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1 **Consumers May Not Benefit from Wellhead Price Controls for Natural Gas**

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Wellhead price controls for natural gas may have resulted in higher consumer prices for the gas. Empirical evidence presented in this article suggests that one effect of regulating wellhead prices of natural gas has been to increase the difference between the wellhead and delivered prices of natural gas. This increased difference has been appropriated by pipeline companies (and, perhaps, other middlemen) and has been retained as profit or dissipated as a failure to minimize operating costs. If wellhead price controls have resulted in a sufficiently larger gap between wellhead and delivered prices, consumers are paying a higher price for natural gas than they would in a free market.

12 **The Economic Impact of Tighter U.S. Border Security**

John K. Hill

By reducing the volume of illegal immigration, a policy of tighter border security will lower the overall level of real income and reduce the degree of income inequality among legal residents of the United States. As a general rule, a host country benefits from an inflow of foreign labor, no matter how skilled that labor is. Although this principle can lose validity if immigrants contribute less in taxes than they receive in social benefits, this does not appear to be the case for the majority of undocumented aliens. A policy of stronger border enforcement will benefit the least skilled members of the U.S. labor force, however.

Consumers May Not Benefit from Wellhead Price Controls on Natural Gas

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Although wellhead prices for most sources of natural gas were deregulated by 1985, important exceptions remain. In fact, nearly half of the domestically produced gas purchased by interstate pipeline companies during 1984 came from reserves scheduled to remain under price controls indefinitely.

Moreover, consumer opposition to further decontrol remains a formidable obstacle to any new legislation that would completely deregulate natural gas prices at the wellhead. Opposition apparently is based largely on the concern that consumer prices for natural gas would rise. This concern could be misplaced, however, because it is not clear that the existing wellhead price controls have reduced consumer prices for natural gas.

Regulating natural gas prices at the wellhead does not guarantee that consumers face lower prices for the gas because there are at least two levels at which transactions occur between the wellhead and the consumer. The first level is a sale

from the producer to a "middleman."¹ The second is from the middleman to the consumer. For consumers to receive any benefit from wellhead price controls for natural gas, reduced wellhead prices must be passed forward through middlemen to consumers in the form of a lower delivered price.

In previous studies of natural gas price controls, it was assumed implicitly that government regulation forced middlemen to pass these benefits forward to consumers.² Middleman companies were presumed to deliver gas at the average wellhead price plus an efficient transportation charge. Empirical evidence presented here, however, suggests that this assumption does not hold. Specifically, the difference between the wellhead price and the

The views expressed are those of the author and do not necessarily reflect the positions of the Federal Reserve Bank of Dallas or the Federal Reserve System.

1. Natural gas middlemen are collection, transportation (pipeline), and distribution (local utilities) companies.
2. See Stephen P. A. Brown, "Will Deregulating Natural Gas Increase Its Price to Consumers?" *Economic Review*, Federal Reserve Bank of Dallas (July 1983): 1-9; and Assistant Secretary for Policy Safety and Environment, U.S. Department of Energy, *Increasing Competition in the Natural Gas Market*, U.S. Government Printing Office DOE/PE-0069 (Washington, D.C.: January 1985).

delivered price of natural gas is shown to be greater than that required to transport the gas efficiently from the wellhead to the consumer. This inflated difference has been appropriated by pipeline companies (and, perhaps, by other middlemen) and either has been retained as profit or dissipated as a failure to minimize operating costs. In short, government regulation has been less than completely effective in shifting forward to consumers the benefits of controlling wellhead prices of natural gas. Consequently, consumers may be paying more for natural gas and consuming less of it than they would in the absence of any wellhead price controls.

Regulated wellhead prices for old gas and the market for natural gas

Before 1978, wellhead prices for all domestically produced natural gas sold in the interstate market were controlled by federal regulation. Natural gas sold in intrastate markets was not subject to federal regulation. The Natural Gas Policy Act of 1978 (NGPA) brought two important changes to federal regulation of natural gas prices. First, the NGPA brought all domestically produced natural gas under wellhead price controls. Second, it provided for the eventual decontrol of most natural gas—some almost immediately, the bulk on January 1, 1985, and a small amount in 1987. Nevertheless, as shown in Table 1, nearly half of the domestically produced gas purchased by interstate pipeline companies during 1984 came from reserves that are scheduled to remain under price controls indefinitely.

Under the NGPA, production from sources commonly known as "old gas" will remain under price controls indefinitely.³ And although the share of the market taken by old gas gradually will be reduced over time as reserves of this gas are exhausted, a recent study by the U.S. Department of Energy indicates that price-controlled gas will remain an important factor in the interstate market for natural gas through at least 1995.⁴ Under the NGPA,

3. When enacted, the Natural Gas Policy Act of 1978 created over 20 categories of natural gas to which different ceiling prices were applied. For purposes of analysis these categories are lumped together into three major groups, identified in Table 1—old gas, new gas and high-cost gas.

4. See *Increasing Competition in the Natural Gas Market*.

Table 1
NATURAL GAS PURCHASES OF MAJOR INTERSTATE PIPELINE COMPANIES DURING 1984

Analysis Category	Purchases (Billions of cubic feet)	Average wellhead prices (Dollars per thousand cubic feet)	Deregulation date
Old gas	4,223	1.45	never
New gas	3,795	3.66	1/1/85*
High-cost gas	844	5.37	11/1/79
Miscellaneous	10	2.77	—
All gas**	8,829	2.78	

* Also includes some gas that will never be deregulated or that will be deregulated 1/1/87.

** Total does not agree in original source.

SOURCE: U.S. Department of Energy, *Natural Gas Monthly*.

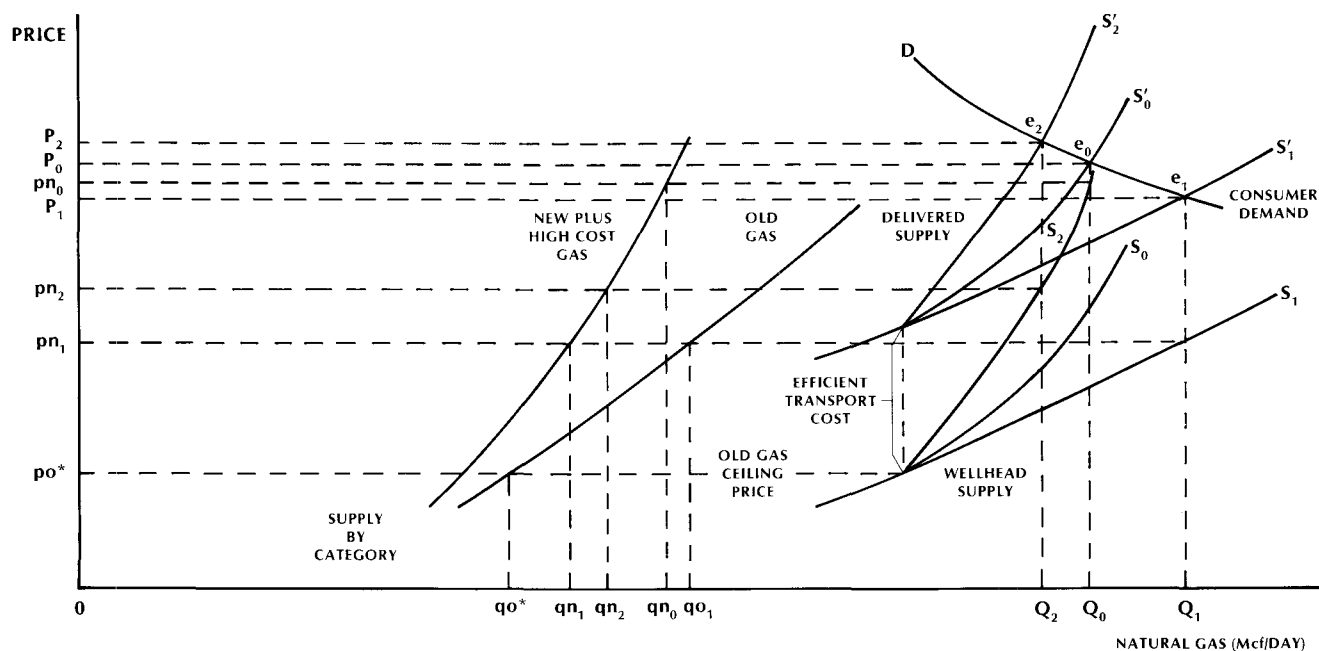
however, price controls for gas identified here as high-cost gas were either set well above market prices or lifted shortly after passage of the act. In addition, price ceilings for "new gas" were increased gradually until January 1, 1985, when wellhead price controls for new gas were lifted.

New and high-cost sources of gas—sources that are now exempt from price controls—are important in determining the effect of the remaining regulation. The existence of unregulated categories of gas—for which price can rise without limit—allows the overall market for natural gas to clear.

Price controls generally are thought to result in a shortage at a price below the market-clearing level. Regulation under the NGPA, however, cannot lead to both lower consumer prices and decreased production because this act allows the overall market for natural gas to clear. Consequently, regulation of old gas yields a lower consumer price only if the total supply of natural gas is increased. If regulation decreases total supply, a higher consumer price for natural gas must result.

The NGPA has set the ceiling on wellhead prices for old gas below the market-clearing level. The result is that wellhead purchasers (middlemen) are not able to buy all the old gas they want at the regulated price. They must leave the old-gas market with an excess demand for gas. Middlemen that are unable to buy all the old gas desired will enter the

Figure 1
The Market For Natural Gas—
Under the Assumption that the Quantity of Old Gas Supplied is Relatively Responsive to Its Price



market for new and high-cost gas, adding to demand for those categories and thereby raising these gas prices.

Nevertheless, the price ceiling on old gas yields a rent to the middlemen purchasing it.⁵ The final disposition of this rent is critical in determining the effect of the NGPA in the natural gas market. If natural gas middlemen fully retain this rent as profit or dissipate it as increased costs, the price of delivered gas will reflect only the prices paid for uncontrolled gas. In this case, the NGPA, in effect, acts to reduce the total supply of gas and the result is increased consumer prices and decreased production of natural gas. If middlemen neither retain the rent as profits nor dissipate it as increased costs,

however, consumer prices for natural gas may be either higher or lower than would prevail in a free market. In such a case, the total quantity of gas supplied will be, respectively, lower or higher than in the absence of regulation.

Graphical analysis permits a more careful examination of the possible effects of price controls on old gas. Two polar cases are considered. While these cases represent extremes, they, nevertheless, provide insights to the effects of the NGPA. In the first case, middlemen retain as profit all of the rent from their purchase of price-controlled old gas or dissipate it as higher costs. In the second case, middlemen pass all of this rent forward to consumers.

An unregulated market for natural gas. For a graphic depiction of the effect of price controls under the NGPA, it is useful to consider the case in which there are no price regulations. This establishes a benchmark against which the effects of wellhead price controls on old gas are judged. In the absence of price controls, the wellhead supply

5. This rent is the difference between the controlled price of old gas and the market value of that gas. The market value of old gas is the price of those sources which provide the last increment of gas under the NGPA—new and high-cost gas.

of natural gas would be the sum of "old," "new" and "high-cost" gas brought forth at every wellhead price (shown as S_1 in Figures 1 and 2)⁶:

$$(1) \quad Q_s = qo(pn) + qn(pn)$$

in which

- Q_s = total quantity of gas supplied
- qo = quantity of old gas supplied
- qn = quantity of new and high-cost gas supplied
- pn = wellhead price of new and high-cost gas.

Delivered supply (shown as S'_1) equals wellhead supply plus the efficient delivery cost required by natural gas middlemen to collect, transport and distribute the gas. Given consumer demand (shown as D in Figures 1 and 2), a market-clearing price and quantity of delivered gas is obtained (at P_1 , Q_1 in either figure).

Regulated market, middlemen retain rent. The NGPA has established a ceiling on wellhead prices for old gas that is below the market-clearing level. As previously discussed, this price ceiling on old gas yields a rent to the middlemen purchasing it. If this rent is not passed forward to consumers, the price that consumers pay for gas will be higher and the total quantity of natural gas consumed will be lower than if the natural gas market was unregulated.

With a price ceiling on old gas (shown as po^* in Figures 1 and 2), its production is reduced (to qo^*). Middlemen purchasing regulated old gas receive rent from access to this gas at below market prices. This rent is the difference between the ceiling price and the value that old gas has in the market. Under the NGPA, the market value of old gas is the price that producers of unregulated new and high-cost gas can command (when old gas is regulated) because these unregulated sources of gas provide the last increment of gas under the NGPA. If natural gas middlemen wholly retain this rent as profit or dissipate it as increased costs, they must sell all gas delivered to consumers on the basis of the price paid for uncontrolled sources of gas:⁷

$$(2) \quad Q_s = qo^* + qn(pn);$$

in which

- qo^* = quantity of old gas supplied at the price ceiling po^*

The result is that total supply is reduced below its free-market level (from S_1 to S_2 in Figures 1 and 2)

and consumers pay a higher price for natural gas (up from P_1 to P_2). This increased consumer price reflects the intersection of the demand curve (D) with the delivered supply curve (S'_2). The total quantity of gas consumed falls (from Q_1 to Q_2). The price received by producers of new and high-cost gas rises somewhat (from pn_1 to pn_2) and their production of this gas is stimulated (from qn_1 to qn_2).

Regulated market, middlemen pass rent forward.

If middlemen companies act to maximize sales or if regulation is successful in restricting the tariff charged by middlemen to a normal profit plus the efficient cost of delivering natural gas, the benefits of wellhead price controls for old gas will be passed forward to consumers. Under these circumstances, it generally is presumed that middlemen sell gas to consumers at the average wellhead price plus a competitive delivery charge:

$$(3) \quad P_d = t + (po^* \cdot qo^* + pn \cdot qn)/(qo^* + qn)$$

in which

- P_d = delivered price of gas
- t = competitive collection, transportation and distribution charge.

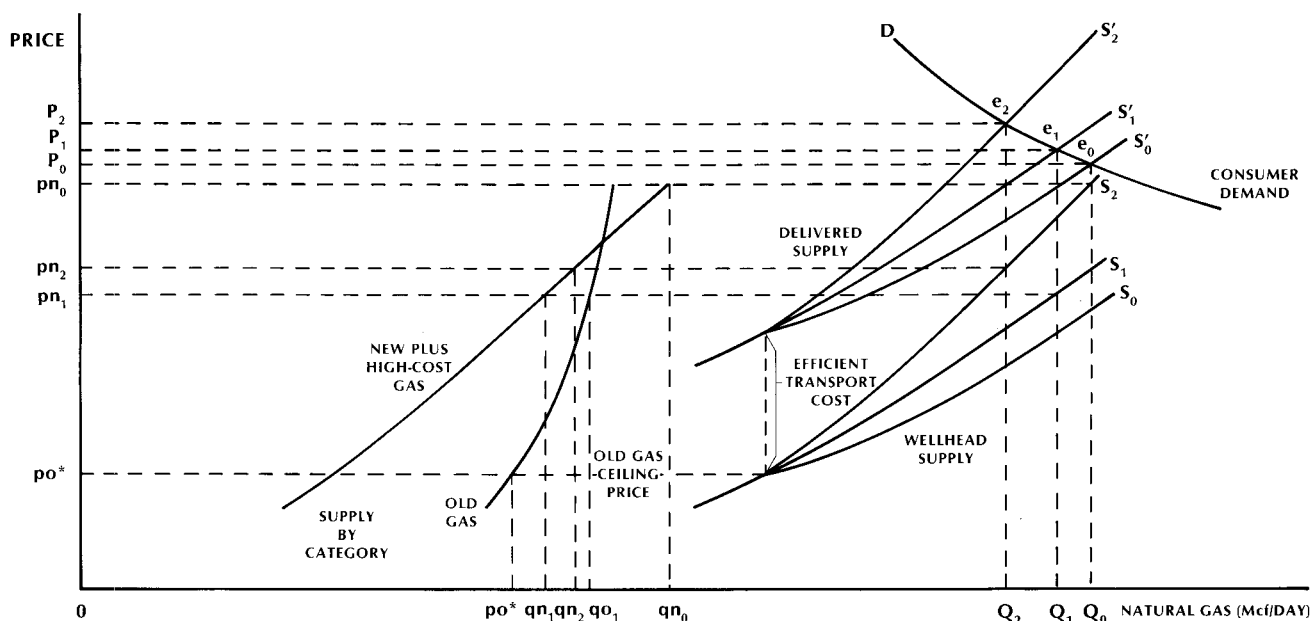
In this case, the market acts as though each point on the wellhead supply curve of gas is the quantity-weighted average of the prices for regulated and unregulated gas.

Under average cost pricing, the effect on consumer prices of regulating the price for old gas depends on the elasticity of supply of old gas relative to that of new and high-cost gas. If the quantity of old gas supplied is relatively responsive to changes in price while the quantity of new and high-cost gas supplied is not, regulating old gas will result in higher consumer prices for natural gas than if wellhead prices are unregulated. In contrast, if

6. Figures 1 and 2 illustrate different assumptions about the elasticities of supply for old, new and high-cost gas. The effect of these differences will be explained later in this section. At this point in the text, the analysis does not depend upon the elasticities of supply and it is not instructive to distinguish between Figures 1 and 2.

7. This method of pricing can be described as "marginal cost pricing" because the price charged to consumers for natural gas is based upon wellhead prices for marginal sources of gas.

Figure 2
The Market For Natural Gas—
Under the Assumption that the Quantity of Old Gas Supplied is Relatively Unresponsive to Its Price



the quantity of new and high-cost gas supplied is relatively responsive to changes in price while the quantity of old gas supplied is not, regulating old gas will result in lower consumer prices for natural gas than if wellhead prices are unregulated. Studies of natural gas supply conditions are not in uniform agreement so both cases bear examination.⁸

Figure 1 illustrates the case in which the quantity of old gas supplied is relatively more responsive to changes in price than is the quantity of new and high-cost gas supplied. With the wellhead price for old gas controlled at p_0^* , the increased production of new and high-cost gas is less than the decrease in old gas production. As a result, supply is shifted inward from its free-market construction (from S'_1 to S'_0), but the shift is not as severe as the case in which marginal cost pricing prevails. The inward shift in supply results in a higher price for delivered gas (P_0) and a smaller quantity of gas consumption (Q_0) than would result in a free market. Never-

theless, the price is lower and the quantity is greater than would prevail under marginal cost pricing. New and high-cost gas receive a much higher price (pn_0) than if middlemen retained the rent and, consequently, production from these reserves is greatly

8. A recent Department of Energy study argues that new and high-cost gas are relatively unresponsive to the higher prices that they receive when old gas is regulated. Because natural gas is an exhaustible resource, high prices for new and high-cost gas generally signal expectations of higher prices for these resources in the future. Although a higher time path of prices generally will advance production of an exhaustible resource forward in time, this will not increase substantially the quantity of new and high-cost gas brought forth in any given time period. While this argument has theoretical merit, the empirical evidence is insufficient to be conclusive. See *Increasing Competition in the Natural Gas Market*.

expanded (to qn_0).⁹

Figure 2 illustrates the case in which the quantity of old gas supplied is relatively less responsive to changes in price than is the quantity of new and high-cost gas supplied. With the wellhead price for old gas controlled at po^* , the production increase in new and high-cost gas is greater than the decrease in old gas production. As a result, supply is shifted outward from its free-market construction (from S'_1 to S'_0). The shift in supply results in a lower price for delivered gas (P_0) and greater gas consumption (Q_0) than if all wellhead prices for natural gas were unregulated. New and high-cost gas would receive a much higher price (pn_0) than if middlemen retained the rent and, consequently, production from these reserves is greatly expanded (to qn_0).

Middlemen and the NGPA. As detailed above, middlemen have an important role in determining the effect of the NGPA on consumer prices. Table 2 presents a comparison of the effects of the NGPA under two assumptions about middleman behavior. If middlemen retain as profits, or dissipate as costs, any of the rent accorded them through purchases of price-controlled natural gas, consumer prices for natural gas are increased. If middlemen retain or dissipate all of this rent, consumer prices are higher than would prevail in a competitive market with unregulated wellhead prices.

There may not be sufficient competition between middlemen, however, to assure that wellhead deregulation will lead to lower consumer prices for natural gas. Pipeline companies which own government franchises for the transportation of gas along specific routes act as marketing agents (buying and reselling most gas). As a result of their franchises,

pipeline companies have monopsony buying power in some production regions and monopoly selling power in some consumption regions. Furthermore, gas utilities own government franchises to distribute natural gas in particular regions or locales, giving each monopoly selling power. To reduce consumer prices for natural gas, competition between middlemen may have to be fostered.

Natural gas middlemen are in a position to capture the rent resulting from wellhead regulation of natural gas prices for two reasons. First, federal and state governments have reduced potential competition between middlemen by restricting entry into the market. Second, middleman activities include buying natural gas from producers, owning it, and selling it to consumers. If middlemen were competitive and their activity was confined to collecting, transporting and distributing natural gas, they would be unable to capture the rent associated with purchases of price-controlled gas.

Regulation of natural gas middlemen

In theory, government regulation may force natural gas middlemen to sell gas to consumers at a price that represents the sum of the average wellhead price, efficient transportation costs, and normal profit. In fact, although they are regulated by federal and state governments, middleman companies in the natural gas market may neither minimize the cost of delivering natural gas to the consumer nor be restricted to a normal profit. The economics literature provides ample evidence that firms that have some market power or economic rent will have little incentive to minimize cost when facing effective regulation of their rates of return.¹⁰ Furthermore, a recent study by Philip Fanara and David Sweet suggests that federal rate-of-return regulation has not completely prevented interstate pipeline companies from pursuing economic profit.¹¹

9. In both Figures 1 and 2, S_0 and S_2 are constructed such that for a given quantity of gas, the average wellhead price is shown along S_0 and the price of the marginal sources of gas is shown along S_2 . New and high-cost gas are the marginal sources of gas. Hence, the price received for these sources of gas is shown along S_2 .

By construction, each point on the supply curve S_0 represents a downward shift from a point on the supply curve S_2 . For a given quantity of gas, each point along S_2 represents the wellhead price for the marginal source of gas. For the same quantity of gas, the corresponding point along S_0 represents the weighted-average price for the marginal (or unregulated) source of gas and the regulated source of gas. See equation 3.

10. See J. R. Hicks, "Annual Survey of Economic Theory: The Theory of Monopoly," *Econometrica* (January 1935); and Harvey Averch and Leland L. Johnson, "Behavior of the Firm under Regulatory Constraint," *American Economic Review* (December 1962): 1052-1069.

11. See Philip Fanara, Jr., and David M. Sweet, "What Do Regulated Firms Maximize? Some Empirical Evidence From the Natural Gas Industry," *The American Economist* (Spring 1984): 44-48.

Table 2
**THE EFFECTS OF THE NATURAL GAS POLICY ACT
 UNDER VARIOUS ASSUMPTIONS ABOUT MIDDLEMAN
 PRICING BEHAVIOR**

	Natural Gas Policy Act vs. Unregulated Wellhead Prices		Marginal Cost Pricing vs. Average Cost Pricing (Under the NGPA)
	Marginal cost pricing	Average cost pricing	
The effect on			
Wellhead prices for old gas . . .	lower	lower	the same
Production of old gas	lower	lower	the same
Wellhead prices for new and high-cost gas	higher	higher	lower
Production of new and high-cost gas	higher	higher	lower
Total gas production	lower	lower or higher*	lower
Consumer prices for delivered gas	higher	higher or lower*	higher

* Depends on the elasticity of supply of old gas relative to those for new and high-cost gas. If the supply of old gas is sufficiently elastic, the total production of gas will be lower and the consumer price of gas will be higher. If the supply of old gas is more inelastic, the total production of gas will be higher and the consumer price of gas will be lower.

Not all the economic rent captured by natural gas middlemen need necessarily become corporate profits. Firms possessing some market power or economic rent have little incentive to minimize cost when facing regulation of their rates of return.¹² Furthermore, as Gordon Tullock and Richard Posner have pointed out, obtaining and protecting the ownership of economic rent can consume that rent.¹³ In addition to competing to obtain rents, middleman companies can be expected to raise a defense of their rent ownership that could cost up to as much as the expected value of successfully defending the rent.¹⁴

Lobbying is one form of rent protection. Financial contributions of the pipeline and gas utility industries to lobbying organizations—such as the American Gas Association and the Interstate Natural Gas Association of America—provide some casual evidence that these companies obtain rents. It should be noted, however, that the rents motivating the lobbying efforts of these particular organizations may not arise from controls on wellhead prices of natural gas.

In addition to dissipating as costs the rent associated with access to price-controlled gas, middlemen may retain some rent as profits. Two avenues appear open for retention of this rent. First, middlemen may retain rents as above-normal profits on their own books. Second, these rents may appear as profits for the unregulated affiliates of the middlemen.

12. An often suggested way in which a utility with a regulated rate of return may raise costs is through over-capitalization. In the economics literature, this activity is known as the Averch-Johnson effect. See Harvey Averch and Leland L. Johnson, "Behavior of the Firm under Regulatory Constraint."

13. See Gordon Tullock, "The Welfare Costs of Tariffs, Monopolies and Theft," *Western Economic Journal*, 5 (June 1967): 224-32 and Richard A. Posner, "The Social Costs of Monopoly and Regulation," *Journal of Political Economy*, 83 (August 1975): 807-27.

14. The efforts of natural gas producers to eliminate ceilings on the price of old gas also would contribute to the social cost of price controls.

Fanara and Sweet have argued that the Federal Energy Regulatory Commission (FERC) has not prevented pipeline companies from pursuing economic profits.¹⁵ Although the FERC has the power to initiate its reviews of pipeline tariffs, the commission's workload has meant that reviews generally only come at the request of pipeline companies. Pipeline companies usually request reviews to seek permission to increase their tariffs. In fact, in examining the relationship of executive compensation in interstate pipeline companies to company profit and sales, Fanara and Sweet find empirical evidence that these firms pursue both profit and sales as management objectives.¹⁶

Vertical integration with related but unregulated activities is another way in which rent can be captured as profits. Once a company is vertically integrated, transactions that enhance the profitability of affiliates can be made "at-less-than-arm's-length." For example, rents obtained from purchases of regulated gas may be used to support higher than market prices for unregulated gas purchased from an affiliated production company.¹⁷ In addition, a regulated middleman may offer gas to its gas-using affiliates at lower than market prices. This may explain the extent to which pipeline companies recently have become vertically integrated through holding companies.¹⁸

Government regulation of middlemen does not assure that the potential benefits of regulating wellhead prices of natural gas are passed forward to consumers. Middlemen may retain or dissipate the rent associated with their purchases of price-controlled gas in various ways. Consumers likely pay

a price for delivered natural gas that is greater than the sum of: the cost for a cost-minimizing middleman to deliver the gas from the wellhead to the consumer, the normal profit on an efficiently determined level of middleman capital, and what the average wellhead price of natural gas would be if middlemen had no affiliates. Furthermore, the wide variety of avenues open to middlemen for retaining or dissipating the rent associated with their purchases of price-controlled gas suggests that examining their reported profits for evidence of the rent could be misleading.

Empirical evidence of pipeline retention and dissipation of rent

There are three types of middlemen in the natural gas market—collection companies that gather gas in the field, distribution companies (utilities) that distribute gas to final users, and pipeline companies that transport gas from the field to the utilities.¹⁹ Ideally, an examination of middleman rent retention would investigate all three types of middlemen. The present empirical inquiry has been limited to interstate pipeline companies because federal regulation has resulted in a uniform data set for these pipeline companies.

Although the reported profits of natural gas middlemen may not be indicative of actual rent retention or dissipation, any rent that middlemen do retain or dissipate should remain evident in the difference between the delivered price of gas and the wellhead price of gas that would prevail if middlemen were unable to buy unregulated gas from affiliated production companies. For pipeline companies, rent retention and dissipation would be evidenced in the difference between the price they pay producers and other pipelines for gas, and the price at which they sell gas to distribution companies and other pipelines.

Passage of the NGPA in 1978 endowed pipeline companies with varying contractual rights to buy price-controlled gas during the succeeding years. Differences in these endowments have contributed to variation in the average wellhead price of gas across pipeline companies. If interstate pipeline companies generally retain or dissipate the rent associated with access to low-cost gas, other things being equal, those firms endowed with greater access to low-cost natural gas should claim a greater mark-up between wellhead prices and delivered

15. See Philip Fanara, Jr., and David M. Sweet, "What Do Regulated Firms Maximize? Some Empirical Evidence From the Natural Gas Industry."

16. *Ibid.*

17. Preliminary 1984 data from "Purchase Gas Adjustment Filings" filed with the Federal Energy Regulatory Commission show that all reporting interstate pipeline companies paid a higher average price for gas purchased from affiliated companies than for gas from unaffiliated companies.

18. Both natural gas price regulation and the vertical integration of pipeline companies with related activities predate passage of the NGPA.

19. Some pipeline companies collect gas at the wellhead and some distribute gas to final consumers.

prices than those with poorer access. Thus, there will be an inverse relationship across firms between the mark-up each pipeline company claims for transporting the gas and the average price at which each purchases gas.

Of course, transportation costs also contribute to the inverse relationship between purchase prices and mark-ups. In a competitive market, natural gas that is farther from its consumption market can be expected to have both a higher transportation cost and lower purchase price than a competing source of gas. Therefore, any empirical investigation must control for transportation distance. Stated more precisely, pipeline company rent retention would be indicated by an inverse relationship across firms between the mark-up each charges for gas and the average price that each pays for gas, when the distance of transporting that gas to market and other variables are held constant:

$$(4) \quad M_i = f(P_i, D_i, O_i)$$

in which

- M_i = charge that pipeline company i commands for transporting the gas
- P_i = price the company paid for gas in a given year
- D_i = distance that the pipeline transports the gas to market
- O_i = other determinants of the mark-up.

Evidence that pipeline companies retain or dissipate the rent associated with their purchases of price-controlled gas is provided by a negative relationship between mark-up and the price that pipelines pay for gas ($\partial M_i / \partial P_i < 0$). A positive relationship between the mark-up and the transportation distance would be expected ($\partial M_i / \partial D_i > 0$).

A linear regression provided econometric evidence that pipeline companies retain or dissipate at least some of the rent associated with their purchases of price-controlled gas. This regression used pooled annual data for 31 interstate pipeline companies and four of the years (1980 through 1983) following implementation of the NGPA.²⁰ Dummy variables were included to allow for changes in the market for natural gas between years that affected all firms equally.²¹ In addition, because FERC regulates pipeline company production of gas differently than purchases, a variable for self-production also was included.²² The regression was

specified as:²³

$$\begin{aligned} \text{MARKUP}_i &= .248 + .013 D81_i + .078 D82_i \\ &\quad (4.87) \quad (.42) \quad (2.47) \\ &+ .140 D83_i - .092 AWP_i + .0033 DIST_i \\ &\quad (4.32) \quad (-2.84) \quad (4.11) \\ &- .385 PCP_i + e_i \\ &\quad (-2.92) \\ R^2 &= .31 \end{aligned}$$

in which

MARKUP_i = difference between the average real price at which a pipeline sold gas to distribution companies and other pipeline companies in a given year and the average real price it paid for gas in that year.²⁴

AWP_i = average real price that a company paid for gas in a given year. It includes wellhead purchases, purchases from other companies (including other subsidiaries of its corporate parent) and imports.

$DIST_i$ = proxy for the distance that the pipeline transports the gas to market. The proxy was computed as the gas consumed in transmission divided by

20. Because data for 1985 are not yet available, the current effect of the NGPA must be inferred from data representing periods in history during which the act provided more extensive price controls.

With the exception of price deflators, annual data for all variables for each company were compiled from Federal Energy Regulatory Commission (FERC) Form No. 11, "Natural Gas Pipeline Company Monthly Statement." Prices were deflated with the implicit GNP deflator.

21. Among the possible changes in the natural gas market which might have affected all firms equally are changes in the prices of competing fuels or changes in regulation.

22. Self-production means production owned by the pipeline company. It does not include purchases from affiliates.

23. Figures shown in parenthesis are t statistics. An F statistic of .43 (with 9, 108 degrees of freedom) justified pooling the data across the four years.

24. Inquiry was limited to sales for resale to avoid the consideration of distribution costs for pipeline companies that have retail customers.

the square root of the total volume transported by the pipeline company.²⁵

PCP_i = percentage of total gas obtained by a pipeline that is produced from reserves that the pipeline company itself owns. This variable excludes purchases of gas from production companies owned by the pipeline's corporate parent.²⁶

$D81_i$ = dummy variable for observations in 1981.

$D82_i$ = dummy variable for observations in 1982.

$D83_i$ = dummy variable for observations in 1983.

As shown by the coefficients, the empirical evidence supports the theory that pipeline companies retained or dissipated at least some of the rent associated with their access to price-controlled gas.²⁷ The coefficient on AWP_i is negative and significant at better than the 99-percent level. In addition, the transportation distance variable is signifi-

cant at better than the 99-percent level, providing confidence that the regression differentiates between rent and transportation costs. The yearly dummy variables indicate that the real mark-up on natural gas has increased over time, indicating some structural change in the natural gas market. This change may indicate that regulation has become less effective in restraining pipeline companies from capturing the rent.

The portion of the rent that all middlemen capture remains an open question. A coefficient of -1 on AWP_i would imply that pipeline companies retain or dissipate all of the rent themselves. A coefficient closer to zero than -1 , such as found here, implies that pipeline companies do not retain or dissipate all of the rent in their own operations. Nevertheless, it is doubtful that much of the remaining rent reaches consumers.²⁸ Pipeline company affiliates and other middlemen may retain or dissipate some of the rent.

Conclusion

From the available evidence, it appears that natural gas middlemen benefit from wellhead price controls on some sources of natural gas. Federal control of wellhead prices for natural gas yields economic rent to middlemen that are able to purchase price-controlled gas. Government regulation of natural gas middlemen has not been effective in shifting all of this rent forward to consumers. Econometric evidence presented here indicates that at least some of this rent is retained or dissipated by pipeline companies. Additional portions of the rent may be retained in unregulated affiliates of pipeline companies. Collection and distribution companies also are likely to retain or dissipate some of the rent.

Furthermore, the available evidence suggests that consumers may not benefit from the current wellhead price controls on natural gas. A recent Department of Energy study finds that the current

25. Gas is used as the fuel for the compressors that push gas along the pipeline. The amount of fuel used in shipping gas is proportional to both the distance the gas is pushed and the resistance that the pipeline has to gas being pushed through it. Because resistance is a function of the wetted surface area of the pipeline, resistance increases in proportion with the square root of volume. Hence, gas used divided by the square root of the total volume of gas pushed through the pipeline is proportional to the distance the gas is pushed.

26. Unfortunately, the data used do not identify purchases from, or sales to, companies affiliated with the pipelines. This data limitation prevents consideration of one means in which pipeline companies could retain and hide rent. Consequently, the test reported here is less likely to reveal pipeline retention of rent than is actually the case.

27. Similar results were found with a regression in which the transportation proxy was constructed to reflect difficulty rather than distance. See S. P. A. Brown, "Natural Gas Pipelines: Rent Revealed," *The Energy Industries in Transition: 1984-2000, Proceedings of the Sixth Annual North American Conference of the International Association of Energy Economists* (San Francisco: November 1984).

28. Some rent may be passed forward to consumers. In the recent past, higher wellhead prices were paid for some sources of natural gas than any customers were charged for gas. However, pipeline company motives for such purchases need closer examination before this evidence is considered conclusive.

price controls have resulted in a higher average wellhead price of natural gas than would prevail in an unregulated market.²⁹ In addition, any of the rent retained or dissipated by middlemen serves to widen the gap between delivered and wellhead prices of natural gas. If an insufficient amount of this rent has been passed forward to consumers, these users

are paying higher prices for natural gas than would prevail in a free market regardless of whether price controls have resulted in a higher average wellhead price of gas.

29. See *Increasing Competition in the Natural Gas Market*.

The Economic Impact of Tighter U.S. Border Security

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From 1981 through 1985, the Immigration and Naturalization Service (INS) received a cumulative, real budget increase of 34 percent. The bulk of this increase has been aimed at improving the INS' ability to prevent the illegal entry of aliens into the United States. In its 1985 budget, for example, the Reagan administration proposed an increase of 1,000 positions to strengthen immigration control along the Southwestern border. This represents an annual increase of some 33 percent in the INS border patrol division. The purpose of this article is to discuss the impact of tighter border security on the economic welfare of legal U.S. residents.

Efforts to reduce the supply of immigrant labor through stronger border enforcement will meet with limited success. Because of the vastness of the U.S. border, to significantly raise the cost of a successful entry will be difficult. Since many immigrants make several border crossings in a lifetime, it also is necessary to consider the effect of tighter border security on the amount of reverse migration.

Although all immigrants will be encouraged to reduce their number of crossings, many also may respond by increasing the amount of time spent per visit in the United States.

To the extent that INS efforts are successful, U.S. national income likely will fall with a reduction in the supply of immigrant labor. This occurs partly because of a general tendency for a host nation to benefit from any international movement of resources and partly because those who immigrate illegally do not appear to be a net drain on the public treasuries. Among legal residents of the United States, the principal beneficiaries of reduced immigration will be low-skilled workers. High-skilled workers and some owners of farmland will suffer. A policy of more vigorous border enforcement then will amount to a tradeoff of some economic efficiency for a more equal distribution of national income.

Effect on immigrant labor supply

Stronger border enforcement ultimately should reduce the number of illegal aliens seeking employment in the U.S. at any moment in time. Migration is economically worthwhile when the present discounted value of future earnings in the destination

The views expressed are those of the author and do not necessarily reflect the positions of the Federal Reserve Bank of Dallas or the Federal Reserve System.

country exceeds the sum of the cost of migrating and the present discounted value of earnings in the home country. By raising the cost of migrating, tighter border security reduces the number of individuals for whom migration is economical.

What is less certain is the degree to which the recent (or any given) build-up in border enforcement will reduce the immigrant working population. First, it is difficult to gauge how much an increase in border manpower will affect the cost of migrating. An added uncertainty derives from a rather unique aspect of much illegal immigration. The traditional view assumes that the decision to migrate is permanent. Much of the migration from Mexico is temporary, however. In a 1976 study by David S. North and Marion T. Houston, respondents had made an average of 4.5 trips to the U.S. in the five years prior to the survey.¹ When assessing the labor market impact of tighter border policy, it is necessary to know not only how immigrants will respond in terms of the number of border crossings, but also in terms of the amount of time they spend in the United States per visit.²

By raising the cost of migrating, a stronger border policy should reduce the number of trips made by an average immigrant. This is difficult to test directly, but there is indirect evidence if distance is

used as a proxy for travelling costs. In the North and Houston survey, non-Mexican respondents, who faced greater distances in migrating, averaged only 1.5 trips in a five-year period as opposed to the 4.5 trips cited earlier for Mexican respondents.³

There also will be an incentive, however—at least for those who continue to migrate—to spend more time in the United States per visit if crossing the border becomes more difficult. And there is some indirect evidence to support this kind of reaction. Viewing distance as a proxy for the cost of migrating, Jorge Bustamante (1977) finds that Mexicans from border states stay in the United States a shorter period of time per visit than those from the interior.⁴ Or, if we use legal status as a measure of migration costs, Joshua Reichert and Douglas Massey (1979) find that, among those sampled, the legal migrant workers had stayed an average of 9.4 months during their last visit to the United States while the illegal workers had stayed an average of 12.4 months.⁵

What is crucial to the labor market impact of stronger border enforcement is the extent to which an immigrant's lifetime work effort in the United States is affected. Some migrants will find it totally prohibitive to seek U.S. employment if a serious effort is made to tighten border security. Others, however, while reducing their number of border crossings, may lengthen the amount of work time in the United States per trip. On balance, a stronger border policy is unlikely to increase the number of illegal immigrants working in the U.S. at any point in time. But it is possible that such efforts may not substantially reduce it.

In order to assess the economic impact of reduced immigration, it is necessary to know the skill

1. David S. North and Marion T. Houston, *The Characteristics and Role of Illegal Aliens in the U.S. Labor Market: An Exploratory Study* (Washington, D.C.: Linton and Co., 1976).

2. These ideas are more formally developed in John K. Hill, "Immigrant Decisions Concerning Length of Stay and Frequency of Visit," Federal Reserve Bank of Dallas Research Paper no. 8502 (May 1985). The immigrant is assumed to maximize life-cycle utility by choosing the fraction of his lifetime work effort he will spend in, and the number of trips he will make to, the United States. Utility depends upon lifetime income net of travelling costs, lifetime work effort in the home country, and the number of trips. Because of a preference for home country residence, total time spent working at home and the number of trips are both "goods."

Tighter border security affects the immigrant by raising the cost of making each trip. The number of border crossings falls. The effect on total time allocated to working in the United States is ambiguous, however. The substitution effect associated with an increase in travelling costs is of unknown sign, depending upon whether total time spent in the home country is complementary with, or substitutable for, frequency of visit. The income effect encourages the immigrant to spend more time working in the United States.

3. North and Houston, *Characteristics of Illegal Aliens*, 86.

4. Jorge A. Bustamante, "Undocumented Immigration from Mexico: Research Report," *International Migration Review* 2 (1977): 149-177; reprinted in Richard C. Jones, ed., *Patterns of Undocumented Migration: Mexico and the United States* (Totowa, N.J.: Rowman and Allanheld, 1984): 15-32.

5. Joshua S. Reichert and Douglas S. Massey, "Patterns of Migration from a Mexican Sending Community: A Comparison of Legal and Illegal Migrants," *International Migration Review* 13 (1979): 599-623; reprinted in Richard C. Jones, ed., *Patterns of Undocumented Migration: Mexico and the United States* (Totowa, N.J.: Rowman and Allanheld, 1984): 15-32.

content of those workers who would be excluded from the U.S. labor force. The more dissimilar the distributions of skills among excluded immigrants and legal U.S. workers, the more of an adjustment that will be required in relative factor prices, in general, and in the structure of wages, in particular. Shown in Table 1 are occupational breakdowns for illegal Mexican aliens working in the United States and for all individuals employed in the United States. The table clearly shows a contrast between the high concentration of Mexican aliens in low-skilled, blue-collar occupations and the high concentration of U.S. residents in skilled, or semi-skilled, white-collar occupations. Whereas 64 percent of illegal Mexican workers are employed as operatives or as farm or nonfarm laborers, only 25 percent of U.S. workers are so employed. In addition, while almost half of all U.S. workers are professionals, owners, managers, or are employed in sales or clerical positions, less than 2 percent of Mexican illegals hold such jobs.

As a broad generalization, the group of U.S. nationals that faces direct competition from illegal immigrant labor consists of individuals employed in low-skilled occupations—particularly laborers, operatives, and service workers. Other individuals—those with high-skilled jobs, owners of land and owners of capital—are affected as changes in the supply of low-skilled labor alter the demands for their services or resources.

So far, we have discussed the effect of tighter border security on the supply of immigrant labor. In view of the income transfer system which operates at all levels of U.S. government, it also is important to know how the number of illegal, nonworking dependents would be affected. Unfortunately, this is a difficult issue to evaluate, both theoretically and empirically. If an immigrant worker chooses to remain in the United States for a longer period of time per trip, then he or she must endure a longer-term family separation should dependents remain behind. However, by carrying dependents, the immigrant worker faces a greater risk of detection and deportation. The empirical evidence also is mixed. In the Reichert and Massey study, 38 percent of the legal migrant workers had brought family members with them to the United States, while only 3 percent of the illegal migrants had done so.⁶ This supports the position that illegals will continue to immigrate without dependents if border crossings are made

Table 1
**OCCUPATIONAL DISTRIBUTIONS OF
ILLEGAL MEXICAN ALIENS AND
U.S. EMPLOYED PERSONS**

	Percent of Mexican aliens	Percent of U.S. employed
Professionals, owners and managers	1	25
Sales and clerical workers	1	24
Service workers	17	13
Craft workers	17	13
Operatives	24	16
Farm and nonfarm laborers	40	9

SOURCE: North and Houstoun, *Characteristic of Illegal Aliens*, 106 and 110.

more difficult. On the other hand, North and Houstoun found a greater incidence of family immigration among non-Mexican illegals, who faced greater distance and travelling costs than did Mexican illegals.⁷ For purposes of this paper, it will be assumed that the ratio of illegal dependents to all illegal immigrants will be unaffected by stronger border enforcement.

In summary, a tightening of U.S. border security will affect the economic welfare of legal residents principally through its effect on the supply of immigrant labor. By making border crossings more difficult, stronger enforcement ultimately should reduce the number of immigrants who seek employment in the United States at any point in time. Significant reductions will be expensive, however, because of the vastness of the U.S. border and because of a tendency for many illegals to lengthen their stays when they do cross the border. The labor market which will be most directly affected by a reduction in illegal immigration is the market for low-skilled labor. Other legal residents will be affected indirectly, as changes in the price of low-skilled labor alter other prices in the economy.

6. *Ibid.*, 101-102.

7. North and Houstoun, *Characteristics of Illegal Aliens*, 82.

Analysis with a classical labor market

In analyzing the economic impact of a reduction in illegal immigration, we assume that the immigrants compete for jobs in an undistorted labor market. Initially, we also ignore any government taxes or expenditures. The situation is described in Figure 1. The line labeled *SS* represents the supply of legal, low-skilled workers. The line *DD* represents the demand for low-skilled workers. Before the change in border policy, there are $(L_{D1} - L_{S1})$ illegal immigrants who secure employment in the U.S. The market-clearing wage is W_1 . There are a total of L_{D1} low-skilled jobs available, and L_{S1} of these are held by legal residents.

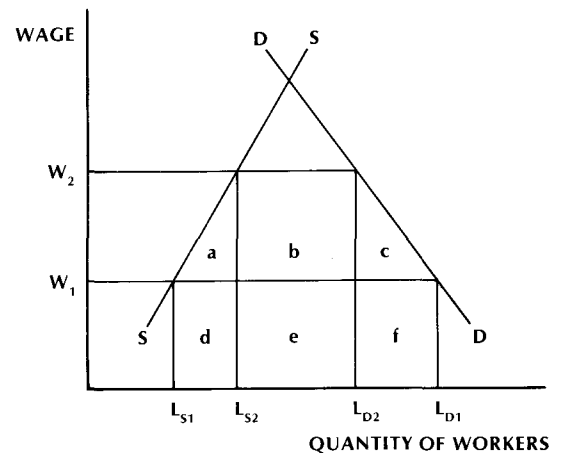
Suppose that the INS succeeds in reducing the supply of illegal workers to $(L_{D2} - L_{S2})$. The immediate result will be a shortage of low-skilled labor. Over time, however, wages will rise as employers compete for scarce labor. The rise in wages will, in turn, reduce the number of available jobs and increase low-skilled employment among legal residents. Ultimately, the low-skilled wage will rise to W_2 . At that wage there will be a total of L_{D2} jobs, and L_{S2} of them will be held by legal residents.

By reducing the supply of low-skilled labor, stronger border enforcement raises the wages and employment opportunities of legal, low-skilled workers. How will U.S. national income be affected? With total employment reduced, output of goods and services produced within the United States—the gross domestic product (GDP)—must fall. This decrease is represented in Figure 1 by the area $(c + f)$.⁸ To arrive at the change in gross national product (GNP)—output of goods and services to which legal U.S. residents have a claim—we then subtract the change in wage payments to illegal workers from the change in GDP.⁹ The earnings of illegal immigrants initially were given by the area $(d + e + f)$ but then changed to $(b + e)$ as a result of the new level of border control. All of these calculations are summarized in equation (1):

$$\begin{aligned} (1) \Delta \text{GNP} &= \Delta \text{GDP} - \Delta(\text{wages paid to illegals}) \\ &= -(c + f) - [(b + e) - (d + e + f)] \\ &= -(b + c) + d. \end{aligned}$$

As can be seen from equation (1) and Figure 1, it is not possible to provide a conclusive statement concerning the effect on gross national product of a reduction in the supply of immigrant labor. GNP

Figure 1
Effect of Immigration on the Market for Low-Skill Labor



can either rise or fall depending upon particular conditions in the labor market.¹⁰

Something more definitive can be said, however, if we broaden our concept of the national product. As defined both here and in the accounting procedures of the U.S. government, GNP refers to measured output. Excluded are the fruits of activities of individuals who are not a part of the organized labor market and whose output is not

8. Assuming there is no appreciable change in the quantities of other factors of production employed in the economy, the height of the demand curve will represent the value of low-skilled labor's marginal product. By integrating or adding up under the demand curve from L_{D2} to L_{D1} , one then obtains the incremental contribution to GDP by those $(L_{D1} - L_{D2})$ workers who had been employed before the change in border policy.
9. This would accord with the conceptual definition of GNP. In practice, payments to illegals are not excluded from GDP.
10. For small reductions in the immigrant working population, GNP will fall precisely when

$$E_S < (L_{D1} - L_{S1})/L_{S1}$$

where E_S is the wage elasticity of the domestic labor supply. Thus it is more likely that GNP will fall the less responsive is the domestic labor supply to changes in the wage and the more important are immigrant workers to the low-skilled labor force.

recorded—the vast array of services produced in the home (child care, cleaning, cooking, etc.) or simply leisure. As a practical matter, output from home production is difficult to measure since no market transactions are involved and there are no prices with which to value the output. It is just as real, however, and a more comprehensive rendering of the change in national product would add to the change in GNP the change in the value of home-produced goods.

When the wage rose in response to the reduced supply of immigrant labor, $(L_{S2} - L_{S1})$ new domestic workers accepted low-skilled jobs. The output from this employment already has been accounted for in our earlier calculation of the change in GNP. What has been ignored, however, is the value of output these workers were producing before they entered the labor force—their opportunity cost of market employment. Theoretically, this can be measured by the area $(a + d)$.¹¹ If this foregone output is subtracted from the change in GNP, the result is given by

$$(2) \quad \begin{aligned} \Delta \text{NEW} &= -(b + c) + d - (a + d) \\ &= -(a + b + c). \end{aligned}$$

For lack of a better term, we refer to the broader concept of national product as national economic welfare (NEW). As is clear from equation (2) and Figure 1, a reduction in illegal immigration must lower NEW. This does not mean that policies aimed at strengthening the U.S. border necessarily conflict with the national interest. Rather, it indicates that such policies will reduce economic efficiency.¹²

Restrictions on immigration are similar to restrictions on trade. There is little economic difference between admitting fewer low-skilled immigrants and taxing imported goods that require large amounts of low-skilled labor during production. Each policy will raise domestic low-skilled wages and will make goods produced with low-skilled labor more expensive. Each policy will tend to reduce the national income.

Illustrative calculations

To appreciate the potential magnitudes of the economic changes we have discussed, it is instructive to use the supply and demand model of the low-skilled labor market to simulate the effects of reduced immigration. Information required in the simulation consists of: the change in the number of

Table 2
DATA USED IN
ECONOMIC CALCULATIONS

$\Delta I = -1$ mill	$W_1 = \$10,000$
$L_{D1} = 20$ mill	$E_D = 1.0$
$L_{S1} = 15$ mill	$E_S = 0.2$

illegal workers (ΔI), initial total employment of low-skilled workers (L_{D1}), the initial number of legal residents holding low-skilled jobs (L_{S1}), the initial wage (W_1), and the wage elasticities of labor demand (E_D) and supply (E_S). The particular data used were selected to provide a reasonable description of the U.S. market for low-skilled labor. The data are reported in Table 2.

The low-skilled labor market is initially comprised of 15 million legal U.S. workers and 5 million illegal workers.¹³ Efforts at strengthening the U.S. border are then assumed to reduce the number of illegal workers by 1 million. This would be a very suc-

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11. The height of the supply curve represents the reservation wage of the marginal worker, i.e., the minimum wage necessary to induce him or her to enter the labor market. As such, it measures the value of nonmarket employment. By integrating under the supply curve from L_{S1} to L_{S2} , we then arrive at the opportunity cost of market employment for all of the new legal workers.
 12. Excluded from the calculation of NEW are the incremental costs of providing a more secure border. Border enforcement consumes resources that otherwise might have been used to produce goods and services of direct utility. This aspect of the problem has been ignored for analytic clarity. Its recognition would reinforce the general conclusion that restrictions on immigration reduce national economic efficiency.
 13. In 1978, there were approximately 15 million full-time equivalent domestic workers who were earning \$3.00 per hour or less. See Michael L. Wachter, "The Labor Market and Illegal Immigration: The Outlook for the 1980s," *Industrial and Labor Relations Review* 33 (April 1980), 351. The figure used for the number of illegal workers is a middle-of-the-road estimate of the number of illegal aliens engaged in labor market activities. See Walter Fogel, "Illegal Alien Workers in the United States," *Industrial Relations* 16 (October 1977): 243-263.

successful campaign—one that would achieve a 20 percent decrease in the pool of illegal workers. If it were accomplished, the total supply of low-skilled labor would be reduced by 5 percent.

The effect this would have on the low-skilled wage depends upon how sensitive employers and suppliers of labor are to changes in the wage. In the language of the economist, it depends upon the wage elasticities of labor demand and labor supply. The particular relationship is given by¹⁴

$$(3) \quad \% \Delta W = -\Delta I \div (L_{D1} E_D + L_{S1} E_S).$$

Conservative estimates indicate that each 10 percent rise in the low-skilled wage reduces the number of low-skilled jobs by 10 percent and increases by 2 percent the number of legal residents seeking low-skilled employment.¹⁵ Based upon these figures and the remaining information used to evaluate equation (3), low-skilled wages will be 4.35 percent higher. Given the elasticity of labor demand, total employment must then be 4.35 percent lower. By making labor more expensive, the tighter border policy eventually will result in the elimination of 870,000 low-skilled jobs. Because 1 million illegal aliens are no longer in the work force, however, this also means that 130,000 additional legal residents will secure low-skilled employment.

These figures summarize the effect of reduced immigration on those legal residents who face direct job competition from illegal workers. It also is possible to determine the changes in gross national product and national economic welfare. The calculations below are based upon equations (1) and (2) and the figures in the preceding paragraph. The initial low-skilled wage is assumed to be \$10,000 per year.

$$(4) \quad \Delta \text{GNP} = -\$8.9 \text{ bill} - (\$41.7 - \$50.0) \text{ bill} \\ = -\$6 \text{ bill}$$

$$(5) \quad \Delta \text{NEW} = -\$6 \text{ bill} - \$1.3 \text{ bill} = -\$1.9 \text{ bill}$$

When values for the relevant economic parameters are selected to fit the U.S. experience, tighter controls on immigration are seen to decrease the gross national product—by some \$600 per excluded immigrant. If allowance also is made for the decline in household production, national economic welfare falls some \$1,900 per excluded immigrant.

Distortions in the labor market

A statement frequently made in debates on illegal immigration is that alien workers take jobs away from legal U.S. residents. There is much that is misleading about this statement. By lowering the price of low-skilled labor, immigration encourages the use of labor and actually increases the number of low-skilled jobs. It is true that fewer legal residents will hold these jobs. But this can simply reflect a change in the composition of employment. Discouraged by the lower wages in unskilled jobs, more legal residents work at home or further their educations and then find skilled jobs. If wages are flexible and these economic adjustments are made, immigration ultimately will raise the level of national income.

It would be misleading, however, to totally disregard taxes, welfare programs, minimum wage laws, and other forms of market intervention which serve to alter the adjustments actually made to immigration. If labor markets are distorted by government regulations or tax and expenditure policies, then immigration need not necessarily raise national income. Conversely, and in contrast to the conclusions of the previous section, restrictions on immigration could conceivably promote national economic efficiency.

There are two types of distortions that warrant discussion. First, the labor market can be distorted if income taxes and public assistance programs combine to reduce the work efforts of legal residents. An inflow of foreign labor could then add to the inefficiency by reducing market employment among individuals whose work efforts already had been artificially discouraged. Evidence from both observed labor market behavior and income-maintenance experiments suggests, however, that taxes and welfare assistance programs have small effects on

14. It is assumed that the supply and demand curves are linear with respect to the wage. The elasticities are point elasticities evaluated at the initial equilibrium.

15. See A. Zucker, "Minimum Wages and the Long-Run Elasticity of Demand for Low-Wage Labor," *Quarterly Journal of Economics* 87 (May 1973): 267-277; P. Cotterill, "The Elasticity of Demand for Low-Wage Labor," *Southern Economic Journal* 41 (January 1975): 520-525; and G. E. Johnson, "The Labor Market Effects of Immigration," *Industrial and Labor Relations Review* 33 (April 1980): 331-341.

the labor supplies of U.S. residents—particularly low-income males who are also the ones to most likely be in competition with illegal workers.¹⁶

A second distortion has to do with minimum wage laws. If legal restrictions prevent wages from falling, the market for low-skilled labor can be in a permanent state of surplus. Legal residents who would be willing to work at the going wage might not be able to do so. Immigration would not create any more low-skilled jobs, but would only serve to increase the number of legal residents who were involuntarily unemployed.

To what extent do minimum wage laws influence the economic impact of illegal immigration? It is not altogether clear. In the North and Houston survey, almost 60 percent of the Mexican respondents earned more than the minimum wage.¹⁷ Minimum wage laws are not binding in these cases. And if wages are effectively flexible, there is no basis for believing that immigration increases unemployment or lowers national income. There are a substantial number of illegal workers who earn less than the minimum wage. Had these workers not been in the United States, a larger number of legal residents might have been hired at the minimum wage. But it is also possible that the jobs would not have been offered at the higher wage. In this case, illegal immigrants would perform a directly productive service by giving economic agents the opportunity to circumvent a law that promotes economic inefficiency. In sum, illegal immigration has an unknown impact on the natural rate of unemployment among legal U.S. residents.

Income transfers

An income transfer system also can directly influence the economic impact of reduced immigration, apart from its effect on the labor supplies of domestic workers. For example, the calculations in section three showed that, provided immigrants neither contribute nor receive transfers, U.S. gross national product would be some \$.6 billion lower if the number of illegal alien workers were reduced by 1 million. Were illegal immigrants to receive the same fiscal benefits as do legal U.S. residents, however, net transfers could be some 30 percent of their wages.¹⁸ With an annual wage of \$10,000, GNP would in this case be \$2.4 billion higher if illegal immigration were reduced.

To what extent do illegal aliens participate in the

U.S. fiscal system? Survey data consistently indicate a high incidence of tax withholding by employers. Shown in Table 3 are results from three studies done in the 1970s. Social security taxes were withheld for 67-88 percent of the illegal workers surveyed. And 70-74 percent of the respondents reported withholdings for federal income taxes. When combined with the automatic payment of sales and excise taxes, these findings suggest that illegal immigrants make substantial contributions to the public treasuries.

Table 3 also provides information on the use of public services by illegal immigrants. In the North and Houston study, over one-fourth of the respondents indicated that they had received some kind of medical treatment at a U.S. hospital or clinic. However, 83 percent of these also said that either they or their health insurance had paid for the care. Other than medical care, the use of public services appears quite low. This may be due in part to the fact that so many illegal workers immigrate without their families. It also is possible they are reluctant to contact assistance agencies for fear of detection and subsequent deportation.

In view of recent court decisions concerning the use of public schools, it is possible that illegal immigrants may avail themselves more and more of the economic benefits available through the U.S. transfer system.¹⁹ The hard evidence which exists,

16. For a survey and references, see Anthony B. Atkinson and Joseph E. Stiglitz, *Lectures on Public Economics* (New York, New York: McGraw Hill, 1980), 48-57.

17. North and Houston, *Characteristics of Illegal Aliens*, 116.

18. Based on the North and Houston survey, the average annual income of an illegal was \$5,850 in 1975. Adjusting for a wage inflation of 67 percent during the period, an equivalent nominal income for 1968 would be \$3,500. It has been estimated that in 1968 the net benefit of the U.S. fiscal system, for all levels of government, was 27.9 percent of family income for families with incomes between \$4,000 and \$5,700 and that it was substantially higher for families with incomes less than \$4,000. See R. A. Musgrave, K. E. Case, and H. B. Leonard, "The Distribution of Fiscal Burdens and Benefits," *Public Finance Quarterly* 2 (July 1974): 259-311.

19. In the case of *Plyler vs. Doe*, for example, the Supreme Court ruled that public schools could not charge tuition to undocumented school-age children if free education was provided to citizens or legally admitted aliens. See *Plyler vs. Doe*, 102 Supreme Court Reporter 2382, 2407 (1982).

Table 3
**PARTICIPATION OF ILLEGAL ALIENS
 IN U.S. FISCAL SYSTEM**

	North and Houstoun study ¹	Orange County study ²	Bustamante study ³
Percent with taxes withheld			
Social security taxes	77	88	67
Federal income taxes	73	70	74
Percent who used services			
Medical care ⁴	27.4	8.0-10.0	7.8
Unemployment compensation . . .	3.9	—	—
Public schools	3.7	—	0.9
Food stamps	1.3	1.6	—
Welfare	0.5	2.8	3.2

1. North and Houstoun, *Characteristic of Illegal Aliens*, 142.
2. Task Force on Medical Care for Illegal Aliens, *The Economic Impact of Undocumented Immigrants on Public Health Services in Orange County* (Orange County, California, March 1978): 6-20.
3. Bustamante, "Undocumented Immigration," 170.
4. Figures in the second and third columns represent the percentage of respondents who had used free medical care while living in the U.S. In the North and Houstoun survey, individuals were asked simply whether they had used any medical services.

however, suggests that illegal aliens contribute more in taxes than they receive in benefits. At the very least, it appears that their principal impact is on the market for low-skilled labor, not on the public treasuries.

Distribution of benefits and costs

Whether national income rises or falls, the economic impact of reduced immigration will not be uniform across groups of legal U.S. residents. By making immigrant labor more scarce and expensive, a tighter border policy will benefit owners of resources that compete with, or substitute for, low-skilled labor. But owners of resources that complement, or are poor substitutes for, low-skilled labor will suffer an economic loss.

The primary beneficiaries of reduced immigration, of course, will be those who compete directly with illegal workers. As discussed earlier, these tend to be low-skilled domestic workers who are employed as laborers, operatives and service workers. The potential gains to this group are significant. For example, whereas U.S. gross national product fell only \$.6 billion in our earlier calculations, total wage

payments to domestic low-skilled labor rose some \$6.5 billion.

Groups with resources that are poor substitutes for low-skilled labor will suffer from reductions in the supply of illegal workers. The economic values of all domestic resources tend to fall when GNP is reduced. If the value of a resource is not at the same time raised because it is a close substitute for low-skilled labor, its real return will fall overall. Empirical studies show that, among broad groups, high-skilled labor is least substitutable for low-skilled labor.²⁰ Reduced immigration then will tend to lower the real wages of domestic high-skilled workers. Because over one-quarter of illegal Mexican aliens work in agriculture, some owners of farms also will be hurt—particularly

20. See Z. Griliches, "Capital-Skill Complementarity," *Review of Economics and Statistics* 51 (November 1969): 465-468; and J. R. Kesselman, S. H. Williamson, and E. R. Berndt, "Tax Credits for Employment Rather Than Investment," *American Economic Review* 67 (June 1977): 339-349.

those whose crops require labor-intensive methods of production.²¹

In the short run, owners of capital will suffer from reduced illegal immigration. Machinery specialized for use with immigrant labor will lose value as that labor is made more scarce. In the long run, however, the return to capital investment may be higher than it would be otherwise. In many cases, the use of machinery has become economical as a means of replacing workers who perform simple and routine tasks. If low-skilled labor is made more expensive, capital investment may become more profitable.²² Of course, the extent of the rise in the return to capital would be limited by the global nature of capital markets.

Conclusion

In the issue of illegal immigration, U.S. policy-makers face a classical choice between economic efficiency and equity in the distribution of national income. Reductions in the supply of illegal workers will lower U.S. national income. Restrictions on international movements of any kind of economic resource, whether labor or capital, decrease the overall level of income in the recipient country. In

the case of illegal migration to the United States, this is reinforced by the fact that illegal immigrants appear to contribute more in taxes than they receive in social services. If the U.S. is to avoid significant reductions in the incomes of its low-skilled workers, however, effective limitations must be placed on the volume of immigration. There is too much mobility among international workers for large differentials in wages to be otherwise maintained.

21. North and Houstoun, *Characteristics of Illegal Aliens*, 108.

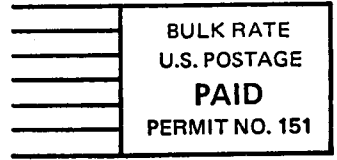
22. In fact, it is easy to produce evidence that the return to capital ultimately would rise with a decrease in immigrant labor supply. The theoretical criterion is

$$s_H(\sigma_{LH} - \sigma_{LK}) + (1 - s_L)\sigma_{KH} + s_L\sigma_{LH} < 0$$

where s_j is the share of domestic product accounted for by factor j , σ_{ij} is the (Allen) elasticity of substitution between factors i and j , and where L , H , and K denote low-skill labor, high-skill labor, and capital, respectively. According to the estimates of J. R. Kesselman, et al. (*ibid.*, 344), $\sigma_{LH} = .48$, $\sigma_{LK} = 1.28$, and $\sigma_{KH} = -.48$. Given these elasticities of substitution, the return to capital will rise for a wide range of values for factor shares. Consider, for example, $s_L = .3$, $s_H = .5$, and $s_K = .2$.

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