6. PREDICTED EFFECTS IN THE BASE CASE

In this section we present predicted effects of the VAVR program under our base-case assumptions. These estimates provide an initial indication of the effects of the program. We present and discuss these estimates in some detail to develop insight into the factors that determine how the VAVR program will affect LDV markets in California. In the next section, we present and discuss the sensitivity of the predictions to various changes in parameter values and develop a quantitative sense of the ranges in which the effects of the program are very likely to fall.

We emphasize predictions for 2010, the year for which the SIP specifies the emissions targets for the program. We also consider annual effects beginning in 2001, the first year the program is assumed to operate. Because the effects of the program continue after 2010, we report results for the key outcomes annually through 2020, by which time the effects are predicted to be insubstantial. Effects of the program in different years are of direct interest because they affect the well-being of Californians. Moreover, examining the time patterns of predicted effects helps develop insights about the forces that are important in determining various effects of the VAVR program.

The section is organized as follows. First, we present and discuss predictions of the effects of scrapping 75,000 older vehicles in the South Coast each year between 2001 and 2010 on used-vehicle prices and the quantities and age compositions of vehicles operating in the South Coast and rest of California. Next, we discuss two key economic factors underlying these results. Finally, we examine predictions of the changes in emissions due to the program.

EFFECTS ON PRICES AND QUANTITIES OF USED LIGHT-DUTY VEHICLES

Table 6.1 presents estimated effects of the 10-year program in 2010. After the VAVR program has operated for 10 years, prices of used LDVs across the state are predicted to be $66 higher than they would be in the absence of the program.[1] (Recall that all prices are expressed in constant 1999 dollars). The total number of vehicles operating in the South Coast in 2010 is predicted to be about 60,000 lower because of the program, which is only about 0.5 percent of the projected stock of almost 12 million LDVs in the region. This decline of 60,000 LDVs is composed of an increase of 87,000 LDVs less than 15 years old and a decrease of 147,000 LDVs at least 15 years old. Thus, the program is predicted to have an appreciable effect on the age distribution of LDVs in the South Coast, as discussed in the next subsection.

[1]The model was not designed to predict prices, quantities, and emissions in the future if the program were not implemented. Thus, for example, the simulated increase in used-LDV prices in the without-program scenario (from $5,500 in 2001 to $5,808 in 2010) should not be taken as a prediction of real used-LDV prices in the future.

Table 6.1

Base-Case Predictions of the Effects in 2010 of Scrapping 75,000 Older South Coast Vehicles per Year from 2001 to 2010

Outcome	With Program	Without Program	Difference	Percentage Difference
A. Values in 2010				
Average used-LDV price ($/vehicle)	5,875	5,808	66	1.1
Vehicles in South Coast				
Total (thousands)	12,066	12,126	-60	-0.5
0 to 14 years old	10,087	10,000	87	0.9
15+ years old	1,979	2,126	-147	-6.9
Percent 15+ years old	16.6	17.9	-1.2	--
Vehicles in rest of California				
Total (thousands)	16,355	16,438	-83	-0.5
0 to 14 years old	12,782	12,825	-43	-0.3
15+ years old	3,573	3,613	-40	-1.1
Percent 15+ years old	21.8	22.0	-0.1	--
LDV emissions (tons of ROG plus NOx per day)				
South Coast	339	352	-13	-3.8
Rest of California	552	555	-3	-0.5
B. Total new-LDV sales between 2001 and 2010 (thousands)				
South Coast	9,133	9,110	23	0.2
Rest of California	10,422	10,396	26	0.2

The third set of rows of Table 6.1 shows that 83,000 fewer vehicles are predicted to be operating in the rest of California in 2010 because of the program. When combined with the 60,000 decline in the South Coast, the total decline in the number of LDVs operating in the entire state is less than one-fifth of the cumulative size of the program.

Figure 6.1 presents predicted effects of the VAVR program on used-LDV prices and the number of vehicles in the South Coast each year from 2001 through 2020. The effects of the program increase over the first five years (2001 to 2005), with the incremental changes in each successive year getting smaller and smaller. The predicted price effects decrease after 2006. In quantitative terms: The VAVR program is predicted to increase prices of used LDVs (see right-hand-side scale) by approximately $20 during the first year of the program (2001); the largest predicted effect is $79 in 2005 and 2006; and the predicted price effect is $66 for 2010 (as reported in Table 6.1). Effects on numbers of vehicles in the South Coast (left-hand scale) are also largest in 2005, showing a decrease of 70,000 LDVs, and then decline (to 60,000 LDVs) by 2010.

What accounts for the predicted increases and subsequent decreases in program effects during the operation of the program? Is this an artifact of the model, or should such a pattern be expected to occur in the real world? We believe the latter. Most important, program effects on the number of LDVs in the South Coast and their prices will cease to grow and will then decline because of two phenomena: reduced levels of natural scrapping because of previous scrapping through the program and increases in new-LDV sales induced by higher used-LDV prices. Once the program has operated for several years, the decline in natural scrapping due to the program in a particular year roughly equals the number of LDVs scrapped through the program in that year, and price and quantity effects cease to increase over time.[2]

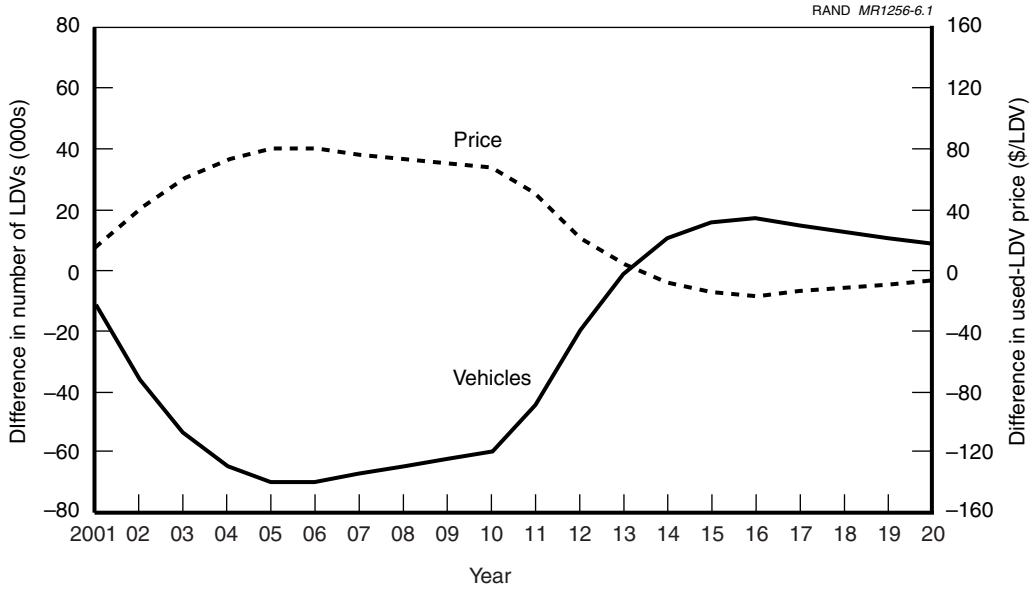

Figure 6.1—Predicted Effects of Program on Price and Numbers of LDVs in the South Coast

How persistent are effects of the program likely to be after it is discontinued in 2010? Figure 6.1 shows that program effects on used-LDV prices and stocks of vehicles in the South Coast dissipate rapidly after 2010. For example, by 2013 the differences between the with- and without-program scenarios for both price and quantity are near zero; i.e., the program effects on these outcomes have been virtually eliminated. After 2013, in fact, used-LDV prices are slightly *lower* and total LDV stocks moderately *higher* in the *with*-program scenario. The legacy of the

[2]More formally, our model can be thought of as a dynamic system where the change in the number of vehicles (the "state" variable) from one year to the next is determined by vehicle retention rates (and other factors). These retention rates are less than one, implying that the system will tend to converge to a steady state in which the number of vehicles does not change over time. To highlight key factors that must be in balance to achieve a steady state, assume that

program in terms of LDV stocks reflects extra new-LDV sales in the with-program scenario and the fact that such LDVs would remain on the road for several years after the program ends. Larger used-LDV stocks after 2010 in the with-program case would also cause lower prices.[3]

These results foreshadow an important implication of the pattern of emissions benefits discussed below: A finite-lived VAVR program will have only transitory benefits on air quality. A program that continues only through 2010 will help the South Coast achieve compliance with the NAAQS in 2010 but will not do much for air quality in subsequent years if it is discontinued.[4]

PROGRAM EFFECTS ON AGE COMPOSITION OF THE FLEET

The VAVR program will alter the age distribution of LDVs operating in the South Coast by accelerating the retirement of older LDVs, and by inducing more new-LDV sales. For example, for our base case, Table 6.1 reports that in 2010 the number of newer vehicles (LDVs less than 15 years old) operating in the South Coast is 0.9 percent larger with the program and the number of older vehicles is smaller by almost 7 percent. The net result of these changes is that the percentage of older vehicles in the South Coast fleet is predicted to be 16.6 percent with the program rather than 17.9 percent if the program is not implemented.

As is also reported in Table 6.1, in the rest of the state the sizes of the stocks of older and newer vehicles are both slightly lower in the with-program scenario, and there is a slight change in the proportion of vehicles that are at least 15 years old. The age distribution does not improve nearly as much as in the South Coast: Out-migration due to the program does not affect the age distribution of the fleet outside the South Coast and, more important, unlike in the South Coast, older LDVs in the rest of the state are not subject to accelerated retirement.[5]

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(1) new car sales are not affected by the program, (2) the average expected life of vehicles sold to the program is the same as those that are not sold, and (3) that vehicle demand is constant over time. In a steady state—with or without the program—the number of vehicles that leaves the fleet in each year must equal new-LDV sales in those years. Without the program, all vehicles scrapped are scrapped naturally. With the program, total (program plus natural) scrapping exceeds that without the program—and the size of the fleet falls over time relative to the without-program scenario—each year until the decrease in the number of vehicles scrapped naturally equals the number that exit through the program. Our model is more complicated than this because new-car sales are endogenous, vehicles sold to the program have shorter expected lives than those not sold, and demand grows over time, but a retention rate that is less than one still governs the behavior of the system.

[3]Simulations beyond 2020 that are not reported here show that effects of the program eventually disappear as all LDVs added to the South Coast stock because of the program are scrapped naturally. This outcome is suggested by Figure 6.1 where by 2020, 10 years after the program is discontinued, the effects of the program are quite small and declining over time.

[4]The effectiveness of the program may diminish over time even if it is continued after 2010 if the differences in emission rates of LDVs of particular pairs of ages narrows over time.

[5]The age distribution outside of the South Coast improves slightly because of additional new-LDV sales induced by statewide increases in used-LDV prices.

Figures 6.2 and 6.3 provide information about the evolution of the age composition of the South Coast fleet over time. Figure 6.2 decomposes annual program effects on total LDV stocks in the South Coast into annual effects on numbers of older LDVs, which decrease because of the program, and numbers of newer LDVs, which increase because of the program. As we saw with

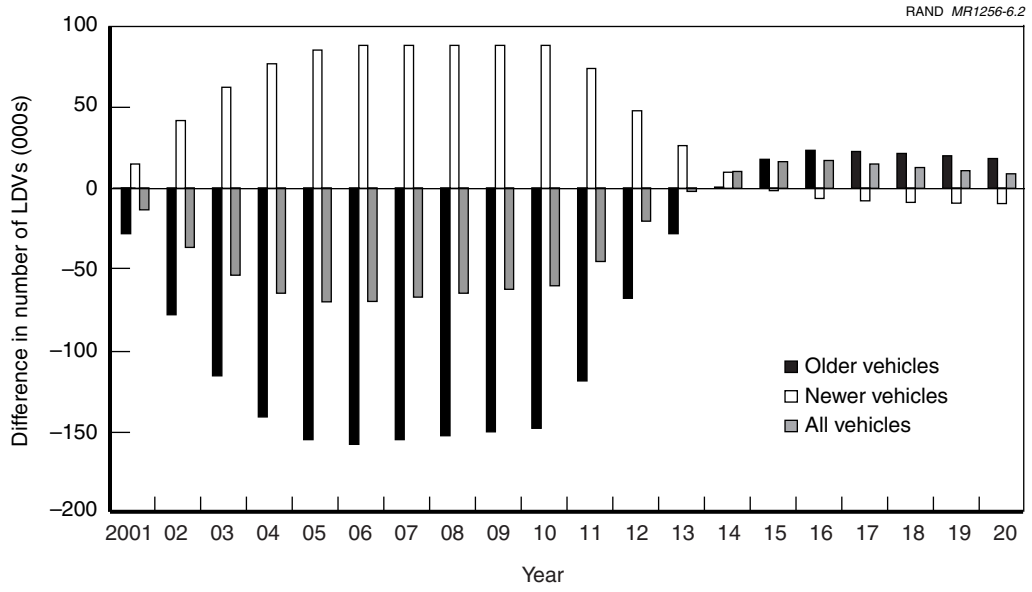

Figure 6.2—Predicted Program Effects on Numbers of Older and Newer LDVs in the South Coast

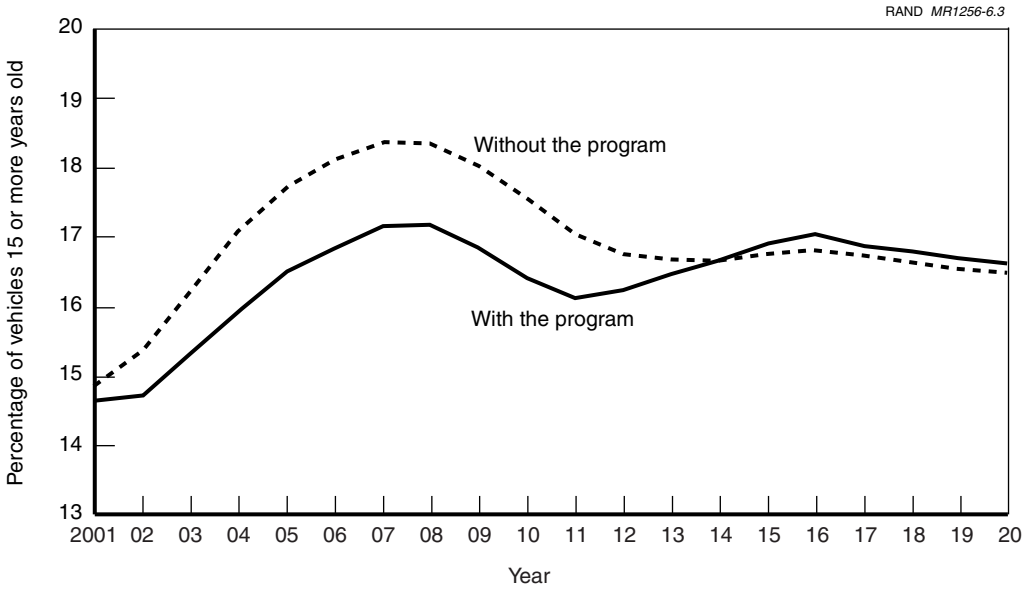

Figure 6.3—Predicted Percentage of South Coast LDVs at Least 15 Years Old

program effects on price and total LDV stocks in Figure 6.1, Figure 6.2 shows that the predicted effects of the program increase at a decreasing rate during the first five or so years that the program operates, decline gradually for the remaining years of the program, and dissipate rapidly after the program is discontinued in 2010. Figure 6.3 plots annual percentages of the South Coast fleet that are at least 15 years old with and without the program. In this figure, the effect of the program in any year is the distance between the two curves. During the first few years of the program, the differences between the with- and without-program scenarios are due to the program attenuating the increases in this percentage that would occur in the absence of the program.

TWO KEY ECONOMIC RESPONSES UNDERLYING PROGRAM EFFECTS

Our model incorporates, and the base-case predictions quantify, the combined operation of several economic forces that are critical for understanding and predicting the effects of the VAVR program in the South Coast. These forces include

- responses of new-LDV sales to higher used-LDV prices, and
- in-migration of LDVs from outside the South Coast.

The fundamental logic of these forces and their quantitative significance in the base case are discussed in turn.

New-LDV Sales Induced by the Program

Increases in used-LDV prices induced by the program will increase the demand for new LDVs, which are substitutes for used LDVs, and increase unit sales of new LDVs because prices of new LDVs should be unaffected by the program.[6] In our base case, the program-induced increases in used-LDV prices over the 2001 to 2010 period (see Figure 6.1) increase new-vehicle sales in California by a total of 49,000 units between 2001 and 2010 (Panel B of Table 6.1). Additional new-LDV sales attenuate tendencies of the program to increase used-LDV prices and decrease LDV stocks. Perhaps more important, these induced new-LDV sales help improve the age distribution of the fleet during the years when these extra LDVs are relatively young and have relatively low emissions rates per year.

The predicted levels of induced new-LDV sales also helps us gauge the extent to which a VAVR program works by *accelerating* retirement of older LDVs. In particular, the results in Table 6.1 suggest that the program will decrease the number of LDVs in California in the year 2010 by approximately 143,000 units (60,000 fewer in the South Coast and 83,000 fewer in the rest of the state). Thus, the program removes 750,000 vehicles from the fleet over the course of 10 years

[6]See Sections 4 and 5.

ending in 2010, but during 2010 there are only 143,000 fewer vehicles in the state because of the program. Approximately 8 percent of this discrepancy of 607,000 LDVs is the predicted additional 49,000 new-vehicle sales, but most of the remainder[7] represents LDVs retired through the program that would have been retired by 2010 anyway. More specifically, given our base-case assumptions—which include that LDVs scrapped through the program average 3 years of remaining life—563,000 of the 750,000 (about 75 percent) of the LDVs scrapped through the program would have been scrapped by the year 2010 anyway.

Program-Induced Migration of LDVs into the South Coast

The tendency for a VAVR program to increase LDV prices in the region where vehicles are purchased and scrapped attracts LDVs into the region. Our estimates suggest that in-migration of LDVs into the South Coast during the course of the VAVR program will be substantial. In particular, in the base case 184,000 vehicles are predicted to move into the South Coast between 2001 and 2010 because of the program. Thus almost one-quarter of 750,000 LDVs scrapped in the South Coast through the program are predicted to be replaced by in-migration induced by the program. The effects of in-migration on emissions depends on the age composition of the in-migrating LDVs. As discussed in Section 2, and as is built into the quantitative model, in any year in-migration should be composed of roughly equal proportions of existing vehicles of each vintage or model year. In fact, in our base case, it is predicted that 145,000 (or almost 79 percent) of the 184,000 vehicles that in-migrate will be less than 15 years old at the time that they migrate. In sum, in-migration replaces about one-quarter of the LDVs scrapped by the VAVR program, but only about 5 percent of the LDVs scrapped by the program are replaced through in-migration by LDVs that are old enough to be eligible for scrapping through the program.

EFFECTS ON LIGHT-DUTY VEHICLE EMISSIONS

The predicted effects of the program on emissions are determined by combining estimates of vehicle emissions per mile with our predictions concerning numbers of vehicles, fleet age compositions, and miles traveled per vehicle. In the base case, the program is predicted to reduce emissions of ROG plus NOx in the South Coast by 13 tons per day in 2010 or 3.8 percent of projected LDV emissions (see Panel A of Table 6.1).[8] Thus, our base-case analysis suggests that a VAVR program that removes 75,000 vehicles per year would have substantial effects on

[7]A small part of the discrepancy is the additional new LDVs sold from 2001 to 2009 that are scrapped by 2010.

[8]Predicted 2010 LDV emissions of ROG plus NOx in the South Coast in the without-program scenario (352 tons per day) are about 8 percent below the roughly 383 tons per day that we calculated from CARB (1999b).

emissions, but will fall almost 50 percent short of meeting the SIP goal for the M1 program of 25 tons per day by 2010.[9] The program would also tend to reduce emissions outside the South Coast; in the base case, these reductions are predicted to be 3 tons per day for the rest of the state.

Policy attention tends to focus on 2010, the year that the federal Clean Air Act requires compliance with the national ambient air quality standards in the South Coast. The VAVR program will affect air quality, however, both before and after 2010, and improving air quality is the fundamental reason to consider programs like the VAVR. Figure 6.4 reports predicted effects on emissions in the South Coast annually from 2001 through 2020. As can be seen from the figure, these emissions effects have a similar pattern over time as those for the other outcomes. The predicted emissions reductions in the South Coast are largest in 2005 at about 18.8 tons per day, decrease gradually during the remaining five years of program operation, and then decrease rapidly after the program ceases to operate in 2010.

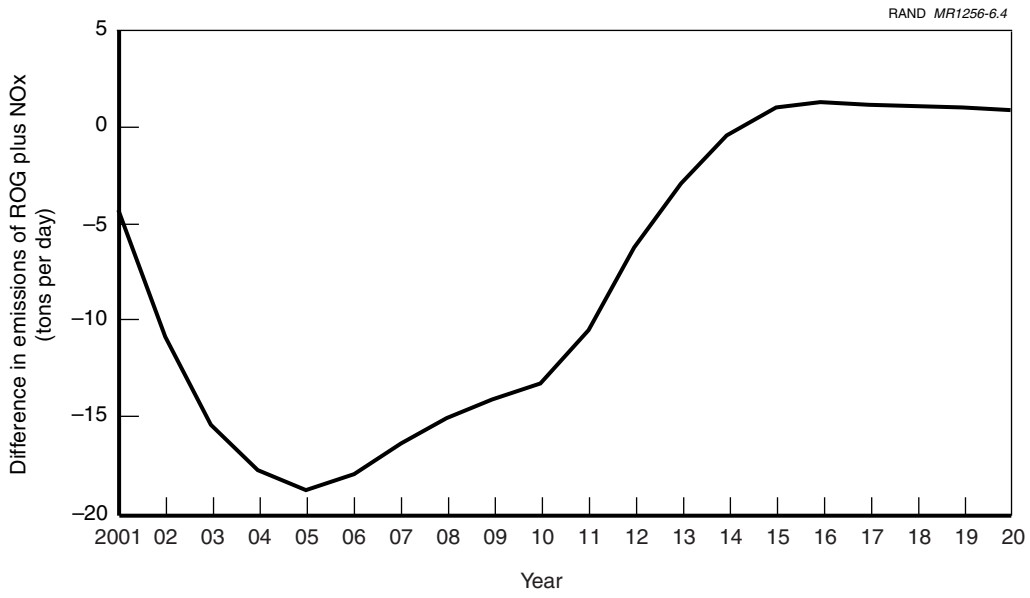

Figure 6.4—Predicted Effects of Program on Emissions in the South Coast

[9]However, as discussed above, our model incorporates several assumptions that tend to make us err on the low side in predicting emission reductions. We enumerate these assumptions and discuss implications in Section 7.