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Research/Technical Note

Measuring Value Creation and Appropriation in the Brazilian Power Distribution Industry

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Abstract

Value creation and appropriation is a common study topic in the context of creating superior value in relation to competitors but is seldom applied in the context of regulated markets. Regulators must create a truly sustainable market environment by promoting a balanced value appropriation among all stakeholders. The objective of this research is to introduce the application of the VCA (Value Creation and Appropriation) method for measuring value creation and appropriation by stakeholders in regulated markets, with the illustrative case of the Brazilian power distribution market. By applying this methodology, we could test 3 specific hypotheses and found that (1) in most scenarios there is no significant difference in the creation and appropriation of value between state-owned and privately-owned companies, (2) despite complains presented by Distribution Companies, there are no indication that the value created and appropriated by stakeholders decreased over time, and (3) the regulatory intervention introduced by the Brazilian government in 2012, to try to force energy price reductions, unequivocally affected the dynamics of total value creation and value appropriation. This paper contributes to both scholars and practitioners and the proposed methodology can serve as a powerful benchmarking tool, especially as a means for policymakers to assess the maturity level of their local market regulation.

Keywords

Strategy, Value Creation, Value Appropriation, Regulation, Electricity

1. Introduction

Value creation is a long-debated topic in the field of strategy, especially since the seminal article by Brandenburger and Stuart [1], in which the authors defined the concept as the difference between the customer's propensity to pay and the cost of vendor opportunity. As a result of this definition, the strategic action to maximize value creation is to seek to expand the propensity to pay customers, which is done by maximizing customers' expectations about how the company's product (or service) attributes will satisfy their needs [2], i.e., by maximizing the customer's perceived value [3].

Another equally relevant theme is the appropriation (or capture) of value by the company, its suppliers, and its customers: the division of value between the supplier and the company is defined by the bargaining power between them in defining the cost of the material and, in parallel, the establishment of the sale price, resulting from the bargaining power between the company and its customers, will define the division of value between the firm and the buyer [1]. Modern Stakeholder Theory argues that other stakeholders also play a

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key role in value creation and, therefore, if the value created is not shared with all relevant parties, a business would lose its business partners and resources as well as its legitimacy [4].

Figure 1 illustrates this value sharing among multiple stakeholders.

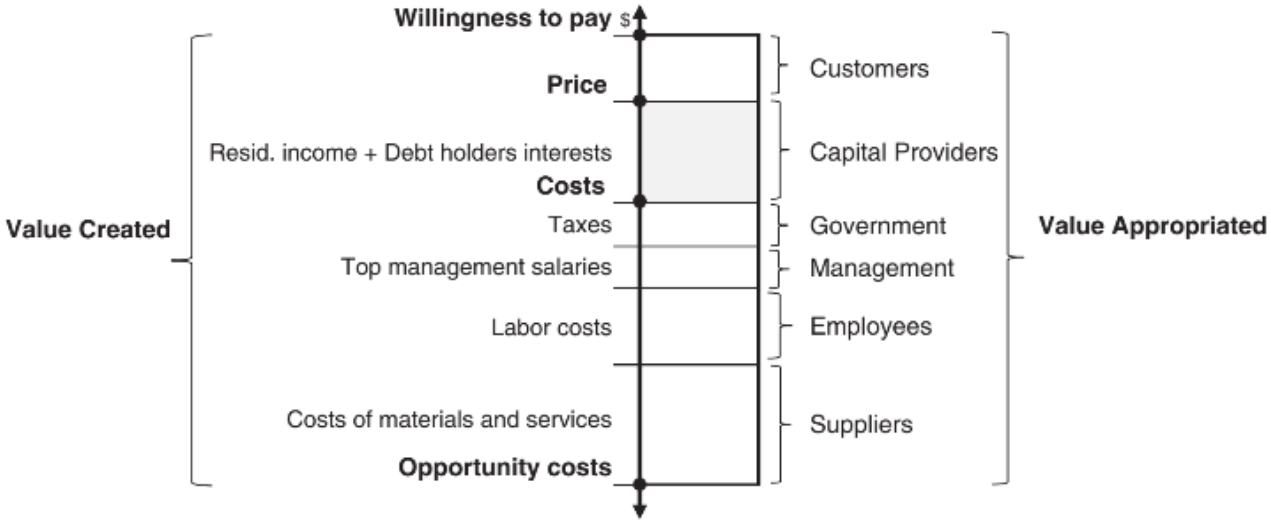

Figure 1. *Value creation and appropriation by multiple stakeholders [5].*

However, discussions of value creation and appropriation are mostly applied in the context of developing competitive advantage as a mechanism for creating superior value in relation to competitors, especially in the light of resource-based theory [6], and is seldom applied in the context of regulated markets, in which the competitive environment is emulated through the action of a regulatory agent [7]. The regulator's role is to induce the regulated firm to work towards the broad interests of society rather than to only pursue its own interests [8]. This challenge still requires further investigation [9].

It is important to expand this discussion for regulated markets because the promotion of a truly sustainable market environment, both competitive and regulated ones, requires a balanced value appropriation among all stakeholders [10]. Indeed, the core characteristic of an incentive-based regulation, one of the most used regulatory mechanisms worldwide, is allowing regulated companies to seek greater profitability by becoming more efficient in order to share gains with consumers [11], as is the case of the electricity distribution sector in Brazil, regulated by the National Electric Energy Agency (ANEEL) [12].

The objective of this research is to introduce the application of the VCA (Value Capture and Appropriation) method, which measures how the total economic value created by a company varies from one period to the next [13], for assessing value creation and appropriation by stakeholders in the context of regulated utilities in Brazil.

The results show the success of the regulatory model for electricity distribution in Brazil, with positive value creation and appropriation by stakeholders, addressing a frequently asked question for empirical evidence of the effects of incentive regulation e.g., [14-16]. The application of this methodology can provide market analysts and researchers with a powerful benchmarking tool, as well as a means for policymakers to assess the maturity level of local market regulation.

2. Methodology

Lieberman et al. [13] proposed a method to estimate the economic value created by a company and appropriated by its stakeholders, which they called the VCA model. Its starting point is a dynamic notion of economic value created - called "economic gain" - defined as the change in the total economic value created by a company from one period to the next. The basis of this approach is a simple accounting identity that equates a company's revenues to the sum of all payments made to its stakeholders, as per Equation 1:

$$pY \equiv wL + mM + rK \quad (1)$$

Where,
p represents the product's price.
Y represents the total output.
w represents the wage paid.
L represents the amount of labor (number of employees).
m represents the price of raw material.
M represents the total volume of raw material utilized.
r represents the return on capital.
K represents the total capital employed.

For the application of the VCA model in the electricity distribution sector in Brazil, the first step was to adapt the equality defined in Equation 1 according to the cost structure of these companies. As they are regulated companies, ANEEL

presents an accounting standard manual [17], which is indicated in a simplified form in the following table:

Table 1. *Basic accounting standard for distribution companies.*

Revenue	(+) Power supply
Non-manageable costs	(-) State taxes (over revenue)
	(-) Sector charges (subsidies)
	(-) Power purchase for resale
Manageable costs	(-) Labor
	(-) Material, Services, and Other
Operational result	(=) EBITDA

Applying the data in Table 1 to adapt Equation 1, we arrive at a notation for determining the stakeholders related to the electricity distribution operation:

Table 2. *Mapping of accounting items do related stakeholders.*

P&L item	Related stakeholder	Notation in Equation
Power supply	Customers	pY
State taxes (over revenue)	Local government	gG
Sector charges (subsidies)	Subsidy receivers	sS
Power purchase for resale	Generation companies	eE
Labor	Employees	wL
Material, Services, and Other	Suppliers	mM
EBITDA	Capital	rK

Thus, the formula from which the model will be built as given by Equation 2:

$$pY \equiv gG + sS + eE + wL + mM + rK \quad (2)$$

Where,

p represents the average price received by the distribution company, calculated by dividing the total revenue by the total energy supplied [$/MWh].

Y represents the total Energy supplied [GWh/year].

g represents the average tax rate, calculated by dividing the total tax paid by the total revenue [%].

G represents the tax base, in this case, total revenue [$/year].

s represents the average sector charge, calculated by dividing the total amount of subsidies paid by the volume of Energy supplied, which is the main base for the calculation of the sectoral charges [18] [$/MWh].

S represents the total Energy supplied [GWh/year].

e represents the average price of power purchased for resale, calculated by dividing the total amount of power purchase expenditures by the total volume of power purchased [$/MWh].

E represents the total volume of power purchased for resale [GWh/year].

w represents the average wage, calculated by dividing the total labor costs by the number of employees [$/employee].

L represents the number of employees at the end of the year [employees].

m represents the average cost of material purchased, calculated by dividing the total cost of Material, Services, and Other by the number of supplied customers [$/supplied customers].

M should represent the volume of material and other inputs. In this case, as a proxy, it was utilized the number of customers supplied by the distribution company [Customers supplied]. Such a choice is aligned with the benchmarking methodology applied by the local regulator [12].

r represents the rate of return, calculated by dividing the EBITDA by the capital employed [%].

K represents the total capital employed [$], calculated by the difference between Total Assets and Current Liabilities [19].

That way, we arrive at Equation 3, which will allow the calculation of total value creation and value appropriation by each stakeholder, as described by Lieberman et al. [13].

$$\overbrace{\frac{\Delta Y}{Y} - \frac{s_G \Delta G}{G} - \frac{s_S \Delta S}{S} - \frac{s_E \Delta E}{E} - \frac{s_L \Delta L}{L} - \frac{s_M \Delta M}{M} - \frac{s_K \Delta K}{K}}^{Total\ value\ created} = \overbrace{\frac{\Delta g s_G}{g} + \frac{\Delta s s_S}{s} + \frac{\Delta e s_E}{e} + \frac{\Delta w s_L}{w} + \frac{\Delta m s_M}{m} + \frac{\Delta r s_K}{r} - \frac{\Delta p}{p}}^{Value\ appropriated\ by\ each\ stakeholder} \quad (3)$$

Where,

Y, G, S, E, L, M, and K represent the volumes as discussed in Equation 2.

g, s, e, w, m, r, p represent the unit costs as discussed in Equation 2.

ΔY represents the variation in quantity Y between periods (also applicable for the other variables: *G, S, E, L, M, K, g, s, e, w, m, r, p*).

s_G, s_S, s_E, s_L, s_M, s_K represent the share of each cost over the total revenue, respectively taxes, subsidies, power, labor, suppliers, and capital.

For this study, we selected the three largest privately-owned electricity distribution companies and the three largest state-owned companies, according to the ANEEL ranking of distributed energy in 2019 [20]. Such choice makes it possible to assess whether the origin of capital influences the dynamics of value creation and appropriation in the same way that it influences, for example, overall efficiency [21], labor productivity [22], improvement in quality indices [23, 24] or the allocation of wealth to employees [25], leading to Hypothesis 1:

H1: The creation and appropriation of value are different in privately and state-owned companies.

Together, the six selected companies represent 41% of the total energy distributed in 2019. The list of companies, with their respective concession areas and market share, are indicated in Figure 1. The companies' information was obtained from their annual reports available on their websites [26-31].

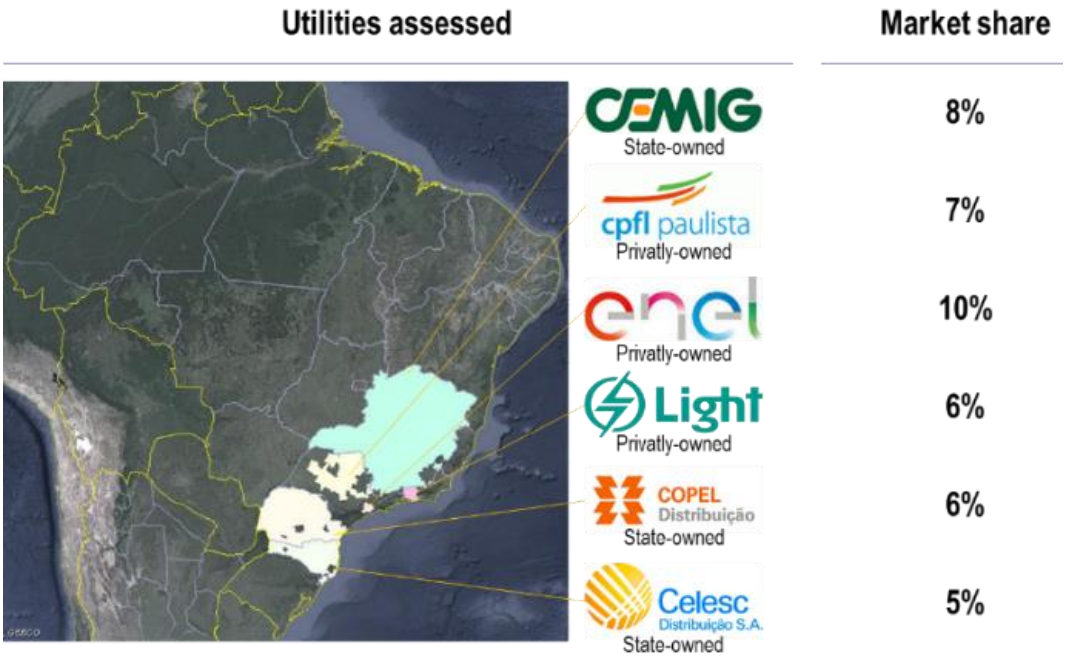

Figure 1. *Own elaboration, based on [20].*

The selected study horizon covers the twelve years between 2007 and 2019, corresponding to three four-year price control cycles, according to sector regulation [32]. This horizon allows the analysis of the evolution of regulatory performance and assessing the potential exhaustion of the regulatory model in its objective of creating and distributing value among consumers and investors [33], leading to Hypothesis 2:

H2: The value created and appropriated by stakeholders decreases over time.

This horizon also allows the assessment of the impacts on the dynamics of creation and appropriation of value caused by an extra-regulatory intervention introduced with the publication of Provisional Measure 579/2012 [34], which was a government attempt to force tariff reduction for energy consumers, but ended up causing a tariff increase shortly after the 2014 election period [35], leading to Hypothesis 3:

H3: The creation and appropriation of value were affected by Provisional Measure 579.

3. Results and Discussion

Table 3 presents the estimated total value created (VT) and the value appropriated by each stakeholder (VC for customers, VG for local government, VS for subsidy receivers, VE for generation companies, VL for employees, VM for suppliers e VK for capital) for the six energy distribution companies listed in the previous section, for the period between 2007 and 2019. All values were calculated adjusting for inflation in the period. Estimates are calculated as logarithmic differences in percentage.

Table 3. *Creation and appropriation of value: largest energy distributors per price control cycle (log differences %).*

		CPFL Pau-lista	Eletro-paulo	Light	Average private-ly-owned	Cemig	Celesc	Copel	Average state-owned	Total average
2007-2011										
VT	Economic gains	8,5	11,2	5,0	8,3	11,1	15,9	4,5	10,5	9,4
VC	Gains to customers	21,2	13,9	11,3	15,5	18,4	16,7	7,2	14,1	14,8
VG	Gains to local gov't	-0,8	0,7	-1,2	-0,4	-4,4	1,1	4,8	0,5	0,0
VS	Gains to subsidy	2,5	1,0	-1,2	0,8	1,3	0,2	-4,5	-1,0	-0,1
VE	Gains to generators	-3,4	-1,9	-2,6	-2,6	-1,3	-0,7	-0,6	-0,8	-1,7
VL	Gains to employees	1,2	-2,1	-1,5	-0,8	2,6	2,2	2,1	2,3	0,8
VM	Gains to suppliers	-14,4	-4,8	-0,7	-6,7	-0,1	-4,5	1,5	-1,0	-3,8
VK	Gains to capital (b/tax)	2,1	4,4	1,0	2,5	-5,4	0,9	-6,1	-3,6	-0,5
2011-2015										
VT	Economic gains	-14,2	-10,4	-3,0	-9,2	-19,9	-3,3	-7,1	-10,1	-9,7
VC	Gains to customers	-35,2	-28,3	-19,3	-27,6	-34,7	-25,4	-31,4	-30,5	-29,0
VG	Gains to local gov't	-3,6	-5,7	1,2	-2,7	-2,4	-3,8	-2,8	-3,0	-2,9
VS	Gains to subsidy	12,7	12,0	6,1	10,2	11,7	10,5	10,8	11,0	10,6
VE	Gains to generators	17,2	14,4	10,8	14,2	11,9	17,3	15,5	14,9	14,5
VL	Gains to employees	-0,1	-0,2	0,2	-0,1	0,2	-2,1	0,0	-0,6	-0,3
VM	Gains to suppliers	1,1	1,1	-1,1	0,4	-2,1	-2,5	-0,2	-1,6	-0,6
VK	Gains to capital (b/tax)	-6,3	-3,7	-0,8	-3,6	-4,4	2,8	0,9	-0,2	-1,9
2015-2019										
VT	Economic gains	5,8	3,4	4,1	4,4	4,8	12,7	14,3	10,6	7,5
VC	Gains to customers	20,0	18,6	3,8	14,1	9,0	24,2	23,4	18,9	16,5
VG	Gains to local gov't	2,1	2,6	-8,9	-1,4	3,7	1,5	1,5	2,2	0,4
VS	Gains to subsidy	-12,6	-11,9	-2,8	-9,1	-9,0	-11,3	-10,3	-10,2	-9,7
VE	Gains to generators	-9,7	-7,0	6,5	-3,4	-3,2	-5,0	-5,7	-4,7	-4,0
VL	Gains to employees	0,1	-1,4	-0,2	-0,5	1,6	0,6	0,7	1,0	0,2
VM	Gains to suppliers	-0,6	-0,7	2,7	0,5	0,0	-0,1	-0,6	-0,2	0,1
VK	Gains to capital (b/tax)	6,7	3,1	3,0	4,3	2,8	2,8	5,3	3,6	3,9

In order to evaluate the hypotheses presented in the previous section, we conducted linear regressions as per equation 4:

$$VX = \beta_0 + \beta_1 State + \beta_2 t + \beta_3 PM579 + \varepsilon \quad (4)$$

Where:

VX represents the respective value created or appropriated *(VT, VC, VG, VS, VE, VL, VM, and VK).*

State is a dummy variable, assuming value 1 for state-owned companies.

t represents the price control cycle, assuming a value of 0 for the cycle 2007-2011, 1 for the cycle 2011-2014, and two for the cycle 2015-2019.

PM579 is a dummy variable that assumes value 1 for the price control cycle 2011-2014, capturing the possible effect of Provisional Measure 579/2012.

The consolidated result of the regressions is shown in Table 4.

Table 4. *Consolidated result of linear regressions.*

	Intercept		State		t		PM579		Adj R2
VT	8,125	**	2,493		-0,934		-18,093	***	0,725
	(0.003)		(0.003)		(0.002)		(0.003)		
VC	14,698	***	0,161		0,861		-44,687	***	0,908
	(0.003)		(0.003)		(0.002)		(0.003)		
VG	-0,685		1,415		0,199		-3,077	.	0,051
	(0.002)		(0.002)		(0.001)		(0.002)		
VS	0,266		-0,709		-4,789	***	15,482	***	0,893
	(0.001)		(0.001)		(0.001)		(0.001)		
VE	-1,953		0,422		-1,144		17,401	***	0,831
	(0.002)		(0.002)		(0.001)		(0.002)		
VL	0,084		1,339	*	-0,261		-0,828		0,208
	(0.001)		(0.001)		(0.000)		(0.001)		
VM	-4,340	*	0,993		1,975	.	1,244		0,076
	(0.002)		(0.002)		(0.001)		(0.002)		
VK	0,057		-1,127		2,225	*	-3,628	*	0,301
	(0.002)		(0.002)		(0.001)		(0.002)		

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Regarding hypothesis H1, testing the difference in the creation and appropriation of value between state-owned and privately-owned companies, despite a higher average total value creation in state-owned companies and an average lower appropriation of value by the holder of capital in these companies, only the superior appropriation of value by employees (VL) is statistically significant at 95% confidence, which suggests a bargaining power associated with the specific rules for hiring and firing civil servants.

Regarding hypothesis H2, except for the value captured by the subsidy receivers (VS), there are no indications that the value created and appropriated by stakeholders decreases over time. In fact, it was observed an increase in the appropriation of value by the capital holder, with 95% confidence, which suggests an improvement in the regulatory management by the operators of the electricity distribution networks.

Finally, regarding hypothesis H3, it is observed that PM 579 unequivocally affected the dynamics of total value creation and value appropriation in "non-manageable" items by the distributors, with a significant redistribution of value from consumers and, marginally, from the distributors' shareholders to subsidy receivers and to generators.

4. Conclusions

This article proposes applying the VCA model to measure the evolution of value creation and Appropriation by the different stakeholders of regulated utilities. This work brings managers and regulators an important benchmarking tool as well as a theoretical-empirical support for future debates about potential adjustments in regulatory models. For academia, this work presents one more empirical application of the theoretical model proposed by Lieberman et al. [13].

Specifically in the Brazilian context in which the model

was applied, we found that, although the privatization of energy companies has brought a set of benefits, there are no statistically significant differences in value creation between state-owned and privately-owned companies, with a significant difference only in the higher level of value appropriation by employees of state-owned companies.

Furthermore, we found that the Brazilian utilities have learned to manage the regulatory process in order to increase the appropriation of value for their shareholders and that the extra-regulatory intervention introduced by Provisional Measure 579/2012 caused a substantial destruction of value in the sector.

One key limitation of this work is that the methodology captures value appropriation in purely qualitative terms and cannot assess issues related to efficiency or quality of service. Additionally, this work inherits the same limitations as identified by the authors of the original VCA method [13]:

1) The limitation of data availability and the need to use proxies may cause some imperfections in the calculations, such as using the number of consumers served by the distributor instead of the quantity of material and other inputs purchased.
2) Possible differences in accounting methods between companies or changes over time by the same company may affect the results, such as possible changes in the allocation of holding costs in the energy distribution business unit affecting the analyses relating to personnel costs.
3) The calculated values are sensitive to the years chosen for the analysis, such as the occurrence of an extraordinary event affecting the results of a particular year among those analyzed.
4) The appropriation of value to the capital owner, as calculated, does not consider the effects brought by capital structure optimization opportunities [36]. As the level of leverage in the electricity sector tends to be high [37], this may represent a relevant factor in differentiating between companies in appropriating value by their shareholders.

A possible extension of this work would be to apply the method to a larger universe of distribution companies and/or perform the calculation for smaller time intervals to assess whether the limitations identified above are, in fact, relevant. Furthermore, it can be beneficial to perform a theoretical evaluation on segregating the appropriation of value in the capital holder between debt and equity.

Abbreviations

ANEEL: National Electric Energy Agency
VCA: Value Creation and Appropriation

Conflicts of Interest

The authors declare no conflicts of interest.

Appendix

Table A1. *Complete regression results for VT.*

VT	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	8.125	2.502	3.248	0.00584	**
State	2.493	2.502	0.997	0.33592	
Time	-0.934	1.532	-0.61	0.55176	
MP579	-18.093	2.654	-6.818	8.35E-06	***
Adj R2	0.725				

Table A2. *Complete regression results for VC.*

VC	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	14.698	3.226	4.556	0.000449	***
State	0.161	3.226	0.05	0.96097	
Time	0.861	1.976	0.436	0.669725	
MP579	-44.687	3.422	-13.06	3.13E-09	***
Adj R2	0.908				

Table A3. *Complete regression results for VG.*

VG	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-0.685	1.641	-0.418	0.6825
State	1.415	1.641	0.862	0.4032
Time	0.199	1.005	0.198	0.8461
MP579	-3.077	1.740	-1.768	0.0988
Adj R2	0.051			

Table A4. *Complete regression results for VS.*

VS	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.266	1.380	0.193	0.85	
State	-0.709	1.380	-0.514	0.616	
Time	-4.789	0.845	-5.668	5.81E-05	***
MP579	15.482	1.463	10.579	4.63E-08	***
Adj R2	0.893				

Table A5. *Complete regression results for VE.*

VE	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-1.953	1.775	-1.101	0.29	
State	0.422	1.775	0.238	0.816	
Time	-1.144	1.087	-1.053	0.31	
MP579	17.401	1.882	9.245	2.45E-07	***
Adj R2	0.831				

Table A6. *Complete regression results for VL.*

VL	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.084	0.588	0.143	0.8886	
State	1.339	0.588	2.276	0.0391	*
Time	-0.261	0.360	-0.724	0.481	
MP579	-0.828	0.624	-1.327	0.2059	
Adj R2	0.208				

Table A7. *Complete regression results for VM.*

VM	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-4.340	1.704	-2.548	0.0232	*
State	0.993	1.704	0.583	0.5693	
Time	1.975	1.043	1.893	0.0792	.
MP579	1.244	1.807	0.689	0.5023	
Adj R2	0.076				

Table A8. *Complete regression results for VR.*

VK	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.057	1.592	0.036	0.9721	
State	-1.127	1.592	-0.708	0.4906	
Time	2.225	0.975	2.282	0.0387	*
MP579	-3.628	1.689	-2.149	0.0496	*
Adj R2	0.301				

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