An Introduction to Economic Impact Assessment

Topics

- Kinds of Economic Measures and Key Terminology
- The Organization of Information in Input-Output Models
- The Economic Assessment Process
- Case Studies and Group Exercises
Objectives

- Understanding of key terms and procedures
- Understanding of regional economic complexities
- Appreciation for the process and appropriateness of these kinds of measures
- Some practical experience developing and critiquing a study scenario
- Reference materials

FIRST, A RE-INTRODUCTION TO REGIONAL ECONOMICS
Regional economics

• Branch of economics mainly concerned with the geographic distribution of population and economic activities

• Regional economics recognizes that there are regional variations in economic performance
  – Or events that differentially impact different regions or types of places (rural vs. urban)

Why should we care about regions?

• The same policy can have different impacts in different regions.

• Regions have different resource endowments;
  – Differences in comparative advantages.

• Regions at different stages of economic development have different structures.
Structure matters

• Key assumptions: economic development is accompanied by ...
  – Changes in consumption patterns (demand);
  – Changes in production structure (supply);
  – Change in linkages among sectors;
  – Changes in capital/labor availability/consumption.

Economic model

• Need to measure the general equilibrium impact of an exogenous shock
  – Why general equilibrium?
    • Because there are indirect as well as direct effects

• Direct impact is one-directional transmission of influence in the first round
  – Incomplete!

• Indirect repercussions (second and higher rounds) generate significant indirect effects
**Input-output model**

- I-O model is known as an inter-industry model because it focuses on interdependence of industries.

- **Main idea:** the output of industry X is used as input for industry Y. In turn, output of Y is used as input for X.

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**IO Math Quick Review:** The Leontief Transformation – Otherwise Known as Making the Multipliers
Basic terms

1. We start with a **table of transactions** among industries (previous picture)
2. That table is transformed into a “production recipe”
3. With the help of a nifty formula that operationalizes the production recipe, we do what is called a Leontief transformation to the data
4. And we get a set of economic multipliers

I’m going to spend a few minutes describing and showing how we get to the multipliers.
The nifty formula

We are using a spreadsheet to build the components to populate the standard IO (or Leontief) equation of:

\[ X = AX + Y \]

Which can (eventually) be re-written for our purposes as

\[ X = (I - A)^{-1}Y \]

Where:
- \( X \) = matrix of outputs,
- \( A \) = matrix of coefficients,
- \( Y \) = matrix of final demand,
- \( I \) = an identity matrix that emerged from transforming the first equation into the second, operational equation

First the Math

\[ X = AX + Y \]

Need to get the \( X \)s together on the left side, so

\[ X - AX = Y \]

And we have \( X \) in common to both terms on the left side, so

\[ (I - A)X = Y \]

"I" is an identity, not "1" in this equation. When you divide a matrix by itself, you get an identity matrix with "1s" on the diagonals

\[
\begin{bmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
0 & 0 & 1
\end{bmatrix}
\]

Finishing with \( X \) on left,

\[ X = (I - A)^{-1}Y \]

This equation lets us build our input output model because we can make all of the parts if we have a statement of inter-industrial transactions.
And we all built a rudimentary, but fully functioning I-O model.
I. Kinds of Economic Measures and Key Terminology

• Input-output accounts
  – Industries/commodities
  – Households
  – Institutions
  – Linkages among all of these entities

• Impact Information Produced/Measured
  – Total industrial output – Usually Analogous to Gross Sales
  – Value added
    • Employee compensation
    • Proprietors’ incomes
    • Property incomes
    • Indirect tax payments
  – Jobs

Measures and Terms (cont’d)

• Direct effects – the industry or set of activities that we are interested in
• Indirect effects – the sets of industrial linkages evident in the region: the purchase of production inputs
• Induced effects (household effects) – what happens when workers spend their paychecks locally
• Total effects = direct + indirect + induced
A Visual Representation

A Simple Multiplier Illustration

More complete models have more initial detail on direct multipliers
We’ve already produced a basic total multiplier table

• For every $1 of final demand change in agriculture in Carroll County, we have these multipliers:

<table>
<thead>
<tr>
<th>Multiplier</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Requirements</td>
<td>1.5140</td>
</tr>
<tr>
<td>Employee Compensation</td>
<td>0.1176</td>
</tr>
<tr>
<td>Proprietor Income</td>
<td>0.1908</td>
</tr>
<tr>
<td>Other Income</td>
<td>0.2333</td>
</tr>
<tr>
<td>Indirect Bus. Taxes</td>
<td>0.0035</td>
</tr>
<tr>
<td>Value Added</td>
<td>0.4570</td>
</tr>
</tbody>
</table>

• We add fixed job factors (per, say, $million of direct output) to get those, as well

Multiplier or Multiplier Effect

Type I (or Inputs) Multiplier
= (direct + indirect)/direct

Type Total (or Type II) Multiplier
= (direct + indirect + induced)/direct
When there is a change in the demand for a particular commodity supplied by an industry in the model, we get three types of economic consequences: Direct, Indirect, and Induced.

1. **Direct:** Change in commodity demand
2. **Indirect:** Effects the demand for commodity and service inputs from regional suppliers
3. **Induced:** Direct and indirect economic activity change leads to changes in worker incomes that are spent to maintain households.

The Economic Impact is the sum of the direct, indirect, and induced consequences of the change in commodity demand. The data are typically summarized in terms of total industrial output, value added, labor income, and jobs.

### Economic Impact of a New Hog Slaughter Facility (Assumes New Pork Production)

<table>
<thead>
<tr>
<th>Impact Type</th>
<th>Employment</th>
<th>Labor Income</th>
<th>Value Added</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Effect</td>
<td>922</td>
<td>$45,781,721</td>
<td>$80,364,197</td>
<td>$575,781,494</td>
</tr>
<tr>
<td>Indirect Effect</td>
<td>468</td>
<td>$53,907,503</td>
<td>$97,947,469</td>
<td>$127,467,690</td>
</tr>
<tr>
<td>Induced Effect</td>
<td>315</td>
<td>$12,085,571</td>
<td>$21,705,375</td>
<td>$38,633,484</td>
</tr>
<tr>
<td>Total Effect</td>
<td>1705</td>
<td>$111,774,795</td>
<td>$200,017,041</td>
<td>$741,882,668</td>
</tr>
<tr>
<td>Multiplier</td>
<td>1.85</td>
<td>2.44</td>
<td>2.49</td>
<td>1.29</td>
</tr>
</tbody>
</table>

### Economic Impact of a New Hog Slaughter Facility (Assumes No New Pork Production)

<table>
<thead>
<tr>
<th>Impact Type</th>
<th>Employment</th>
<th>Labor Income</th>
<th>Value Added</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Effect</td>
<td>922</td>
<td>$45,781,721</td>
<td>$80,364,197</td>
<td>$575,781,494</td>
</tr>
<tr>
<td>Indirect Effect</td>
<td>27</td>
<td>$3,054,413</td>
<td>$5,549,728</td>
<td>$7,222,351</td>
</tr>
<tr>
<td>Induced Effect</td>
<td>146</td>
<td>$5,618,697</td>
<td>$10,091,035</td>
<td>$17,961,074</td>
</tr>
<tr>
<td>Total Effect</td>
<td>1095</td>
<td>$54,454,830</td>
<td>$96,004,960</td>
<td>$600,964,919</td>
</tr>
<tr>
<td>Multiplier</td>
<td>1.19</td>
<td>1.19</td>
<td>1.19</td>
<td>1.04</td>
</tr>
</tbody>
</table>
Multiplier Per $1 Million in Direct Output Change

<table>
<thead>
<tr>
<th>Impact Type</th>
<th>Employment</th>
<th>Labor Income</th>
<th>Value Added</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Effect</td>
<td>1.60</td>
<td>$79,512</td>
<td>$139,574</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Indirect Effect</td>
<td>0.05</td>
<td>$5,305</td>
<td>$9,639</td>
<td>$12,544</td>
</tr>
<tr>
<td>Induced Effect</td>
<td>0.25</td>
<td>$9,758</td>
<td>$17,526</td>
<td>$31,194</td>
</tr>
<tr>
<td>Total Effect</td>
<td>1.90</td>
<td>$94,576</td>
<td>$166,739</td>
<td>$1,043,738</td>
</tr>
</tbody>
</table>

Economic Impacts and Non-impacts

- I-O models initially identify sets of economic values or economic effects
- We need to distinguish, therefore, between effects that describe the strength and extent of linkages versus the effects that imply causality or economy expansion or contraction
- Economic impacts are generally reserved for describing a discernible change in regional production, employment, or household spending, either positive or negative
Factors to Consider

- Export production
  - Base industries (manufacturing, agriculture, resources, regional trade concentrations, tourism and recreation)
  - Import substitution
  - Government institutions and payments
- Regional industrial structures and changes
- Regional consumption and demand
- Interstate dynamics (RAC example)

Additional Factors

- Industrial structures and relationships over time.
  - Model does well with traditional commodities – ag, mining, forestry, manufacturing.
  - Model does less well in other areas – technology sectors, computer programming, business and producer services – especially if technical inputs are changing rapidly
- Consequently, strong on historical relationships but poorer on emerging relationships
- Is forced to compute average effects – what you see is what we’ll get
- Is not an appropriate tool for forecasting – at best it is describing the current structure, not the future structure
Limitations / Assumptions

1. No substitutes
2. I & O proportions are fixed (no price, scale, or technology changes)
3. Ignorant of external scale economies
4. M and X proportions are fixed
5. No resource constraints (input and factor supplies are perfectly elastic)
6. No slack in the economy – all regional resources are perfectly employed

Most Common Impact Analysis Mistakes

• Inaccurately specifying the final demand change
  – Often happens with new industrial development
  – Many unknowns, plus regional production may react to a new industry (fertilizer example)
• Improper use or interpretation of multipliers
  – Implying causality versus contribution
  – Using the wrong region of analysis
  – Misunderstanding rules internal to I/O analysis
Economic Regions

- Counties
- Groups of counties
  - Contiguous
  - Noncontiguous
- State
- States
- Nation
Multiplier Misuse

- Wrong industry
- Wrong region
- Wrong time
- Wrong type
- Wrong conclusion
- Wrong promotion
- Wrong headed
The Data

• Benchmark Input-Output Accounts
• National Income and Product Accounts
• Quinquennial surveys of industry
• County Business Patterns
• QCEW – quarterly census of employment and wages
• All compiled and “smoothed” by modeling companies or academics

II. The Organization of Information in Input-Output Models

• Social accounts
• Total requirements and direct coefficients
• Regional purchases and regional purchase coefficients (RPCs)
• Primary data and surveys
Initial Industrial Summary

Table 1. Iowa Industrial Output, Jobs, Labor Income and Value Added by Industrial Sector, 1998

<table>
<thead>
<tr>
<th>Sector</th>
<th>Output</th>
<th>Percent of Total</th>
<th>Jobs</th>
<th>Percent of Total</th>
<th>All Labor Income</th>
<th>Percent of Total</th>
<th>Value</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>11,505.8</td>
<td>7.2%</td>
<td>120,378.5</td>
<td>6.8%</td>
<td>9,488.7</td>
<td>6.8%</td>
<td>5,315.0</td>
<td>6.8%</td>
</tr>
<tr>
<td>Mining</td>
<td>299.9</td>
<td>0.2%</td>
<td>2,508.0</td>
<td>0.1%</td>
<td>96.7</td>
<td>0.2%</td>
<td>204.6</td>
<td>0.3%</td>
</tr>
<tr>
<td>Construction</td>
<td>11,477.5</td>
<td>7.2%</td>
<td>118,108.1</td>
<td>6.2%</td>
<td>3,921.8</td>
<td>7.3%</td>
<td>4,463.0</td>
<td>5.4%</td>
</tr>
<tr>
<td>Food Processing</td>
<td>18,293.4</td>
<td>11.4%</td>
<td>50,781.5</td>
<td>2.7%</td>
<td>1,857.9</td>
<td>3.5%</td>
<td>3,088.9</td>
<td>3.9%</td>
</tr>
<tr>
<td>All Other Manufacturing</td>
<td>39,050.8</td>
<td>24.4%</td>
<td>217,526.8</td>
<td>11.4%</td>
<td>8,942.3</td>
<td>16.7%</td>
<td>13,297.3</td>
<td>16.4%</td>
</tr>
<tr>
<td>TCIU</td>
<td>10,714.3</td>
<td>6.7%</td>
<td>79,012.1</td>
<td>4.1%</td>
<td>2,957.2</td>
<td>5.5%</td>
<td>5,987.4</td>
<td>7.4%</td>
</tr>
<tr>
<td>Trade</td>
<td>19,497.6</td>
<td>12.2%</td>
<td>415,396.1</td>
<td>21.8%</td>
<td>8,473.4</td>
<td>15.8%</td>
<td>14,075.2</td>
<td>17.4%</td>
</tr>
<tr>
<td>Finance, Ins., &amp; Real Est.</td>
<td>15,914.6</td>
<td>10.0%</td>
<td>124,353.1</td>
<td>6.5%</td>
<td>3,867.0</td>
<td>7.2%</td>
<td>11,253.3</td>
<td>13.9%</td>
</tr>
<tr>
<td>Services</td>
<td>22,446.5</td>
<td>14.0%</td>
<td>510,159.1</td>
<td>26.7%</td>
<td>11,591.1</td>
<td>21.7%</td>
<td>13,693.0</td>
<td>16.9%</td>
</tr>
<tr>
<td>Government</td>
<td>10,269.7</td>
<td>6.4%</td>
<td>248,702.9</td>
<td>13.0%</td>
<td>8,174.9</td>
<td>15.3%</td>
<td>9,307.7</td>
<td>11.5%</td>
</tr>
<tr>
<td>Other</td>
<td>328.4</td>
<td>0.2%</td>
<td>11,675.0</td>
<td>0.6%</td>
<td>99.4</td>
<td>0.2%</td>
<td>328.4</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

159,788.6 100% 1,907,601.1 100% 53,467.5 100% 80,963.8 100%

Note: All financial amounts in $millions.

Direct and Total Requirements

- When industries make a product or service, they require inputs
- We are interested in the kinds of purchases that industries make
- They allow us to discern their “production recipe”
- They then allow us to figure out sets of direct coefficients
- And from this, we use the Leontief transformation to produce a regional table of total requirements
Table 2. Industry Balance Sheet

<table>
<thead>
<tr>
<th>Industry Commodity Demand</th>
<th>Direct Coefficients</th>
<th>Requirements (millions)</th>
<th>Value Added Coefficients</th>
<th>Value Added (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Estate</td>
<td>0.07847</td>
<td>227.62</td>
<td>0.01621</td>
<td>47.03</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>0.06045</td>
<td>175.07</td>
<td>0.32977</td>
<td>956.63</td>
</tr>
<tr>
<td>Agriculture Services, etc.</td>
<td>0.05615</td>
<td>162.87</td>
<td>0.18113</td>
<td>525.43</td>
</tr>
<tr>
<td>Other Agricultural Chemicals</td>
<td>0.05401</td>
<td>156.68</td>
<td>0.05180</td>
<td>150.27</td>
</tr>
<tr>
<td>Nitrogenous and Phosphatic Fertilizers</td>
<td>0.04301</td>
<td>124.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance and Repair Other Facilities</td>
<td>0.01169</td>
<td>33.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Freight Transport and Warehousing</td>
<td>0.01076</td>
<td>31.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petroleum Refining</td>
<td>0.00915</td>
<td>26.54</td>
<td>0.00825</td>
<td>23.93</td>
</tr>
<tr>
<td>Lubricating Oils and Greases</td>
<td>0.00825</td>
<td>23.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed Grains</td>
<td>0.00873</td>
<td>19.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Repair Shops</td>
<td>0.00688</td>
<td>19.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitary Services and Steam Supply</td>
<td>0.00590</td>
<td>17.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Other Costs</td>
<td>0.06984</td>
<td>202.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Commodity Demand</td>
<td>0.421088</td>
<td>1,221.52</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regional Purchases and RPCs

- Regional Purchase estimates are both the strength and weakness of I-O models
- RPCs are the adjustments that we make to the direct coefficients to account for the availability of commodities locally
- It is always legitimate to question the accuracy of the RPCs that we are using
Table 3. Regional Purchases and Coefficients -- Feed Grains

<table>
<thead>
<tr>
<th>Industry Commodity Demand</th>
<th>Total Requirements (millions)</th>
<th>Regional Purchase Coefficients</th>
<th>Estimated Regional Purchases (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Estate</td>
<td>227.62</td>
<td>44.0%</td>
<td>100.05</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>175.37</td>
<td>81.3%</td>
<td>142.57</td>
</tr>
<tr>
<td>Agriculture Services, Etc.</td>
<td>162.87</td>
<td>55.5%</td>
<td>90.37</td>
</tr>
<tr>
<td>Other Agricultural Chemicals</td>
<td>156.68</td>
<td>48.1%</td>
<td>75.41</td>
</tr>
<tr>
<td>Nitrogenous and Phosphatic Fertilizers</td>
<td>124.77</td>
<td>45.6%</td>
<td>56.91</td>
</tr>
<tr>
<td>Maintenance and Repair Other Facilities</td>
<td>33.91</td>
<td>96.5%</td>
<td>32.74</td>
</tr>
<tr>
<td>Motor Freight Transport and Warehousing</td>
<td>31.20</td>
<td>71.2%</td>
<td>22.22</td>
</tr>
<tr>
<td>Petroleum Refining</td>
<td>26.54</td>
<td>0.9%</td>
<td>0.23</td>
</tr>
<tr>
<td>Lubricating Oils and Greases</td>
<td>23.93</td>
<td>39.8%</td>
<td>9.54</td>
</tr>
<tr>
<td>Feed Grains</td>
<td>19.53</td>
<td>26.4%</td>
<td>5.15</td>
</tr>
<tr>
<td>Miscellaneous Repair Shops</td>
<td>19.38</td>
<td>58.6%</td>
<td>11.37</td>
</tr>
<tr>
<td>Sanitary Services and Steam Supply</td>
<td>17.12</td>
<td>76.8%</td>
<td>13.14</td>
</tr>
<tr>
<td>All Other Industries (Wtd Avg)</td>
<td>202.60</td>
<td>41.9%</td>
<td>84.85</td>
</tr>
<tr>
<td><strong>Total Commodity Demand</strong></td>
<td><strong>1,221.52</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Regional Totals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>All Imports (1-RPC)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Amending the RPCs

- Surveys
  - Costly
  - Industries hate them
  - Skewed incentives
    - Industries won’t reveal costs
    - Economic developers tend to paint rosy pictures
- University research
- Census of industry
- Industry trade publications
- Your own experience/expertise

Not to be confused with LPCs used for certain I/O analysis
The Economic Assessment Process

• The study scenario
• Getting the numbers
• Specifying the region
• Running the model and interpreting output
• Just saying No!

The Scenario

• Plant opening, closing, expanding, contracting
  – Construction effects or ongoing operations
  – Temporary or continuous outcomes
• Change in output, workers, compensation
• Change in household spending
• Offsets and other factors (like with the slaughter plants or other value added manufacturing)
• Figuring out what you can know, what you can’t
• Managing client expectations
Getting the Numbers

- Total output or gross annual sales
- Number of employees
- Total payroll and benefit costs (earnings)
- Ideally, major production
  - By prices paid
  - Percentage purchased locally
- Whether locally (proprietor) or externally owned and controlled

Information about the workers
- Number eligible for social insurance (unemployment compensation) and the value and duration of those benefits
- Other severances and offsets
- Residence of the workers

Information about the community economic structure
- Regional distribution of jobs by industry (competitive strengths or weaknesses)
- Recent changes in jobs and industrial activity (trends and transformations)
- Characteristics of local trade and commerce (pull factors, change over time)
- Demographics – what’s been going on with the regional population and its composition
The Study Region

- Initial effects might be localized/nodal
- Long-term effects often have regional consequences
- Specifying the region to narrowly or too broadly can lead to problems
- Need to have compelling reason to produce non-contiguous regions

Retail and Wholesale Margining

- In IO analysis, retail and wholesale output excludes the cost of goods sold. Those payments are allocated upstream to the ...
  - Wholesaler (in the case of retail)
  - Transporters (between manufacturers and final sellers)
  - Manufacturers
- That means that we do not use the value of cash register sales when modeling retail or wholesale activities
Margin examples

<table>
<thead>
<tr>
<th>Description</th>
<th>Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale trade</td>
<td>17.40%</td>
</tr>
<tr>
<td>Retail - Motor vehicle and parts</td>
<td>20.60%</td>
</tr>
<tr>
<td>Retail - Food and beverage stores</td>
<td>27.90%</td>
</tr>
<tr>
<td>Retail - Electronics and appliance</td>
<td>20.20%</td>
</tr>
<tr>
<td>Retail - Gasoline stores</td>
<td>10.80%</td>
</tr>
</tbody>
</table>

Other Special Rules or Considerations

- Construction impacts must be properly specified and expressed for the years in which the construction activity takes place.
- Construction temporary impacts must be reported distinct from and never combined with the ongoing operational impacts of the finished activity.
- Usually require detailed “bill of goods” analyses that are complicated.
Here is how I displayed multi-year construction data in a recent hydroelectric dam project.

For the construction of the hydro-electric dam at Lake Red Rock, along with all transmission line additions, these are the job impacts by year:

Here is how I displayed multi-year construction and ongoing operations data in a recent study of wind energy deployment strategies:
Economic Impact Topics

• Large Construction/Capital Development
  – Bakken pipeline
  – Oramesco fertilizer plant
  – Data centers
  – Wind / solar energy
  – Hydroelectric
  – Other civil engineering activities

Economic Impact Topics

• Tourism / entertainment
  – Arts / entertainment districts
  – New attractions (nature preserve)
  – Amenities (bike trails)
  – Events and spectacles
  – Sporting venues
Economic Impact Topics

• Value Added Agriculture / Local Foods / Buy Local
  – Enhanced regional value added opportunities
  – Import substitution
  – Local food promotion / production
  – Farmers’ markets
  – Food hubs
  – Organized “shop local” campaigns

Distinguishing between an impact analysis and a contribution analysis

• Contribution (footprint) analysis usually involves an industry class or a specified group of industries
  – All area health care
  – A food production cluster in CR
  – A university
  – A retail or service sector
  – A broadly defined set of linked industries (forestry)
• Impacts are reserved for instances where we can discern increased final demand gains as a result of the industry we are studying
• Impacts can be a distinct subset of a contribution analysis
Case

• Annually, maybe around 12,000 (8,500 week-long and 1,500 per day) spandex-clad cyclists ride from the Missouri River to the Mississippi River in what is called RAGBRAI stopping in some new community every night.

• I was asked by a reporter to tell them the economic impact of the shindig. Working with some basic assumptions, I gave him the answer over the phone. Was it big, medium, or dinky, all things considered?