A publication of the
Indiana Business Research Center,
Indiana University School of Business

Indiana Business Review

Volume 64, Number 3 August 1989

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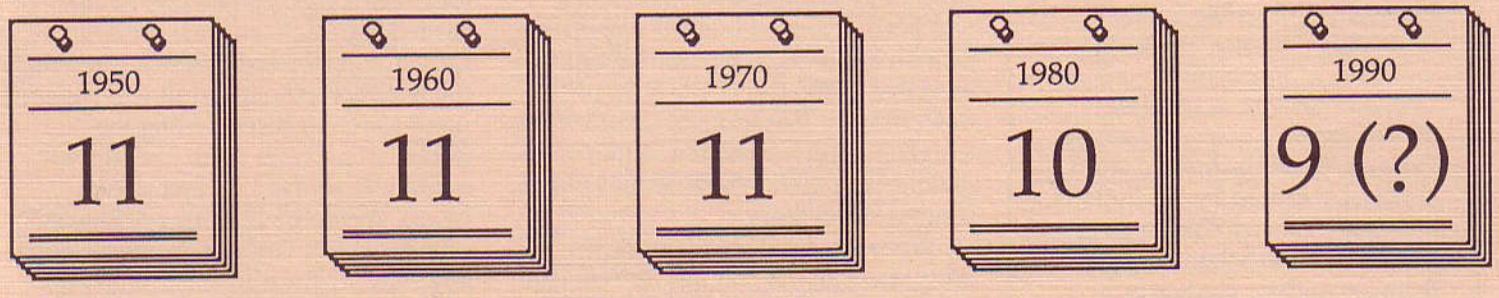

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Published six times each year by the Indiana Business Research Center, Graduate School of Business, Indiana University.

Jack R. Wentworth, Dean
Morton J. Marcus, Director and Editor

Brian K. Burton, Managing Editor; Darren Wells, Editorial Assistant; Vicki Fowler, Compositor Coordinator; Melva Needham, Dorothy Fraker, Circulation; Jo Clontz, Office Manager. Printed by Indiana University Printing Services.

Unless otherwise noted, information appearing in the *Indiana Business Review* is derived from material obtained by the Indiana Business Research Center for instruction in the School of Business and for studies published by the Center. Subscriptions to the *Indiana Business Review* are available to Indiana residents without charge.

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By early 1979 Indiana was gearing up for the 1980 Census of the Population along with the rest of the United States. Since the primary function of the census count is the reapportionment of congressional seats, many of the demographic pundits of the day tried to predict which states would gain or lose seats.

Nearly all of these predictions stated that Indiana would not lose its 11th congressional seat. Although it was acknowledged that the population growth of the state had not kept pace with that of the rest of the U.S., projections showed that Indiana would retain a high enough proportion of the national population to keep all 11 of its congressional seats.

When the final results came in, however, Indiana had lost its 11th congressional seat—by only 7,600 people. That is, if 8,000 more Hoosiers had been counted, Indiana would have kept its 11th seat and New York would have lost its 34th seat.

What went wrong? Were the projections inaccurate? Was the census count in error? Were the congressional seats apportioned incorrectly? Could it happen again in 1990?

The purpose of this article is to answer these questions by examining the results of the 1980 census and the reapportionment procedure. This information can then be used to help give a more accurate prediction of what the 1990 census results will mean to Indiana.

Methodology

The decennial census of the population determines the number of people in each of the states. On the basis of this enumeration, apportionment calculations are made to determine the number of representatives to which each state is entitled. According to the Constitution, representatives are to be apportioned to the states "according to their respective numbers, . . . but each state shall have at least one representative" (Article I, section 2, clause 3). However, the framers of the Constitution did not specify a method for this apportionment, nor do they seem to have been aware of the difficulties involved. The 1792 Apportionment Act, known as the Jefferson plan, gave one representative to each state for every 33,000 people and disregarded the fractional remainders. Daniel Webster and others argued that the Jefferson plan discriminated against small states by disregarding the fractional parts no matter what size quota was set per representative. Under Webster's plan an additional representative would be apportioned to any state with a fractional remainder population one-half or more of the set population-per-representative value. A fault in the Webster plan was that the size of the House of Representatives could not be predetermined.

The Vinton plan (named after Representative Samuel Vinton of Ohio) was an apportionment method that used a predetermined number of representatives and a fixed population-to-representative ratio. Under the Vinton plan, the number of representatives was determined, a population-to-representative ratio was derived, representatives were assigned to states equal to their integer multiple of the population-to-representative ratio, and the remaining seats were apportioned to states in order of the largest fractional remainders. A problem with the Vinton plan was what was known as the Alabama paradox—a situation in

Table 1
Multipliers for the Determination of Priority Values

n	*Multiplier*
2	0.70710678
3	0.40824829
4	0.28867513
5	0.22360680
6	0.18257419
7	0.15430335
8	0.13363062
9	0.11785113
10	0.10540926
11	0.09534626
. . . . .	
55	0.01834940
56	0.01801875
57	0.01769981
58	0.01739196
59	0.01709464
60	0.01680732

Table 2
Determination of Priority Values

State	*1980 Population*	*Number of Representatives*	*Multiplier*	*Priority Value*
California	23,668,000	2	0.70710678	16735800
		3	0.40824829	9662420
		4	0.28867513	6832363
New York	17,558,000	2	0.70710678	12415380
		3	0.40824829	7168023
		4	0.28867513	5068558
Indiana	5,490,000	2	0.70710678	3882016
		3	0.40824829	2241283
		4	0.28867513	1584827

which a state could actually lose a representative if the size of the House of Representatives were increased.

Research in apportionment methods continued until 1941, when Congress adopted the method of equal proportions—a method that "satisfies the oft-expressed view of Congress that the average number of persons per congressional district should be as nearly equal as possible among the States, and will also satisfy the inter-State application of the 'one man, one vote' principle."

Suppose P_X represents the population of state X and R_X represents the number of representatives apportioned to state X. Then the value P_X/R_X represents the population per representative and the value R_X/P_X represents the representatives per person in state X. Using an ideal apportionment method, the ratios P_X/R_X and P_Y/R_Y, population per representative of states X and Y, should be equal; and the ratios R_X/P_X and R_Y/P_Y, representatives per person, should be equal. However, it is impossible to achieve this goal in practice. The next best situation, then, would be to minimize the percentage difference between like-valued ratios. This minimization is achieved using the method of equal proportions. This method also has the advantage of not placing any emphasis on larger states over smaller states.

At the heart of the method of equal proportions is a set of multipliers, a sequence of numbers generated from the formula $1/\sqrt{((n-1)n)}$, such as $1/\sqrt{(2x3)}$, $1/\sqrt{(3x4)}$, $1/\sqrt{(4x5)}$. The integer n in the multiplier formula corresponds directly to the number of representatives, or the size of the state's delegation. **Table 1** lists some of the values in the set of multipliers as calculated from the formula. The set of multipliers, the population of each state, and the total number of representatives to be assigned to all of the states (currently set at 435) are the only quantities needed to perform the calculations and assign the representatives to which each state is entitled.

Using the method of equal proportions, assignment of representatives to the states is based upon the ordering of a set of priority values calculated for each state. Each of the state's priority values is the product of the state's population and a value from the set of multipliers. The results of calculating the first three priority values for California, New York, and Indiana are given in **Table 2** and show that, for a given number of representatives, a state with a large population will have a higher priority value than a state with a small population. Recalling that each state is entitled to at least one representative (so that 50 of the 435 seats are preassigned), once the priority values have been calculated, seats 51 through 435 are assigned to the states on the basis of highest to lowest priority value. That is, the state with the highest priority value is assigned the 51st seat, the state with the next highest priority value the 52nd seat, and so forth until all 435 seats have been assigned. A partial listing of the reapportionment based upon the 1980 census is shown in **Table 3**.

Results

The Census Bureau's population pro-

Table 3
Priority Value Sequencing and Numbering in Rank Ordering

State	*Priority Value*	*Number of Representatives*	*Rank Order*
California	16735800	2	51
New York	12415380	2	52
Texas	10061420	2	53
California	9662420	3	54
Pennsylvania	8389115	2	55
Illinois	8080109	2	56
Ohio	7635339	2	57
New York	7168023	3	58
Florida	6891463	2	59
California	6832363	4	60
Kansas	528606	5	430
Colorado	527639	6	431
Pennsylvania	527419	23	432
Florida	527003	19	433
Ohio	526888	21	434
New York	524178	34	435
Indiana	523451	11	436

Table 4
1980 Apportionment as Projected Before the Census

State	*Priority Value*	*Number of Representatives*	*Rank Order*
Massachusetts	519448	12	426
Indiana	518493	11	427
Maryland	518191	9	428
California	518149	44	429
Oklahoma	517415	6	430
Kansas	517203	5	431
Missouri	514608	10	432
Texas	513746	26	433
Tennessee	512063	9	434
Michigan	510078	19	435
New York	509515	36	436

jections for 1980, published in March of 1979, showed that they expected the 1980 population of the United States to be 221,651,000 and of Indiana to be 5,438,000. Given the population level for Indiana and the distribution of the total U.S. population throughout the other states, the assignment of the last 10 representatives as a result of the 1980 reapportionment was projected to be as shown in **Table 4**.

Given these projected results, Indiana had 88,257 people to spare to keep its 11th congressional seat.[1] The many projections of congressional reapportionment made in the late 1970s and the secure feeling in Indiana that we would retain our 11th congressional seat were based upon these calculations.

When the 1980 census was concluded, and the subsequent reapportionment was completed, Indiana had indeed lost its 11th congressional seat. (See Table 3 for the results of the priority value calculations for seats 430 through 436.) Furthermore, the seat was lost by a margin of only 7,625 people.[2]

What happened? The primary reason for this turnaround was that Indiana's population count was not as complete as that of the U.S. as a whole. The 1979 projection of the 1980 U.S. population was 221,651,000. But the actual 1980 census count was 226,546,000, an almost 3% increase over the projected value. In Indiana, the 1979 projection of the 1980 population was 5,438,000; the actual 1980 census count was 5,490,000. This represented an increase of only 1.3% over the projection. The discrepancy between the nation's 3% greater and Indiana's 1.3% greater actual count than projected count served to make Indiana's proportion of the U.S. total population lower than had been expected. Consequently, what had been considered a "safe seat" was lost by a very small margin.[3]

The Census Bureau's 1990 projections for the U.S. and all 50 states have been released. A congressional reapportionment based upon these projected populations would have the results shown in **Table 5**.

The Census Bureau projects Indiana's population at 5,550,000 and

Table 5
Projected Apportionment After the 1990 Census

State	*Priority Value*	*Number of Representatives*	*Rank Order*
New Jersey	585513	14	426
Indiana	585021	10	427
Ohio	583511	19	428
New York	582800	31	429
North Carolina	582290	12	430
Texas	580799	31	431
Georgia	579940	12	432
Arizona	578946	7	433
Kentucky	577866	7	434
Minnesota	577819	8	435
Pennsylvania	577098	21	436

Table 6
Projected 1990 Apportionment if Indiana's Relative Performance Matches 1980

State	*Priority Value*	*Number of Representatives*	*Rank Order*
Minnesota	595154	8	434
Pennsylvania	594411	21	435
California	594084	51	436
Indiana	592626	10	437
Florida	586924	23	438

the U.S. population at 249,891,000. Given these projections, Indiana would retain its 10th congressional seat by a margin of 68,324 people.

But what would be the fate of Indiana's 10th congressional seat if the 1990 census results were to have the same level of improvement over the 1989 projections as the 1980 census results had over the 1979 projections? A 1.3% increase in Indiana's projected 1990 population would give the state 5,622,000 people. A 3% increase in the projected U.S. population would give the nation a total of 257,388,000 people. If this 3% increase in the nation's total was spread evenly across the other 49 states, the congressional reapportionment calculations would be as shown in **Table 6**.

Given these results, Indiana would fall short of retaining its 10th congressional seat by 16,933 people.

An additional 20,000 people to our census count in 1990 might not seem to be a major issue when it is assumed we have a 70,000 person margin. But it could be devastating if we are in fact 17,000 people short of holding on to our 10th congressional seat.

This brings us to a major misconception about census results: The final count is all that matters. Actually, the primary measurement is the state's proportion of the total U.S. population. In this case, while Indiana's counting more people than projected is a positive factor, not improving as well as the rest of the country makes it less of a positive factor. Thus the short-term victory of an improved census count in the state is more than offset by the long-term effect of a smaller share of the U.S. population.

What are the chances that the U.S. population count will be more complete than Indiana's again in 1990? Probably very good. Many of the states that stand to gain or lose in the upcoming census have committed time, personnel, and money in public awareness programs to address the issue. Also, states with demographic research centers have provided additional resources to assist in pre-census local reviews, post-census local reviews, and the all-important count reviews of the population numbers.[4] Indiana is in the process of developing these programs.

Implications

Regardless of whether Indiana loses or retains its 10th congressional seat, there will be some dramatic changes in the boundaries of Indiana's congressional districts after 1990 (see the **Figure**). Given the "one man, one vote" provision for drawing district lines, and the major (and uneven) changes in the distribution of Indiana's population, a fundamental restructuring of congressional district borders will be required.

Three of the state's congressional districts, the 1st, 2nd, and 5th, will probably show actual population losses for the decade. Thus, even if the state holds onto the 10th seat, these three districts will have to be expanded to meet population requirements. On the other hand, the 3rd and 6th districts

have shown the greatest population increases. Consequently, if Indiana retains its 10th seat, these two districts are most likely to be reduced in size.

If the state loses its 10th seat, no one really knows which district will be eliminated. But due to the demographic changes that we know of and the "one man, one vote" requirement, it is safe to say that the 2nd, 5th, and 7th districts are prime candidates.

Conclusion

Indiana has much at stake in the upcoming census. Not only is the 10th congressional seat a major consideration; so are the federal funds distribution connected to the population numbers and the redrawing of state senate and representative districts (*IBR*, April 1989).

However, there is a strong possibility that a situation identical to the one that existed after the 1980 census will exist after the 1990 census—that is, Indiana fails to do as well as the rest of the nation. If this is so, the fate of Indiana's 10th congressional seat may not be decided until after the late fall of 1990.

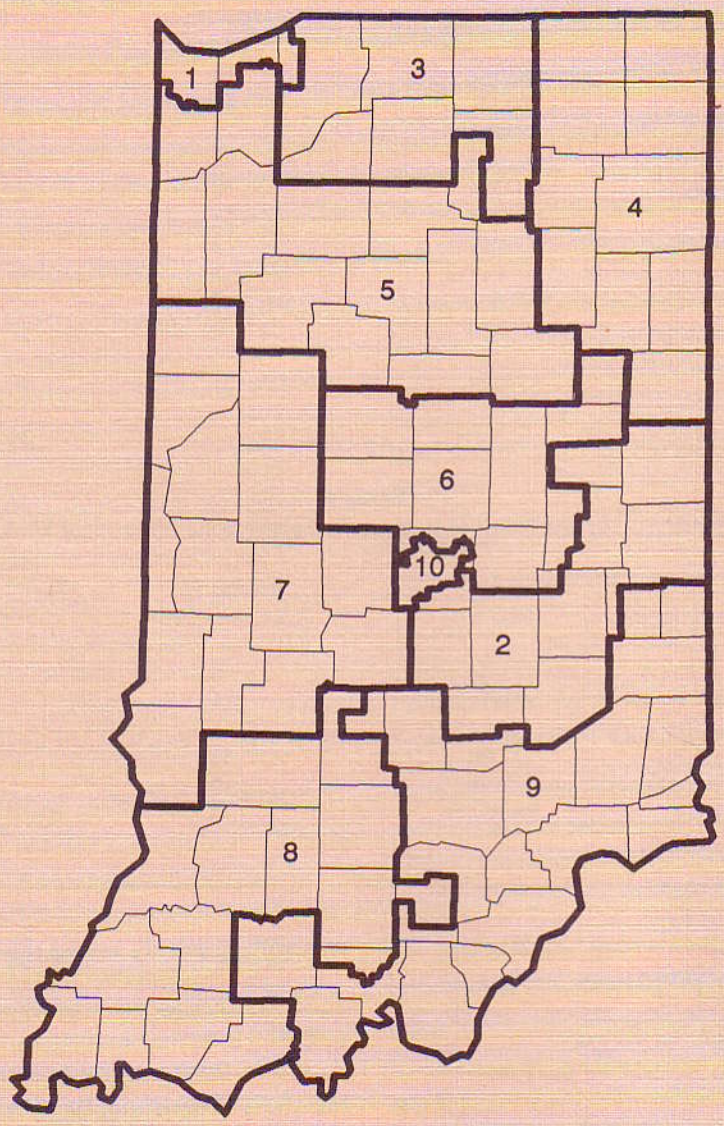
1. This margin of 88,257 people is determined by taking the difference between the priority values and Indiana's 11th seat and the 435th seat and dividing it by the multiplier for Indiana's 11th seat: (518,493-510,078)/0.09534626=88,257.

2. The 435th seat has been decided by an even smaller margin. In 1970, Oregon lost out to Oklahoma for the last seat by a scant 250 people.

3. The margin by which the 11th Indiana seat was lost, 7,625 people, was 0.14% of the 1980 population of Indiana.

4. The count review is a process in which the actual census results are reviewed by the state's Federal-State Cooperative on Population Estimates agency; if there is a discrepancy, a challenge is filed along with statistical proof.

Figure
Indiana's Congressional Districts



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The Impact of Wages on Import Penetration; Manufacturing and the Role of Human Capital Widening in Indiana

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In this article we present the results of a two-part study. In part one we propose and statistically confirm the hypothesis that foreign exporters successfully targeted Indiana high-wage manufacturing industries for import penetration. We theorize that import penetration was most successful where the relative industrial wage failed to reflect productivity. In part two we theorize that foreign manufacturing plants use technologies similar to U.S. plants because of global capital markets and global transfer of technologies. We further theorize that the best opportunities for domestic productivity gains lie in investment in human capital. And we hypothesize that human capital widening—namely, increasing the proportion of the population who have a college or similar technical education—provides better competitive opportunities for advanced manufacturing installations than human capital deepening (attaining increasingly higher levels of technical skills through graduate training).

We demonstrate that higher manufacturing wages tend to be associated with human capital widening in the major industrial markets in Indiana. Moreover, after account is taken of possible interactions with external variables, such as ethnic composition of the labor force, female labor force participation, property tax rates, income, and wealth, human capital widening (by increasing the size of the college-educated population) appears an effective countermeasure to import penetration of high wage industries.

In other words, if our hypothesis is correct, rising industrial wages may attract import penetration, but increasing the proportion of the population with college education may lessen the impact of such penetration and may limit the loss of manufacturing jobs.

Industrial Wages and Import Penetration

A series of theoretical studies by the Federal Reserve Bank of Chicago analyzes the probable impact of union/nonunion wage differentials on import penetration. The studies suggest that much import penetration can be traced to union wages rising above equilibrium levels.

One of the caveats to consider when pinning the entire blame for import penetration on labor unions is that labor cost as a percentage of sales is declining in high-wage manufacturing. This may mitigate the impact of differential wage levels on import penetration.

In the early post-war decades imports tended to penetrate mostly labor-intensive industries, because foreign exporters tended to use their more abundant factor, labor, while U.S. exporters tended to use their more abundant factor, capital.

Indiana is a good state in which to test the hypothesis of targeting because of the state's concentration in varied manufacturing and active participation in international trade. We found a wide range of weekly earnings, from a low of $276.95 in the fourth quarter of 1987 in Hendricks County to a high of $754.13 in Howard County.

Hypotheses and Assumptions

We tested the hypothesis that nations that seek to penetrate American markets tend to target industries where wages are higher than in other U.S. industries, such as steel and autos. Such a strategy tends to maximize foreign exporters' comparative advantage. Steel imports, for example, rose from 13.7% of the domestic market in 1969 to 22% in 1981.

If this hypothesis is correct, then Indiana high-wage industries would attract foreign competition even if high domestic wages were to reflect higher marginal physical products. That is, we expect an inverse relationship between growth in wage rates and growth of employment, even after accounting for possible changes in factor productivity.

We assume that the international cost of capital is the same for all traders and that technology is instantly transferable. Namely, we assume that emerging industrializing countries obtain development loans and consequently can bid for the most advanced technological capital. We further assume that, in the period from 1980 to the present, no drastic changes in tastes have caused short-run technological obsolescence in Indiana plants. Finally, we assume that in the absence of import targeting, Indiana manufacturing firms would reflect national business conditions (the business cycle) except for random shocks. By exclusion, systematic divergence from national trends not shared by other industries in Indiana would have to be attributed to import targeting in the specific industry studied.

Testing the Hypotheses

If the foregoing assumptions are correct, we would expect the following:

1. During the period 1981-1984, a period of rapid economic recovery for the nation but rising imports of manufactured goods and a rising exchange rate of the dollar, industries with high wage levels and rising wage rates would be expected to experience greater declines in employment than industries with low or falling wage rates. (The exchange rate index of the

Figure
Definition of Variables

Difference between logarithms of employment in the period from 1981 to 1984	DN1
Difference between logarithms of employment in the period from 1985 to 1988	DN2
Difference between logs of average weekly manufacturing earnings between 1981 and 1984	DW1
Difference in logs of average weekly manufacturing earnings between 1985 and 1988	DW2
Log of mean weekly manufacturing earnings in county, in period 1981-1984	LW1
Same as above for period 1985-1988	LW2
Log of fraction of population over 24 completing college times 100	LCOL
Log of median price of home	LHOME
Log of fraction of non-white workers in labor force times 100	LBLN
Log of property tax rates in period one and period two	LTX1, LTX2
Log of fraction of females in labor force times 100	LFMN

Table 1
Partial Regression Coefficents

	Independent Variables						
Dependent Variable	*LW1*	*DW1*	*LW2*	*DW2*	*Constant*	*DN1*	R^2
DN1	–0.6082*	–0.4898*			3.571*		0.4279
	(–3.451)	(1.573)			(3.419)		
DN2			0.7045	0.0089	–0.4171		0.0136
			(0.467)	(.011)	(.439)		
DN2			–0.2358	–0.3057	1.4176	–0.488	0.3119*
			(1.371)	(.431)	(1.338)	(2.715)	

*Note: T statistics are in parantheses; * indicates statistical significance.*

dollar rose from 94.5 in the first quarter of 1981 to 156.5 in the first quarters of 1985.)

2. In the period 1985-1988, a period of continued, albeit diminished, national economic growth and devaluation of the dollar, the differential growth rate—between the rates of change of 1985-1988 and 1981-1984—should have been greater for high-wage industries than for low-wage industries. The latter would have benefited less from the falling exchange rate of the dollar. (The exchange rate of the dollar declined from an index of 156.5 to below 95, going the full cycle from peak to trough.)

The Sample

We selected 21 counties in the state with substantial manufacturing sectors. We obtained manufacturing employment, averaged quarterly, from 1981 to 1988, and weekly earnings in manufacturing, averaged quarterly, for the same time period. Growth rates were computed for each of the 21 counties. A time series-cross section specification was adopted. The data were obtained from Indiana University's STATIS data base, and estimates were obtained from National Decision Systems. Additional current data were received from the State Department of Employment and Training Services. The labels used for the variables are given in the **Figure**.

The regression results (**Table 1**) confirm the hypothesis that in the period 1981-1984 (hereafter referred to as the first period), when the dollar was overvalued, Indiana counties with higher relative wage levels and rising wage rates experienced proportionately greater losses in manufacturing employment. According to our regression results almost 50% of the employment decline can be explained by the relative level of and proportionate rise in wages.

When we move to equation No. 2 in Table 1 we discover that in the period 1985-1988 (hereafter referred to as the second period), when the dollar was devalued, the inverse relationship between proportionate changes in employment and wage levels no longer exists. In fact, both the size of the

Table 2
Partial Regression Coefficients
Sample: Twelve Major Manufacturing Counties

Dependent Variable	*COL*	*Constant*	R^2
DW1	0.711551*	0.27232	0.39864
	(2.303)	(5.179)	
DW2	–0.6892	0.35743	0.1533
	(.353)	(1.075)	
WR1	1.28783	1.12372	0.16662
	(1.265)	(6.485)	
WR2	2.3140*	0.9807	0.40706
	(2.344)	(5.835)	

*Note: T statistics are in parantheses; * Indicates statistical significance.*

partial regression coefficients and the t-statistics have significantly declined. Moreover, the negative partial regression coefficient for DN1 in period 2 clearly confirms the hypothesis that manufacturing sectors that were most affected by job losses in period 1 would gain most in period 2.

One may argue that if a dramatic statistical change occurs congruently with a relatively sudden and major economic event, such as the turnaround in the exchange rate of the dollar, then certain consequences may be imputed to that event. We may contend that the break in the statistical regime between the first and the second period was caused by the depreciation of the dollar, which in effect lowered U.S. wages in targeted industries. U.S. exports became cheaper and imports more expensive. Both targeted Indiana industries and other industries returned to their normal regimes; namely, both targeted and other Indiana manufacturing sectors were affected by the same economic forces and behaved accordingly.

The following may be noted. In the long run, wages must equal the contribution of each additional unit of labor to total revenue, or marginal revenue product. If markets are competitive, nationally and internationally, inter-industry wage differentials will tend to reflect differences in marginal physical product—the marginal contribution of each unit of labor to output.

Some industries, such as steel and autos, may wield more domestic market power as sellers of output. They may be confronted with monopolistic sellers of inputs (labor unions as well as sellers of intermediate products). In such an event, sellers of inputs may raise their prices above competitive levels.

Open international markets tend to reduce or eliminate the surplus that exists between marginal revenue product at the domestic monopolistic price and the marginal revenue product that would prevail at the global competitive price. It is logical to assume that the greater the surplus, the more vulnerable the industry is to international competition.

Devaluation and VRAs (Voluntary Restraint Agreements) defend the surplus against foreign competition. For example, if in the U.S., one extra hour of labor produces three units of output at $4, the equilibrium wage is $12. If the physical product is the same in Korea, but the wage is $6, Korea can target the surplus of $2 per unit by selling below the U.S. price of $4. This appears to have happened in Indiana in the second period.

Firms usually discontinue their least-efficient (or most labor-intensive) operations in response to import penetration. Thus, by raising productivity to six pieces per unit of labor, the higher wage becomes affordable at the international price of $2. Employment, however, declines.

The Possible Impact of Human Capital Widening

Massive amounts of literature document the impact on income and wealth of human capital deepening—raising the level of technical and managerial skills by graduate education. There is scant literature on the impact on industrial wages of human capital widening—increasing the proportion of the population with college degrees. We theorize that such human capital widening may permeate through the industrial labor force. A more skilled, better supervised, and possibly better motivated labor force may raise productivity, which would be reflected in higher wages. While the proof of the hypothesis of targeting in part 1 was statistically straightforward, the statistical procedures in part 2 are of necessity more complex.

If the hypothesis is true, we would expect the relationship to emerge in the major manufacturing centers in Indiana. **Table 2** gives some credence to the proposition that human capital widening may indeed be associated with higher manufacturing wages.

One would not have expected a priori that college education would affect industrial wages. On the other hand, a high proportion of the population with college degrees may be a measure of the overall sophistication of the citizenry, who may demand and may get better secondary schools as

Table 3
First Period Model

				Independent Variable					
Dependent Variable	*DN1*	*LW1*	*LCOL1*	*LHOME*	*LBLN*	*LTX1*	*LFMN*	*CNST*	R^2
DN1		–0.4845*	–0.0321	--	–0.025	–0.4480*	--	3.6561*	0.6689
		(3.289)	(.368)		(.084)	(2.819)		(3.821)	
LW1	–0.5904*		0.0222	--	–0.026	--	–0.2337	6.5369*	0.3762
	(2.375)		(.138)		(.066)		(.668)	(6.026)	
LCOL1	--	–1514		.6950*	–0.1327*	--	5.3079*	–25.337*	0.7177
		(.578)	(3.183)	(3.744)	(4.490)		(3.534)		

*Note: T statistics are in parantheses; * indicates statistical significance.*

Table 4
Second Period Model

				Independent Variable					
Dependent Variable	*DN2*	*LW2*	*LCOL2*	*LHOME*	*LBLN1*	*LTX2*	*LFMN*	*DN1*	*R2*
DN2		–0.1486	–0.0171	--	–0.0148	0.1611	--	–0.342	0.336
		(.802)	(.198)		(.500)	(.799)		(1.279)	
LW2	–0.4493		–0.0993	--	–0.0103	--	0.1209	–0.8875*	0.489
	(1.271)		(.597)		(.248)		(.335)	(3.137)	
LCOL2		–0.2515		.7964*	–0.1672*	--	5.9449*	–0.7229*	0.7803
		(.948)		(3.906)	(4.460)		(4.971)	(2.138)	

*Note: T statistics are in parantheses; * indicates statistical significance.*

well as more advanced technical education. *Thus human capital widening may generate a spillover effect.*

The statistical evidence in Table 2 is incomplete, however. The connection between industrial wages, human capital, and import penetration is circuitous. There are a number of intervening variables, and significant intercorrelation exists; high industrial wages may make college education affordable to more households, for example. The size of the sample limits the number of independent variables we can introduce within the available degrees of freedom.

Given these restraints, we attempted to build a simultaneous equations model for both period 1 and period 2. In this context the endogenous variables are DN1, LW1 (or DW1), and LCOL in period 1 and DN2, LW2 (or DW2), and LCOL in period 2. The remaining variables are exogenous.

There is evidence that manufacturing companies are sensitive to high property-tax rates, and several Indiana companies—some partially foreign-owned—have sought to locate or relocate into counties with favorable tax rates.

In Table 3 and Table 4 we give the estimates of the partial regression coefficients for each of three simultaneous equations in period 1 and period 2. Each of the three endogenous variables has a play in the system.

The first equation in Table 3 introduces two statistically significant variables: the relative wage, which is negative, and the property tax rate, which is also negative. This is as anticipated. There is evidence that manufacturing companies are sensitive to high property-tax rates, and several Indiana companies—some partially foreign-owned—have sought to locate or relocate into counties with favorable tax rates. College education has a t-statistic below unity, indicating that we can not be sure of the sign of the partial regression coefficient.

The equations are of the log variety; thus the partial regression coefficients can be read as elasticities.

Table 5
Two Stage Least Squares Period One

Dependent Variable	*LHOME*	*LCOL*	*LW1*	*LFMN*	*CONS.*	R^2
DN1	0.1619	.01017*	–.4653*	0.9711	–2.777	0.5417
	(1.081)	(2.378)	(2.589)	(1.118)	(0.567)	

Note: Only the first period is relevant for the present hypothesis; T statistics are in parentheses.

The partial regression coefficients measure the proportional impact of the independent variables on the dependent variable. For example, other things being equal, a 10% increase in property taxes will cause employment to decline by 4.48% (10% x .448).

The second equation in Table 3 has only one significant entry, DN1, with the expected sign. Female labor participation and the proportion of blacks in the labor force have the expected signs but lack statistical significance.

The third equation in Table 3 introduces three statistically significant variables: LHOME, which is a proxy for wealth, LFMN, female participation in the labor force, and LBLN, the proportion of blacks in the labor force. The positive coefficient for LFMN—female participation—is an interesting and positive statement about the Indiana labor force. The other signs are as expected.

The analysis of Table 4 is similar to that of Table 3. There were no surprises. The R^2s in Table 2 are significantly higher for period 1 than for period 2, as hypothesized.

Two Stage Least Squares

The task now is to sort out the various interactions and combine all relevant variables into one equation. Each available analytical technique has strong points and some shortcomings. We opted for a simultaneous system solution, which yielded the equation in Table 5 for period one. Only that period is relevant for the present hypothesis.

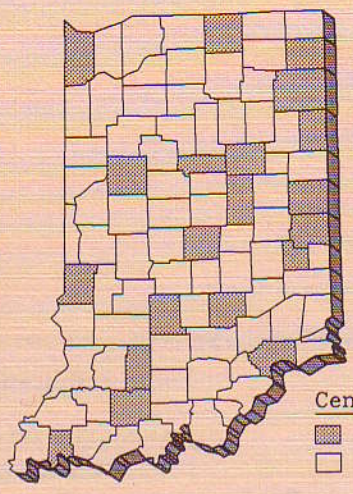
Investment in physical capital can not be neglected; a college-educated labor force is maximally productive when working with the most advanced physical capital.

In Table 5 there are two statistically significant variables. LW1, the relative wage rate, is negative as anticipated. The partial regression coefficient of LCOL, the logarithm of the percentage of the population with a college degree, is positive. Unfortunately, the value of the coefficient is relatively low, though statistically significant. To some degree the foregoing analysis tends to confirm our hypothesis. Statisticians might argue that the relative wage, LW1, has dominated the loss of jobs, DN1, because of import penetration. This relationship might have introduced a downward bias, causing the sample estimate of the elasticity coefficient of LCOL to be lower than its true population value. We may note that the first order correlation coefficient between DN1 and LCOL is .332; the correlation coefficient between DN1 and LW1 is –.591.

Policy Implications and Conclusions

If Voluntary Restraint Agreements (VRAs) are not extended indefinitely and the dollar appreciates, industrial wages might have to move in stricter congruence with marginal revenue product at internationally competitive prices. Otherwise targeting of Indiana industries will resume.

The Indiana data appear to point toward increasing productivity by widening investment in human capital. A rising proportion of the college-educated labor force emerged as a statistically significant explanatory variable that made the targeting of Indiana high-wage industries less successful. However, investment in physical capital can not be neglected; a college-educated labor force is maximally productive when working with the most advanced physical capital. One might even suggest that human capital widening acts as a kind of economic vaccine, immunizing Indiana industry against excessive import penetration.



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Indiana Business Review

Indiana Business Research Center
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August 1989

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