰ In both of these policy rules, to make the solutions algebraically simple, we assume that $\underline{R} = \underline{r} + \underline{\pi}$. This does not correspond to an assumption that the central bank knows the real interest rate—it is only a normalization that serves to make the average and target inflation rates or price level paths coincide.

²¹ Interestingly, if one modifies the rule so that it is the expected rate of inflation that is targeted, $R_t = \underline{R} + g(E_t \pi_{t+1} - \underline{\pi}) + x_t$, then the same condition for a standard rational expectations equilibrium emerges, $g > 1$. It is also the case that $g > 1$ is the relevant condition for a model with flexible prices, which may be verified by combining the Fisher equation and the policy rule.

equilibrium so long as $f > 0$. More specifically, imposing $(\underline{R} - \underline{\pi} - \underline{r}) = 0$, we can show that the unique stable solution takes the form

$$P_t = \mu_1 P_{t-1} + \left(\frac{s\psi}{1 + s\psi} \right) \left\{ \sum_{j=0}^{\infty} \left(\frac{1}{\mu_2} \right)^{j+1} (f \underline{P}_{t+j} - E_t x_{t+j} - \underline{\pi}) \right\}, \quad (20)$$

where the μ parameters satisfy $\mu_1 < \frac{1}{(1+s\psi)}$ and $\mu_2 > 1$ if $f > 0$.²² The form of this solution is plausible, given the structure of the model. The past price level is important because this is a model with a Phillips curve, i.e., it is a sticky price solution. Expectations of a higher target price level path raise the current price level. Increases in the current or future autonomous component of the interest rate lower the current price level.

This simple and intuitive condition for price level determinacy prevails in all of the models studied analytically in this article and in many other simulation models that we have constructed. (For example, it is also the case that $f > 0$ is the relevant condition for a model with flexible prices, which may be verified by combining the Fisher equation and the policy rule as in Boyd and Dotsey [1994]). All the monetary authority needs to do to provide an anchor for expectations is to follow a policy of raising the nominal interest rate when the price level exceeds a target path.²³

4. EXPECTATIONS AND AGGREGATE SUPPLY

In this section, we consider the introduction of expectations into the aggregate supply side (or Phillips curve) of the model economy. Given the emphasis that macroeconomics has placed on the role of expectations on the aggregate supply side (or the “expectations adjustment” of the Phillips curve), this placement may seem curious. However, we have chosen it deliberately for two reasons, one historical and one expositional.

²² To reach this conclusion, we write the basic dynamic equation for the model (14) as

$$s\psi R_t + (1 + s\psi)\underline{\pi} = [(1 + s\psi)\mathbf{F} - 1][\mathbf{F} - 1]E_t P_{t-1}, \quad (21)$$

using the lead operator \mathbf{F} , defined so that $\mathbf{F}^n E_t x_{t+j} = E_t x_{t+j+n}$. Inspecting this expression, we see that the two roots of the polynomial $H(\mathbf{z}) = (1 + s\psi)[\mathbf{z} - \frac{1}{(1+s\psi)}][\mathbf{z} - 1]$ are 1 and $\frac{1}{(1+s\psi)}$. More generally, for any second order polynomial $H(\mathbf{z}) = A[\mathbf{z}^2 - S\mathbf{z} + P] = A(\mathbf{z} - \mu_1)(\mathbf{z} - \mu_2)$, the sum of the roots is S and the product of the roots is P . If there is a price level target in place, then we require $R_t = \underline{R} + f(P_t - \underline{P}_t) + x_t$, which alters the polynomial to $(1 + s\psi)[\mathbf{z} - \frac{1}{(1+s\psi)}][\mathbf{z} - 1] - f\mathbf{z}$, i.e., we perturb the sum, but not the product, of the roots. Accordingly, one root satisfies $\mu_1 < \frac{1}{(1+s\psi)}$ and the other satisfies $\mu_2 > 1$.

²³ This difference between price level and inflation rules is very suggestive. That is, by binding itself to a long-run path for the price level, the monetary authority appears to give itself a wider range of short-run policy options than if it seeks to target the inflation rate. We are currently using the models of this article and related fully articulated models to explore these connections in more detail.

We started our analysis of interest rate rules by studying the textbook IS-LM-PC model that became the workhorse of Keynesian macroeconomics during the early 1960s.²⁴ In the late 1960s, a series of studies by Milton Friedman suggested an alternative set of linkages to the IS-LM-PC model. First, Friedman (1968a) suggested that there was a “natural” real rate of interest that monetary policy cannot affect in the long run. He used this natural rate of interest to argue that the long-run effect of a sustained inflation due to a monetary expansion could not be that suggested by the Keynesian model discussed in Section 1 above, which associated a lower interest rate with higher inflation. Instead, he argued that the nominal interest rate had to rise one-for-one with sustained inflation and monetary expansion due to the natural real rate of interest. Friedman thus suggested that this natural rate of interest placed important limits on monetary policies. In Section 2 of the article, using a model with a natural rate of interest but with a long-run Phillips curve, we found such limits on interest rate rules. By focusing first on the role of expectations in aggregate demand (the IS curve), we made clear that the crucial ingredient to our case for limits on interest rate rules is the existence of a natural real rate of interest rather than information on the long-run slope of the Phillips curve.

Friedman (1968b) argued that a similar invariance of real economic activity to sustained inflation should hold, i.e., that there should be no long-run slope to the Phillips curve. He suggested this invariance resulted from the one-for-one long-run expected inflation on the wage and price determination that underlay the Phillips curve. We now discuss adding expectations in aggregate supply, working first with flexible price models and then with sticky price models.

Flexible Price Aggregate Supply Theory

In an influential study, Sargent and Wallace (1975) developed a log-linear model that embodied Friedman’s ideas and followed Lucas (1972) in assuming rational expectations. Essentially, Sargent and Wallace took the IS schedule and Fisher equation from the Keynesian model of Section 1, but introduced the following expectational Phillips curve:

$$\pi_t = \psi(y_t - \underline{y}) + E_{t-1}\pi_t. \quad (22)$$

Initial interest in the Sargent and Wallace (1975) study focused on a “policy irrelevance” implication of their work, which was that systematic monetary policy—cast in terms of rules governing the evolution of the stock of money—had no effect on the distribution of output. That conclusion is now understood

²⁴ Our model was somewhat simplified relative to the more elaborate dynamic versions of these models, in which lags of inflation were entered on the right-hand side of the inflation equation (5), perhaps as proxies for expected inflation.

to depend in delicate ways on the specification of the IS curve (3) and the Phillips curve (22), but it is not our focus here.

Another important aspect of the Sargent and Wallace study was their finding that there was nominal indeterminacy under a pure interest rate rule. To exposit this result, it is necessary to introduce a money demand function of the form used by Sargent and Wallace,

$$M_t^d - P_t = \delta y_t - \gamma R_t,$$

where M_t^d is the demand for nominal money, M_t .

Since nominal indeterminacy in the Sargent-Wallace model arises even if real output is constant, we may proceed as follows to determine the conditions under which such indeterminacy arises. First, we may take expectations at $t - 1$ of (22), yielding $E_{t-1}y_t = \underline{y}$. Second, using the standard IS function (3), we learn that this output neutrality result implies $E_{t-1}r_t = \underline{r}$, i.e., that the real interest rate is invariant to expected monetary policy. Third, the Fisher equation then implies that $E_{t-1}R_t = \underline{r} + E_{t-1}\pi_{t+1}$. Fourth, the pure interest rate rule implies that $E_{t-1}R_t = \underline{R} + E_{t-1}x_t$. Combining these last two equations, we find that expected inflation is well determined under an interest rate rule, $E_{t-1}\pi_{t+1} = (\underline{R} - \underline{r}) + E_{t-1}x_t$, but that there is nothing that determines the levels of money and prices, i.e., the money demand function determines the expected level of real balances, $E_{t-1}(M_t - P_t) = \delta \underline{y} - \gamma E_{t-1}R_t$, not the level of nominal money or prices.

It turns out that our two policy rules resolve this nominal indeterminacy under exactly the same parameter restrictions as are required to yield a determinate equilibrium in Section 3 above. For example, it is easy to see that the inflation rule, which implies that $E_{t-1}R_t = \underline{R} + g(E_{t-1}\pi_t - \underline{\pi}) + E_{t-1}x_t$, requires $g > 1$ if the implied dynamics of inflation $E_{t-1}\pi_{t+1} = (\underline{R} - \underline{r}) + g(E_{t-1}\pi_t - \underline{\pi}) + E_{t-1}x_t$ are to be determinate, which leads to a determinate price level. A similar line of argument may be used to show that $f > 0$ is the condition for determinacy with a price-level target.

Practical macroeconomists have frequently dismissed the Sargent and Wallace (1975) analysis of limits on interest rate rules because of its underlying assumption of complete price flexibility. However, as we have seen, conclusions concerning indeterminacy similar to those arising from the Sargent-Wallace model occur in natural rate models without price flexibility.²⁵

²⁵ From this perspective, the Sargent-Wallace analysis is of interest because there is a natural real rate of interest without an expectational IS schedule. Instead, the natural rate arises due to general equilibrium conditions. Limits to interest rate rules thus appear to arise in natural rate models, irrespective of whether these originate in the IS specification or as part of a complete general equilibrium model.

Sticky Price Aggregate Supply Theory

An alternative view of aggregate supply has been provided by New Keynesian macroeconomists. One of the most attractive and tractable representations is due to Calvo (1983) and Rotemberg (1982), who each derive the same aggregate price adjustment equation from different underlying assumptions about the costs of adjusting prices.²⁶ To summarize the results of this approach, we use the alternative expectations-augmented Phillips curve,

$$\pi_t = \beta E_t \pi_{t+1} + \psi(y_t - \underline{y}), \quad (23)$$

which is a suitable approximation for small average inflation rates. This relationship has a long-run trade-off between inflation and real activity, $\psi/(1 - \beta)$. Since the parameter β has the dimension of a real discount factor in this model, β is necessarily smaller than unity but not too much so, and the long-run inflation cost of greater output is very high. Thus, while the Calvo and Rotemberg specification is not quite as classical as that of Sargent and Wallace, in the long run it is still *very* classical relative to the naive Phillips curve that we employed above.

With the Calvo and Rotemberg specification of the expectations-augmented Phillips curve (23), the expectational IS function (11) and the Fisher equation (6), we can again show that there are limits to interest rate rules of exactly the form discussed earlier. Further, we can also show that the necessary structure of nominal anchors is $g > 1$ for inflation targets and $f > 0$ for price level targets.²⁷ That is, we again find that the monetary authority can anchor the economy by responding weakly to the deviations of the price level from a target path, but that much more aggressive responses to deviations of inflation from target are required.

5. SUMMARY AND CONCLUSIONS

In this article, we have studied limits on interest rate rules within a simple macroeconomic model that builds rational expectations into the IS schedule and the Phillips curve in ways suggested by recent developments in macroeconomics.

We began with a version of the standard fixed-price textbook model. Working within this setup in Section 1, we replicated two results found by many prior researchers. First, almost any interest rate rule can feasibly be employed:

²⁶ Calvo (1983) obtains this result for the aggregate price level in a setting where individual firms have an exogenous probability of being permitted to change their price in a given period. Rotemberg (1982) derives it for a setting in which the representative firm has quadratic costs of adjusting prices. Rotemberg (1987) discusses the observational equivalence of the two setups.

²⁷ The derivations are somewhat more tedious than those of the main text and are available on request from the authors.

there are essentially no limits on interest rate rules. In particular, we found that a central bank can even follow a “pure interest rate rule” in which there is no dependence of the interest rate on aggregate economic activity. Second, under this policy specification, the monetary equilibrium condition—the LM schedule of the traditional IS-LM structure—is unimportant for the behavior of the economy because an interest rate rule makes the quantity of money demand-determined. Accordingly, as suggested in the title of this article, we showed why many central bank and academic researchers have regarded the traditional framework essentially as an “IS model” when an interest rate rule is assumed to be used.

We then undertook two standard modifications of the textbook model so as to consider the consequences of sustained inflation. One was the addition of a Phillips curve mechanism, which specified a dependence of inflation on real activity. The other was the introduction of the distinction between real and nominal interest rates, i.e., a Fisher equation. Within such an extended model, we showed that there continued to be few limits on interest rate rules, even with rational expectations, as long as prices were assumed to adjust gradually and output was assumed to be demand-determined.

Our attention then shifted in Section 2 to alterations of the IS schedule, incorporating an influence of expectations of future output. To rationalize this “aggregate demand” modification, we appealed to modern consumption and investment theories—the permanent income hypothesis and the rational expectations accelerator model—which suggest that the standard IS schedule is badly misspecified. These theories predict a relationship between the expected growth rate of output (or aggregate demand) and the real interest rate, rather than a connection between the level of output and the real interest rate. (That is, the standard IS schedule will give the correct conclusions only if expected future output is unaffected by the shocks that impinge on the economy, which is a case of limited empirical relevance). We showed that such an “expectational IS schedule” places substantial limits on interest rate rules under rational expectations. These limits derive from a major influence of expected future policies on the present level of inflation and real activity. Analysis of this model consequently required us to discuss alternative solution methods for rational expectations models in some detail. We focused on the conditions under which such equilibria exist and are unique.

Depending on the equilibrium concept that one employs, pure interest rate rules are either infeasible or undesirable when there is an expectational IS schedule. If one follows McCallum (1983) in restricting attention to minimum state variable equilibria, in which only fundamentals drive inflation and real activity, then there is likely to be no equilibrium under a pure interest rate rule. Equilibria are unlikely to exist because existence requires that the pure interest rate make the (unconditional) expected value of the nominal rate and the expected value of the real rate coincide, i.e., that it make the unconditional

expected inflation rate zero. We find it implausible that any central bank could exactly satisfy this condition in practice. Alternatively, if one follows Farmer (1991) and Woodford (1986) in allowing a richer class of monetary equilibria, in which fundamental and nonfundamental sources of shocks can be relevant to inflation and real activity, then there are also major limits or, perhaps more accurately, drawbacks to conducting monetary policy via a pure interest rate rule. The short-term effects of changes in interest rates on macroeconomic activity were found to be of arbitrary sign (or zero); the longer term effects are of opposite sign to the predictions of the standard IS model.

In Section 3, we followed prior work by Parkin (1978), McCallum (1981), and others in studying interest rate rules that have a nominal anchor. First, we showed that a policy of targeting the price level can readily provide the nominal anchor that leads to a unique real equilibrium: there need only be modest increases in the nominal rate when the price level is above its target path. Second, we also showed that a policy of inflation targeting requires a much more aggressive response of nominal interest rates: a unique equilibrium requires that the nominal interest rate must increase by more than one percent when inflation exceeds the target path by one percent. Our focus on these two policy targeting schemes was motivated by their current policy relevance.

In Section 4, we added expectations to the aggregate supply side of the economy, proceeding according to two popular strategies. First, we considered the flexible price aggregate supply specification that Sargent and Wallace (1975) used to study interest rate rules. Second, we considered the sticky price model of Calvo (1983) and Rotemberg (1982). Both of these extended models required the same parameter restrictions on policy rules with nominal anchors as in the simpler model of Section 3, thus suggesting a robustness of our basic results on the limits to interest rate rules and on the admissible form of nominal anchors in the IS model.

Having learned about the limits on interest rate rules in some standard macroeconomic models, we are now working to learn more about the positive and normative implications of alternative feasible interest rate rules in small-scale rational expectations models. We are especially interested in contrasting the implications of rules that require a return to a long-run path for the price level (as with our simple price level targeting specification) with rules that allow the long-run price level to vary through time (as with our simple inflation targeting specifications).

APPENDIX

This appendix discusses issues that arise in the solution of linear rational expectations models, using as an example the first model studied in the main text. That model is comprised of a Phillips curve ($\pi_t = P_t - P_{t-1} = \psi(y_t - \underline{y})$), an IS function ($y_t - \underline{y} = -s(r_t - \underline{r})$), the Fisher equation ($r_t = R_t - E_t\pi_{t+1}$) and a pure interest rate rule for monetary policy ($R_t = \underline{R} + x_t$). Combining the expressions we find a basic expectational difference equation that governs the inflation rate,

$$\pi_t = \theta E_t \pi_{t+1} - \theta(\underline{R} - \underline{r} + x_t), \quad (24)$$

where we define $\theta = s\psi$ so as to simplify notation in this discussion. Iterating this expression forward, we find that

$$\pi_t = - \left\{ \sum_{j=0}^{J-1} \theta^{j+1} E_t [\underline{R} - \underline{r} + x_{t+j}] \right\} + \theta^J E_t \pi_{t+J}. \quad (25)$$

Our analysis will focus on the important special case in which

$$x_t = \rho x_{t-1} + \varepsilon_t, \quad (26)$$

where ε is a serially uncorrelated random variable, but we will also discuss some additional specifications.²⁸

The Standard Case

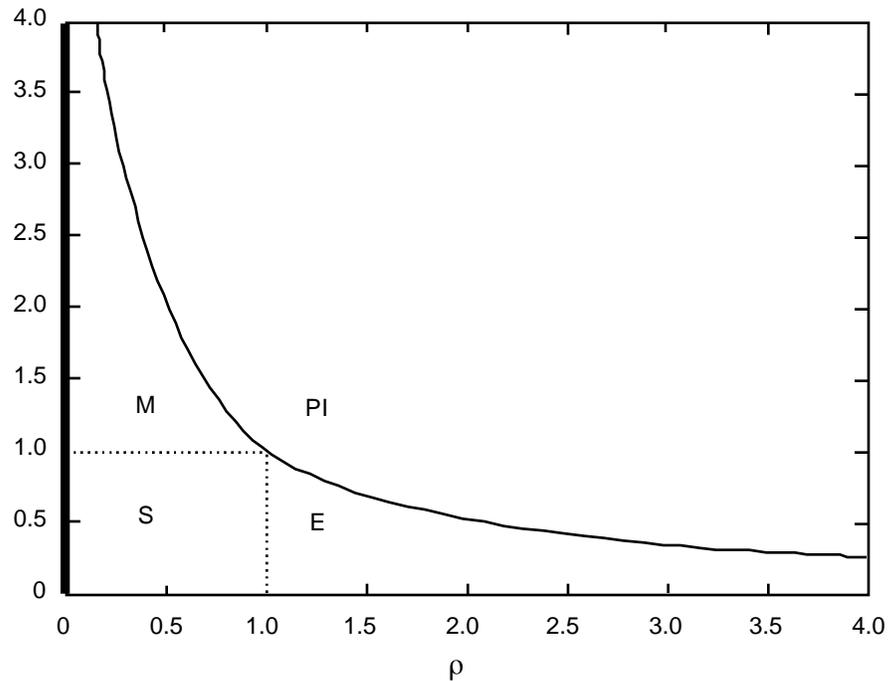
The standard case explored in the literature involves the assumption that $\theta < 1$ and $\rho < 1$. Then, the policy rule implies that the interest rate is a stationary stochastic process and it is natural to look for inflation solutions that are also stationary stochastic processes. It is also natural to take the limit as $J \rightarrow \infty$ in (25), drop the last term, and write the result as

$$\pi_t = - \left\{ \sum_{j=0}^{\infty} \theta^{j+1} E_t [\underline{R} - \underline{r} + x_{t+j}] \right\}. \quad (27)$$

Figure A1 indicates the region that is covered by this standard case. Under the driving process (26), it follows that the stationary solution is one reported many times in the literature:

$$\pi_t = - \left\{ \frac{\theta}{1-\theta} [\underline{R} - \underline{r}] + \frac{\theta}{1-\theta\rho} x_t \right\}. \quad (28)$$

²⁸ If we write a general autoregressive driving process as $x_t = \rho v_t$ and $v_t = \sum_{j=0}^J \rho_j v_{t-j} + \varepsilon_t$, then one can always (i) cast this in first-order autoregressive form and (ii) undertake a canonical variables decomposition of the resulting first-order system. Then, each of the canonical variables will evolve according to specifications like those in (26) so that the issues considered in this appendix arise for each canonical variable.

Figure A1 Alternative Solution Regions

This solution will be a reference case for us throughout the remainder of the discussion: it can be derived via the method of undetermined coefficients as in McCallum (1981) or simply by using the fact that $E_t x_{t+j} = \rho^j x_t$ together with the standard formula for a geometric sum.

In Figure A1, the region $\rho = 0$ is drawn in more darkly to remind us that it implicitly covers all driving processes of the finite moving average form,

$$x_t = \sum_{h=0}^H \delta_h \varepsilon_{t-h},$$

some of which will get more attention later.

Extension to $\rho \geq 1$

There are a number of economic contexts which mandate that one consider larger ρ . Notably, the studies of hyperinflation by Sargent and Wallace (1973) and Flood and Garber (1980), which link money rather than interest rates to prices, necessitate thinking about driving processes with large ρ so as to fit the explosive growth in money over these episodes.

It turns out that (28) continues to give intuitive economic answers when $\rho = 1$ even though its use can no longer be justified on the grounds that it involves a “stationary solution arising from stationary driving processes” as in Whiteman (1983). Most basically, if $\rho = 1$, then shifts in x_t are expected to be permanent in the sense that $E_t x_{t+j} = x_t$. The coefficient on x_t is therefore equal to the coefficient on $\underline{R} - \underline{r}$, which is natural since each is a way of representing variation that is expected to be permanent.

In Figure A1, the entire region E, as defined by $\rho \geq 1$ and $\theta\rho \leq 1$, can be viewed as a natural extension of the standard case. This latter condition is important for two reasons. First, it requires that the geometric sum defined in (27) be finite. Sargent (1979) refers to this as requiring that the driving process has exponential order less than $\frac{1}{\theta}$. Second, it requires that a solution of the form (28) has the property that

$$\lim_{J \rightarrow \infty} \theta^J E_t \pi_{t+J} = - \lim_{J \rightarrow \infty} \theta^J E_t \left\{ \frac{\theta}{1-\theta} [\underline{R} - \underline{r}] + \frac{\theta}{1-\theta\rho} x_{t+J} \right\} = 0,$$

so that it is consistent with the procedure of moving from (25) to (27). Violation of either the driving process constraint or the limiting stock price constraint implies that defined in (25) is infinite when $J \rightarrow \infty$. Parametrically, these two situations each occur when $\theta\rho \geq 1$ in Figure A1. Following the terminology of Flood and Garber (1980) these outcomes may be called process inconsistent, so that this region—in which equilibria do not exist—is labelled PI.

Extension to $\theta \geq 1$

There are also a number of models that require one to consider larger θ than in the standard case. In this case, McCallum (1981) has shown that there is typically a unique forward-looking equilibrium based solely on exogenous fundamentals. There may also be other “bubble” equilibria: these are considered further below but are ignored at present.

To understand the logic of McCallum’s argument, it is best to start with the case in which $\rho = 0$ and $\underline{R} - \underline{r} = 0$. In this case, (24) becomes

$$\pi_t = \theta E_t \pi_{t+1} - \theta \varepsilon_t.$$

Since interest rate shocks are serially uncorrelated and mean zero, it is natural to treat $E_t \pi_{t+1} = 0$ for all t and thus to write the solution as

$$\pi_t = -\theta \varepsilon_t.$$

Thus, there is no difficulty with the finiteness of $\sum_{j=0}^{\infty} \theta^{j+1} E_t [x_{t+j}]$ in this case since $E_t [x_{t+j}] = 0$ for all $j > 0$. There is also no difficulty with $\lim_{J \rightarrow \infty} \theta^J E_t \pi_{t+J} = 0$ since $E_t \pi_{t+J} = 0$ for all $J > 0$.

There are two direct extensions of this “white noise” case. First, with any finite order moving average process ($x_t = \sum_{h=0}^H \delta_h \varepsilon_{t-h}$), it is clear that similar solutions can be constructed that depend only on the shocks in the

moving average.²⁹ In this case, it is also clear that $\sum_{j=0}^{\infty} \theta^{j+1} E_t[x_{t+j}] < \infty$ since $E_t[x_{t+J}] = 0$ for all $J > H$. Likewise, it is clear that $\lim_{J \rightarrow \infty} \theta^J E_t \pi_{t+J} = 0$ since $E_t \pi_{t+J} = 0$ for all $J > H$. Second, for any $\rho \leq \frac{1}{\theta}$, it follows that the stationary solution (28), which is $\pi_t = -\frac{\theta}{1-\theta\rho} x_t$ in this case, is a rational expectations equilibrium for which the conditions $\sum_{j=0}^{\infty} \theta^{j+1} E_t[x_{t+j}] < \infty$ and $\lim_{J \rightarrow \infty} \theta^J E_t \pi_{t+J} = 0$ are fulfilled since $\rho\theta < 1$. The full range of equilibria studied by McCallum is displayed in the area of Figure A1.

As stressed in the main text, there is also a central limitation associated with this region—there cannot be a constant term in the “fundamentals” that enter in equations like (24), which implies that in this context that $\underline{R} = \underline{r}$. The reason that this constant term is inadmissible when $\theta \geq 1$ is direct from (25): if it is present when $\theta \geq 1$, then it follows that the limiting value of the fundamentals component is infinite. While potentially surprising at first glance, this requirement is consistent with the general logic of McCallum’s solution region—as indicated by Figure A1, it is obtained by requiring driving processes that have exponential order less than $\frac{1}{\theta}$, so that a constant term is generally ruled out along with $\rho = 1$ since, as discussed above, each is a way of representing permanent changes.

Bubbles

To this point, we have considered only solutions based on fundamentals. Let us call these solutions f_t and write the inflation rate as the sum of these and a bubble component b_t :

$$\pi_t = f_t + b_t.$$

In view of (24), the bubble solution must satisfy

$$b_t = \theta E_t b_{t+1}$$

or equivalently

$$b_{t+1} = \frac{1}{\theta} b_t + \zeta_{t+1},$$

where ζ_{t+1} is a sequence of unpredictable zero mean random variables (technically, a martingale difference sequence). Thus, in the standard case of $\theta < 1$, the bubble must be explosive—this sometimes permits one to rule out bubbles on empirical or other grounds (such as the transversality condition in certain optimizing contexts). By contrast, in the situation where $\theta > 1$ then the bubble component will be stationary.

²⁹ The form of this solution is $\pi_t = \sum_{h=0}^H \omega_h \varepsilon_{t-h}$, where the ω_h coefficients satisfy $\omega_h = \sum_{j=0}^{H-h} \theta^{j+1} \delta_{h+j}$.

These conditions arise because the bubble enters only in the term in (25) with the “exponential coefficient” θ^J . If $\theta < 1$, the future is discounted: we require that very large changes in expectations about the future must take place to produce a bubble of a given size today. By contrast, with $\theta > 1$, a very small change in long-term expectation can induce a bubble of a given size today because it is “emphasized” rather than discounted by the term θ^J .

Bubble solutions are sometimes written as

$$\pi_t = \frac{1}{\theta} \pi_{t-1} + R_{t-1} + \xi_t, \quad (29)$$

where ζ_{t+1} is a sequence of unpredictable zero mean random variables as in Farmer (1991). In this solution, the lagged inflation rate appears as a “state variable” and there is no evident effect of shocks to R_t on π_t . This latter implication is apparently inconsistent with the $\pi_t = f_t + b_t$ decomposition that we used earlier. However, upon substitution, we find that

$$\pi_t = f_t + b_t = \frac{1}{\theta}(f_{t-1} + b_{t-1}) + R_{t-1} + \xi_t,$$

and using $\theta E_{t-1} f_t = b_{t-1} + \theta R_{t-1}$, we find that

$$(f_t - E_{t-1} f_t) + (b_t - E_{t-1} b_t) = \xi_t,$$

where $E_{t-1} b_t = \frac{1}{\theta} b_t$. Thus, in the representation (29), ξ_t could depend on shocks to R_t since it is arbitrary. Alternatively, $(b_t - E_{t-1} b_t)$ could “offset” shocks to $(f_t - E_{t-1} f_t)$, leaving no effects of changes in the interest rate within period t .

REFERENCES

- Abel, Andrew B. “Consumption and Investment,” in Benjamin M. Friedman and Frank H. Hahn, eds., *Handbook of Monetary Economics*, Vol. 2. Amsterdam: North-Holland, 1990.
- Boyd, John, and Michael Dotsey. “Interest Rate Rules and Nominal Determinacy,” Working Paper. Richmond: Federal Reserve Bank of Richmond, 1994.
- Calvo, Guillermo A. “Staggered Prices in a Utility Maximizing Framework,” *Journal of Monetary Economics*, vol. 12 (September 1983), pp. 383-98.
- Fama, Eugene F. “Short-Term Interest Rates as Predictors of Inflation,” *American Economic Review*, vol. 65 (June 1975), pp. 269-82.
- Farmer, Roger E. A. “Sticky Prices,” *Economic Journal*, vol. 101 (November 1991), pp. 1369-79.

- Flood, Robert, and Peter M. Garber. "An Economic Theory of Monetary Reform," *Journal of Political Economy*, vol. 88 (February 1980), pp. 24-58.
- Friedman, Milton. "Factors Affecting the Levels of Interest Rates," United States Savings and Loan League Conference Proceedings on Savings and Residential Financing, 1968a, pp. 11-27.
- . "The Role of Monetary Policy," *American Economic Review*, vol. 57 (March 1968b), pp. 1-17.
- . *A Theory of the Consumption Function*. Princeton: Princeton University Press, 1957.
- Fuhrer, Jeffrey, and George Moore. "Inflation Persistence," *Quarterly Journal of Economics*, vol. 110 (February 1995), pp. 127-160.
- Goodfriend, Marvin. "Interest Rate Policy and the Inflation Scare Problem: 1979-1992," Federal Reserve Bank of Richmond *Economic Quarterly*, vol. 79 (Winter 1993), pp. 1-24.
- . "Interest Rate Smoothing and Price Level Trend Stationarity," *Journal of Monetary Economics*, vol. 19 (May 1987), pp. 335-48.
- Hall, Robert E. "Consumption," in Robert J. Barro, ed., *Modern Business Cycle Theory*. Cambridge, Mass.: Harvard University Press, 1989.
- Henderson, Dale W., and Warwick J. McKibbin. "An Assessment of Some Basic Monetary-Policy Regime Pairs: Analytical and Simulation Results from Simple Multiregion Macroeconomic Models," in Ralph C. Bryant, Peter Hooper, and Catherine L. Mann, eds., *Evaluating Policy Regimes*. Washington: The Brookings Institution, 1993.
- Hicks, John R. "Mr. Keynes and the 'Classics': A Suggested Interpretation," *Econometrica*, vol. 5 (April 1937), pp. 147-59.
- Kim, Jinill. "Monetary Policy in a Stochastic Equilibrium Model with Real and Nominal Rigidities," Ph.D. dissertation. Yale University, 1996.
- King, Robert G. "Will the New Keynesian Macroeconomics Resurrect the IS-LM Model?" *Journal of Economic Perspectives*, vol. 7 (Winter 1993), pp. 67-82.
- , and Mark W. Watson. "Money, Prices, Interest Rates, and the Business Cycle," *Review of Economics and Statistics*, vol. 78 (February 1996), pp. 35-53.
- . "The Post-War U.S. Phillips Curve: A Revisionist Econometric History," Carnegie-Rochester Conference Series on Public Policy, vol. 41 (December 1994), pp. 157-219.
- Leeper, Eric M. "Equilibria Under 'Active' and 'Passive' Monetary and Fiscal Policies," *Journal of Monetary Economics*, vol. 27 (February 1991), pp. 129-47.

- Lucas, Robert E., Jr. "Expectations and the Neutrality of Money," *Journal of Economic Theory*, vol. 4 (April 1972), pp. 103-24.
- McCallum, Bennett T. "Topics in Monetary Theory and Policy," Lectures at the Institute for Advanced Studies, Vienna, Austria, May 1995.
- _____. "On Non-Uniqueness in Rational Expectations Models: An Attempt at Perspective," *Journal of Monetary Economics*, vol. 11 (March 1983), pp. 139-68.
- _____. "Price Level Determinacy with an Interest Rate Policy Rule and Rational Expectations," *Journal of Monetary Economics*, vol. 8 (November 1981), pp. 319-29.
- Nelson, Charles R., and William G. Schwert. "Short-Term Interest Rates as Predictors of Inflation: On Testing the Hypothesis That the Real Rate of Interest is Constant," *American Economic Review*, vol. 67 (June 1977), pp. 478-86.
- Parkin, Michael. "A Comparison of Alternative Techniques of Monetary Control under Rational Expectations," *Manchester School of Economic and Social Studies*, vol. 46 (September 1978), pp. 252-87.
- Poole, William. "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," *Quarterly Journal of Economics*, vol. 84 (May 1970), pp. 197-216.
- Rotemberg, Julio J. "The New Keynesian Microfoundations," in Stanley Fischer, ed., *NBER Macroeconomics Annual*. Cambridge, Mass.: MIT Press, 1987.
- _____. "Sticky Prices in the United States," *Journal of Political Economy*, vol. 90 (December 1982), pp. 1187-1211.
- Sargent, Thomas J. *Macroeconomic Theory*. New York: Academic Press, 1979.
- _____, and Neil Wallace. "Rational Expectations, the Optimal Monetary Policy Instrument, and the Optimal Money Supply Rule," *Journal of Political Economy*, vol. 83 (April 1975), pp. 241-54.
- _____. "Rational Expectations and the Dynamics of Hyperinflation," *International Economic Review*, vol. 14 (June 1973), pp. 328-50.
- Schmitt-Grohe, Stephanie, and Martin Uribe. "Balanced-Budget Rules, Distortionary Taxes and Aggregate Instability," Working Paper. Washington: Board of Governors of the Federal Reserve System, September 1995.
- Sims, Christopher A. "A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy," *Economic Theory*, vol. 4 (1994), pp. 381-99.
- Taylor, John B. "Discretion Versus Rules in Theory and Practice," *Carnegie-Rochester Conference Series on Public Policy*, vol. 40 (December 1993), pp. 195-214.

Whiteman, Charles. *Linear Rational Expectations Models: A User's Guide*.
Minneapolis: University of Minnesota Press, 1983.

Woodford, Michael. "Monetary Policy and Price Level Determinacy in a
Cash-in-Advance Economy," *Economic Theory*, vol. 4 (1994), pp. 345-80.

_____. "Stationary Sunspot Equilibria: The Case of Small Fluctuations
around a Deterministic Steady State," Working Paper. Chicago: University
of Chicago, September 1986.

The Economics of Electronic Benefit Transfer Payments

David B. Humphrey

Currently, federal and state agencies transfer almost \$500 billion in benefits to recipients each year. This includes cash benefits, food stamps, Social Security, student loans, unemployment, retirement, and other benefit payments. Almost 70 percent of these payments are paper-based. Paper is used for 60 percent of the more than \$400 billion in federal benefits. And it constitutes close to 100 percent of the \$95 billion in state benefits.

Most benefit recipients have checking or savings accounts at depository institutions and increasingly receive their payments electronically as a direct deposit to their account. Indeed, 58 percent of Social Security recipients now receive their payments electronically. However, many of the recipients participating in other benefit programs—including food stamps and Aid to Families with Dependent Children (AFDC)—do not have an account at a depository institution. These recipients rely on paper-based delivery of their estimated \$112 billion in benefit payments.

Overall, 10 percent of all U.S. households do not have a deposit account. These households are the so-called “un-banked” and are unable to receive an electronic direct deposit. For low income households, this figure is even higher. For households in the lowest income quintile (lowest one-fifth of income), 26 percent do not have a deposit account. And for families receiving AFDC, general assistance, or food stamps, the figure is higher still: almost 75 percent do not have a deposit account (Wood and Smith 1991, Tables 1 and 2).

Targeted at families without a deposit account, electronic benefits transfer (EBT) will allow these families to draw their benefits electronically through

■ The author is the F. W. Smith Eminent Scholar in Banking and Professor of Finance at Florida State University. Comments and suggestions by Margaret Andrews, Tom Humphrey, John Kirlin, Jeff Lacker, John Walter, and John Weinberg are appreciated. The views expressed are those of the author and do not necessarily represent those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

automated teller machines (ATMs) and retail point-of-sale (POS) terminals instead. As envisioned by federal and state benefit-issuing agencies, benefit recipients will have the convenience of an integrated electronic delivery system that they can access with a single card. EBT is estimated to also cost less than the current paper-based benefit delivery system. The annual savings from EBT are estimated to be \$195 million per year. Additional advantages will include a reduction in fraud and increased assurance that benefits are used for their intended purpose. Overall, surveys from pilot programs indicate that the majority of benefit recipients, banks, and retailers all prefer EBT over the existing paper-based system.

This article focuses on economic issues related to EBT. Its primary purpose is to (1) outline who would be affected by EBT and how it would work; (2) illustrate its likely impact on U.S. payment structure; (3) report cost/benefit results based on EBT pilot programs; (4) assess how EBT costs may be affected by scale economies; and (5) note the replacement of checks by EBT and other electronic payments.

1. EBT: WHO IT WOULD AFFECT AND HOW IT WOULD WORK

Table 1 lists the major federal and state benefit programs and the percent that beneficiaries and their families are of the total U.S. population. Because some recipients receive benefits from more than one program, adding up the percentages shown in column 1 (totaling 47 percent) will overstate the percent of the population receiving benefits.¹ A more accurate and conservative estimate would be that around one-third of all U.S. families receives one or more benefit payments, ranging from food stamps to Social Security to military, state, and federal retirement payments.

Benefit Recipients without a Deposit Account

EBT focuses on those benefit recipients that do not have a deposit account.² As seen in column 2, the percent of recipients without an account ranges from 8 percent for recipients of military, state, and federal retirement pensions to 75 percent for recipients of AFDC. These are the recipients targeted for EBT. Recent estimates of the EBT caseload (with some double counting) are

¹ Food stamps and AFDC, for example, have an especially large overlap since 80 percent of AFDC households also receive food stamps while 43 percent of food stamp households also receive AFDC.

² Even those with deposit accounts are being encouraged to switch away from government-issued checks, at both the federal and the state level, to electronic direct deposit of payroll, Social Security, retirement, and other benefits. Indeed, recent federal legislation requires most federal government payments to be made electronically by 1999 (Marjanovic 1996).

Table 1 Benefit Recipients in U.S. Population and Recipients Without Deposit Accounts (1985)

Government Benefit Program	Percent of Families in U.S. Population*	Percent of Families without Accounts
Food Stamps	6	73
Aid to Families with Dependent Children	3	75
Food Programs for Women, Infants, and Children	1	56
General Assistance	1	74
Social Security	26	14
Supplemental Security Income	2	50
Pensions	8	8
Unemployment and Student Loans	n.a.	n.a.

*Percent of families receiving benefits approximates percent of population.

Source: Adapted from U.S. General Accounting Office (1988), p. 44 (as reported in Wood and Smith [1991]).

shown in Table 2. There are potentially some 31 million users of EBT out of perhaps a total of 86 million benefit recipients (estimated to be one-third of the U.S. population of 258 million). In sum, EBT would directly affect about 12 percent of the U.S. population and involve \$112 billion in payment transfers.³

How Benefits are Delivered

An illustration of how EBT works is provided in Figure 1. The flow of the payment instrument or payment information is shown with a solid line; the actual movement of funds is represented by a dotted line. Under paper-based delivery of benefits, checks or food stamps (the current payment instruments) are distributed by mail or picked up by recipients at local benefit offices. Recipients then cash their benefit check at a bank, check-cashing outlet, or store

³ The push for EBT has come from the executive branch of the federal government; primarily, Vice President Gore, officials in the Treasury Department and the Office of Management and Budget (to improve efficiency), the Department of Agriculture (to improve the food stamp program), and the Department of Health and Human Services (to improve federal and state welfare programs).

Table 2 EBT Caseload and Value of Benefits

(Pooled Federal and State Benefits, 1993)

Government Benefit Program	EBT Caseload¹ (millions)	Value of Benefits (\$ billions)
Food Stamps	10.8	22.0
Aid to Families with Dependent Children	3.7	16.9
Food Programs for Women, Infants, and Children	1.4	2.1
General Assistance	1.3	5.5
Social Security	5.9	41.1
Supplemental Security Income	3.0	12.2
Pensions ²	0.6	4.7
Unemployment and Student Loans	4.4	7.2
	31.1	111.7

¹EBT caseload refers to families, not number of individuals covered.²Federal, military, railroad, and veterans' pensions.

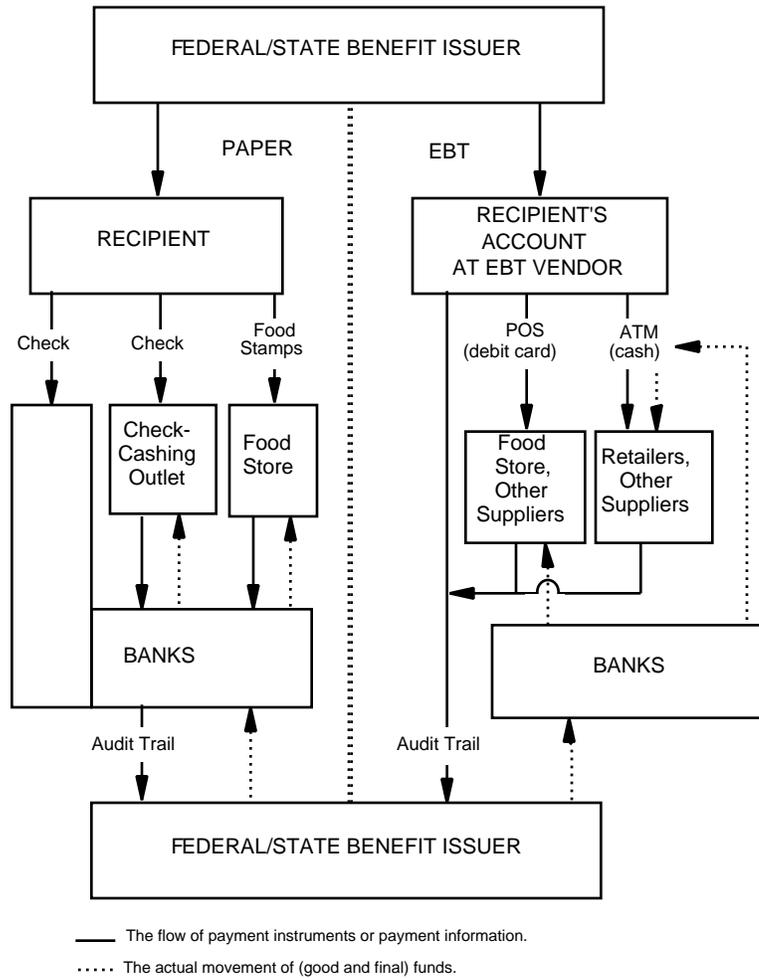
Source: Federal EBT Task Force (1994), p. 8.

and trade food stamps for permitted food items at participating supermarkets. The cashed benefit checks and redeemed food stamps are processed within the banking system and then physically presented to the issuing agency or paying agent, often a Federal Reserve Bank. As few programs are funded before transactions occur, it is at this point that the actual transfer of funds takes place—from government agency to the banks and finally to the food stores and other entities that accepted the payment instrument.

With EBT, the arrangement is somewhat different. First, the government agency (or its paying agent) provisionally credits the benefit recipient's account at the EBT vendor. The provisional credit equals the value of the benefits to be received (the payment information).⁴ Using a personal identification number, or PIN, the recipient withdraws cash through an ATM and/or debits his EBT

⁴ The EBT vendor may or may not be a bank: it all depends on who submitted the winning bid for the EBT contract.

Figure 1 Paper and EBT Flow



account using a debit card. The initial crediting process enables the benefit recipient to buy groceries at stores that accept debit cards through their POS network and, in some cases, pay rent at housing offices using the same debit card. At the end of the day, EBT vendors determine the total cash withdrawn and the sum of POS debits made to all EBT accounts. This audit information is provided to the benefit-issuing government agency, who then transfers the necessary covering funds to the banks. The banks in turn reimburse the ATM

owners and credit the accounts of businesses where the POS transactions occurred. Thus the essential difference between the two benefit transfer sequences shown in Figure 1 is the substitution of electronic payment information via EBT for paper-based check and food stamp payment instruments.

2. THE EFFECT OF EBT ON THE STRUCTURE OF U.S. PAYMENTS

Current Payment Structure

Cash transactions are by far the most numerous. They have been estimated to account for perhaps 83 percent of all U.S. payments, with similarly high percentages in other countries as well.⁵ Since the average value per transaction is quite low (estimated to be less than \$10 in the United States), cash payments account for only a small percent of the value of all payments.⁶

With EBT, the main focus is on the substitution of electronic for paper-based payment methods. Excluding large-value wire transfers, the current structure of noncash transactions is shown in Table 3.⁷ Checks account for 78 percent of noncash transaction volume and 89 percent of their value. Checks are now, and always have been, the dominant noncash payment method in the United States. Electronic payments include credit card, debit card (POS), and automated clearing house (ACH) payments. ACH payments include direct debits (preauthorized bill payments), direct deposits (direct deposit of payroll, Social Security, and retirement income), and corporate cash management debits. As seen in Table 3, credit cards are currently the most important class of electronic payments in terms of transaction volume (17 percent) while ACH is the most important in terms of value (10 percent, due to large-value corporate cash management debits).

While EBT will expand consumers' use of ATMs as a way to obtain cash (instead of cashing a benefit check), the net effect of EBT will be to shift a significant portion of "cash-like" paper transactions to electronic payments. Food purchases made with food stamps—which are like cash—will shift to

⁵ Cash accounts for 86 percent of all transactions in Germany, 78 percent in the Netherlands, 90 percent in the U.K. (Boeschoten 1992, pp. 73–74), and is probably higher still in Japan, where cash is used heavily.

⁶ One important area for cash transactions concerns the 2.7 million vending machines where cold drinks, candy, and other products are dispensed. Vending machine transactions totaled 26 billion in 1994 with an average value of just over \$0.60 each (*Vending Times* 1995).

⁷ Wire transfers average \$4.3 million per transaction and clearly are not representative of normal consumer or even standard business payments. These payments represent less than 1 percent of noncash transactions but, due to their large average amount per transaction, account for 86 percent of payment value.

Table 3 The Structure of U.S. Noncash Payments
(1994 percent composition and average dollar amounts)

	Transaction Volume:		Transaction Value:		Average Value
	Billions	%	\$ Billions	%	
Check	61.7	78.3	71,500	89	\$1,159
Credit Card	13.7	17.3	731	1	53
Debit Card (POS)	1.1	1.4	45	0	41
Direct Debit & ACH	2.3	3.0	8,370	10	3,639
Total	78.8		80,646		

Source: Annual data computed from Bank of International Settlements (1995).

noncash electronic debit card transactions at grocery stores. In addition, the number of government checks issued, mailed, received (and possibly mishandled), will be reduced. Benefits now provided by check will shift to ATMs (for cash withdrawal) and to POS as a portion of food, housing, clothing, and other transactions previously handled with cash, food stamps, payment vouchers, or money orders moves to an EBT (debit) card.

Changes in Payment Structure from EBT

Debit card payments have been growing quite rapidly (Caskey and Sellon 1994) and currently are over a billion transactions a year. If EBT were fully implemented today, the number of debit card transactions could double or triple.⁸ As seen in Table 3, such an increase in debit card transactions would expand their role to 3 to 4 percent of noncash payments, thus equaling or exceeding the level of direct debits and other ACH payments (at 3 percent).⁹ A rise in debit card payments from the current level of 1.4 percent of noncash payments up to a level of 3 to 4 percent may not sound important. However, it is

⁸ Based on experience with EBT pilot programs, Abt Associates has estimated that two benefit programs—food stamps and AFDC—could add 0.8 billion new POS transactions (Kirlin et al. 1990, p. 230). These two programs account for 47 percent of the estimated EBT caseload in Table 2. If the other benefit programs generate similar POS use, then EBT by itself may lead to an additional 1.7 billion POS transactions. Another source suggested an additional 3 billion in POS transactions from EBT (Piskora 1995, p. 14).

⁹ While EBT would also increase ATM transactions from their current base of around 8 billion, ATM transactions primarily involve the withdrawal of cash (not electronic payments). ATM transactions are composed of cash withdrawal (86 percent), cash or check deposit (10 percent), and account transfer (3 percent), with only 1 percent involving an electronic bill payment (Board of Governors 1991).

significant when compared to the past growth of ACH transactions, which were specifically designed to be a direct substitute for the paper check.¹⁰ The ACH was established in 1972 and it has taken over twenty years for this electronic payment method to reach its current level of 3 percent of noncash payments. Viewed in this light, it is clear that EBT will have an important impact on the composition of retail payments over a relatively short time period.

3. EBT VERSUS PAPER: A COST/BENEFIT COMPARISON

Experience with a number of EBT pilot programs permits a cost/benefit comparison of electronic versus paper benefits transfer. During the planned seven-year EBT implementation period from 1994 to 2000, an ongoing government investment is needed to purchase, install, and operate new POS terminals. Reflecting the multiyear lifetime of these terminals, this fixed cost is amortized over a period of years. As benefit delivery is increasingly shifted from paper to EBT during this period, the reduction in paper costs is expected to be sufficient not only to pay back this terminal investment but also to provide net savings to U.S. taxpayers of over \$250 million overall. Once the program is fully established, as shown in Table 4, the net savings are estimated to be \$195 million annually.

The virtue and value of EBT is that it is predicted to deliver benefits at a lower cost as checks and food stamps are replaced by debit cards and ATM use. The largest ongoing expense of a mature EBT program is the electronic payment processing cost incurred by the benefit issuer and the EBT processor. As noted below, the few studies that exist have shown that electronic payments are cheaper than paper-based payments, both in the United States and in other countries.

Additional benefits from EBT are obtained from enhancing security and reducing fraud associated with counterfeit food stamps. And, although difficult to quantify, there will be greater assurance that benefits will go toward their intended purpose. For example, EBT will eliminate “cash change” in food stamp transactions. It will also reduce the opportunity for diversion of benefits to secondary markets—where some recipients sell their stamps, at a discount, in order to purchase nonbenefit items. Finally, the electronic cash registers now in place in most supermarkets can be programmed to control the purchase of items not covered through benefit programs (e.g., alcoholic beverages, rather than food items).

The EBT cost estimate in Table 4 includes \$116 million a year to account for the possible expense from theft or misuse of EBT cards. However, some experts think this estimate is too low. The Federal Reserve Board has waived

¹⁰ Unlike ACH, credit card transactions started out as paper transactions. Only recently have almost all portions of the credit card transaction been switched over to electronics.

Table 4 Federal EBT Costs and Benefits

	Annual Values in Year 2000 and After (\$ millions)
Federal EBT Cost:	
Infrastructure	5.0
Administration, Design and Development	1.3
Operations	234.8
Total	241.1
Federal EBT Benefit:	
Reduction in Paper-Based Benefit Delivery Cost	
Total	435.8
Annual EBT Savings over Paper Delivery of Benefits:	194.7

Source: Federal EBT Task Force (1994), p. 38.

until 1997 any extension to EBT of protections currently available to consumers from Regulation E. Regulation E sets an upper limit on losses cardholders can face (currently \$50) if they promptly report the theft or loss of their ATM, credit, or debit card to the card issuer. This permits the issuer to stop further transactions and thereby limit losses. Some estimates of the possible additional expense of extending Regulation E consumer protections to EBT are as high as \$500 million to \$800 million a year (Stix 1994, p. 86). If this level of extra expense for EBT from Regulation E were incurred, it would more than offset the forecasted net benefits of the program shown in Table 4.

At present, procedures are being investigated that would minimize losses in the event that some or all of the consumer protections offered by Regulation E are extended to EBT. Pilot tests are underway in two states (New Jersey and New Mexico) to provide accurate estimates of the potential expense involved. Under Regulation E, issuers of benefits could not limit their losses—as banks now can—by refusing to serve high-risk recipients who make repeated claims of lost or stolen cards and benefits.

A reasonable compromise may be to provide beneficiaries with the same sort of (limited) protections from loss and theft that they currently receive under the existing paper-based system. Although less comprehensive than Regulation E, such an arrangement would not disadvantage beneficiaries relative to their current position. It is important to note that loss of an EBT card by itself would

not lead to recipient or card issuer losses. This is because *both* the card and the recipient's PIN number have to be used to obtain cash from an ATM or authorize a POS transaction. The same is not now the case for fraudulent use of consumer credit cards (where only a signature is required) but does apply to use of consumer ATM and debit cards.

The Ratio of EBT to Paper Payment Costs

In Table 4, the ratio of estimated annual EBT costs (\$241 million) to the documented cost of paper-benefit delivery (\$436 million) is 0.55. For the level of benefits to be delivered, the cost of EBT card use in store POS debit card terminals and ATM cash withdrawals is thus apparently a little more than half of the current cost of issuing checks and food stamps. This overall cost comparison is supported, in part, by some results from a recent EBT pilot program. Although all costs were not tallied, those associated with smart card off-line EBT and food stamp coupons were compared: the resulting EBT card/food stamp cost ratio was 0.57 (Food and Nutrition Service 1994).¹¹

A more comprehensive cost comparison, although on a per-transaction basis, is to contrast the estimated social cost of an electronic payment with that for a check. Social cost includes payer, retailer, bank, and payee expenses while the costs in Table 4 concern government (and bank and some retailer) costs. The ratio of the estimated social cost of a debit card POS payment (approximately equivalent to an EBT POS transaction) with that for a check is 0.59 (Humphrey and Berger 1990, p. 50). A more recent study compares the social cost of an electronic ACH payment with that for a check and obtains an (average) ratio of 0.45 (Wells 1994, p. 40). Finally, a study of Norwegian payer and payee bank costs of processing an electronic POS debit (including terminal costs) versus that of a check yielded a ratio of 0.32 while the cost ratio for an ATM transaction to that of a check was 0.25 (Robinson and Flatraaker 1995, p. 211). What this demonstrates is that whether one compares the government per-transaction cost of EBT versus food stamps, or the social cost of debit card or ACH payments versus that of a check, or the bank costs of a POS debit or an ATM transaction versus checks, in every case electronic payments are less costly than those relying on paper (checks or food stamps). This result gives indirect support for the EBT/paper cost comparison results of Table 4.

EBT Card Technology: Magnetic Stripe Versus Smart Card

The cost estimates for EBT assume the use of a card with a standard magnetic stripe and dial-up (telephone) access to EBT account information for

¹¹ Exhibit 1 in this source was used after converting the retailer and financial institution costs shown there to a per-case-month basis (dividing these costs by 1,000/190).

verification of transactions, either through ATMs or POS.¹² A 1993 congressional Office of Technology Assessment study, however, suggested that new “smart-card” technology applied to EBT may yield even lower longer-run costs.

Smart cards have an apparent operating cost advantage over magnetic stripe cards. Use of a smart card would allow EBT authorization and transaction information to be handled at the terminal itself. The chip in the card would periodically be credited with “value” due a beneficiary. A program in the chip would identify the beneficiary, authenticate each transaction, and debit the stored value each time the card was used. Once a day, smart card (off-line) terminals would be accessed to determine the value of funds the benefit-issuing agencies would need to provide to pay for the beneficiary transactions made that day.¹³ In contrast, magnetic stripe cards require, at a minimum, the use of dial-up authorization for each transaction and, with standard on-line ATM and POS systems, the even more costly capability to debit or place a hold on the cardholder’s account for the amount of the transaction at the time the transaction occurs.

While the smart card may have a lower operating cost once an EBT system is in place, the cost of the cards themselves and the need to deploy a new type of terminal would cause the government’s initial investment to be higher than with magnetic stripe cards. This is because some 109,000 ATMs and 376,000 POS terminals that read magnetic stripe cards already are in the marketplace and most of them already have the on-line communication capability needed for EBT applications (Caskey and Sellon 1994). Therefore, the higher government investment required for smart cards at a time when budgets are being cut, coupled with the sunk cost in existing magnetic stripe cards and terminal equipment, along with the uncertainty regarding use of an unfamiliar technology, will all probably mean that magnetic stripe cards will be the instrument of choice for EBT in the foreseeable future.

The Experience of EBT Pilot Programs

Since 1984, there have been pilot programs in eight counties and cities which have tested various aspects of EBT. These results, including relative costs and implementation procedures, have been extensively documented by Abt

¹² Access to account information for transaction verification involves comparing a user’s card and PIN number against a data file containing valid card and PIN numbers for transaction authorization. It need not also involve the immediate debiting (or placing a hold on) the cardholder’s account and the transfer of funds to the payee. When these additional steps are taken at the end of the day, the terminal network is classified as being “off-line”; if these steps are taken at the same time the transaction is authorized, the terminal network is “on-line.”

¹³ In pilot programs, however, these costs have been higher than expected. This has resulted from a need to (1) update off-line terminals each day with a list of unauthorized (lost/stolen) cards, raising communication costs; (2) replace lost cards and issue new ones as beneficiaries move into and out of benefit programs; and (3) reconcile card and account balances due to terminal errors.

Associates and others. Recipients, retailers, and banks participating in the pilot programs have consistently shown a preference for EBT compared to current paper-based benefit transfer methods. At present, ten states have operational EBT programs. Three states (Maryland, New Mexico, and South Carolina) are operating statewide and others are expanding in that direction. Over thirty-three states have active plans to implement EBT in the near future (Food and Consumer Service 1995). Some of these programs will involve multistate arrangements.

4. SCALE ECONOMIES AND FUTURE EBT COSTS

Previous studies have shown that large scale economies exist for ATM terminal use and ACH electronic payment processing. Economies associated with POS terminals also likely exist and would probably be similar to those reported for ATMs. In contrast, empirical analyses indicate that scale economies in check processing are much lower than for electronic payments and have already been largely realized (Humphrey 1985; Bauer and Hancock 1992). Given scale economies in ATM, ACH, and (by implication) POS, it is expected that future EBT costs may fall substantially as volume rises. As shown below, there are important limits to this expected result.

ATM and Other Payment Scale Economies

Payment scale economies exist when the percent increase in total costs from a rise in transaction volume is less than the percent increase in transactions, so the average cost of a payment transaction falls. Holding other cost influences constant, check processing expenses rise by an average of 8.8 percent for each 10 percent increase in transaction volume (Bauer 1993) while ATM costs only rise by 3 to 5 percent for each 10 percent increase in volume (Walker 1978; Humphrey 1994). Although check processing scale economies are less than those for ATMs, there is an upper limit to the ATM economies. Busy or actively used ATMs have queuing problems. Customers who have chosen to use an ATM because it is more convenient than waiting in a teller line when a branch office is open have a similar problem at an ATM when the volume of transactions per machine exceeds 7,000 to 8,000 per month.¹⁴ At this point, banks typically supply an additional terminal to address the peak-time queuing problem. The additional terminal expense raises the average cost per ATM transaction so that scale economies are realized only up to a certain volume level per ATM.

¹⁴ If an ATM transaction occurred every three minutes, there would be 300 transactions for a day that began at 8:00 a.m. and ended at 11:00 p.m. Over a month, there could be 9,000 transactions per terminal. However, peak load problems would create queues at substantially lower levels of monthly use.

There is another limitation to ATM scale economies. As banks have discovered, the increased convenience for consumers of using an ATM for cash withdrawal, as opposed to withdrawing cash at a branch office or writing a check for cash at a retail outlet, has led bank customers to expand their use of ATMs. Banks expected to reduce operating costs by shifting customer transactions—primarily cash withdrawal—to ATMs since an ATM transaction costs about half as much as the same transaction at a bank branch office (Berger 1985). However, ATMs are extraordinarily convenient. Customers now choose to “stop at the ATM” for cash twice (or even three times) as frequently as they used to visit their banks to cash a check. As a result, the gains banks were planning on from lower costs and scale economies at ATMs have been largely offset by an unexpected rise in frequency of use. While the cost per transaction of a customer cash withdrawal fell by around one-half when an ATM was used instead of a teller, the frequency of use effectively doubled, leaving total costs relatively unchanged overall (Humphrey 1994).

The same convenience benefits that have led to greater-than-expected use of ATMs by bank customers will also exist for EBT recipients.¹⁵ To deal with this, after a certain number of free transactions each month, EBT recipients may incur a fee that covers the average cost of additional ATM transactions until the next benefit month rolls around. Such a pricing arrangement will help control EBT costs. It may also lead banks to adopt a more cost-based pricing arrangement for ATM services provided to depositors. Currently, only around 25 percent of banks charge their customers for using the bank’s own ATMs. Fees almost always apply for customer use of a “foreign” ATM—an ATM owned by another bank.¹⁶

Like ATMs, POS terminals would face an upper limit for scale economies due to queuing problems associated with very intensive use. In addition, a number of POS terminals would have to be placed in relatively low volume locations to provide the same degree of access with EBT as now occurs with food stamps. Thus, while POS terminals could potentially see the same degree of scale economies that have been measured for ATMs, the realization of these economies will be limited. Over time, however, EBT could “pull” more non-EBT consumers into using point-of-sale EBT and debit card terminals, due merely to their increased availability. If this occurs, POS scale economies will

¹⁵ In pilot tests, the frequency of shopping trips rose with EBT compared to when food stamps were used. This would increase the frequency of POS transactions and add to EBT costs.

¹⁶ The average fee for customer use of its own bank’s ATM is around \$0.40 while the fee for use of a foreign ATM is around \$1.00 (Barthel 1993). Even so, use of foreign ATMs has grown from 15 percent of all ATM transactions in the mid-1980s to around 50 percent today (McAndrews 1991). Compared to a traveler’s check, a \$1.00 fee for use of a foreign ATM is cost-effective if more than \$100 is withdrawn (since the fee for a traveler’s check is typically 1 percent of the dollar value purchased). More recently, some ATM owners (including some owned by banks) have imposed an additional surcharge (often around \$1.00) for use of a foreign ATM.

be more fully realized by jointly serving these two groups at locations where EBT volume per terminal may be low.

ACH Scale Economies

When magnetic stripe cards are used, EBT will require dial-up access to beneficiary account information for authorization of each ATM or POS transaction. It will usually also require the on-line debiting of (or placing a hold on) the cardholder's EBT account, which is typical today with ATM or debit card use. The flow of funds and final settlement for these transactions (involving government to bank to retailer funds transfers for each day's EBT transactions) will usually be through overnight ACH interbank transfers. ACH costs increase by 6 to 7 percent for each 10 percent rise in transaction volume so scale economies exist here too (Humphrey 1985; Bauer and Hancock 1995). While ACH average costs fall as volume increases, the cost reduction is not as fast as one might have expected. ACH costs are composed of computer processing expenses (which experience strong scale economies) along with interbank communication costs (which face few such economies). In setting up the ACH, the Federal Reserve connected all banks, rather than only those with sufficiently high volume. Thus scale economies from computer transaction processing were partially offset by the high cost of communicating with banks with low ACH volume. In addition, since ACH applications tended to be concentrated at certain times of the month for bill payments and payroll disbursements, rather than spread more evenly on a day-to-day basis, peak-load processing problems occurred. Thus the potential for scale economies associated with a relatively constant ACH volume flow were eroded because of substantial excess (and unused) ACH capacity during most of the month.

The overall implication for EBT from scale economies in ATM and POS terminals and ACH processing is that major future reductions in EBT costs from this source should not be expected. While EBT costs may fall somewhat over time, this will likely be due as much to standard learning curve effects as it is to realizing scale economies in electronic payments. In repetitive tasks, learning curve effects often lead to reductions in initial unit cost of from 10 percent to 20 percent (sometimes more) as cumulative output expands over time (Mansfield 1996).

5. ELECTRONIC PAYMENT AND EBT REPLACEMENT OF CHECKS

Electronic payments have long been touted as a potentially lower-cost payment method that could replace many check and some cash transactions. The first electronic substitute specifically designed to replace checks was the ACH, the prototype of which was launched in California in 1972. Only recently has

the ACH made much headway in this replacement effort. Substitution has occurred chiefly through programs that replaced checks with direct deposit of Social Security, retirement, and government and private payrolls, along with pre-authorized direct debits for recurring bill payments. Even so, it has taken over twenty years for the ACH to account for 3 percent of noncash transaction volume (Table 3). The 2.3 billion in ACH transactions during 1994 are presumed to have replaced this many checks.

Introduced in 1971, ATMs have likely been more successful than the ACH in terms of check replacement. Before ATM use became common, approximately 8 percent of all checks were written to obtain cash (Bank Administration Institute 1979). In 1994, there were 8.3 billion ATM transactions. Approximately 86 percent or 7.1 billion of these transactions represented cash withdrawal. Since customers use the ATM to withdraw cash over twice as often as they cashed checks for the same purpose, the 7.1 billion ATM cash withdrawal transactions likely displaced over 3.5 billion checks. Thus ATMs are estimated to have replaced 3.5 billion check transactions while the ACH has only replaced around 2.3 billion.

In terms of overall transaction volume, the most important electronic substitute for a check has been the credit card. Credit card transactions were initially paper-based but now are almost wholly electronic. Credit cards account for over 13 billion transactions. While some credit card transactions have probably replaced cash, the vast majority represent check replacement (since the average value of a credit card transaction is \$53 while that for cash is less than \$10).

As noted above, EBT will shift check and food stamp transactions to cash withdrawals at ATMs and POS electronic debit card payments. This increase in POS use may expand debit card transactions from their current level of 1.4 percent of noncash payments to 3 to 4 percent. This translates into a possible check replacement of from 1.7 billion to 3 billion from EBT alone.¹⁷ Thus, overall, EBT by itself may replace as many checks over a short period of time as have been replaced by ACH over the past twenty years. While this result is not a "revolution" in payment practices, it will reduce further the already slow growth in per-person use of checks. Preliminary forecasts are that per-person use of checks in the United States will turn negative in the next few years, a result that should be accelerated by the expansion of EBT.

¹⁷ Additional check replacement may follow the increase in availability of POS terminals associated with EBT. About 600,000 POS terminals may be needed in a mature, nationwide EBT system (Kirlin et al. 1990, p. 202). Many food stores participating in the food stamp program would have to be supplied with new terminals even though there are almost 500,000 POS terminals in place today.

6. SUMMARY AND CONCLUSION

Federal and state benefits total almost \$500 billion a year and range from food stamps to Social Security to Aid to Families with Dependent Children to military retirement. Many benefit recipients have accounts at depository institutions and increasingly receive benefits through an electronic direct deposit. However, one-third of recipients do not have a deposit account and are the focus of electronic benefits transfer. EBT delivers benefits electronically through ATMs (for cash withdrawal) and retail POS debit card terminals. An EBT transaction is expected to cost only about half of what a paper-based benefit transaction (check, food stamp) costs. Overall, EBT is projected to disburse \$112 billion in benefits each year, cover 31 million families (12 percent of the population), and may save \$195 million annually by the year 2000.

Currently, 78 percent of all U.S. noncash transactions are made by check, while 22 percent are made electronically (mostly credit cards). As EBT expands, POS use may double or triple from its current level of 1.4 percent of noncash transactions up to 3 to 4 percent of these payments. Thus EBT could by itself expand electronic payments by perhaps 2 percentage points, lowering check use to 76 percent of noncash transactions. Overall, EBT will contribute to check replacement, improve the efficiency of delivering benefit payments at the federal and state level, and should also provide greater availability of POS debit card terminals (and thereby promote further the ongoing shift to electronic payments).

REFERENCES

- Bank Administration Institute. *Checking Account Usage in the United States*. Park Ridge, Ill.: Bank Administration Institute, September 1979.
- Bank for International Settlements. *Statistics on Payment Systems in the Group of Ten Countries*. Basle: BIS, December 1995.
- Barthel, Matt. "ATM Fees Rise for Usage at Customer's Bank," *American Banker*, September 17, 1993.
- Bauer, Paul W. "Efficiency and Technical Progress in Check Processing," Federal Reserve Bank of Cleveland *Economic Review*, vol. 29 (Quarter 3, 1993), pp. 24–38.
- _____, and Diana Hancock. "Scale Economies and Technological Change in Federal Reserve ACH Payment Processing," Federal Reserve Bank of Cleveland *Economic Review*, vol. 31 (Quarter 3, 1995), pp. 14–29.

- _____. "The Efficiency of Federal Reserve Check Processing Facilities," Finance and Economics Discussion Series (FEDS) #214. Washington: Board of Governors of the Federal Reserve System, 1992.
- Berger, Allen N. "The Economics of Electronic Funds Transfers," Working Paper. Washington: Board of Governors of the Federal Reserve System, October 1985.
- Board of Governors of the Federal Reserve System. *Functional Cost Analysis*. Washington: Board of Governors, 1991.
- Boeschoten, Willem C. *Currency Use and Payment Patterns*. Financial and Monetary Policy Studies, Vol. 23. Dordrecht, the Netherlands: Kluwer Academic Publishers, 1992.
- Caskey, John P., and Gordon H. Sellon, Jr. "Is the Debit Card Revolution Finally Here?" Federal Reserve Bank of Kansas City *Economic Review*, vol. 79 (Fourth Quarter 1994), pp. 79–95.
- Federal EBT Task Force. *Creating a Benefit Delivery System that Works Better & Costs Less*. Washington: GAO, May 1994.
- Food and Consumer Service. "EBT Report to Congress," U.S. Department of Agriculture, May 1995.
- Food and Nutrition Service. "Evaluation of the Off-Line Electronic Benefits Transfer Demonstration," U.S. Department of Agriculture, May 1994.
- Humphrey, David B. "Delivering Deposit Services: ATMs Versus Branches," Federal Reserve Bank of Richmond *Economic Quarterly*, vol. 80 (Spring 1994), pp. 59–81.
- _____. "Resource Use in Federal Reserve Check and ACH Operations after Pricing," *Journal of Bank Research*, vol. 16 (Spring 1985), pp. 45–53.
- _____, and Allen N. Berger. "Market Failure and Resource Use: Economic Incentives to Use Different Payment Instruments," in David B. Humphrey, ed., *The U.S. Payment System: Efficiency, Risk and the Role of the Federal Reserve*. Norwell, Mass.: Kluwer Academic Publishers, 1990.
- Kirlin, John A., Charles R. King, Elizabeth E. Davis, Christopher Jones, and Gary P. Silverstein. *The Feasibility of a Nationwide Electronic Benefit Transfer System for the Food Stamp Program*. Report for the U.S. Department of Agriculture, Food and Nutrition Service. Cambridge, Mass.: Abt Associates, Inc., April 1990.
- Mansfield, Edwin. *Managerial Economics*. New York: W. W. Norton & Company, 1996.
- Marjanovic, Steven. "N.Y., Mass. Eye Bills on Shift to Electronic Payments," *American Banker*, May 16, 1996.

- McAndrews, James J. "The Evolution of Shared ATM Networks," Federal Reserve Bank of Philadelphia *Business Review*, May/June 1991, pp. 3–16.
- Office of Technology Assessment. *Making Government Work: Electronic Delivery of Federal Services*. Washington: OTA, September 1993.
- Piskora, Beth. "U.S. Invites Bids on EBT in 7 Southern States," *American Banker*, March 17, 1995, p. 14.
- Robinson, Pål Erik, and Dag-Inge Flatraaker. "Costs in the Payments System," Norges Bank *Economic Bulletin*, vol. 66 (June 1995), pp. 207–16.
- Stix, Gary. "Welfare Plastic," *Scientific American*, vol. 271 (August 1994), pp. 84–87.
- U.S. General Accounting Office. *Government Check-Cashing Issues*. Washington: GAO, 1988.
- Vending Times*. Census of the Industry issue, vol. 33, August 1995.
- Walker, David A. "Economies of Scale in Electronic Funds Transfer Systems," *Journal of Banking and Finance*, vol. 2 (June 1978), pp. 65–78.
- Wells, Kirstin E. "The Social Costs of Paper and Electronic Payments," Master of Arts Thesis. Virginia Polytechnic Institute, 1994.
- Wood, John C., and Dolores S. Smith. "Electronic Transfer of Government Benefits," *Federal Reserve Bulletin*, vol. 77 (April 1991), pp. 203–17.