Economic & Fiscal Impact Analysis of the Proposed Lowe's Home Center in South Dennis

Prepared for

Local Business for a Strong Cape Economy

Prepared by

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CONTENTS

INTRODUCTION

FXM Associates has been retained by *Local Business for a Strong Cape Economy* to prepare an independent assessment of potential economic and tax effects of the proposed Lowe's Home Center in South Dennis. During the course of FXM's work the project proponents submitted a report to the Cape Cod Commission, *Economic and Fiscal Impact Analysis: Lowe's Home Center,* prepared for Lowe's Home Center, Inc. by Clyde W. Barrow, d/b/a Pyramid Associates LLC (hereinafter referred to as "Proponent's Report"). In order to facilitate the Cape Cod Commission's review, FXM's report focuses on the analyses and findings contained in the "Proponent's Report", pointing out where our independent analyses and findings may be similar to or different from those contained in the "Proponent's Report", as well as the rationale for FXM's work.

As part of FXM's research, a confidential survey was conducted of private businesses on Cape Cod (hereinafter referred to as "Survey Group") that offer products considered directly competitive to those that would be sold by the proposed Lowe's Home Center. Within the Proponent Report's Defined Market Area, the businesses surveyed by FXM account for about 30% of sales -- approximately $100 million per year -- and over 450 employees within the industry sectors (NAICS codes) cited in the Proponents Report as relevant to sales projected for Lowe's. The surveyed businesses include a cross-section of building materials suppliers, hardware, paint, home appliances, and nursery/garden stores that would be affected significantly by the proposed Lowe's. The average tenure of these establishments on Cape Cod is over 50 years: these establishments operated on Cape Cod for a median number of years just over 25 years. Highly confidential data was obtained from the survey group by FXM on business sales, customer profiles, employment, and employee compensation with a strict pledge that such information would only be reported in the aggregate for all participating businesses. Except for the information contained in this report, no information from that survey, including the names of participating businesses, has been or will be made available to any parties outside FXM Associates staff.

Every effort has been made to include only data sources widely considered to be reliable. Moreover, no single source was relied upon in FXM's analyses. In accordance with standard professional practice, the consultant assumes no responsibility for the accuracy of information compiled by others, whether reported in publicly available secondary sources, proprietary data sources, or the information obtained in the primary survey research discussed in this report.

Following this Introduction, FXM's report includes a **Summary Findings** section and sections addressing **Market Capture and Impact on Existing Store Sales**; **Impacts on Employee Compensation and Jobs**; and **Total Direct, Indirect & Induced Economic and Fiscal Effects**. Analytic assumptions, sources and methods are noted as warranted throughout the report.

SUMMARY FINDINGS

As noted on page 2 of the Proponent's Report with respect to the Cape Cod Commission's review of the project, "…the applicant bears the burden of demonstrating to the Commission that the benefits of the project outweigh the detriments", and that "… the Commission will evaluate the economic impacts of proposed developments, taking into account net job creation, fiscal impact, employee benefits, and services and/or products provided that the Commission will consider any negative or positive impacts that a project may have on the Cape Cod economy".

The essential findings of FXM's analysis are that the proposed Lowe's in South Dennis will result in a) *negative* net job creation, b) *negative* net fiscal impact (taxes) to local communities, c) *negative* net employee earnings, insurance and pension benefits, and d) no new services and products not already provided by existing Cape Cod retailers, and will detract from those already provided.

With respect to specific economic development goals of the Cape Cod Commission's 2009 Regional Policy Plan[1], FXM's analysis finds the following:

- The proposed Lowe's in South Dennis, , will ***not*** "…promote a balanced economy with a broad business, industry, employment, cultural, and demographic mix capable of supporting year-round and quality employment opportunities." *By virtue of its negative effects on net jobs, household earnings, and local taxes the proposed Lowe's will detract from this economic development goal* (ED 2). Lowe's will displace the sales and jobs of existing retailers; have higher sales per employee, and therefore provide fewer jobs associated with its sales; will pay its employees less than existing competing retailers, thereby reducing the income earned and spent in the region; will make fewer purchases from local Cape Cod businesses for inputs to its annual operations than made by existing competing Cape Cod stores; and will retain fewer of its profits within the regional economy than will existing Cape Cod retailers.

- The proposed Lowe's in South Dennis will ***not*** "…promote economic activity that retains and attracts income to the region and benefits residents, thus increasing economic opportunity for all." In fact, *counting all the direct and indirect effects the proposed Lowe's will cause a net loss of jobs, income, business sales, profits and taxes to the region across all economic sectors, not just retailing.* Lowe's will offer no net new or different types of jobs that could increase economic opportunities for Cape Cod residents (ED 3).

Results of FXM's technical analyses that support the above general findings include the following:

[1] Stated on page 1 of the Proponent's Report

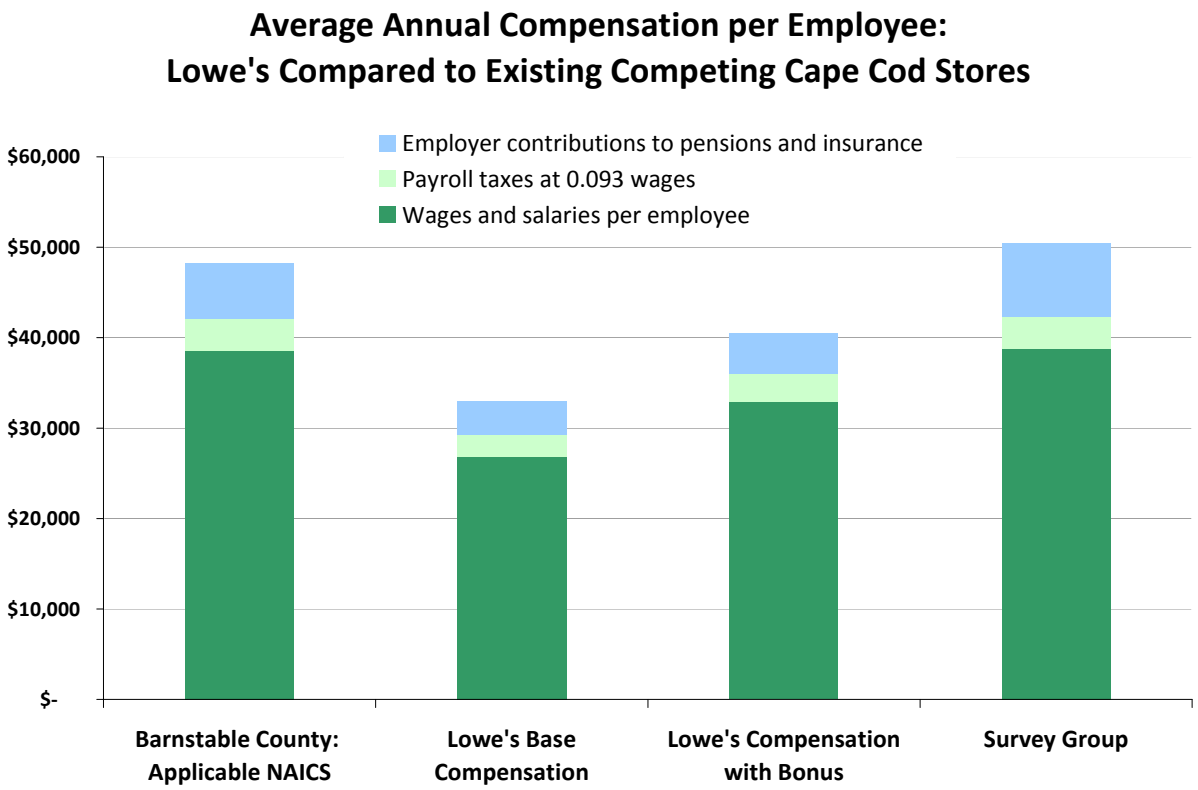
- Proponent's Report asserts (page 10) that Lowe's will displace $19.2 million in sales from existing Cape Cod stores in 2014, and will reach its $35 million in sales by capturing *all* of the Proponent's Report projected growth in sales in the applicable NAICS sectors products and services between 2012 and 2014 when Lowe's opens. We find this assertion incredulous because it assumes that Cape Cod customers will spend all of their presumed "new" money at Lowe's (and accordingly, will spend none of their purported increased income at existing stores in 2013 or 2014). This disallows even sales increases to existing retailers attributable to inflation, and presumes that existing Cape Cod retailers have neither the capacity nor the desire to grow their sales. *Lowe's will compete with existing Cape Cod stores for market share and has no exclusive claim to capturing market growth.*

- Further, the Proponent's Report provides no evidence that potential sales within the applicable NAICS sectors are now being made off-Cape ("leakage") or that Lowe's will otherwise generate "new" demand that cannot now be captured by existing retailers. *All of Lowe's estimated $35 million in sales will come at the expense of existing Cape Cod stores*.

- The impact of Lowe's $35 million in sales is estimated at **10%** of the sales of all existing competing retailers within the Proponent's Report Defined Market Area projected for 2014; **10.2%** of sales by existing competing retailers within a 15-minute drive time of Lowe's South Dennis location; **19.4%** of sales for existing competing stores located within a 10-minute drive-time of the proposed new Lowe's; and **15.3%** of the sales of competing stores located in the Town of Dennis.(see Table 1 and text on page 12 of this report for data and assumptions). For perspective, these percentage losses in sales will put existing Cape Cod stores, at best, back to their sales levels at the depths of the recent recession (2008-2009). With profit margins estimated at about 2% per year, existing Cape Cod retailers – even assuming they can survive these magnitudes of sales losses – will have no choice but to reduce their current employment and will purchase fewer goods and services from local Cape Cod suppliers.

- Using verifiable secondary source data and information provided in the Proponent's Report, FXM estimates that existing retailers within the applicable NAICS categories paid wages & salaries that averaged $38,528 in 2012, compared to $32,957 for Lowe's employees assuming all reach their "bonus targets", and $26,794 for Lowe's employees if the "bonus targets" are not achieved. Counting payroll taxes and employer contributions to insurance and pensions, existing retailers pay an average of $48,276 per year per employee, compared to $40,542 for Lowe's employees assuming they all reach their "bonus targets" and $32,961 if they do not reach their "bonus targets" (see Table 2, page 16 of this report). *Thus, existing competing retailers in 2012 paid 19% more in*

total compensation than that projected for Lowe's employees assuming all Lowe's employees reach their "bonus targets", and 46% more if Lowe's employees do not reach their "bonus targets".[2] The figure below shows these differences graphically:



- Using data from the Proponent's Report and verifiable secondary source data, FXM finds that sales per employee at Lowe's would be $304,000 compared to $215,000 per employee at existing competing stores on Cape Cod. For $35 million in sales, existing retailers therefore provide 163 full and part time jobs compared to the 115 at Lowe's stated in the Proponent's Report – a difference of 48 retail jobs directly displaced by Lowe's. The difference in household income per year for these 48 jobs would be $477,000 per year assuming Lowe's employees reach their "bonus targets" and $841,000 per year (2012 dollars) if Lowe's employees do not reach their "bonus targets".

[2] The differences would be greater if we had added -- to estimated year 2012 compensation to employees of existing retailers – historical average annual increases in employee compensation to derive compensation for the target year 2014 of Lowe's opening. However, it was not clear from the Proponent's Report whether the employee compensation they report for Lowe's is for 2012 or 2014.

- The total direct, indirect & induced economic effects to the Barnstable County economy from Lowe's capturing $35 million in sales from existing retailers is estimated at net (-$6.6 million) in lost business sales within all sectors annually, net (-92) jobs lost, and a net loss of (-$4.2 million) per year in household earnings. These *net* effects include the total direct, indirect & induced impacts of Lowe's capturing $35 million in sales. *The Proponent's Report does not show net effects of Lowe's capturing $35 million in sales compared to the total direct, indirect and induced effects generated by existing retailers. It does not account for even the $19.2 million in sales allegedly displaced in the Proponent's Report.* Losses in local taxes to all communities within Barnstable County are estimated at net (-$257,000) per year and lost profits, dividends, and interest income to the region are estimated at (-$893,000) per year (see pages 18 and 19 of this report for table and text explanations. Table 3 from page 18 is shown below).

Net Annual Losses to the Barnstable County Economy Attributable to Lowe's Displacing $35 million in Sales from Existing Cape Cod Stores

Industry Sectors	Business Sales $1,000	Employment Jobs	Earnings $1,000
Agriculture, Forestry, Fishing, and Hunting	-35.5	0	-6.3
Mining	-0.4	0	-0.2
Utilities	-114.2	0	-18.7
Construction	-6.4	0	-2.3
Manufacturing	-333.0	-1	-65.9
Wholesale Trade	-1,489.1	-1	-98.5
Retail Trade	-1,280.3	-72	-2,963.1
Transportation and Warehousing	-203.9	-1	-62.9
Information	-188.9	-1	-56.8
Finance, Insurance, Real Estate, Rental, and Leasing	-1,317.9	-2	-195.0
Professional and Business Services	-380.4	-2	-160.6
Educational Services, Health Care, and Social Assistance	-817.2	-7	-414.7
Arts, Entertainment, Recreation, Accomodation, and Food Services	-296.8	-4	-100.5
Other Services (except Governement)	-144.1	-1	-54.5
TOTAL ECONOMIC EFFECTS:	**-6,608.1**	**-92**	**-4,200.0**

TAX EFFECTS	Business	Household	Total
Total Taxes	$ (348,400)	$ (1,022,300)	$ (1,370,700)
a.Local	$ (67,900)	$ (189,000)	$ (256,900)
b.State	$ (176,400)	$ (190,700)	$ (367,100)
c.Federal	$ (104,100)	$ (642,600)	$ (746,700)

Source: R/ECON Input Output Model

It should be noted that, even if one accepts Proponent Report's claim that only $19.2 million of the sales of existing competing Cape Cod retailers would be displaced by the proposed Lowe's – rather than the $35 million in displaced sales that would actually occur – the *net* total direct, indirect & induced economic and tax effects annually on the Barnstable County economy *would still be negative*. Net losses would be 55% of the net losses shown in the above table in each category. It should also be noted that FXM used for compensation to Lowe's employees the amounts that included "bonus targets", beyond the base compensation cited in the Proponent's Report. If we had used the base compensation amounts the *net* negative effects to the Barnstable County economy would be at least 20% larger than those shown in the above table.

MARKET CAPTURE AND IMPACT ON EXISTING STORE SALES

This section of the report addresses the extent to which sales projected for the proposed Lowe's are likely to affect the sales of existing Cape Cod business offering products similar to those that would be sold at Lowe's.

Market Area Size & Market Trends

The primary and secondary market areas within which the proposed Lowe's is expected to capture the $35,000,000 in sales is, according to the Proponent's Report, comprised of 11 communities, beginning with the Town of Barnstable and including Brewster, Chatham, Dennis, Harwich, Orleans and Yarmouth (primary market area), as well as Eastham, Provincetown, Truro, and Wellfleet (secondary market area).[3] To estimate the overall market size in terms of business sales/receipts within applicable NAICS categories corresponding to Lowe's product offerings, the Proponent's Report uses business receipts reported in the *2007 Economic Census of Retail Trade* for Barnstable County overall.[4] That Report estimates that approximately 60% of Barnstable County sales in the applicable NAICS categories occur within the Defined Market Area. The Proponent's Report extrapolates from the 2007 Economic Census Data to estimate business sales in 2012, 2013, and 2014 using the assumption that changes in disposable income (nominal dollars, not adjusted for inflation) within Barnstable County reasonably predict future sales volumes in the Defined Market Area. In this vein, the Report estimates that sales in the Defined Market Area of businesses within the applicable NAICS categories total about $300 million in 2012, $315 million in 2013, and $331 million in 2014 when the proposed Lowe's opens for business.

FXM used several data sources and methods and conducted sensitivity tests of all data and assumptions to check the reasonableness of the business sales estimates contained in the Proponent's Report. Among the additional data sources used by FXM were the US Department of Commerce, Bureau of Economic Analysis, *Regional Economic Information System* (REIS), which provides estimates of compensation to employees by NAICS category through 2011 that can then be converted to sales estimates using ratios of compensation to sales contained in the *2007 Economic Census of Retail Trade;* and A.C. Nielsen *Claritas Site Reports* which extrapolates from the *2007 Economic Census: Retail Trade* using other proprietary data to provide estimates of sales by NAICS category in 2012 for specified geographic areas (including Barnstable County, the proponents Defined Market Area, and more conventional definitions of retail trade areas defined by drive times from the subject site that will be noted subsequently). FXM also analyzed potential sales changes since 2007 using changes in income reported by REIS adjusted for inflation by the Consumer Price Index, and changes in population and retail jobs, also reported by REIS.

[3] Pyramid Report, description and map p.6
[4] Pyramid Report, Table 3, page 10

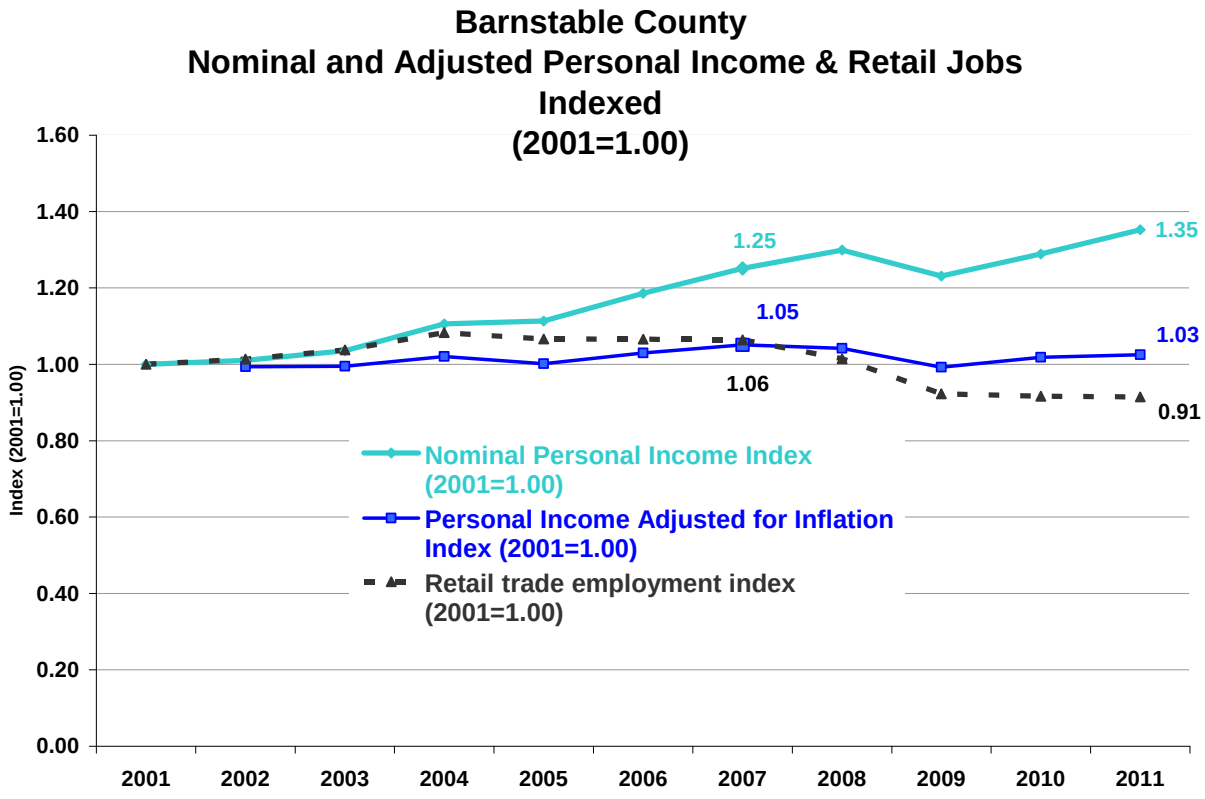
Sales Trends

FXM's analysis estimated that sales within the applicable NAICS categories within Barnstable County declined between 2007 and 2011 by (-13%), or (-3.2%) on an average annual basis over this period. The Proponent's Report estimated that sales in 2012 were about the same as in 2007. FXM's analysis estimates that there was a slight gain in sales (2%) between 2011 and 2012, and in its higher growth scenario projects a 2% per year increase in sales through 2014. The Proponent's Report employs a substantially higher rate of 5% per year increase in sales through 2014.

Income Trends

As shown by the data in Figure A, *real (inflation-adjusted) personal income tracks much more closely with retail jobs (and sales) than do the aggregate nominal disposable personal income estimates used in the Proponent's Report*. As shown in Figure A, income adjusted for inflation declined between 2007 and 2011, as did retail jobs. While nominal personal income had grown by 35% between 2001 and 2011, and by 10% between 2007 and 2011, inflation-adjusted income grew by only 3% since 2001 and declined by (-2%) between 2007 and 2011. In 2011, retail jobs in Barnstable County were 91% of those reported in 2001 and had declined by (-14%) between 2007 and 2011, as shown in Figure A.

Figure A

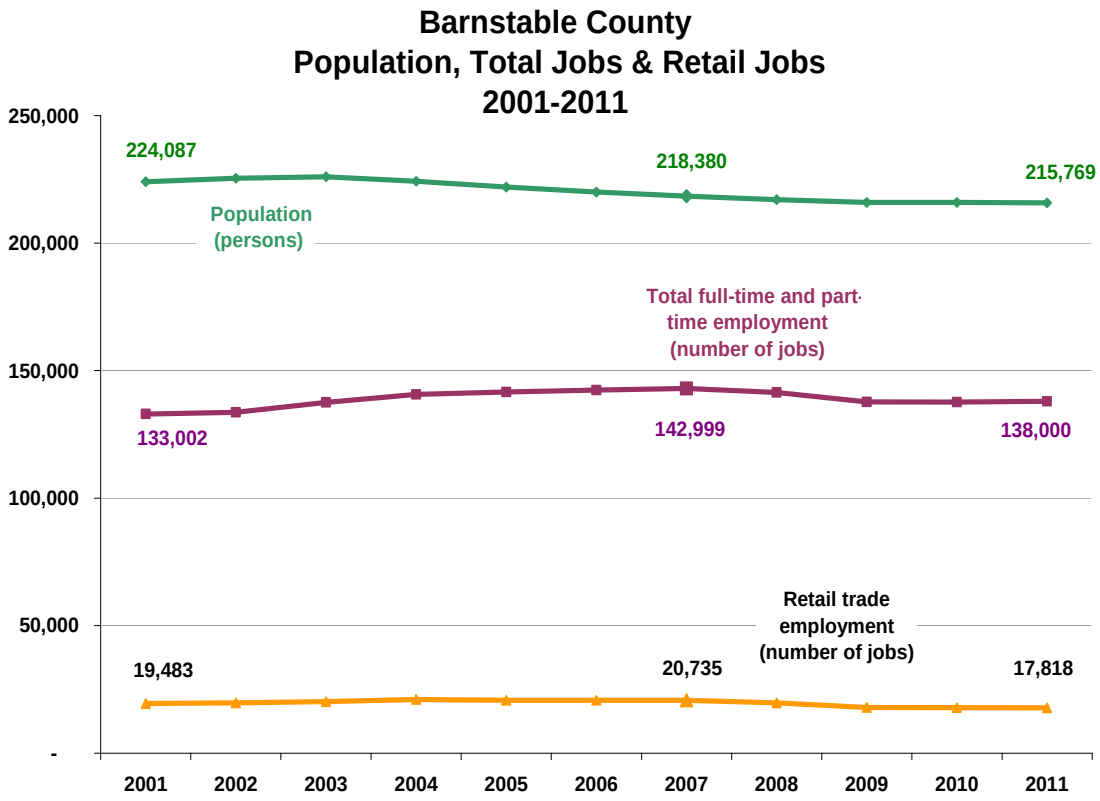


Sources: US Department of Commerce, Bureau of Economic Analysis, *Regional Economic Information System;* US Department of Labor, Bureau of Labor Statistics, Consumer Price Index; and FXM Associates

Population and Employment Trends

Other measures of market trends include changes in population and jobs. Data in Figure B show changes in population, total jobs and retail jobs in Barnstable County since 2001. Barnstable County's population declined steadily between 2001 and 2011, by (-8,300) persons or (-3.7%). Overall jobs increased by 3.7% between 2001 and 2011, while retail jobs decreased by (-8.5%) over this period. Population, total jobs, and retail jobs each declined between 2007 and 2011.

Figure B



Sources: US Department of Commerce, Bureau of Economic Analysis, *Regional Economic Information System* and FXM Associates

Summary

FXM's analysis of market area trends differs substantially from that in the Proponent's Report. Interestingly, however, we derived estimates of business sales in 2012 that are slightly higher than those estimated in the Proponent's Report – notwithstanding that we estimated a (-13%) decline in sales between 2007 and 2011 while the Proponent's Report assumed that sales in 2012 were roughly the same as in 2007.[5] FXM's estimate of sales in the applicable NAICS categories

[5] Part of this apparent contradiction is caused because FXM estimated that sales within the Defined Market Area for 2007 were higher than the corresponding sales assumed in the Proponent's Report.

within the Defined Market Area for 2012 is $335 million, compared to the $300 million estimated in the Proponent's Report.

The important distinction between FXM's market analysis and that contained in the Proponent's Report relates to the interpolation of historical trends to future sales. While there appear to have been slight gains in business sales over the past year or two (slightly less than inflation in FXM's analysis[6]), longer-term trends in population, employment, and real income (adjusted for inflation) suggest that caution is warranted in projecting future demand for the products sold by Lowe's and competing existing establishments.[7] There is nothing in the Proponent's Report to substantiate a sales growth projection of 5% per year between 2012 and 2014 on Cape Cod -- even under the optimistic assumption that apparent slight growth over the past two years is evidence of a change in longer-term trends. As previously discussed (see Figure A), changes in nominal personal income (unadjusted for inflation) used in the Proponent's Report do not track with changes in retail employment and sales on Cape Cod.

Potential Impact of Lowe's on Sales of Existing Businesses

The key assumptions in the Proponent's Report related to the potential impact of Lowe's sales on the sales of existing Cape Cod establishments are stated in the last paragraph on page 10 of the Proponent's Report:

> "If it is further assumed that the proposed Lowe's Home Center captures all of the anticipated annual market growth (+5%) when it opens in 2014, then approximately $19.2 million of its first year annual sales will substitute for purchases at existing establishments, which means it will capture 6.1% of the existing (2014) market from competitors to reach its $35 million sales target, although market substitution could be as low as 1.3% depending on the rate of market growth, the rate at which Lowe's penetrates the existing market, the willingness of customers to change store loyalty, customer awareness of the new store, and competitors response to the Lowe's Home Center."

We do not agree with the notion that Lowe's capture rate of existing store sales will decline because Lowe's will capture *all* new growth. Mathematically, $35 million is a greater percentage of the 2013 sales of $315 million estimated in the Proponent's Report than it is of their 2014 estimated $331 million in sales, but to suggest that the $15.8 million difference all goes to Lowe's so that only $19.2 should be counted against the sales of existing retailers is, at best, disingenuous. The impact to existing competing stores will be significantly larger. The argument stated in the

[6] According to the Consumer Price Index, inflation averaged 2.4% per year between 2001 and 2012 and 2.1% per year between 2007 and 2012 (including the 2009 negative inflation year).

[7] On a national basis, changes in per capita disposable income have been and are projected to be less than those claimed in the Proponent's Report. According to IBIS*World,* a widely-used source of industry trend reports, US per capita disposable income decreased by 0.5% between 2010 and 2011; increased by 1% between 2011 and 2012; and is projected to increase by less than 2% per year between 2013 and 2018.

Proponent's report implies that Cape Cod customers would not spend any "new" money at existing retailers – all of it will go to Lowe's. In this vein, it even disallows any inflation adjustment of existing sales volumes of current Cape retailers. In the real world, whatever the market size it will be pursued by existing as well as new stores. Further, if there is overall market growth in future years, Lowe's sales would be expected to increase along with the sales of existing retailers.

The assertion that Lowe's will not displace the current or future potential sales of existing establishments – for all of its $35 million or whatever amount in sales -- cannot be substantiated by any empirical evidence in the Proponent's Report or by common sense logic. There are only two conditions under which a new retailer will not displace existing store sales within its market area. The most likely occurs when demand for the new retailers products or services is now strictly being captured outside the market area ("leakage"). A second occurs when existing establishments have no capacity to satisfy further growth in market demand. The Proponent's Report provides no evidence of "leakage" (purchases of Lowe's prospective products now made outside the market area), nor do they provide evidence that existing retailers do not have the capacity or desire to absorb growth in demand for the products sold by them and Lowe's. Indeed, objective market data shows that competing existing retailers have had higher sales—and hence greater capacity—in prior years. Accordingly, FXM's subsequent analysis of Lowe's impact on existing store sales dismisses in its entirety the incredulous "new growth instead of substitution" argument stated on page 10 in the Proponent's Report.

The other assertions contained in the above quoted paragraph from page 10 in the Proponent's Report are also dismissed. Specifically, the following statement is unfathomable: "…market substitution could be as low as 1.3% depending on the rate of market growth, the rate at which Lowe's penetrates the existing market, the willingness of customers to change store loyalty, customer awareness of the new store, and competitors' response to the Lowe's Home Center." It seems logical to assume that if Lowe's cannot achieve its full $35 million in sales potential within its required two-year period– regardless of what competing retailers might or might not do – then it would not open a new store in South Dennis.

Impact on Local Sales

Data in Table 1 show FXM's estimate of the impact of Lowe's projected sales in 2014 on sales of existing businesses within the Defined Market Area. Also shown are estimates of Lowe's impact on the sales of establishments located within 10 and 15 minute drive times of Lowe's South Dennis location, and for the Town of Dennis.[8] The proportion of Lowe's sales expected within each of these drive time market areas is based in part on the average distribution of sales reported by our Survey Group – which were remarkably consistent in their estimates of sales to customers located within the respective drive times. Because Lowe's is bigger than most of the stores in our survey group, and would be expected to draw customers willing to drive further, we have lowered the expected capture rates for Lowe's in

[8] See Appendix for drive time maps

the 10-minute and below drive time market areas compared to our Survey Group. Estimates for impacts within the Town of Dennis are based on a 5-minute drive time market area capture, which likely understates the impact in Dennis. The capture rates by drive time market area are also consistent with FXM's prior work assessing drive-time market-area capture rates in other areas with similar consumer purchasing power (including seasonal residents and visitors who add about 31% to overall retail sales Cape-wide). Most retailers view their market areas in terms of drive times, with 15 minutes the typical outside range within which Big Box retailers expect to capture 80% or more of their sales except in very rural areas. Drive-time market areas are typically used by sophisticated retailers in their assessment of market-area demand and competition.

In order to not overstate the potential impacts of Lowe's on existing store sales, the Projected Store Sales in 2014 shown in Table 1 assume a 2% per year growth in sales between 2012 (latest available estimate of actual store sales) and 2014. As previously discussed, longer-term historical trends in population, real personal income, retail employment, and estimated store sales suggest that even 2% annual growth may be optimistic. Uncertainties over the effect of federal budget cuts on GDP (and real income) are also prevalent. In the far right column of Table 1 the higher estimated impact percentages reflect no projected growth in sales from 2012 to 2014. If market-area demand were to increase beyond 2014, we would expect that Lowe's sales would increase at least at pace with overall market growth and that their estimated capture rate (and percentage impact on sales of existing establishments) would remain similar to that shown in Table 1.[9]

Table 1
Estimated Impact of Lowe's Sales on Existing Cape Cod Store Sales

MARKET AREA	Projected Store Sales in 2014	Estimated % of Lowe's Sales by Market Area	Estimated Lowe's Sales by Market Area	Estimated Impact of Lowe's Sales by Market Area on Existing Store Sales	*Tested Range of Potential Impacts on Existing Store Sales*
Proponent Defined Market Area	$ 349,086,000	100%	$ 35,000,000	**10.0%**	*10.0-10.4%*
15-minute Drive Time	$ 273,653,000	80%	$ 28,000,000	**10.2%**	*10.2-11.3%*
10-minute Drive Time	$ 90,391,000	50%	$ 17,500,000	**19.4%**	*19.4-22.2%*
Town of Dennis	$ 57,131,000	25%	$ 8,750,000	**15.3%**	*15.3 -19.1%*

Sources: US Department of Commerce, Bureau of Economic Analysis, *Regional Economic Information System,* 2001-2011 data*;* US Department of Commerce, *2007 Economic Census: Retail Trade;* A.C. Nielsen, *Claritas Site Reports,* 2008, 2011, 2012 data; Survey of Cape Cod Businesses, December 2012-February 2013; "Economic and Fiscal Impact Analysis: Lowe's Home Center", Pyramid Associates LLC, November 2012; and FXM Associates

[9] For the sake of argument, if FXM had assumed the Proponent Report's claim of 5% per year sales growth between 2012 and 2014, the impacts shown in Table 1 would drop by 1% -- for the Defined Market Area it would be 9% instead of 10%. If we had used the Proponent Report's estimate of $331.2 million sales within the Defined Market Area in 2014, the impact on existing stores would be 11%.

Our Survey Group – owners and managers of a cross-section of stores representing about 30% of sales within applicable NAICS groups in the Defined Market Area – estimated that Lowe's could impact, on average for the overall group, about 15% of their sales. As shown by the data in Table 1, FXM's estimate suggests that stores within the 10-minute drive time of Lowe's, and in Dennis particularly, would be most severely affected.

The extent to which sales losses ranging from 10-20%, on average for existing stores, would cause any particular establishment to close cannot be estimated from the data available for this analysis. However, to compensate for sales losses existing retailers will almost surely have to reduce employment.[10] Potential effects of Lowe's on overall employment, employee compensation and household income are addressed in the subsequent two sections of this report.

Also worthy of note with respect to competitive impacts is Proponent's Table 4, page 11. In this table Proponent's Report compares employment in applicable NAICS businesses in the Town of Barnstable in 2002 and 2011, noting the increase in employment between those benchmark years. We find this puzzling since Home Depot's first full year of operation was 2004. Total employment in Proponent's Table 4 in 2004 was 812. In 2011 total employment shown in that table was 610, a *loss* of (-212) jobs, (-26%) of the jobs in 2004. This table, in fact, suggests exactly the opposite effects of Home Depot in the Town of Barnstable as those alleged in the Proponent's Report.

[10] If establishments do close because sales losses are too great to absorb, employment losses could be greater than those attributable to the direct sales losses alone.

IMPACTS ON EMPLOYEE COMPENSATION AND JOBS

Two important measures of the potential impact Lowe's will have on the Cape Cod economy are average compensation per job and average sales per employee. Table 2 shows average compensation per employee estimated for the applicable NAICS in Barnstable County overall,[11] average employee compensation at Lowe's shown in the Proponent's Report, and average per employee compensation reported by our Survey Group. We have included Lowe's base compensation per employee (without bonus) as well because the Proponent's Report noted "bonus targets" and did not indicate the criteria under which such bonuses would be paid.[12]

Table 2
Comparisons of Average Compensation per Employee: Lowe's and Existing Cape Cod Stores: 2012

	Barnstable County: Applicable NAICS	Lowe's Base Compensation	Lowe's Compensation with Bonus	Survey Group
Wages and salaries per employee	$ 38,528	$ 26,794	$ 32,957	$ 38,735
Payroll taxes at 0.093 wages	$ 3,583	$ 2,492	$ 3,065	$ 3,602
Employer contributions to pensions and insurance	$ 6,164	$ 3,675	$ 4,520	$ 8,134
% pensions & insurance	16%	14%	14%	21%
Total compensation per employee	**$ 48,276**	**$ 32,961**	**$ 40,542**	**$ 50,472**

Sources: US Department of Commerce, Bureau of Economic Analysis, *Regional Economic Information System,* 2001-2011 data; US Department of Commerce, *2007 Economic Census: Retail Trade;* Survey of Cape Cod Businesses, December 2012-February 2013; "Economic and Fiscal Impact Analysis: Lowe's Home Center", Pyramid Associates LLC, November 2012; and FXM Associates

As shown by the data in Table 2, average wages and salaries per employee are higher within Barnstable County overall as well as in the Survey Group than those reported for Lowe's in the Proponent's Report for the applicable NAICS categories. Existing employer contributions to pensions and health insurance are also higher as a percentage of wages as well as in absolute dollars, particularly in our Survey Group which reports insurance and pension (401(K)) contributions at 21% of wages compared to 16% by all competing employers in Barnstable County and 14% by

[11] Sources: US Department of Commerce, *2007 Economic Census: Retail Trade,* updated to 2012 using data from the US Department of Commerce, Bureau of Economic Analysis, *Regional Economic Information System.* Compensation has increased an estimated 2.6% per year since 2007 within the applicable NAICS. FXM did not include the "missing sectors" estimated in Table 3, page 10, of the Proponent's Report because average wages for the unreported detailed NAICS in 2007 were estimated in the Proponent's Report at $18,000 per year and are clearly anomalous for the building materials sectors overall where 2007 payroll averaged $34,400 per employee.

[12] Pyramid Report, Table 13, page 25. Data shown in Table 13 purporting comparisons between Lowe's compensation and that within Barnstable County overall by "job title" are irrelevant since compensation within the applicable NAICS categories (Proponent's Report, Table 3, page 10) are substantially higher than the average for all retail jobs in Barnstable County and those noted in Table 13.

Lowe's. Existing retailers on Cape Cod within applicable NAICS categories are paying their workers, on average, 19% more in total compensation than would Lowe's including bonuses, and 46% more if Lowe's employees do not reach their "bonus targets." This means that, in addition to the impact on individual households, to the extent Lowe's displaces jobs at existing Cape Cod stores there will be less aggregate income spent in the regional economy.

Another important measure of direct impacts of Lowe's is sales per employee. Lowe's, like other Big Box retailers, is able -- by virtue of its variety of products in a single store and large store size -- to generate more sales per employee than local retailers. In this instance, according to the Proponent's Report, average sales per employee ($35 million divided by 115 employees) will be approximately $304,000. Within our Survey Group average sales per employee are $204,000 and within all competing retailers in Barnstable County are estimated at about $215,000.[13]

Doing the math for sales and compensation per employee at existing Cape Cod retailers within the applicable NAICS categories yields 163 full and part-time employees for $35 million in sales ($35 million divided by $215,000 per employee), compared to 115 at Lowe's – a difference of 48 jobs. The difference in household income per year would be $477,000 assuming Lowe's employees reach their bonus targets and $841,000 per year if they do not reach their bonus targets.

[13] Sources: US Department of Commerce *2007 Economic Census: Retail Trade* and US Department of Commerce, Bureau of Economic Analysis, *Regional Economic Information System,* 2007-2011 data.

TOTAL DIRECT, INDIRECT & INDUCED ECONOMIC AND FISCAL EFFECTS

Table 3 shows total direct, indirect & induced economic and tax effects to the Barnstable County economy from Lowe's capturing $35 million in sales from existing retailers. FXM used the R/ECON Input-Output Model, maintained by Rutgers University, for this analysis. The Proponent's Report used the IMPLAN Input Output Model for its analysis of total direct, indirect & induced effects attributable to Lowe's $35 million in sales. The assumptions, data sources, and methods inherent to both models are not significantly different and both are widely accepted within the professional and academic communities for regional economic and fiscal impact assessments.[14] *Data in Table 3 assume the total effects predicted for Lowe's and compared these to total effects predicted from existing retailers.* The principal reasons for net losses attributable to Lowe's are differences in compensation per employee and sales per employee compared to existing local retailers, as discussed in the previous section of this report.[15]

Table 3

Net Annual Losses to the Barnstable County Economy Attributable to Lowe's Displacing $35 million in Sales from Existing Cape Cod Stores

Industry Sectors	Business Sales $1,000	Employment Jobs	Earnings $1,000
Agriculture, Forestry, Fishing, and Hunting	-35.5	0	-6.3
Mining	-0.4	0	-0.2
Utilities	-114.2	0	-18.7
Construction	-6.4	0	-2.3
Manufacturing	-333.0	-1	-65.9
Wholesale Trade	-1,489.1	-1	-98.5
Retail Trade	-1,280.3	-72	-2,963.1
Transportation and Warehousing	-203.9	-1	-62.9
Information	-188.9	-1	-56.8
Finance, Insurance, Real Estate, Rental, and Leasing	-1,317.9	-2	-195.0
Professional and Business Services	-380.4	-2	-160.6
Educational Services, Health Care, and Social Assistance	-817.2	-7	-414.7
Arts, Entertainment, Recreation, Accomodation, and Food Services	-296.8	-4	-100.5
Other Services (except Governement)	-144.1	-1	-54.5
TOTAL ECONOMIC EFFECTS:	**-6,608.1**	**-92**	**-4,200.0**

TAX EFFECTS	Business	Household	Total
Total Taxes	$ (348,400)	$ (1,022,300)	$ (1,370,700)
a.Local	$ (67,900)	$ (189,000)	$ (256,900)
b.State	$ (176,400)	$ (190,700)	$ (367,100)
c.Federal	$ (104,100)	$ (642,600)	$ (746,700)

Source: R/ECON Input-Output Model

[14] Unlike IMPLAN, the R/ECON IO Model has been vetted several times in refereed academic journals, since 1983.

[15] FXM input the higher compensation average for Lowe's employees (including "bonus targets").

As shown by data in Table 3, after allowing for the total direct, indirect & induced effects of Lowe's capturing $35 million in sales, *the Barnstable County economy will lose an estimated $6,608,000 in business sales annually (all sectors, although we assume no direct losses in the retail sales), 92 permanent jobs, and $4,200,000 per year in earnings (household income).* That is, Barnstable County employers will lose an additional $6.6 million in sales that currently support local businesses that will lose activity through direct competition with Lowe's. That level of lost support business is associated with 44 additional job losses, over and above the 48 lost directly. Those lost indirect jobs are associated with $2.4 million in compensation.

Lowe's impacts on total direct, indirect, and induced sales, jobs and household income in Barnstable County include fewer purchases of services and goods from local suppliers for its annual operations than made by existing Cape Cod businesses, as is typical for national chain stores compared to locally-based companies.[16] Effects on GDP (Gross Domestic Product) for Barnstable County include a net loss of profits, dividend, and interest income totaling (-$893,000) annually. Local communities across Barnstable County will lose about (-$256,000) in property and other taxes each year.[17]

If Lowe's employees do not reach their "bonus targets," or if the new Lowe's is successful and captures more than the $35 million in sales assumed in the Proponent's Report , net losses to the regional economy will be larger.

It should be noted that, even if one accepts Proponent Report's claim that only $19.2 million of the sales of existing competing Cape Cod retailers would be displaced by the proposed Lowe's – rather than the $35 million in displaced sales that would actually occur – the *net* total direct, indirect & induced economic and tax effects annually on the Barnstable County economy *would still be negative*. Net losses would be 55% of the net losses shown in the above table in each category.

It should also be noted that FXM used for compensation to Lowe's employees the amounts that included "bonus targets", beyond the base compensation cited in the Proponent's Report. If we had used the base compensation amounts the *net* negative effects to the Barnstable County economy would be at least 20% larger than those shown in Table 3.

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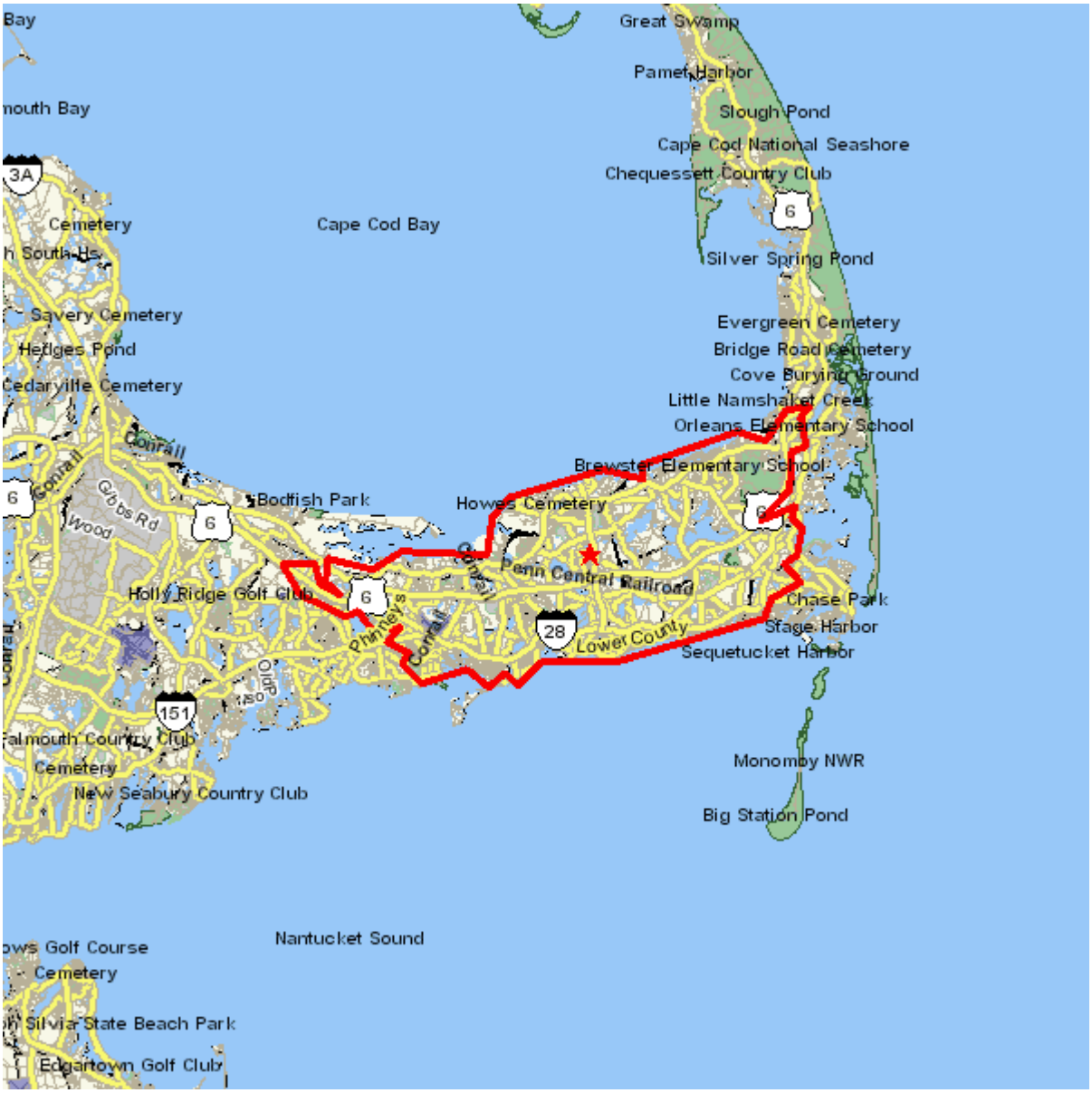
[16] This effect has been extensively documented in prior studies of Big Box and other chain retailers. See, for example, *Assessment of the Direct, Indirect and Induced Economic Effects of Chain Stores on the Regional Economy of Cape Cod,* FXM Associates (June 2005). The Appendix to this report contains a list of the primary case studies and reports reviewed by FXM in the course of research for this project.

[17] Assuming communities within the Defined Market Area absorb about 80% of these local tax losses, the average tax loss for the 11 communities would be about $19,000 per year per community. Further assuming an average property tax rate of $10/1,000 valuation, these communities, on average, would need an additional $1,900,000 in property valuation to recover the net losses attributable to Lowe's.

APPENDIX

15-minute Drive Time of Proposed Lowe's



Source: A.C. Nielsen, *Claritas Site Reports,* 2012

10-minute Drive Time of Proposed Lowe's

Source: A.C. Nielsen, *Claritas Site Reports,* 2012

PRIMARY CASE STUDIES & REPORTS

The Economic and Fiscal Impact of Lowe's in Silverthorne, Colorado, Development Research Partners (February 2010)

Thinking Outside the Box: A Report on Independent Merchants and the Local Economy, Dan Houston, Civic Economics & The Urban Conservatory (September 2009)

Santa Rosa Lowe's Economic Impact Analysis, Michael Brandman Associates & CBRE Consulting (July 2008)

Local Works: Examining the Impact of Local Business on the West Michigan Economy, by Civic Economics, commissioned by Local First Grand Rapids (2008.

The San Francisco Retail Diversity Study, Civic Economics & Locally Owned Merchants Alliance (May 2007)

The Geneseo Town centre – An Economic and Fiscal Impact Assessment of the Proposed Lowe's, CGR (May 2006)

Assessment of the Direct, Indirect and Induced Economic Effects of Chain Stores on the Regional Economy of Cape Cod, FXM Associates (June 2005)

The Andersonville Study of Retail Economics, Civic Economics (October 2004)

The Economic Impact of Locally Owned Businesses vs. Chains: A Case Study in Midcoast Maine, Institute for Local Self-Reliance & Friends of Midcoast Maine (September 2003)

Economic Impact Analysis: A Case Study - Local Merchants vs. Chain Retailers, Civic Economics (December 2002)

The Impact of "big Box" Building Materials Stores On Host Towns and Surrounding Counties in a Midwestern State, Kenneth E. Stone & Georgeanne M. Artz at Iowa State University (August 2001)

Are Chain Stores Bad? A Research Brief, Ridley & Associates, Inc., Cape Cod Commission (undated)

INPUT-OUTPUT ANALYSIS:
Technical Description and Application

This appendix discusses the history and application of input-output analysis and details the input-output model, called the R/ECON™ I-O model, developed by Rutgers University. This model offers significant advantages in detailing the total economic effects of an activity including multiplier effects.

ESTIMATING MULTIPLIERS

The fundamental issue determining the size of the multiplier effect is the "openness" of regional economies. Regions that are more "open" are those that import their required inputs from other regions. Imports can be thought of as substitutes for local production. Thus, the more a region depends on imported goods and services instead of its own production, the more economic activity leaks away from the local economy. Businessmen noted this phenomenon and formed local chambers of commerce with the explicit goal of stopping such leakage by instituting a "buy local" policy among their membership. In addition, during the 1970s, as an import invasion was under way, businessmen and union leaders announced a "buy American" policy in the hope of regaining ground lost to international economic competition. Therefore, one of the main goals of regional economic multiplier research has been to discover better ways to estimate the leakage of purchases out of a region or, relatedly, to determine the region's level of self-sufficiency.

The earliest attempts to systematize the procedure for estimating multiplier effects used the economic base model, still in use in many econometric models today. This approach assumes that all economic activities in a region can be divided into two categories: "basic" activities that produce exclusively for export, and region-serving or "local" activities that produce strictly for internal regional consumption. Since this approach is simpler but similar to the approach used by regional input-output analysis, let us explain briefly how multiplier effects are estimated using the economic base approach. If we let **x** be export employment, **l** be local employment, and **t** be total employment, then

$$\mathbf{t} = \mathbf{x} + \mathbf{l}$$

For simplification, we create the ratio **a** as

$$\mathbf{a} = \mathbf{l}/\mathbf{t}$$

so that $\mathbf{l} = \mathbf{at}$

then substituting into the first equation, we obtain

$$\mathbf{t} = \mathbf{x} + \mathbf{at}$$

By bringing all of the terms with t to one side of the equation, we get

$$\mathbf{t} - \mathbf{at} = \mathbf{x} \text{ or } \mathbf{t}\,(1-\mathbf{a}) = \mathbf{x}$$

Solving for **t,** we get $\mathbf{t} = \mathbf{x}/(1-\mathbf{a})$

Thus, if we know the amount of export-oriented employment, **x,** and the ratio of local to total employment, **a**, we can readily calculate total employment by applying the economic base multiplier, 1/(1-**a**), which is embedded in the above formula. Thus, if 40 percent of all regional employment is used to produce exports, the regional multiplier would be 2.5. The assumption behind this multiplier is that all remaining regional employment is required to support the export employment. Thus, the 2.5 can be decomposed into two parts the direct effect of the exports, which is always 1.0, and the indirect and induced effects, which is the remainder—in this case 1.5. Hence, the multiplier can be read as telling us that for each export-oriented job another 1.5 jobs are needed to support it.

This notion of the multiplier has been extended so that **x** is understood to represent an economic change demanded by an organization or institution outside of an economy—so-called final demand. Such changes can be those effected by government, households, or even by an outside firm. Changes in the economy can therefore be calculated by a minor alteration in the multiplier formula:

$$\Delta \mathbf{t} = \Delta \mathbf{x}/(1-\mathbf{a})$$

The high level of industry aggregation and the rigidity of the economic assumptions that permit the application of the economic base multiplier have caused this approach to be subject to extensive criticism. Most of the discussion has focused on the estimation of the parameter **a**. Estimating this parameter requires that one be able to distinguish those parts of the economy that produce for local consumption from those that do not. Indeed, virtually all industries, even services, sell to customers both inside and outside the region. As a result, regional economists devised an approach by which to measure the *degree* to which each industry is involved in the nonbase activities of the region, better known as the industry's *regional purchase coefficient*. Thus, they expanded the above formulations by calculating for each ***i*** industry

$$\mathbf{l}_i = \mathbf{r}_i \mathbf{d}_i$$

and

$$\mathbf{x}_i = \mathbf{t}_i - \mathbf{r}_i \mathbf{d}_i$$

given that $\mathbf{d}_i$ is the total regional demand for industry ***i***'s product. Given the above formulae and data on regional demands by industry, one can calculate an accurate traditional aggregate economic base parameter by the following:

$$\mathbf{a} = \mathbf{l}/\mathbf{t} = \Sigma \mathbf{l}_{ii}/\Sigma \mathbf{t}_i$$

Although accurate, this approach only facilitates the calculation of an aggregate multiplier for the entire region. That is, we cannot determine from this approach what the effects are on the various sectors of an economy. This is despite the fact that one must painstakingly calculate the regional demand as well as the degree to which they each industry is involved in nonbase activity in the region.

As a result, a different approach to multiplier estimation that takes advantage of the detailed demand and trade data was developed. This approach is called input-output analysis.

REGIONAL INPUT-OUTPUT ANALYSIS: A BRIEF HISTORY

The basic framework for input-output analysis originated nearly 250 years ago when François Quesenay published *Tableau Economique* in 1758. Quesenay's "tableau" graphically and numerically portrayed the relationships between sales and purchases of the various industries of an economy. More than a century later, his description was adapted by Leon Walras, who advanced input-output modeling by providing a concise theoretical formulation of an economic system (including consumer purchases and the economic representation of "technology").

It was not until the twentieth century, however, that economists advanced and tested Walras's work. Wassily Leontief greatly simplified Walras's theoretical formulation by applying the Nobel prize–winning assumptions that both technology and trading patterns were fixed over time. These two assumptions meant that the pattern of flows among industries in an area could be considered stable. These assumptions permitted Walras's formulation to use data from a single time period, which generated a great reduction in data requirements.

Although Leontief won the Nobel Prize in 1973, he first used his approach in 1936 when he developed a model of the 1919 and 1929 U.S. economies to estimate the effects of the end of World War I on national employment. Recognition of his work in terms of its wider acceptance and use meant development of a standardized procedure for compiling the requisite data (today's national economic census of industries) and enhanced capability for calculations (i.e., the computer).

The federal government immediately recognized the importance of Leontief's development and has been publishing input-output tables of the U.S. economy since 1939. The most recently published tables are those for 1987. Other nations followed suit. Indeed, the United Nations maintains a bank of tables from most member nations with a uniform accounting scheme.

Framework

Input-output modeling focuses on the interrelationships of sales and purchases among sectors of the economy. Input-output is best understood through its most basic form, the *interindustry transactions table* or matrix. In this table (see figure 1 for an example), the column industries are consuming sectors (or markets) and the row industries are producing sectors. The content of a matrix cell is the value of shipments that the row industry delivers to the column industry. Conversely, it is the value of shipments that the column industry receives from the row industry. Hence, the interindustry transactions table is a detailed accounting of the disposition of the value of shipments in an economy. Indeed, the detailed accounting of the interindustry transactions at the national level is performed not so much to facilitate calculation of national economic impacts as it is to back out an estimate of the nation's gross domestic product.

FIGURE 1
Interindustry Transactions Matrix (Values)

	Agriculture	Manufacturing	Services	Other	Final Demand	Total Output
Agriculture	10	65	10	5	10	$100
Manufacturing	40	25	35	75	25	$200
Services	15	5	5	5	90	$120
Other	15	10	50	50	100	$225
Value Added	20	95	20	90		
Total Input	100	200	120	225		

For example, in figure 1, agriculture, as a producing industry sector, is depicted as selling $65 million of goods to manufacturing. Conversely, the table depicts that the manufacturing industry purchased $65 million of agricultural production. The sum across columns of the interindustry transaction matrix is called the *intermediate outputs vector*. The sum across rows is called the *intermediate inputs vector*.

A single *final demand* column is also included in Figure 1. Final demand, which is outside the square interindustry matrix, includes imports, exports, government purchases, changes in inventory, private investment, and sometimes household purchases.

The *value added* row, which is also outside the square interindustry matrix, includes wages and salaries, profit-type income, interest, dividends, rents, royalties, capital consumption allowances, and taxes. It is called value added because it is the difference between the total value of the industry's production and the value of the goods and nonlabor services that it requires to produce. Thus, it is the *value* that an industry *adds* to the goods and services it uses as inputs in order to produce output.

The value added row measures each industry's contribution to wealth accumulation. In a national model, therefore, its sum is better known as the gross domestic product (GDP). At the state level, this is known as the gross state product—a series produced by the U.S. Bureau of Economic Analysis and published in the Regional Economic Information System. Below the state level, it is known simply as the regional equivalent of the GDP—the gross regional product.

Input-output economic impact modelers now tend to include the household industry within the square interindustry matrix. In this case, the "consuming industry" is the household itself. Its spending is extracted from the final demand column and is appended as a separate column in the interindustry matrix. To maintain a balance, the income of households must be appended as a row. The main income of households is labor income, which is extracted from the value-added row. Modelers tend not to include other sources of household income in the household industry's row. This is not because such income is not attributed to households but rather because much of this other income derives from sources outside of the economy that is being modeled.

The next step in producing input-output multipliers is to calculate the *direct requirements matrix*, which is also called the technology matrix. The calculations are based entirely on data from

figure 1. As shown in figure 2, the values of the cells in the direct requirements matrix are derived by dividing each cell in a column of figure 1, the interindustry transactions matrix, by its column total. For example, the cell for manufacturing's purchases from agriculture is 65/200 = .33. Each cell in a column of the direct requirements matrix shows how many cents of each producing industry's goods and/or services are required to produce one dollar of the consuming industry's production and are called *technical coefficients*. The use of the terms "technology" and "technical" derive from the fact that a column of this matrix represents a recipe for a unit of an industry's production. It, therefore, shows the needs of each industry's production process or "technology."

FIGURE 2
Direct Requirements Matrix

	Agriculture	Manufacturing	Services	Other
Agriculture	.10	.33	.08	.02
Manufacturing	.40	.13	.29	.33
Services	.15	.03	.04	.02
Other	.15	.05	.42	.22

Next in the process of producing input-output multipliers, the *Leontief Inverse* is calculated. To explain what the Leontief Inverse is, let us temporarily turn to equations. Now, from figure 1 we know that the sum across both the rows of the square interindustry transactions matrix (**Z**) and the final demand vector (**y**) is equal to vector of production by industry (**x**). That is,

$$\mathbf{x} = \mathbf{Zi} + \mathbf{y}$$

where **i** is a summation vector of ones. Now, we calculate the direct requirements matrix (**A**) by dividing the interindustry transactions matrix by the production vector or

$$\mathbf{A} = \mathbf{Z}\mathbf{X}^{-1}$$

where $\mathbf{X}^{-1}$ is a square matrix with inverse of each element in the vector **x** on the diagonal and the rest of the elements equal to zero. Rearranging the above equation yields

$$\mathbf{Z} = \mathbf{AX}$$

where **X** is a square matrix with the elements of the vector **x** on the diagonal and zeros elsewhere. Thus,

$$\mathbf{x} = (\mathbf{AX})\mathbf{i} + \mathbf{y}$$

or, alternatively,

$$\mathbf{x} = \mathbf{Ax} + \mathbf{y}$$

solving this equation for **x** yields

$$\mathbf{x} = (\mathbf{I}-\mathbf{A})^{-1}\ \mathbf{y}$$

Total Output = Total Requirements * Final Demand

The Leontief Inverse is the matrix $(\mathbf{I}-\mathbf{A})^{-1}$. It portrays the relationships between final demand and production. This set of relationships is exactly what is needed to identify the economic impacts of an event external to an economy.

Because it does translate the direct economic effects of an event into the total economic effects on the modeled economy, the Leontief Inverse is also called the *total requirements matrix.* The total requirements matrix resulting from the direct requirements matrix in the example is shown in figure 3.

FIGURE 3
Total Requirements Matrix

	Agriculture	Manufacturing	Services	Other
Agriculture	1.5	.6	.4	.3
Manufacturing	1.0	1.6	.9	.7
Services	.3	.1	1.2	.1
Other	.5	.3	.8	1.4
Industry Multipliers	.33	2.6	3.3	2.5

In the direct or technical requirements matrix in Figure 2, the technical coefficient for the manufacturing sector's purchase from the agricultural sector was .33, indicating the 33 cents of agricultural products must be directly purchased to produce a dollar's worth of manufacturing products. The same "cell" in Figure 3 has a value of .6. This indicates that for every dollar's worth of product that manufacturing ships out of the economy (i.e., to the government or for export), agriculture will end up increasing its production by 60 cents. The sum of each column in the total requirements matrix is the *output multiplier* for that industry.

Multipliers

A *multiplier* is defined as the system of economic transactions that follow a disturbance in an economy. Any economic disturbance affects an economy in the same way as does a drop of water in a still pond. It creates a large primary "ripple" by causing a *direct* change in the purchasing patterns of affected firms and institutions. The suppliers of the affected firms and institutions must change their purchasing patterns to meet the demands placed upon them by the firms originally affected by the economic disturbance, thereby creating a smaller secondary "ripple." In turn, those who meet the needs of the suppliers must change their purchasing patterns to meet the demands placed upon them by the suppliers of the original firms, and so on; thus, a number of subsequent "ripples" are created in the economy.

The multiplier effect has three components—direct, indirect, and induced effects. Because of the pond analogy, it is also sometimes referred to as the *ripple effect*.

- A *direct effect* (the initial drop causing the ripple effects) is the change in purchases due to a change in economic activity.

- An *indirect effect* is the change in the purchases of suppliers to those economic activities directly experiencing change.

- An *induced effect* is the change in consumer spending that is generated by changes in labor income within the region as a result of the direct and indirect effects of the economic activity. Including households as a column and row in the interindustry matrix allows this effect to be captured.

Extending the Leontief Inverse to pertain not only to relationships between *total* production and final demand of the economy but also to *change*s in each permits its multipliers to be applied to many types of economic impacts. Indeed, in impact analysis the Leontief Inverse lends itself to the drop-in-a-pond analogy discussed earlier. This is because the Leontief Inverse multiplied by a change in final demand can be estimated by a power series. That is,

$$(\mathbf{I}-\mathbf{A})^{-1}\,\Delta\mathbf{y} = \Delta\mathbf{y} + \mathbf{A}\,\Delta\mathbf{y} + \mathbf{A}(\mathbf{A}\,\Delta\mathbf{y}) + \mathbf{A}(\mathbf{A}(\mathbf{A}\,\Delta\mathbf{y})) + \mathbf{A}(\mathbf{A}(\mathbf{A}(\mathbf{A}\,\Delta\mathbf{y}))) + \ldots$$

Assuming that $\Delta\mathbf{y}$—the change in final demand—is the "drop in the pond," then succeeding terms are the ripples. Each "ripple" term is calculated as the previous "pond disturbance" multiplied by the direct requirements matrix. Thus, since each element in the direct requirements matrix is less than one, each ripple term is smaller than its predecessor. Indeed, it has been shown that after calculating about seven of these ripple terms that the power series approximation of impacts very closely estimates those produced by the Leontief Inverse directly.

In impacts analysis practice, $\Delta\mathbf{y}$ is a single column of expenditures with the same number of elements as there are rows or columns in the direct or technical requirements matrix. This set of elements is called an *impact vector*. This term is used because it is the *vector* of numbers that is used to estimate the *economic impacts* of the investment.

There are two types of changes in investments, and consequently economic impacts, generally associated with projects—*one-time impacts* and *recurring impacts*. One-time impacts are impacts that are attributable to an expenditure that occurs once over a limited period of time. For example, the impacts resulting from the construction of a project are one-time impacts. Recurring impacts are impacts that continue permanently as a result of new or expanded ongoing expenditures. The ongoing operation of a new train station, for example, generates recurring impacts to the economy. Examples of changes in economic activity are investments in the preservation of old homes, tourist expenditures, or the expenditures required to run a historical site. Such activities are considered changes in final demand and can be either positive or negative. When the activity is not made in an industry, it is generally not well represented by the input-output model. Nonetheless, the activity can be represented by a special set of elements that are similar to a column of the transactions matrix. This set of elements is called an economic

disturbance or impact vector. The latter term is used because it is the vector of numbers that is used to estimate the impacts. In this study, the impact vector is estimated by multiplying one or more economic *translators* by a dollar figure that represents an investment in one or more projects. The term translator is derived from the fact that such a vector *translates* a dollar amount of an activity into its constituent purchases by industry.

One example of an industry multiplier is shown in figure 4. In this example, the activity is the preservation of a historic home. The *direct impact* component consists of purchases made specifically for the construction project from the producing industries. The *indirect impact* component consists of expenditures made by producing industries to support the purchases made for this project. Finally, the *induced impact* component focuses on the expenditures made by workers involved in the activity on-site and in the supplying industries.

FIGURE 4
Components of the Multiplier for the
Historic Rehabilitation of a Single-Family Residence

DIRECT IMPACT	INDIRECT IMPACT	INDUCED IMPACT
Excavation/Construction Labor Concrete Wood Bricks Equipment Finance and Insurance	Production Labor Steel Fabrication Concrete Mixing Factory and Office Expenses Equipment Components	Expenditures by wage earners on-site and in the supplying industries for food, clothing, durable goods, entertainment

REGIONAL INPUT-OUTPUT ANALYSIS

Because of data limitations, regional input-output analysis has some considerations beyond those for the nation. The main considerations concern the depiction of regional technology and the adjustment of the technology to account for interregional trade by industry.

In the regional setting, local technology matrices are not readily available. An accurate region-specific technology matrix requires a survey of a representative sample of organizations for each industry to be depicted in the model. Such surveys are extremely expensive.[18] Because of the expense, regional analysts have tended to use national technology as a surrogate for regional technology. This substitution does not affect the accuracy of the model as long as local industry technology does not vary widely from the nation's average.[19]

[18]The most recent statewide survey-based model was developed for the State of Kansas in 1986 and cost on the order of $60,000 (in 1990 dollars). The development of this model, however, leaned heavily on work done in 1965 for the same state. In addition the model was aggregated to the 35-sector level, making it inappropriate for many possible applications since the industries in the model do not represent the very detailed sectors that are generally analyzed.

[19]Only recently have researchers studied the validity of this assumption. They have found that large urban areas may have technology in some manufacturing industries that differs in a statistically significant way from the national average. As will be discussed in a subsequent paragraph, such differences may be unimportant after accounting for trade patterns.

Even when local technology varies widely from the nation's average for one or more industries, model accuracy may not be affected much. This is because interregional trade may mitigate the error that would be induced by the technology. That is, in estimating economic impacts via a regional input-output model, national technology must be regionalized by a vector of regional purchase coefficients,[20] **r**, in the following manner:

$$(\mathbf{I}-\mathbf{rA})^{-1}\,\mathbf{r}\cdot\Delta\mathbf{y}$$

or

$$\mathbf{r}\cdot\Delta\mathbf{y} + \mathbf{rA}\,(\mathbf{r}\cdot\Delta\mathbf{y}) + \mathbf{rA}(\mathbf{rA}\,(\mathbf{r}\cdot\Delta\mathbf{y})) + \mathbf{rA}(\mathbf{rA}(\mathbf{rA}\,(\mathbf{r}\cdot\Delta\mathbf{y}))) + \ldots$$

where the vector-matrix product **rA** is an estimate of the region's direct requirements matrix. Thus, if national technology coefficients—which vary widely from their local equivalents—are multiplied by small RPCs, the error transferred to the direct requirements matrices will be relatively small. Indeed, since most manufacturing industries have small RPCs and since technology differences tend to arise due to substitution in the use of manufactured goods, technology differences have generally been found to be minor source error in economic impact measurement. Instead, RPCs and their measurement error due to industry aggregation have been the focus of research on regional input-output model accuracy.

A COMPARISON OF THREE MAJOR REGIONAL ECONOMIC IMPACT MODELS

In the United States there are three major vendors of regional input-output models. They are U.S. Bureau of Economic Analysis's (BEA) RIMS II multipliers, Minnesota IMPLAN Group Inc.'s (MIG) IMPLAN Pro model, and CUPR's own R/ECON™ I–O model. CUPR has had the privilege of using them all. (R/Econ™ I–O builds from the PC I–O model produced by the Regional Science Research Corporation's (RSRC).)

Although the three systems have important similarities, there are also significant differences that should be considered before deciding which system to use in a particular study. This document compares the features of the three systems. Further discussion can be found in Brucker, Hastings, and Latham's article in the Summer 1987 issue of *The Review of Regional Studies* entitled "Regional Input-Output Analysis: A Comparison of Five Ready-Made Model Systems." Since that date, CUPR and MIG have added a significant number of new features to PC I–O (now, R/ECON™ I–O) and IMPLAN, respectively.

Model Accuracy

RIMS II, IMPLAN, and R/ECON™ I–O all employ input-output (I–O) models for estimating impacts. All three regionalized the U.S. national I–O technology coefficients table at the highest levels of disaggregation (more than 500 industries). Since aggregation of sectors has been shown to be an important source of error in the calculation of impact multipliers, the retention of

[20] A regional purchase coefficient (RPC) for an industry is the proportion of the region's demand for a good or service that is fulfilled by local production. Thus, each industry's RPC varies between zero (0) and one (1), with one implying that all local demand is fulfilled by local suppliers. As a general rule, agriculture, mining, and manufacturing industries tend to have low RPCs, and both service and construction industries tend to have high RPCs.

maximum industrial detail in these regional systems is a positive feature that they share. The systems diverge in their regionalization approaches, however. The difference is in the manner that they estimate regional purchase coefficients (RPCs), which are used to regionalize the technology matrix. An RPC is the proportion of the region's demand for a good or service that is fulfilled by the region's own producers rather than by imports from producers in other areas. Thus, it expresses the proportion of the purchases of the good or service that do not leak out of the region, but rather feed back to its economy, with corresponding multiplier effects. Thus, the accuracy of the RPC is crucial to the accuracy of a regional I–O model, since the regional multiplier effects of a sector vary directly with its RPC.

The techniques for estimating the RPCs used by CUPR and MIG in their models are theoretically more appealing than the location quotient (LQ) approach used in RIMS II. This is because the former two allow for crosshauling of a good or service among regions and the latter does not. Since crosshauling of the same general class of goods or services among regions is quite common, the CUPR-MIG approach should provide better estimates of regional imports and exports. Statistical results reported in Stevens, Treyz, and Lahr (1989) confirm that LQ methods tend to overestimate RPCs. By extension, inaccurate RPCs may lead to inaccurately estimated impact estimates.

Further, the estimating equation used by CUPR to produce RPCs should be more accurate than that used by MIG. The difference between the two approaches is that MIG estimates RPCs at a more aggregated level (two-digit SICs, or about 86 industries) and applies them at a desegregate level (over 500 industries). CUPR both estimates and applies the RPCs at the most detailed industry level. The application of aggregate RPCs can induce as much as 50 percent error in impact estimates (Lahr and Stevens, 2002).

Although both R/ECON™ I–O and IMPLAN use an RPC-estimating technique that is theoretically sound and update it using the most recent economic data, some practitioners question their accuracy. The reasons for doing so are three-fold. First, the observations currently used to estimate their implemented RPCs are based on 30-year old trade relationships—the Commodity Transportation Survey (CTS) from the 1977 Census of Transportation. Second, the CTS observations are at the state level. Therefore, RPC's estimated for substate areas are extrapolated. Hence, there is the potential that RPCs for counties and metropolitan areas are not as accurate as might be expected. Third, the observed CTS RPCs are only for shipments of goods. The interstate provision of services is unmeasured by the CTS. IMPLAN replies on relationships from the 1977 U.S. Multiregional Input-Output Model that are not clearly documented. R/ECON™ I–O relies on the same econometric relationships that it does for manufacturing industries but employs expert judgment to construct weight/value ratios (a critical variable in the RPC-estimating equation) for the nonmanufacturing industries.

The fact that BEA creates the RIMS II multipliers gives it the advantage of being constructed from the full set of the most recent regional earnings data available. BEA is the main federal government purveyor of employment and earnings data by detailed industry. It therefore has access to the fully disclosed and disaggregated versions of these data. The other two model systems rely on older data from *County Business Patterns* and Bureau of Labor Statistic's Quarterly Covered Employment and Wage data, which have been "improved" by filling-in for

any industries that have disclosure problems (this occurs when three or fewer firms exist in an industry or a region).

Model Flexibility

For the typical user, the most apparent differences among the three modeling systems are the level of flexibility they enable and the type of results that they yield. R/Econ™ I–O allows the user to make changes in individual cells of the 515-by-515 technology matrix as well as in the 11 515-sector vectors of region-specific data that are used to produce the regionalized model. The 11 sectors are: output, demand, employment per unit output, labor income per unit output, total value added per unit of output, taxes per unit of output (state and local), nontax value added per unit output, administrative and auxiliary output per unit output, household consumption per unit of labor income, and the RPCs. Te PC I–O model tends to be simple to use. Its User's Guide is straightforward and concise, providing instruction about the proper implementation of the model as well as the interpretation of the model's results.

The software for IMPLAN Pro is Windows-based, and its User's Guide is more formalized. Of the three modeling systems, it is the most user-friendly. The Windows orientation has enabled MIG to provide many more options in IMPLAN without increasing the complexity of use. Like R/ ECON ™ I–O, IMPLAN's regional data on RPCs, output, labor compensation, industry average margins, and employment can be revised. It does not have complete information on tax revenues other than those from indirect business taxes (excise and sales taxes), and those cannot be altered. Also like R/ECON™, IMPLAN allows users to modify the cells of the 538-by-538 technology matrix. It also permits the user to change and apply price deflators so that dollar figures can be updated from the default year, which may be as many as four years prior to the current year. The plethora of options, which are advantageous to the advanced user, can be extremely confusing to the novice. Although default values are provided for most of the options, the accompanying documentation does not clearly point out which items should get the most attention. Further, the calculations needed to make any requisite changes can be more complex than those needed for the R/ ECON ™ I–O model. Much of the documentation for the model dwells on technical issues regarding the guts of the model. For example, while one can aggregate the 538-sector impacts to the one- and two-digit SIC level, the current documentation does not discuss that possibility. Instead, the user is advised by the Users Guide to produce an aggregate model to achieve this end. Such a model, as was discussed earlier, is likely to be error ridden.

For a region, RIMS II typically delivers a set of 38-by-471 tables of multipliers for output, earnings, and employment; supplementary multipliers for taxes are available at additional cost. Although the model's documentation is generally excellent, use of RIMS II alone will not provide proper estimates of a region's economic impacts from a change in regional demand. This is because no RPC estimates are supplied with the model. For example, in order to estimate the impacts of rehabilitation, one not only needs to be able to convert the engineering cost estimates into demands for labor as well as for materials and services by industry, but must also be able to estimate the percentage of the labor income, materials, and services which will be provided by the region's households and industries (the RPCs for the demanded goods and services). In most cases, such percentages are difficult to ascertain; however, they are provided in the R/Econ™ I–O and IMPLAN models with simple triggering of an option. Further, it is impossible to change

any of the model's parameters if superior data are known. This model ought not to be used for evaluating any project or event where superior data are available or where the evaluation is for a change in regional demand (a construction project or an event) as opposed to a change in regional supply (the operation of a new establishment).

Model Results

Detailed total economic impacts for about 500 industries can be calculated for jobs, labor income, and output from R/ECON™ I–O and IMPLAN only. These two modeling systems can also provide total impacts as well as impacts at the one- and two-digit industry levels. RIMS II provides total impacts and impacts on only 38 industries for these same three measures. Only the manual for R/Econ™ I–O warns about the problems of interpreting and comparing multipliers and any measures of output, also known as the value of shipments.

As an alternative to the conventional measures and their multipliers, R/ECON™ I–O and IMPLAN provide results on a measure known as "value added." It is the region's contribution to the nation's gross domestic product (GDP) and consists of labor income, nonmonetary labor compensation, proprietors' income, profit-type income, dividends, interest, rents, capital consumption allowances, and taxes paid. It is, thus, the region's production of wealth and is the single best economic measure of the total economic impacts of an economic disturbance.

In addition to impacts in terms of jobs, employee compensation, output, and value added, IMPLAN provides information on impacts in terms of personal income, proprietor income, other property-type income, and indirect business taxes. R/ECON™ I–O breaks out impacts into taxes collected by the local, state, and federal governments. It also provides the jobs impacts in terms of either about 90 or 400 occupations at the users request. It goes a step further by also providing a return-on-investment-type multiplier measure, which compares the total impacts on all of the main measures to the total original expenditure that caused the impacts. Although these latter can be readily calculated by the user using results of the other two modeling systems, they are rarely used in impact analysis despite their obvious value.

In terms of the format of the results, both R/ECON™ I–O and IMPLAN are flexible. On request, they print the results directly or into a file (Excel® 4.0, Lotus 123®, Word® 6.0, tab delimited, or ASCII text). It can also permit previewing of the results on the computer's monitor. Both now offer the option of printing out the job impacts in either or both levels of occupational detail.

RSRC Equation

The equation currently used in the R/ECON™ I–O model for estimating RPCs is reported in Treyz and Stevens (1985). In this paper, the authors show that they estimated the RPC from the 1977 CTS data by estimating the demands for an industry's production of goods or services that are fulfilled by local suppliers (*LS*) as

$$LS = D^{e(-1/x)}$$

and where for a given industry

$x = k\, Z_1^{a1} Z_2^{a2}\, P_j\, Z_j^{aj}$ and D is its total local demand.

Since for a given industry RPC = LS/D then

$$\ln\{-1/[\ln(\ln LS/\ln D)]\} = \ln k + a_1 \ln Z_1 + a_2 \ln Z_2 + S_j\, a_j \ln Z_j$$

which was the equation that was estimated for each industry.

This odd nonlinear form not only yielded high correlations between the estimated and actual values of the RPCs, it also assured that the RPC value ranges strictly between 0 and 1. The results of the empirical implementation of this equation are shown in Treyz and Stevens (1985, table 1). The table shows that total local industry demand (Z_1), the supply/demand ratio (Z_2), the weight/value ratio of the good (Z_3), the region's size in square miles (Z_4), and the region's average establishment size in terms of employees for the industry compared to the nation's (Z_5) are the variables that influence the value of the RPC across all regions and industries. The latter of these maintain the least leverage on RPC values.

Because the CTS data are at the state level only, it is important for the purposes of this study that the local industry demand, the supply/demand ratio, and the region's size in square miles are included in the equation. They allow the equation to extrapolate the estimation of RPCs for areas smaller than states. It should also be noted here that the CTS data only cover manufactured goods. Thus, although calculated effectively making them equal to unity via the above equation, RPC estimates for services drop on the weight/value ratios. A very high weight/value ratio like this forces the industry to meet this demand through local production. Hence, it is no surprise that a region's RPC for this sector is often very high (0.89). Similarly, hotels and motels tend to be used by visitors from outside the area. Thus, a weight/value ratio on the order of that for industry production would be expected. Hence, an RPC for this sector is often about 0.25.

The accuracy of CUPR's estimating approach is exemplified best by this last example. Ordinary location quotient approaches would show hotel and motel services serving local residents. Similarly, IMPLAN RPCs are built from data that combine this industry with eating and drinking establishments (among others). The result of such aggregation process is an RPC that represents neither industry (a value of about 0.50) but which is applied to both. In the end, not only is the CUPR's RPC-estimating approach the most sound, but it is also widely acknowledged by researchers in the field as being state of the art.

But in the case of the U.S. Virgin Islands, CUPR had direct access to data on both domestic and international trade being moved on to and off of the Islands. To estimate RPCs in this case,

CUPR simply estimated demand from techniques described in Treyz and Stevens (1985), and then estimated the amount of that demand supplied by local USVI industries (the *LS* above) by subtracting imports from the demand total. As mentioned previously, the RPC is the share of demand that is met by local supplies or $RPC = LS / D$. This then was estimated for each USVI industry in the input-output model with RPC of zeros where the industry does not exist in the USVI.

Advantages and Limitations of Input-Output Analysis

Input-output modeling is one of the most accepted means for estimating economic impacts. This is because it provides a concise and accurate means for articulating the interrelationships among industries. The models can be quite detailed. For example, the current U.S. model currently has about 500 industries representing many six-digit North American Industrial Classification System (NAICS) codes. CUPR's model used in this study has the same number. Further, the industry detail of input-output models provides not only a consistent and systematic approach but also more accurately assesses multiplier effects of changes in economic activity. Research has shown that results from more aggregated economic models can have as much as 50 percent error inherent in them. Such large errors are generally attributed to poor estimation of regional trade flows resulting from the aggregation process.

Input-output models also can be set up to capture the flows among economic regions. For example, the model used in this study could have estimated impacts for each major island as well as the total territory economy, if the data on employment and imports had been made available.

The limitations of input-output modeling should also be recognized. The approach makes several key assumptions. First, the input-output model approach assumes that there are no economies of scale to production in an industry; that is, the proportion of inputs used in an industry's production process does not change regardless of the level of production. This assumption will not work if the technology matrix depicts an economy of a recessional economy (e.g., 1982) and the analyst is attempting to model activity in a peak economic year (e.g., 1989). In a recession year, the labor-to-output ratio tends to be excessive because firms are generally reluctant to lay off workers when they believe an economic turnaround is about to occur.

A less-restrictive assumption of the input-output approach is that technology is not permitted to change over time. It is less restrictive because the technology matrix in the United States is updated frequently and, in general, production technology does not radically change over short periods.

Finally, the technical coefficients used in most regional models are based on the assumption that production processes are spatially invariant and are well represented by the nation's average technology.