

## **ESTIMATION RESULTS:**

### **THE DESIGN OF A COMPREHENSIVE MICROSIMULATOR OF HOUSEHOLD VEHICLE FLEET COMPOSITION, UTILIZATION, AND EVOLUTION**

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**Table 1 Estimates of the Vehicle Type Choice Component of Vehicle Selection Module**

<b>Variable →</b>	<b>Constant</b>	<b>Purchase Price*10,000 (\$)</b>	<b>Fuel cost per gallon (\$)</b>	<b>Miles per Gallon /100</b>	<b>Fuel cost per year /10,000 (\$)</b>	<b>Maintenance cost per year/1000 (\$)</b>	<b>Acceleration Time (0 to 60 mph)</b>	<b>Car pooling</b>	<b>Free parking</b>
No vehicle	--	--	--	--	--	--	--	--	--
Compact Car (CC)	-0.9117 (-5.85)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Car	-1.3308 (-9.04)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Small cross utility vehicle (SCU)	-2.9238 (14.59)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
SUV	-2.5837 (-15.43)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Van	-3.6083 (-10.70)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Pickup	-2.0264 (-11.91)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Gasoline	--	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Flex Fuel	-6.1869 (-24.57)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Plug-in Hybrid	-6.4528 (-16.31)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
CNG	-10.1116 (-12.66)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Diesel	-4.3623 (-19.11)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Hybrid Electric	-4.2090 (-23.99)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
Fully Electric	-9.2395 (-12.53)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
New Car	--	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
1 or 2 years	-1.9025 (-7.45)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
3 to 7 years	-1.3159 (-13.45)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
8 to 12 years	-3.2003 (-17.58)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)
> 12 years	-3.8367 (-14.69)	-0.6706 (-18.65)	-0.1292 (-1.75)	4.8922 (13.74)	-4.7037 (-10.23)	-0.4797 (-2.34)	-0.0487 (-3.60)	1.3049 (11.41)	1.4489 (12.37)

**Table 1 Estimates of the Vehicle Type Choice Component of Vehicle Selection Module (Continued)**

Variable →	\$1,000 Tax credits	50% Reduced toll	\$1,000 Vehicle price reduction	Fuel availability (1 in 50 stations)	Vehicle range (150 to 200 miles)	Vehicle range (>200 miles)	Number of male adults	Number of female adults	Presence of children			Presence of senior adults
									0 to 4 years	5 to 11 years	12 to 15 years	
No vehicle	--	--	--	--	--	--	--	--	--	--	--	--
Compact Car	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	--	--	-0.2289 (-1.86)	--	--	--
Car	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	0.5032 (7.93)	--	--	--	--	0.4328 (5.07)
SCU <sup>2</sup>	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	--	--	--	-0.8603 (-3.92)	--	--
SUV	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	0.3504 (7.61)	0.3504 (7.61)	0.5474 (5.20)	--	--	--
Van	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	0.5067 (3.80)	--	1.0985 (6.88)	--	--	--
Pickup	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	0.6937 (8.31)	--	--	--	--	--
Gasoline	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	--	--	--	--	--	--	--	--	--
Flex Fuel	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	--	--	--	--	--	--	--	--	-0.3471 (-1.87)
Plug-in Hybrid	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	--	--	--	-0.5550 (-8.10)	--	--	--	--	--
CNG	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	--	--	--	--	--	--
Diesel	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	--	--	--	--	-0.4723 (-4.30)	-0.4503 (-2.55)	--	0.3547 (2.35)	--
Hybrid Electric	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	--	--	--	-0.5550 (-8.10)	--	--	--	--	0.3306 (3.40)
Fully Electric	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	--	0.4141 (2.86)	0.7095 (3.69)	--	--	--
New Car	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	--	--	--	--	--	--
1 or 2 years	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	--	--	--	--	--	--
3 to 7 years	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	--	--	--	--	0.4027 (4.76)	-0.5171 (-6.25)
8 to 12 yrs	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	--	--	--	-0.5502 (-3.13)	0.4027 (4.76)	-0.5171 (-6.25)
> 12 years	1.5317 (12.90)	1.1163 (9.93)	1.2648 (10.62)	-0.3177 (-1.45)	4.6733 (5.58)	4.8541 (5.97)	0.5137 (3.19)	--	--	-0.5502 (-3.13)	0.4027 (4.76)	-0.5171 (-6.25)

**Table 1 Estimates of the Vehicle Type Choice Component of Vehicle Selection Module (Continued)**

Variable→	# full time workers	# part time workers	# full time workers from home	# part time workers from home	Household Income							Education Attainment	
					< \$20K	(\$20K,\$40K)	(\$40K,\$60K)	(\$60K,\$80K)	(\$80K,\$100K)	(\$100K,\$120K)	> \$120K	College	Post graduate
No vehicle	--	--	--	--	--	--	--	--	--	--	--	--	--
CC <sup>1</sup>	--	--	--	0.2774	--	--	--	0.5170	0.5170	0.5170	0.8070	0.4023	0.6152
	--	--	--	(1.70)	--	--	--	(4.72)	(4.72)	(4.72)	(6.64)	(2.99)	(4.39)
Car	-0.1082	0.3939	--	--	--	--	0.5461	1.1675	1.1675	1.1675	1.6206	--	--
	(-2.27)	(6.50)	--	--	--	--	(4.02)	(8.51)	(8.51)	(8.51)	(11.09)	--	--
SCU <sup>2</sup>	--	--	--	--	--	--	--	0.9495	0.9495	0.9495	1.7926	0.4122	--
	--	--	--	--	--	--	--	(5.27)	(5.27)	(5.27)	9.76	(3.03)	--
SUV	--	--	0.3494	0.3299	--	--	0.3742	1.3508	1.3508	1.4086	1.8632	0.1229	--
	--	--	(1.68)	(1.83)	--	--	(2.25)	(8.88)	(8.88)	8.43	(11.52)	(1.52)	--
Van	--	--	0.3494	0.6413	--	--	--	0.5556	0.5556	0.5556	0.5556	0.6972	1.0739
	--	--	(1.68)	(2.43)	--	--	--	(3.42)	(3.42)	3.41	(3.52)	(2.44)	(3.57)
Pickup	--	0.2457	--	--	--	--	0.5289	0.8474	0.8474	0.8081	0.8081	--	-0.6168
	--	(2.94)	--	--	--	--	(3.27)	(5.51)	(5.51)	5.12	(4.95)	--	(-5.27)
Gasoline	--	--	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--	--	--
Flex Fuel	--	--	-0.9007	--	0.5198	0.5198	--	--	--	--	--	--	0.3209
	--	--	(-1.65)	--	(2.42)	(2.42)	--	--	--	--	--	--	(1.99)
Plug-in	--	--	-0.7582	--	-0.4065	--	--	--	--	--	--	0.7613	1.4306
	--	--	(-2.96)	--	(-1.55)	--	--	--	--	--	--	(2.69)	(4.26)
CNG	--	--	-1.5787	1.0726	--	--	--	--	--	--	--	--	--
	--	--	(-1.69)	(2.86)	--	--	--	--	--	--	--	--	--
Diesel	0.1012	--	--	--	-0.9168	-0.9168	--	--	--	--	--	-0.2847	--
	(1.40)	--	--	--	(-5.07)	(-5.07)	--	--	--	--	--	(-2.55)	--
Hybrid	--	--	--	0.5098	--	--	--	0.3004	0.3004	0.3004	0.3004	--	0.6496
	--	--	--	(2.40)	--	--	--	(2.87)	(2.87)	(2.87)	(2.87)	--	(6.84)
Fully	--	--	--	--	--	--	--	--	--	--	--	1.5267	1.6261
	--	--	--	--	--	--	--	--	--	--	--	(2.58)	(2.70)
New Car	--	--	0.4229	--	--	--	--	0.7828	0.7828	0.7828	0.7828	0.2544	--
	--	--	(4.00)	--	--	--	--	(12.94)	(12.94)	13.75	(12.94)	(3.70)	--
1 or 2 years	0.1447	0.2032	--	--	--	0.6052	0.6052	0.6052	1.0111	1.0111	1.0111	--	-0.4107
	(2.90)	(3.15)	--	--	--	(2.37)	(2.37)	(2.37)	(3.85)	(3.85)	(3.85)	--	(-5.39)
3 to 7 years	0.2817	0.3271	--	--	--	0.6052	0.6052	0.6052	--	--	--	--	-0.4107
	(6.53)	(5.19)	--	--	--	(2.37)	(2.37)	(2.37)	--	--	--	--	(-5.39)
8 to 12 yrs	0.2576	0.3722	--	--	--	0.9582	0.6525	--	--	--	-0.7201	--	-0.4107
	(4.19)	(4.19)	--	--	--	(6.70)	(4.33)	--	--	--	(-3.81)	--	(-5.39)
>12 years	0.2576	0.3722	--	--	--	0.9582	0.6525	--	--	--	-0.7201	--	-0.4107
	(4.19)	(4.19)	--	--	--	(6.70)	(4.33)	--	--	--	(-3.81)	--	(-5.39)

**Table 1 Estimates of the Vehicle Type Choice Component of Vehicle Selection Module (Continued)**

Variable→	Caucasian	Sub-urban	Rural	Existing Fleet Characteristics						Replaced vehicle Characteristics					
				Presence of CC <sup>1</sup>	Presence of Car	Presence of SCU <sup>2</sup>	Presence of SUV	Presence of Van	Presence of pickup	Compact Car	SCU	SUV	Van	Pickup	Gasoline
No vehicle	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC	0.1250 (1.81)	--	--	-1.9361 (-13.00)	-2.0499 (-11.68)	-0.3459 (-2.22)	-2.0936 (-10.44)	-0.5155 (2.82)	-0.8660 (-4.41)	-1.6086 (-8.82)	-0.9692 (-3.41)	-1.3853 (-6.29)	--	-2.1658 (-8.54)	1.6696 (13.14)
Car	0.1883 (2.69)	--	--	--	-2.1967 (-12.60)	--	-2.0936 (-10.44)	-0.2741 (-1.69)	-0.7987 (-4.36)	1.9325 (12.66)	--	0.9366 (4.45)	1.1706 (4.29)	-0.7988 (-2.90)	--
SCU	--	--	--	-0.8924 (-4.25)	-1.1602 (-5.40)	--	-1.2080 (-4.95)	--	-0.9808 (-3.67)	--	2.5704 (9.52)	--	--	--	0.4980 (3.03)
SUV	--	0.2538 (3.50)	--	-1.6156 (-10.13)	-1.6086 (-9.24)	--	-1.8499 (-9.17)	-0.2741 (-1.69)	-0.7089 (-3.72)	--	--	2.6346 (12.80)	1.6286 (6.55)	--	--
Van	--	--	--	-1.3541 (-6.77)	-1.2939 (-5.77)	--	-1.8499 (-9.17)	-1.2033 (-3.68)	-0.5128 (-2.15)	--	--	--	4.7031 (13.84)	--	--
Pickup	--	0.5639 (5.92)	0.8941 (3.95)	-1.6428 (-9.12)	-1.6495 (-8.57)	--	-1.8499 (-9.17)	--	-1.7037 (-8.04)	-0.4344 (-1.66)	--	1.3970 (5.09)	--	4.3531 (16.18)	-0.8213 (-4.51)
Gasoline	--	--	--	--	--	-0.5262 (-4.39)	--	-1.1169 (-10.50)	--	--	-0.6849 (-3.20)	--	--	-1.1219 (-5.32)	--
Flex Fuel	--	-0.2261 (-1.50)	--	1.9512 (10.51)	1.3386 (7.34)	--	2.0363 (15.40)	--	0.7940 (3.47)	--	--	--	--	-0.8788 (-2.70)	0.8057 (3.85)
Plug-in	-0.1356 (-1.62)	-0.3138 (-2.84)	--	1.8957 (12.28)	1.2243 (6.89)	--	2.0363 (15.40)	--	0.6725 (3.77)	0.5600 (2.76)	--	--	0.8335 (2.93)	-0.9356 (-2.90)	0.8060 (3.86)
CNG	-0.1356 (-1.62)	--	--	0.9095 (3.46)	0.9336 (3.63)	--	1.2938 (4.53)	--	--	--	--	--	--	--	--
Diesel	--	--	1.4152 (5.94)	1.8767 (12.04)	1.4222 (8.42)	--	1.5166 (8.16)	--	0.5480 (3.32)	0.7665 (3.61)	--	1.0472 (4.38)	--	0.7583 (2.55)	-0.6599 (-3.86)
Hybrid	--	-0.4147 (-4.82)	0.6952 (2.25)	1.1161 (9.33)	0.8375 (7.32)	-0.5749 (-2.63)	1.5480 (11.99)	-0.5585 (-2.89)	0.4450 (2.99)	--	--	--	--	-1.6493 (-6.00)	1.5226 (12.38)
Fully	-0.1356 (-1.62)	-0.6446 (-4.04)	--	0.5559 (2.77)	0.6060 (3.23)	--	1.0224 (5.10)	--	--	--	--	--	--	--	-0.5509 (-2.36)
New Car	--	--	--	-1.0822 (-7.64)	-1.1471 (-7.12)	-0.9657 (-5.18)	-1.1730 (-5.99)	-1.2532 (-7.01)	-0.9933 (-5.48)	--	--	1.7962 (2.86)	--	0.4567 (2.94)	3.3193 (8.11)
1 or 2 years	--	--	--	-0.6007 (-4.39)	-0.6517 (-4.07)	-0.9657 (-5.18)	-0.7664 (-3.88)	-0.7943 (-4.14)	-0.5935 (-3.27)	--	--	1.7962 (2.86)	--	--	3.3193 (8.11)
3 to 7 years	--	--	--	-0.7897 (-5.84)	-0.6517 (-4.07)	-0.7792 (-3.66)	-0.7664 (-3.88)	-0.7943 (-4.14)	-0.5935 (-3.27)	--	--	1.7962 (2.86)	--	--	3.3193 (8.11)
8 to 12 yrs	0.4913 (4.55)	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0143 (4.65)
More than	0.4913 (4.55)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

<sup>1</sup> Compact Car

<sup>2</sup> Small Cross-utility vehicle

**Table 2 Estimates of the Vehicle Usage Component of Vehicle Selection Module**

<b>Variable</b>	<b>Parameter</b>	<b>t-stat</b>
Constant	8.3763	131.94
<i>Presence of children</i>		
Under 4 years	0.0401	1.69
Presence of senior adults	-0.1030	-5.08
<i>HH Income</i>		
Above \$80K	0.0434	2.59
<i>Location of HH</i>		
Sub-urban	0.1203	7.85
<i>Number of workers</i>	0.0829	7.80
<i>Number of vehicles</i>		
Two	-0.0633	-2.69
Three	-0.1757	-6.10
Four	-0.2810	-7.31
<i>Mean distance to work /10 (miles)</i>	0.1008	14.69
<i>Vehicle Characteristics</i>		
Car	0.0495	2.18
Small cross utility vehicle	-0.1369	-3.23
SUV or Van	0.0792	3.19
8 to 12 years old	-0.415	-8.17
More than 12 years old	-0.7032	-12.71
<i>Standard error of the estimate</i>	0.7356	44.25

The scale parameter ( $\lambda$ ) was estimated to be 0.5556 with a t-statistic of 24.15 (against a value of 1) and copula dependency parameter ( $\theta$ ) is estimated to be equal to -3.367 with a t-statistic of -9.39.

**Table 3 Replacement Decision of Evolution Module: Binary Logit model**

<b>Variable</b>	<b>Parameter</b>	<b>t statistic</b>
Constant	-2.1093	-10.13
<i>Race of household (other race is base)</i>		
Caucasian	0.1231	1.92
Hispanic	0.9166	2.11
Large Household ( size >=5)	0.1695	1.50
Large household*Replaced vehicle is SUV	-0.4539	-2.14
<i>Household Income (Base is below \$60,000)</i>		
Between \$60,000 and \$100,000	0.1469	1.84
Above \$120,000	0.2042	2.30
<i>Presence of children</i>		
0 to 4 years	-0.3872	-3.16
5 to 11 years	-0.1598	-1.49
12 to 15 years	0.4287	3.00
<i>Characteristics of vehicle getting replaced</i>		
Sports car or cross utility vehicle	-0.3579	-2.06
SUV	-0.1415	-1.68
Van	-0.1569	-1.39
Pickup	-0.1420	-1.57
1-3 years old	0.1849	2.21
3-7 years old	0.2312	2.87
8-12 years old	0.5624	4.00
More than 12 years old	0.2810	1.74
Gasoline Fueled	0.4519	2.34

Log-likelihood = -2857.53

**Table 4 Addition Decision of Evolution Module: Binary Logit model**

<b>Variable</b>	<b>Parameter</b>	<b>t statistic</b>
Constant	-4.7298	-13.18
<i>Race of the household (other race is base)</i>		
Caucasian	-0.3970	-1.73
Hispanic	-6.8937	-6.82
Number of adults	0.8023	5.13
Large Household ( size >=5)	0.7123	2.18
<i>Household Income (Base is above \$20,000)</i>		
Between \$20,000	1.4400	2.99
Presence of children 12 to 15 years	1.2956	4.48
Presence of senior adults	-1.8692	-3.40
<i>Region (Base is urban and sub-urban)</i>		
Rural	0.9976	2.15
<i>Household Vehicle Fleet Characteristics</i>		
Number of compact cars	-0.7604	-3.13
Number of cars	-0.4485	-1.95
Number of SUVs	-0.2952	-1.58
Number of Pickup trucks	-0.5677	-2.29

Log-likelihood = -430.261