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The predictive power of an experimental transportation output index

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A monthly output index for the US Transportation sector over January 1979–June 2003 is reported covering air, rail, water, truck, transit and pipeline activities. Separate indexes for freight and passenger are also constructed. The strong cyclical movements observed in the transportation output appear to be well synchronized with the NBER-defined recessions and growth slowdowns of the US economy. The series reflects the profound impact of 9/11 on the transportation sector, especially on the airlines. By December 2002 it has reached its historical peak. Given the observed relationship of the transportation output with the economy, the recent upward trend in the freight transportation strongly suggests that both the sector and the overall economy have recovered from their latest slump.

I. INTRODUCTION

The economic importance of the service-providing sectors relative to the goods-producing sectors has steadily increased in the post-war period in most developed countries. For instance, in the US during 1953–2002, the share of goods-producing sectors in the total non-farm employment has declined from 39% to 17%, compared to an increase in the share of private service-providing sectors from 47% to 66%. Among the service-providing sectors, transportation-related sectors[1] (viz., transportation services, transportation equipment and transportation infrastructure) had been of great interest to the early NBER scholars in studying business cycles, see Dixon (1924), Burns and Mitchell (1946, p. 373), Hultgren (1948) and Moore (1961, volume I, pp. 48–50). These efforts, however, were hindered due to the discontinuation of many indicators measuring output and finance in various transportation sub-sectors.

In a study sponsored by the US Bureau of Transportation Statistics (BTS), a set of monthly experimental transportation indexes has been developed to measure the economic output of the US transportation sector. This transportation services output index (TSOI) includes the total index and its two components, freight and passenger. The total index is developed from eight constituent series: five from freight and the rest measuring passenger travel. The series for the freight are: trucking tonnage, air revenue ton miles of freight, railroads freight traffic, a waterway tonnage indicator, and movements of crude oil and petroleum products and natural gas by pipelines. Similarly, the passenger series are: air revenue passenger miles (RPM), rail RPM, and national transit riderships. The included industries correspond to North American Industry Classification System (NAICS) codes 481–486, which cover nearly 90% of the total for-hire transportation. The Transportation Services Output Index (TSOI) is conceptually similar to Industrial Production (IP) series. Given the critical role transportation plays in facilitating economic activity between sectors and across regions, such a measure will not only summarize the current state of the US transportation sector, but can also be an important indicator for the level of general economic activity.

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[1] Using different concepts about the scope of the transportation industry would yield different measures of its importance, varying anywhere from 3.09% (Transportation GDP) to 16.50% (Transportation-driven GDP).

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Except for the two airlines series that are directly available from BTS, the rest of the data series are available from either other government agencies or industry associations.[2] These data series also differ in their timeliness varying from one week to four months. Using standard time series models, a preliminary value of TSOI can be released with a five-week lag when the trucking data, the major component, is available. Given these individual series, the index method to aggregate them is the so-called Fisher-ideal quantity index, which is the same as that currently used for US National Income and Product Account (NIPA) and the IP series. The formula for the growth of monthly transportation indexes is given by

$$\frac{I_m^A}{I_{m-1}^A} = \sqrt{\frac{\sum_j I_{jm} P_{jy(m-6)}}{\sum_j I_{jm-1} P_{jy(m-6)}} * \frac{\sum_j I_{jm} P_{jy(m+6)}}{\sum_j I_{jm-1} P_{jy(m+6)}}}, \qquad (1)$$

where I_{jm} is output index in subsector j in month m; $P_{jy(m)}$ is the value added weight for subsector j in year y. The subscript, $y(m)$, denotes 'year containing month m' and the superscript, A, denotes 'Aggregate.' The TSOI (total), as well as its freight and passenger subtotals, are computed as the cumulative product of a monthly series of these growth estimates from 1980/1 onwards. For $I_0^A = 100$ in the base year,

$$I_m^A = \frac{I_m^A}{I_{m-1}^A} \times \frac{I_{m-1}^A}{I_{m-2}^A} \times \cdots \times \frac{I_1^A}{I_0^A} \times 100 \qquad (2)$$

For details of index construction and its comparison with benchmark series, see Lahiri *et al*. (2004).

II. HISTORICAL RECORD

The seasonally adjusted total index during January 1979–June 2003 is depicted in Figure 1.[3] The dark shaded areas represent business cycles that the National Bureau of Economic Research (NBER) has defined for the US economy, and the lightly shaded areas represent the official growth slowdowns defined by NBER as well. As it can be seen, there were a total of six growth slowdowns (3/79–7/80, 7/81–12/82, 9/84–1/87, 1/89–12/91, 1/95–1/96, and 6/00–not yet determined) during this period, only four of which culminated in full-fledged recessions (namely, 1/80–7/80, 7/81–11/82, 7/90–3/91, and 3/01–11/01).[4] The other two (i.e., 9/84–1/87 and 1/95–1/96) are stand-alone slowdowns. The total index has led all NBER-defined recessions (i.e., the dark shades) consistently with a lead of 9, 7, 22 and 16 months respectively. It is seen to be roughly coincident at the troughs of the NBER recessions. The index also declined precipitously along with the onset of the two growth slowdowns in the US economy of 9/84–1/87 and 1/95–1/96. This is true for the other slowdowns as well; on the average over the whole period, TSOI has acted a steady coincident indicator for each of the six growth slowdowns in the economy. However, as pointed out before, when it comes to signaling recessions, TSOI had a respectable lead time of 13.5 months on the average with two false signals. The smoothed TSOI series has also been plotted in Figure 1 where we can see cyclical movements in the total index more clearly. The conclusions on the temporal relationship between transportation and the economy based on either series are largely the same.

The freight index is presented in Figure 2. It is seen that, with the exception of the latest recession, the cyclical movements in the total index came mostly from its freight component. Like the total index, the freight index is highly synchronized with the economy-wide growth slowdowns and recessions with similar lead time. Its movements are also seen more clearly in the smoothed version of the series.

The cyclical movements of the seasonally adjusted total index can be studied based on the deviation of

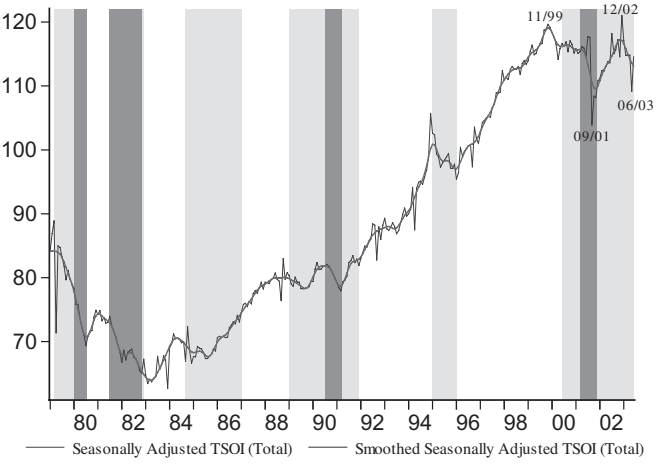

Fig. 1. *Total transportation output* (*TSOI*) *and US economic cycles* (**Dark shaded areas represent the NBER-defined recessions for the US economy; lightly shaded areas represent the NBER-defined growth cycle recessions for the US economy*)

[2] The data sources are: *Monthly Trucking Report* of the American Trucking Association, *Weekly Railroads Traffic* (WRT) of the Association of American Railroads, *FRA Accident/Incident Bulletin* of the Federal Railway Administration, the Waterborne Commerce Statistics Center of the US Army Corps of Engineers, *Petroleum Supply Monthly* and *Monthly Energy Review* of the Energy Information Administration of the US Department of Energy, and *APTA Quarterly Transit Ridership Report* of the American Public Transportation Association.
[3] The seasonal adjustment was done using the US Census Bureau's X12-ARIMA program with adjustment for trading day and holiday effects.
[4] See Zarnowitz and Ozyildirim (2002) for more discussions on growth cycles.

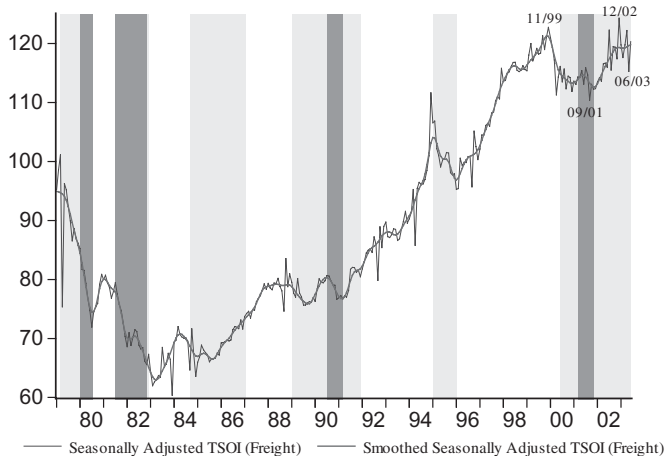

Fig. 2. *Freight transportation output* (*TSOI*) *and US economic cycles* (**Dark shaded areas represent the NBER-defined recessions for the US economy; lightly shaded areas represent the NBER-defined growth cycle recessions for the US economy*)

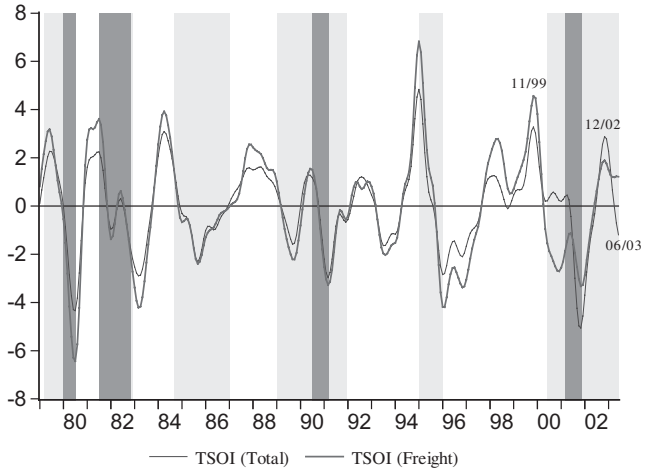

Fig. 3. *Cyclical movements in the TSOI* (**Dark shaded areas represent the NBER-defined recessions for the US economy; lightly shaded areas represent the NBER-defined growth cycle recessions for the US economy*)

TSOI from its trend estimated from the Hodrick and Prescott (1997) filter. This deviation represents only the cyclical movements with irregular disturbances removed (see Figure 3). It is observed that the total index has preceded the peak of economy-wide growth cycles by 5.6 months on average, and has the similar lead time at troughs as well. The lead and lag relationship with economic cycles is largely the same when only the freight index is considered. These observations suggest that the cyclical movements in the total and freight TSOI foreshadow not only the recessions, but also the growth slowdowns of the economy with consistent regularity. Thus, the newly constructed TSOI can be very useful in monitoring the fluctuations in general economic activity from the perspective of transportation.

III. PERFORMANCE IN THE LATEST RECESSION

One of the features shared by the two most recent US recessions is that they were both preceded and followed by fairly long slowdowns. In Figures 1 and 2, the onset of the slowdowns and the start of economic recoveries are well captured by TSOI. Thus, TSOI can give early signals to the onset of economic recessions while being contemporaneous to economic recovery. Consistent with its historical record, the total index gave an early signal for a slowdown in the economy that began in June 2000 and culminated into a full-fledged recession beginning March 2001. Figure 1 also shows the profound impact of the 9/11 event on the transportation sector, especially on passenger travel. Since then this sector has been well on its track to recovery. September 2001 also marks the lowest point in aggregate transportation activity since its last peak in November 1999, and is roughly coincident with the recently announced trough of November 2001 for the latest recession of the economy. By July 2002, the US transportation sector had recovered to its pre-9/11 level, and by December 2002 it had reached its historical peak. Given the observed relationship of the transportation output series with the economy, the recent upward movement of the series suggests that both the transportation sector and the overall economy had fully recovered from their latest slump. This is supported by the strong consistent upward trend in the freight index since 9/11. However, the recovery in passenger travel since December 2002 has shown signs of disruption partially due to SARS and the Iraqi war. This disruption of passenger travel, as well as the volatility in the freight movement, is consistent with the slow pace of economic recovery in the first half of 2003.

IV. CONCLUDING REMARKS

This study reports a newly constructed monthly measure of aggregate transportation activity covering airlines, trucking, rail, transit, waterborne and pipelines. Also presented is the freight index that tends to dominate the total index. The freight index, as the 'stage-of-fabrication' model of Humphreys *et al.* (2001) suggests, plays an important role in building up input inventories (materials and supplies) for the production process in the economy. Lahiri *et al.* (2003a, b) highlight the close non-linear relationship between freight transportation, inventory cycles and industrial production. Our empirical tests based on Granger-causality also confirm strong feedback relationships

between transportation output, input inventories, and alternative measures of aggregate economic activity.

In order to understand the role of transportation output indices in business cycle analysis, it is useful to distinguish between growth slowdowns and full-fledged recessions of the aggregate economy. Typically, a recession is bordered by periods of slow growth, but there are stand-alone growth slowdowns that do not culminate into full-fledged recessions. It is found that there exists a strong one-to-one correspondence between cyclical movements in the two transportation output series and that of the economy. The total and the freight output indices are seen to lead the onset of recessions and recoveries from growth slowdowns with consistent regularity. On the other hand, it is roughly coincident with the onset of growth slowdowns, and recoveries from recessions. The observed asymmetry in the lead times at recessions and recoveries that the transportation output series exhibits in foreshadowing turning points in economy-wide business cycles, will be a future topic of research.

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