their elected leaders fail to address. They also claim that initiatives help to educate citizens about public policy and the democratic process. Critics point out, however, that the initiative may empower special interests at the expense of the general public. While narrow economic interests rarely have the resources to mount successful initiative campaigns independently, well-organized citizens' groups may be able win passage of new laws at the expense of minorities, the poor, and other disadvantaged populations.

Beyond their direct effects on public policy through the creation of new laws, initiatives have myriad indirect effects on citizens, interest groups, and political parties. For citizens, they help to stimulate voter turnout, cultivate civic engagement, and enhance trust in government. Interest groups may threaten to propose an initiative if the legislature does not do its bidding on a particular subject, thus enhancing the influence of such groups in policy matters. Political parties may invoke ballot initiatives as a means to achieve broader electoral objectives. For example, during the 2004 presidential election, Republican Party officials proposed initiatives banning same-sex marriage in critical swing states as part of an effort to promote voter turnout among conservatives sympathetic to President George W. Bush. Although survey evidence suggests that the marriage initiatives may not have had the effect that Republicans intended in 2004, their continued use in the 2006 midterm elections indicates that political parties now see polarizing ballot initiatives as a staple in their electoral strategies.

The debate over whether the initiative is beneficial or detrimental to democracy is unlikely to abate in the foreseeable future. While it is unclear which specific interests are most advantaged or disadvantaged by the initiative's existence, it is clear that savvy political actors will continue to invent ways to co-opt initiatives to advance their goals.

SEE ALSO *Ballots; Democracy; Democracy, Representative and Participatory; Interest Groups and Interests; Progressives; Referendum; Voting*

BIBLIOGRAPHY

Boehmke, Frederick J. 2005. *The Indirect Effect of Direct Legislation: How Institutions Shape Interest Group Systems.* Columbus: Ohio State University Press.

Cronin, Thomas E. 1989. *Direct Democracy: The Politics of Initiative, Referendum, and Recall.* Cambridge, MA: Harvard University Press.

Gerber, Elisabeth R. 1999. *The Populist Paradox: Interest Group Influence and the Promise of Direct Legislation.* Princeton, NJ: Princeton University Press.

Matsusaka, John G. 2004. *For the Many Or the Few: The Initiative, Public Policy, and American Democracy.* Chicago: University of Chicago Press.

Smith, Daniel A., and Caroline J. Tolbert. 2004. *Educated by Initiative: The Effects of Direct Democracy on Citizens and Political Organizations in the American States.* Ann Arbor: University of Michigan Press.

Smith, Daniel A., Matthew DeSantis, and Jason Kassel. 2006. Same-Sex Marriage Ballot Measures and the 2004 Presidential Election. *State and Local Government Review* 38 (2): 78–91.

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INKBLOT TEST

SEE *Rorschach Test.*

INPUT-OUTPUT MATRIX

An input-output matrix, A, is a square table with elements a_{ij}, representing the amount of input i required per unit of output j. A column of the matrix depicts the inputs needed for the production of a specific output and, therefore, can be considered a technique. The matrix is a constellation of techniques. For example, if $A = \begin{pmatrix} 0 & 1/3 \\ 1/2 & 0 \end{pmatrix}$, then the technique for product 1 is $\begin{pmatrix} 0 \\ 1/2 \end{pmatrix}$ (1/2 a unit of input 2 per unit of output 1), while the technique for product 2 is $\begin{pmatrix} 1/3 \\ 0 \end{pmatrix}$ (1/3 a unit of input 1 per unit of out put 2).

If the list of inputs is complete, including factor inputs, the input-output matrix also contains "techniques" for the production of the factor services. In 1936, in the first input-output study, the Russian-born American economist Wasily Leontief (1906–1999) presented consumption coefficients for the "production" of labor services. This case is the so-called closed input-output model. If only produced inputs enter the input-output matrix, one speaks of the open input-output model.

The basic equation of the open model is the material balance, $x = Ax + y$, where x is the vector of gross outputs, Ax the vector of intermediate inputs, and y is the vector of net outputs. The latter comprises the commodity components of household and government consumption, investment, and net exports. The material balance can be solved to determine the gross outputs, x, that are required to sustain the production of alternative bills of final demands, y. The solution is obtained by applying the so-called Leontief inverse, $(1 - A)^{-1} = 1 + A + A^2 + \ldots$, to the equation: $x = (1 - A)^{-1}y = y + Ay + A^2y + \ldots$. The total output equals the final demand itself plus the direct input requirements given by the input-output matrix plus the indirect requirements. For $A = \begin{pmatrix} 0 & 1/3 \\ 1/2 & 0 \end{pmatrix}$, we have $(I - A)^{-1} = \begin{pmatrix} 1.2 & 0.4 \\ 0.6 & 1.2 \end{pmatrix}$. The first application was the U.S. World War II (1939–1945) effort.

The second equation of the open model is the financial balance, $p = pA + v$, where p is the row vector of prices, pA the row vector of material unit costs, and v the row vector of value-added coefficients, representing the factor costs per unit of output of each product. The financial balance can be solved to trace the effects of changes in the factor costs (such as wages, rental rates, and taxes) on all the commodity prices. The solution is $p = v + vA + vA^2 + \ldots$ Price equals unit factor costs plus the unit factor costs of the direct input requirements plus the unit factor costs of the indirect input requirements.

A simple but important application is the national income identity. Simple manipulation of the two equations yields the identity $py = vx$. On the left-hand side is the value of the net output of the economy or the national product, and on the right-hand side is the value added generated in the production of the gross outputs or the national income. The identity between the national product and income cannot be disaggregated. For example, business services belong to intermediate demand, and hence do not constitute a component of the national product. Their production, however, contributes to national income. If one neglects that the national product must be based on the net output of the economy, one makes the mistake of double counting.

Roughly speaking, an input-output matrix details the average input requirements for the various products, and reductions in input-output coefficients represent productivity gains. The most important source of such reductions is technical change, but input-output coefficients may also be reduced by eliminating waste or by efficiency change. The third source of productivity growth is a composition effect. If relatively efficient firms gain market share, the input-output coefficients of the industry will fall.

Some confusion surrounds the dimensions of an input-output matrix. Some practitioners (including Leontief) consider these to be products, others consider them industries, and still others think of "sectors," a concept that supposedly integrates products and industries. To clarify, one must consider the statistical roots of an input-output matrix. These are an input matrix or use table $U = (u_{ij})_{i = 1, \ldots, m; j = 1, \ldots, n}$ and an output matrix or make table $V = (v_{ij})_{i = 1, \ldots, m; j = 1, \ldots, n}$. Here m is the number of products and n is the number of activities (firms or industries). The first column of the use table depicts the inputs of the first activity (typically agriculture) and the first column of the make table depicts the outputs of that activity. The question is how to construct an input-output matrix on the basis of an input and an output matrix.

The United Nations (1993) advocates the so-called commodity technology model. In the case of square tables (with an equal number of products and industries), this amounts to taking the product of the input matrix and the inverse of the output matrix. However natural, this construction is troublesome. A complication is that the consequent input-output matrix may have negative cells, due to the presence of secondary products. (The off-diagonal entries in the output table create negative elements in the inverse.) In the case of rectangular tables (with more firms than products), the commodity technology model stipulates that the input-output coefficients are the regression coefficients in the equation where the inputs are regressed on the outputs.

To circumvent the problem of negatives and to distinguish between average requirements and best practices, modern input-output analysis works directly with the input and output matrices, without constructing input-output matrices. The gross output variable, x, is replaced by an activity vector, s. (If the first component is 1.01, this means that agriculture produces an additional 1 percent.) In the material balance, intermediate demand, Ax, is replaced by Us, and gross output x by Vs. In short, by working directly with the input and output matrices one can calculate activity levels that sustain alternative bills of final demands without addressing the complications that surround the construction of an input-output matrix (ten Raa 2005).

The logic of input-output analysis can be extended from production to income distribution. Households consume products (the inputs) and provide factor services (the outputs). Social accounting matrices treat different types of households (e.g., rural and urban) as separate "industries." Just as a product row of a use table depicts the distribution of output across industries, a factor-income row of a social-accounting matrix depicts the distribution of factor incomes across households and other income institutions.

SEE ALSO *Fixed Coefficients Production Function; Leontief, Wassily; Social Accounting Matrix*

BIBLIOGRAPHY

Leontief, Wassily. 1936. Quantitative Input and Output Relations in the Economic System of the United States. *The Review of Economics and Statistics* 18 (3): 105–125.

ten Raa, Thijs. 2005. *The Economics of Input-Output Analysis.* Cambridge, U.K.: Cambridge University Press.

United Nations Statistics Division. 1993. *Revised System of National Accounts.* Studies in Methods, Series F, No. 2, Rev. 4. New York: United Nations.

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