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Abstract

The Export Price Index (EPI) is a measure of exogenous price shocks to a city's export industries. Thus far the EPI has been used to estimate models of metropolitan statistical area employment demand and appears to capture exogenous demand shocks to the regional economy. This article explains the intuition behind and construction of the EPI. Glaeser (2008) has noted that because "the economic theory of cities emphasizes a search for exogenous causes of endogenous outcomes like local wages, housing prices, and city growth, it is unsurprising that the economic empirics on cities have increasingly focused on the quest for exogenous sources of variation." The EPI is such an exogenous cause. The EPI data discussed in this note are available through The George Washington University Center for Economic Research website at http://www.gwu.edu/~cer1/datasets/datasets.html.

Introduction

Modeling of metropolitan statistical area (MSA) economies has been hampered by the lack of a truly exogenous indicator of shifts in demand for regional product. Although an endless number of regional and national "demand shift" variables exist, including aggregate income, payrolls, output, government purchases, and employment, none of these are specifically related to a given MSA. Thus New York State output or income can be used to measure demand for output from Buffalo, but the same variable could also be used for Rochester or Syracuse. It is not surprising that researchers have resorted to identifying determinants of demand shifts through the use of exclusion restrictions (Carlino and Mills, 1987; Voith, 1998), which are less satisfying on theoretical grounds. As Carlino and Mills admit, "judgment and experimentation are entailed in specifying the (exogenous variables)." Unfortunately, no obvious indicator of growth in demand for MSA-specific output exists.

The Export Price Index (EPI) is a weighted index of export goods prices that enables researchers to identify exogenous demand shocks to the economy of an MSA. Urban development models, such as Henderson's (1988) system of cities model, assert the importance of a region's export industries. Regional economic development stems from the performance of a modest number of export industries, which produce goods for sale in national or world markets where they are price takers. Examples of base industries include Detroit's automotive industry and San Jose's high-technology industry. When these industries experience positive price shocks, the positive effects ripple throughout the local economy, and when the national and world prices of their products fall, output in industries producing for local consumption, particularly in the retail and service sectors, also shrinks. The theoretical principle that one of the major sources of shocks to an MSA economy is fluctuations in national and world prices of goods that the city exports is well established.

If we assume that the national price for industry output is exogenous and that a region's export industry cannot by itself affect its national output price,[1] fluctuations in the EPI can be regarded as demand shocks to which MSA output and employment are expected to respond positively. A price increase would be viewed as an indication of an increase in demand to which the export industry would respond by increasing output and employment because productivity is fixed in the short run. As will be discussed later, this result holds empirically.

Construction of the EPI

Construction of the EPI requires two types of data: national goods prices and MSA export employment by sector. The goods prices are collected from three sources: the Producer Price Index (PPI), the Consumer Price Index (CPI), and sector prices. Each of these price indexes is produced by the Bureau of Labor Statistics (BLS). The frequency and length of the price data determine the structure of the series. The current EPI series relies on annual price data from 1981 to 2000. The index, however, can be easily extended to quarterly or monthly frequencies and over longer time periods.

[1] Regional development models, such as Henderson's (1988) system of cities model, treat export price shocks as exogenous drivers of local output change.

Identification of MSA export employment by sector is the most challenging part of the EPI. Although multiple sources of local industry employment exist, the Quarterly Census of Employment and Wages (QCEW), the series formerly known as ES-202, is used to identify export industries and calculate export employment, as explained later in this discussion. The advantage of this series is its industry detail. QCEW data are available for the 4-digit Standard Industrial Classification (SIC) level pre-2000 and for the 6-digit North American Industry Classification System (NAICS) level, subsequently.[2] This level of detail is desirable because it creates more homogenous product categories. Other popular employment series, including the Bureau of Economic Analysis' Regional Economic Information System (REIS) and the Census Bureau's County Business Patterns, provide less industrial detail. In addition, the QCEW data are compiled from state unemployment insurance filings and, therefore, are a census of all employees covered by state unemployment insurance, whereas the REIS and County Business Patterns data are survey based.

The export base industries are identified using location quotients (LQs). An excellent discussion of the construction and use of LQs is found in Brown, Coulson, and Engle (1992). The LQ is the quotient of the fraction of total employment in a particular sector and the fraction of total U.S. employment in that sector. The LQ for industry *i* located in region *r*, is given by

$$LQ_{ir} = (e_{ir} / e_{r}) / (e_{i} / e). \quad (1)$$

An LQ exceeding 1 indicates that the region has a greater concentration of employment in that industry than the country as a whole. As interpreted throughout the regional economics literature, this indication implies that the industry produces more than required for local consumption and thus a portion of that industry's output is "exported" to other areas. In the most current version of the EPI, the LQs are calculated using 1999 QCEW employment data at the 4-digit SIC level.

Two groups of industries are excluded regardless of whether their LQ was greater than 1: (1) industries that produce strictly for local consumption, which includes court system activities, construction, and utilities, and (2) industries for which no price could be determined. The latter group primarily includes mining services, military hardware, and vague retail industries. The exclusion of these industries has little practical effect on the EPI because none represents a major metropolitan export industry.

The industry prices are then matched to the export industries. As mentioned previously, three BLS data sets on industry prices are used. The PPI is the primary source, used for approximately two-thirds of the more than 900 industries, covering the agriculture, mining, and manufacturing industries. The CPI and sector prices primarily cover the wholesale and retail trade and service industries.

After matching prices with industries, the prices are weighted using the industry's export employment. Export employment, x_{ir}, is the industry employment needed to produce only the portion of its output that is exported and is calculated as

$$x_{ir} = (1 - 1 / LQ_{ir}) * e_{ir} = (e_{ir} / e_{i} - e_{r} / e) * e_{i} \text{ if } LQ_{ir} > 1, \text{ and 0 otherwise.} \quad (2)$$

[2] Through 2000, BLS reported QCEW data using the SIC codes. Beginning in 2001, these data are reported using the NAICS codes.

Dividing an industry's export employment by the region's total export employment provides the industry's weight.

$$w_{ir} = x_{ir} / \sum_{i} x_{ir} \quad (3)$$

The LQs and weights used to create the index were computed using data on an area's industrial structure at a point in time—in this case, 1999. Holding the weights constant, this computation is done under the assumption that the fundamental structure of a city's export base changes slowly over time. Short-term variation in the weights used to calculate the EPI could easily be due to cyclical fluctuations at the national level and the local level. Some experiments were done with other base years and empirical results were found to be insensitive to the choice of base year within the time period studied. This finding is most likely because industrial structures change slowly over time, particularly at the aggregate MSA level.

Finally, the index is created by summing the weighted industry prices.

$$EPI_r = \sum_{r} w_{ir} * x_{ir} * P_i .$$

Extending the EPI to the Subregional Level

In addition to the availability of MSA-level EPI, separate series representing the central city and suburbs are also available. This extension requires only two adjustments. First, the new regions are defined. In this case, because metropolitan areas are defined along county borders, the central city is represented by the county of a metropolitan area's central city. The suburbs consist of the remaining counties in the metropolitan area, as defined by the Office of Management and Budget (OMB).[3]

Second, export employment is recalculated for the subregions. The central city and suburb EPI series also relies importantly on MSA-level LQs. This reliance on MSA-level LQs avoids biasing the indices with trade between the two areas, which would introduce an endogenous element to the otherwise exogenous measure. For each MSA-level export industry, export employment is calculated separately for the central city and suburbs, based on their share of MSA-level industry employment.

Although the extension here was to the subregional level, the concept could easily be applied to regions, such as counties and states, or even to countries. Similar modifications would apply; that is, (1) define the region and (2) calculate LQs and export employment. For international indices, the world competitive price would be substituted as well.

Scope of the Data

The current EPI series contains data both at the MSA level and at the city-suburb level from 1981 through 2000 for 77 metropolitan areas. Exhibit 1 lists the 77 MSAs with their 2000 employment levels. The metropolitan areas included in the sample are generally the largest MSAs in the United

[3] See OMB, 1999.

Exhibit 1

Metropolitan Areas[a] Included in EPI Data Set

MSA Name	2000 MSA Employment	MSA Name	2000 MSA Employment
Akron, OH PMSA	318,705	Lexington, KY MSA	266,130
Albuquerque, NM MSA	343,657	Little Rock-North Little Rock, AR MSA	305,878
Ann Arbor, MI PMSA	277,960	Louisville, KY-IN MSA	556,836
Atlanta, GA MSA	2,131,450	Macon, GA MSA	146,876
Atlantic-Cape May, NJ PMSA	178,795	Memphis, TN-AR-MS MSA	565,900
Austin-San Marcos, TX MSA	665,694	Milwaukee-Waukesha, WI PMSA	839,064
Baltimore, MD PMSA	1,195,287	Minneapolis-St. Paul, MN-WI MSA	1,705,376
Baton Rouge, LA MSA	302,391	Nashville, TN MSA	671,826
Birmingham, AL MSA	453,432	New Orleans, LA MSA	608,598
Boise City, ID MSA	224,873	New York, NY PMSA	4,139,454
Buffalo-Niagara Falls, NY MSA	538,014	Newark, NJ PMSA	946,689
Canton-Massillon, OH MSA	182,174	Norfolk-Virginia Beach-Newport News, VA-NC MSA	689,828
Charleston-North Charleston, SC MSA	241,249		
Charlotte-Gastonia-Rock Hill, NC-SC MSA	823,391	Oakland, CA PMSA	1,032,933
		Oklahoma City, OK MSA	529,217
Chattanooga, TN-GA MSA	228,411	Omaha, NE-IA MSA	413,869
Chicago, IL PMSA	4,067,246	Orlando, FL MSA	864,805
Cincinnati, OH-KY-IN PMSA	863,043	Philadelphia, PA-NJ PMSA	2,311,470
Cleveland-Lorain-Elyria, OH PMSA	1,147,800	Phoenix-Mesa, AZ MSA	1,580,155
Columbia, SC MSA	288,849	Pittsburgh, PA MSA	1,080,905
Columbus, OH MSA	855,733	Portland-Vancouver, OR-WA PMSA	963,029
Dallas, TX PMSA	1,964,430	Roanoke, VA MSA	140,556
Daytona Beach, FL MSA	153,595	Rochester, NY MSA	532,524
Denver, CO PMSA	1,165,355	Rockford, IL MSA	174,764
Des Moines, IA MSA	285,591	Sacramento, CA PMSA	724,557
Detroit, MI PMSA	2,089,830	St. Louis, MO-IL MSA	1,300,152
Fort Wayne, IN MSA	266,926	Salem, OR PMSA	143,562
Fort Worth-Arlington, TX PMSA	763,012	Salt Lake City-Ogden, UT MSA	702,284
Fresno, CA MSA	362,066	San Antonio, TX MSA	705,289
Gary, IN PMSA	254,469	San Francisco, CA PMSA	1,099,277
Harrisburg-Lebanon-Carlisle, PA MSA	347,189	Santa Fe, NM MSA	66,283
Houston, TX PMSA	2,037,414	Seattle-Bellevue-Everett, WA PMSA	1,385,893
Huntsville, AL MSA	175,800	Springfield, IL MSA	146,473
Indianapolis, IN MSA	860,475	Syracuse, NY MSA	334,543
Jackson, MS MSA	210,517	Toledo, OH MSA	317,533
Jacksonville, FL MSA	530,001	Tulsa, OK MSA	389,811
Kansas City, MO-KS MSA	944,655	Washington, DC-MD-VA-WV PMSA	2,689,825
Knoxville, TN MSA	321,272	Wichita, KS MSA	279,267
Lansing-East Lansing, MI MSA	218,270	Wilmington-Newark, DE-MD PMSA	304,952
Las Vegas, NV-AZ MSA	746,786		

EPI = Export Price Index. MSA = metropolitan statistical area. PMSA = primary metropolitan statistical area.

[a] Metropolitan areas are defined using 1999 Office of Management and Budget definitions.

States, ranging from 66,283 employed workers in Santa Fe, New Mexico, to more than 4 million in New York City and Chicago. The median city is Buffalo, New York, with employment of 538,014. Exhibit 2 provides summary statistics for the MSA-, central city-, and suburb-level EPIs by employment size. On average, the MSA-level EPI increased 3.69 percent annually across all MSAs. As might be expected, export prices increased more in larger metropolitan areas, not only at the MSA level, but also at the central city and suburb level. This increase indicates that favorable trade shocks may explain regional growth; that is, regions with larger price shocks grow faster.

Although one cannot confer a causal relationship from these descriptive statistics, Pennington-Cross (1997) has illustrated the importance of the EPI in modeling regional growth.[4] Exhibit 3

Exhibit 2

Annual Percentage Change in EPI by MSA Employment, 1981–2000

Employment Range	MSAs	Annual Change in		
		MSA-Level EPI (%)	Central City EPI (%)	Suburb EPI (%)
MSA Employment < 300,000	23	3.62	3.76	3.05
MSA Employment between 300,000 and 750,000	27	3.66	3.77	3.26
MSA Employment > 750,000	27	3.78	3.94	3.57
All MSAs	**77**	**3.69**	**3.83**	**3.31**

EPI = Export Price Index. MSA = metropolitan statistical area.

Exhibit 3

Using the EPI in a Reduced-Form Model of Employment Growth[a]

Dependent Variable: e_{rt}	MSA total employment[b]		
Variable	**Description**	**Coefficient**	**t-Statistic**
epi_{rt}	MSA Export Price Index	0.29*	12.2
ppi_t	Producer Price Index	– 0.27*	– 12.5
i_t	Short-term interest rate (6-month Treasury)	– 0.02*	– 3.3
l_t	Long-term interest rate (10-year Treasury)	0.10*	11.2
T_t	Time trend	0.06*	36.0
h_{rt}	Fair Market Rent for two-bedroom apartments[c]	0.01	0.7
el_{rt}	Household electricity rates[d]	0.00	1.5
$ccty_{rt}$	Central city crime rate[e]	0.01	0.6
$cmsa_{rt}$	MSA overall crime rate[e]	0.15*	3.3
$natw_t$	National average wage rate[b]	– 0.85*	– 22.5

EPI = Export Price Index. MSA = metropolitan statistical area.

** Significant at 95 percent.*

[a] Results from Pennington-Cross (1997). e_{rt}, epi_{rt}, ppi_{rt}, h_{rt}, $natw_t$ are in natural logs. Sample period: 1977–92.

[b] Bureau of Economic Analysis.

[c] U.S. Department of Housing and Urban Development.

[d] Typical Electric Bills, U.S. Department of Energy.

[e] Uniform Crime Index, Federal Bureau of Investigation.

[4] Pennington-Cross (1997) relied on a previous version of the EPI ranging from 1977 to 1992.

reproduces estimates of a reduced form model of MSA employment obtained by Pennington-Cross (1997). Importantly, the coefficient on the EPI is positive and significant, indicating that the EPI is indeed capturing demand shocks. Specifically, the results show that a 10-percent increase in export prices leads to a 3-percent increase in total employment in the MSA.

Conclusion

The Export Price Index provides a reliable and theoretically justified indicator of economic growth, which has been successfully demonstrated in the peer-reviewed literature. The index is also computationally easy to reproduce at different regional levels. These properties make the EPI useful in testing hypotheses about MSA development, particularly where structural estimation of area demand and supply effects is needed. An updated EPI could also play a useful role in forecasting growth of regional economies.

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