

Appendix A

Apportionment Mechanism for FHWA Grants

Sources:

FHWA (2005), "Analysis of the Conference Report to H.R.3 as filed on 7/28/05 (RTA-000-1664A)."

URL as of 11/3/2011: <http://www.fhwa.dot.gov/safetealu/fundtables.htm>

FHWA (1999), "Financing Federal-Aid Highways", Publication No. FHWA-PL-99-015.

FHWA (2007), "Financing Federal-Aid Highways", Publication No. FHWA-PL-07-017.

Bureau of Transportation Statistics (1992), "Intermodal Surface Transportation Efficiency Act of 1991 – Summary"

TEA-21, FY1998-2003 (continued through 2004 via continuing resolutions)

Step 1:

Each individual FHWA program's national budget authorization is provisionally apportioned to states based on formula factors, conditional on a minimum apportionment share of 0.5%:

$$A'_{pi} = A_p \left\{ \min \left[f_p \left(\frac{z_{pi}^1}{z_p^1}, \frac{z_{pi}^2}{z_p^2}, \dots \right), 0.005 \right] \right\} \quad (1)$$

for each program p and state i . z denotes formula factors (e.g., highway lane-miles). "Primes" on variables indicate that they are provisional, not final, values.

Step 2:

Calculate provisional total FHWA apportionment for each state:

$$A'_i = \sum_p A_{pi} \quad (2)$$

Step 3:

Apply “Minimum Guarantee” constraint, which ensures that each state receives a minimum return, R, on its contribution to the Highway Trust Fund (HTF):

$$A_i = \max[A'_i, RH_i], \quad (3)$$

where H_i is state i 's contribution to the HTF. R is 90.5% during all TEA-21 years. Amounts required to satisfy the minimum-guarantee ($A_i - A'_i$) come out of a separate Congressional appropriation. That is, it does NOT lower the apportionments determined by steps 1 and 2 for other states. This amount is called the Minimum Guarantee apportionment and is reported in Tables FA-4 on the FHWA Highway Statistics website.

SAFETEA-LU, FY2005-2009 (continued through FY2011 via continuing resolutions)

Steps 1 and 2 are the same as under TEA-21. In SAFETEA-LU, the Minimum Guarantee program (Step 3) is replaced with the “Equity Bonus” program. The Equity Bonus program also imposes a minimum guaranteed return, R, on contributions to the HTF (though now R varies by year: R=90.5% in 2005-6, 91.5% in 2007, and 92% in 2008-9), but also imposes two additional constraints. First, for states satisfying certain criteria, the state must receive a total FHWA apportionment share at least as great as its average share over the TEA-21 period. Second, for all states, the state must receive at least a specified percentage of its average annual apportionment (T_i) under TEA-21. This percentage (M) is 117% in 2005, 118% in 2006, 119% in 2007, 120% in 2008, and 121% in 2009.

The effect of these added constraints is to replace equation (3) with the following:

$$A_i = \max \left[A'_i, RH_i, \frac{T_i}{T} A'_i D_i, MT_i \right], \quad (5)$$

where D is a dummy variable indicating whether the state is one of the selected states mentioned above.

The $A_i - A'_i$ amount is called the Equity Bonus apportionment and is reported in Table FA-4 on the FHWA Highway Statistics website. Note, however, that for years 2007 onward (only), the apportionments for the STP, NHS, IM, Bridge, CMAQ, and HSIP programs in Table

FA-4 include the amounts those programs received out of the equity bonus and the equity bonus apportionment in Table FA-4 excludes the amounts distributed to those core programs.

ISTEA, FY1992-1997

Steps 1 and 2 are the same as under TEA-21. But in ISTEA, the Minimum Guarantee program was more complicated. In addition to getting a minimum guaranteed return, $R = 90.5\%$, on contributions to the HTF, states whose return on contributions to the HTF was below 100% (“donor” states) received an additional bonus.

Appendix B. Data Glossary

Format: **variable_name** – Data description. (Source)

BEA_employment – Total annual employment from the BEA’s National Income and Product Accounts. (Haver Analytics/Bureau of Economic Analysis)

capoutlays_total – State highway agency total capital outlays, in millions of dollars. These data are obtained from the Office of Highway Policy Information’s annual Highway Statistic Series publications. (Federal Highway Administration)

capoutlays_fedaid – State highway agency capital outlays on federal-aid highways, in millions of dollars. These data are obtained from the Office of Highway Policy Information’s annual Highway Statistic Series publications. (Federal Highway Administration)

F_S – State government expenditures on construction of regular and toll highways, in millions of dollars. This variable is one of the components of **Shighway_gross**. (US Census Annual Survey of State & Local Government Finances)

FHWA_oblig – Total federal funds obligated by the Federal Highway Administration to state governments, in millions of dollars. These data are obtained from the Office of Highway Policy Information’s annual Highway Statistic Series publications, Table FA-4B, various years. Note that obligations due to grants from the 2009 American Recovery and Reinvestment Act (ARRA) ARE included in these reported totals. (Federal Highway Administration)

FHWA_apport – Federal Funds apportioned by the Federal Highway Administration to state governments, in millions of dollars. These data are obtained from the Office of Highway Policy Information’s annual Highway Statistic Series publications, Table FA-4, various years. Because these data do NOT include the additional grants in 2009 from the ARRA, we add the ARRA apportionments to the 2009 total. We obtained state-level ARRA apportionments (as well as outlays) for fiscal year 2009 from the DOT’s Financial and Activity Report as of Oct. 9, 2009 (which covers data through the end of fiscal year 2009) for TAFS code 69-0504, which corresponds to Highway Funding. (Federal Highway Administration and DOT)

FHWA_outlays – Total outlays (expenditures) of federal funds by the Federal Highway Administration to state governments, in millions of dollars. These data are obtained from the Office of Highway Policy Information’s annual Highway Statistic Series publications, Table FA-

3, various years. Because the totals in Table FA-3 do NOT include the additional outlays in 2009 from the ARRA, we add the ARRA outlays to the 2009 total. We obtained state-level ARRA outlays for fiscal year 2009 from the DOT's Financial and Activity Report as of Oct. 9, 2009 (which covers data through the end of fiscal year 2009) for TAFS code 69-0504, which corresponds to Highway Funding. (Federal Highway Administration and DOT)

LNAGRA – Total nonfarm employment. The annual employment figure is the 12-month mean of monthly data over the calendar year. (Haver Analytics/BLS Establishment Survey)

population – Annual resident population (Haver Analytics/ US Census Bureau)

RealGSP_TO – Real gross domestic product by state, in millions of chained 2005 dollars. (Haver Analytics/Bureau of Economic Analysis)

Shighway_gross – State government highway expenditures, in millions of dollars. This data series is constructed from the Census Bureau's Annual Survey of State & Local Government Finances (SLGF). It is the sum, for regular and toll highways, of state government expenditures on state government expenditures on current operations; construction capital outlays; other capital outlays; and transfers to local governments for roads. (US Census Bureau)

totaldisbursements – Total state and local government disbursements for highways, in millions of dollars. These data are obtained from the Office of Highway Policy Information's annual Highway Statistic Series publications, Table SF-2, various years. Total disbursements are the sum of capital outlays; maintenance; administration, research and planning; highway law enforcement and safety; interest payments on highway bonds; bond retirement; and transfers to local governments for roads. (Federal Highway Administration)

YPH – Real annual personal income, in millions of chained 2005 dollars. (Haver Analytics/Bureau of Economic Analysis)

Appendix C

Constructing Real-time Forecasts of Expected Future Highway Funding

Our objective is to forecast, as of the beginning of a given year t , the present value of current and future federal highway grants for each state, using only real-time information available at the beginning of t . At the beginning of year t , agents have the following information: (1) year t apportionments (grants) in each state i for each FHWA program p (along with the formula factors that determine these apportionments), (2) the path of nationwide apportionment authorizations for the remaining years of the current highway authorization legislation (which typically cover a 5-6 year period), and (3) the formulas used to distribute each program's grants to states for the remainder of the current legislation. What agents do not know is the future values of the formula factors that determine the distribution of grants for the remaining years of the current legislation, nor do they know (1)-(3) above for years beyond the current legislation.

To construct real-time forecasts of future highway grants, we follow and extend the methodology used by the FHWA Office of Legislation and Strategic Planning (FHWA 2005) in its report providing forecasts, as of 2005, of apportionments by state for the years of the 2005-2009 SAFETEA-LU highway bill. Basically, the methodology involves assuming that a state's current formula factors (as a share of the nation), and hence the state's current share of federal grants for each of the 17 FHWA apportionment programs, are constant over the forecast horizon. (As detailed below, we treat the one-time extra apportionments from the 2009 American Recovery and Reinvestment Act as a separate program.) That is, the best guess of what the relative values of formula factors will be going forward is their current year relative values. Given apportionment shares for each program, one can then distribute to states the known nationwide totals for each program for the remaining years of the current legislation. One can then aggregate across programs to get a state's total apportionments in each of these future years.

We extend this methodology such that if one is forecasting for years beyond the current legislation, one assumes a continuation of the use of current formulas (i.e., one's best guess of the formulas to be used in future legislation is the formulas currently in use) and one assumes that nationwide apportionments by program grow with inflation from the last authorized amount in the current legislation.

More formally, we construct real-time forecasts of future highway grants by state using the following three-step procedure:

1. Let $A_{i,p,t+s} \equiv \omega_{i,p,t+s} A_{p,t+s}$ denote state i 's apportionments for program p in year $t+s$, where $A_{p,t+s}$ is nationwide apportionments for program p and $\omega_{i,p,t+s}$ is state i 's share of those apportionments. Calculate the forecast $E_t[A_{i,p,t+s}]$ for all p and for $s \geq 0$ by assuming that $\omega_{i,p,t+s} = \omega_{i,p,t}$ and using the known authorized levels of $A_{p,t+s}$ for year $t+s$ within the current highway legislation. (Note that, for $s = 0$, $E_t[A_{i,p,t}] = A_{i,p,t}$.) For any year $t+s$ beyond the last year of the current legislation, $t+j$, assume $A_{p,t+s} = A_{p,t+j} (1 + \pi^e)^{s-j}$, where π^e is expected future inflation. We assume $\pi^e = 0.03$.

In 2009 (and only in 2009), there was a special one-time additional amount of apportionments authorized by the American Recovery and Reinvestment Act (ARRA). We treat the ARRA as simply another program ($p = ARRA$). The ARRA was passed on Feb. 10, 2009 and immediately authorized the FHWA to apportion \$27.5 billion in formula grants to states (i.e., $A_{ARRA,2009} = \$27.5 \text{ Billion}$).¹ The apportionment formula was:

$$\omega_{i,ARRA,2009} = 0.5 \times \omega_{i,STP,2009} + 0.5 \times \omega_{i,FHWA,2008} .$$

That is, each state's share of the \$27.5 billion in grants was to be distributed 50% based on the apportionment formula used by the FHWA to distribute grants for the Surface Transportation Program (STP) in 2009 and 50% based on the distribution of total FHWA grants in 2008. Thus,

$$\begin{aligned} E_t[A_{i,ARRA,t+s}] &= 0 && \forall t \neq 2009, \forall s, \\ E_{2009}[A_{i,ARRA,2009+s}] &= 0 && \forall s > 0, \\ E_{2009}[A_{i,ARRA,2009}] &= (0.5\omega_{i,STP,2009} + 0.5\omega_{i,FHWA,2008})A_{ARRA,2009} . \end{aligned}$$

¹ States were required to obligate all ARRA funds by March 2, 2010.

- Sum across programs within state for each forecast horizon:

$$E_t[A_{i,t+s}] = \sum_p E_t[A_{i,p,t+s}].$$

- Calculate the present value of current and expected future highway grants:

$$E_t[PV_i] = \sum_{s=0}^5 \frac{E_t[A_{i,t+s}]}{(1+r_t)^s} + \frac{E_t[A_{i,t+5}]}{(1+r_t)^5} \frac{1}{(1-\beta_t)},$$

where $E_t[A_{i,t+s}]$ is the forecast as of t of apportionments (in nominal dollars) in year $t+s$ and $\beta_t = (1 + \pi_t^e)/(1 + r_t)$. The second term on the right hand side reflects the fact that, because highway appropriations bills cover at most 6 years (t to $t+5$), forecasts beyond $t+5$ simply assume perpetual continuation of $A_{i,t+5}$ (discounted by $(1 + r_t)^5$) growing with expected future inflation of π_t^e . We measure the nominal discount rate, r_t , using a 10-year trailing average of the 10-year Treasury bond rate as of the beginning of the fiscal year t (e.g., Oct. 1, 2008 is the beginning of fiscal year $t = 2009$). The trailing average is meant to provide an estimate of the long-run expected nominal interest rate. We measure expected future inflation, π_t^e , using the median 5- or 10-year ahead inflation forecast for the first quarter of the fiscal year (fourth quarter of prior calendar year) from the Survey of Professional Forecasters (SPF).²

Dealing with the Equity-Bonus/Minimum-Guarantee Apportionments

One complication for implementing the above is that the equity-bonus/minimum-guarantee apportionments are treated differently in the FHWA data tables in years prior to 2007 than they are for 2007 onward. Prior to 2007, apportionments for all programs in the FHWA highway statistics (Table FA-4) do not include any added amounts distributed to those programs from the pool of funds Congress authorizes to satisfy the equity-bonus/minimum-guarantee constraints discussed in Appendix X. For 2007 onward, however, the reported apportionments for the “core programs” (STP, NHS, IM, Bridge, CMAQ, and HSIP) include the amounts distributed from the equity-bonus/minimum-guarantee pool. Therefore, apportionments by

² 5-year ahead forecasts are available in the SPF only from 2006 onward. Prior to 2006, we use the 10-year ahead forecast. The two forecasts are very similar in the data.

program, $A_{i,p,t}$, from the raw FHWA data are not comparable before and after 2007. We handle this by distributing, for years prior to 2007, part of the equity-bonus/minimum-guarantee nationwide authorization to each of these core programs in proportion to their share of total FHWA authorizations for that year. This extra amount is added to the reported $A_{i,p,t}$ to get the true $A_{i,p,t}$ that we use in the steps above.

Data

Data on actual apportionments by program, state, and year ($A_{i,p,t}$), which also are used to construct apportionment shares ($\omega_{i,p,t}$), were obtained from FHWA Highway Statistics, Table FA-4 (various years). Data on nationwide authorizations by program and year ($A_{p,t+s}$) for each of the three highway authorization legislations during our sample period were obtained from FHWA (1992), FHWA (1999), and FHWA (2007).