Technical Appendix to Accompany "Designing Compensation for Distributed Solar Generation: Is Net Metering Ever Optimal?"
by
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Appendix A. Proofs of the Formal Conclusions

Proof of Proposition 1.

Let $\lambda_F \geq 0$ denote the Lagrange multiplier associated with constraint (6). Then at an interior solution to [RP-F]:

$$K_G: \quad \lambda_F \left[\int_{\underline{\theta}}^{\overline{\theta}} \left(-\frac{\partial C^G(\cdot)}{\partial Q^v} \frac{dQ^v}{dK_G} - \frac{\partial C^G(\cdot)}{\partial K_G} \right) dF(\theta) - C^{K\prime}(K_G) - \frac{\partial T(\cdot)}{\partial K_G} \right] = 0\,; \qquad (20)$$

$$w: \quad \int_{\underline{\theta}}^{\overline{\theta}} \theta\, K_D \; dF(\theta) \,-\, \lambda_F \left[\int_{\underline{\theta}}^{\overline{\theta}} \theta\, K_D \; dF(\theta) \right.$$
$$\left. + \int_{\underline{\theta}}^{\overline{\theta}} \left(w\,\theta + \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial K_D} \right) \frac{\partial K_D}{\partial w} \, dF(\theta) + \frac{\partial T(\cdot)}{\partial K_D} \frac{\partial K_D}{\partial w} \right] = 0\,; \qquad (21)$$

$$R: \quad -\,2 + 2\,\lambda_F \;=\; 0\,; \qquad (22)$$

$$r: \quad \sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(\left[\frac{\partial V^j(X^j(\cdot))}{\partial X^j} - r \right] \frac{\partial X^j}{\partial r} - X^j(\cdot) \right) dF(\theta)$$
$$+\, \lambda_F \left[\sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(r\, \frac{\partial X^j}{\partial r} + X^j(\cdot) \right) dF(\theta) \right.$$
$$\left. -\, \sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial X^j} \frac{\partial X^j}{\partial r} \, dF(\theta) \right] = 0\,. \qquad (23)$$

$\frac{\partial V^j(X^j(r),\theta)}{\partial X^j} = r$ for $j \in \{D, N\}$ since $V^j(X, \theta)$ is the gross surplus consumer j derives from output X in state θ. Also, $\lambda_F = 1$ from (22) and $\frac{\partial Q^v}{\partial X^j} = 1$ because $Q^v(\cdot, \theta) = X(\cdot) - \theta\, K_D$. Therefore, (23) can be written as (9).

Since $\lambda_F = 1$ and $\frac{dQ^v}{\partial K_G} = 0$, (20) can be written as (7). Since $\lambda_F = 1$ and $\frac{\partial K_D}{\partial w}$ is not a function of θ, (21) can be written as:

$$\left[\int_{\underline{\theta}}^{\overline{\theta}} \left(w\,\theta + \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial K_D} \right) dF(\theta) + \frac{\partial T(\cdot)}{\partial K_D} \right] \frac{\partial K_D}{\partial w} \;=\; 0\,. \tag{24}$$

Because $\frac{\partial Q^v(\cdot,\theta)}{\partial K_D} = -\,\theta\,$, (24) can be written as (8).

Since $\lambda_F = 1$, (4) implies that (10) holds. ■

Proof of Corollary 1

The proof follows immediately from (8) and (9). ■

Proof of Corollary 2

(8) and (9) imply:

$$r \;>\; w \quad\Leftrightarrow\quad \frac{\sum\limits_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial X^j}{\partial r}\, dF(\theta)}{\sum\limits_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial X^j}{\partial r}\, dF(\theta)} \;>\; \frac{1}{\theta^E} \left[\int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial C^G(\cdot)}{\partial Q^v}\, \theta\, dF(\theta) - \frac{\partial T(\cdot)}{\partial K_D} \right]$$

$$\Leftrightarrow\quad \frac{\partial T(\cdot)}{\partial K_D} \;>\; \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial C^G(\cdot)}{\partial Q^v}\, \theta\, dF(\theta) \;-\; \frac{\theta^E \sum\limits_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial X^j}{\partial r}\, dF(\theta)}{\sum\limits_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial X^j}{\partial r}\, dF(\theta)}\,. \quad ■$$

Proof of Proposition 2

At an interior solution to [RP-r]:

$$K_G: \quad \lambda_r \left[\int_{\underline{\theta}}^{\overline{\theta}} \left(-\frac{\partial C^G(\cdot)}{\partial Q^v} \frac{dQ^v}{dK_G} - \frac{\partial C^G(\cdot)}{\partial K_G} \right) dF(\theta) - \; C^{K\,\prime}(K_G) - \frac{\partial T(\cdot)}{\partial K_G} \right] \;=\; 0\,; \tag{25}$$

$$\begin{aligned} w: \quad & \int_{\underline{\theta}}^{\overline{\theta}} \theta\, K_D\; dF(\theta) \;-\; \lambda_r \left[\int_{\underline{\theta}}^{\overline{\theta}} \theta\, K_D\; dF(\theta) \right. \\ & \qquad \left. + \int_{\underline{\theta}}^{\overline{\theta}} \left(w\,\theta + \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial K_D} \right) \frac{\partial K_D}{\partial w}\, dF(\theta) + \frac{\partial T(\cdot)}{\partial K_D} \frac{\partial K_D}{\partial w} \right] \;=\; 0\,; \end{aligned} \tag{26}$$

$$r: \quad \sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(\left[\frac{\partial V^j(X^j(\cdot))}{\partial X^j} - r \right] \frac{\partial X^j}{\partial r} - X^j(\cdot) \right) dF(\theta)$$

$$+\ \lambda_r \Bigg[\sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(r \, \frac{\partial X^j}{\partial r} + X^j(\cdot) \right) dF(\theta)$$

$$- \sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial C^G(\cdot)}{\partial Q^v} \, \frac{\partial Q^v}{\partial X^j} \, \frac{\partial X^j}{\partial r} \, dF(\theta) \Bigg] \;=\; 0\,. \tag{27}$$

Because $\frac{\partial Q^v}{\partial X^j} = 1$, (27) can be written as:

$$\lambda_r \left[\sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(r - \frac{\partial C^G(\cdot)}{\partial Q^v} \right) \frac{\partial X^j}{\partial r} \, dF(\theta) \right]$$

$$+\ [\,\lambda_r - 1\,] \left[\sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} X^j(\cdot)\, dF(\theta) \right] \;=\; 0\,. \tag{28}$$

If $\lambda_r \;=\; 0$, then $\sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} X^j(\cdot)\, dF(\theta) \;=\; 0$, from (28). But this contradicts the maintained assumption that $X^j(\cdot) \;>\; 0$ for all $\theta \in [\,\underline{\theta},\, \overline{\theta}\,]$. Therefore, $\lambda_r \;>\; 0$, and so (13) follows from (4).

Since $\lambda_r \;>\; 0$ and $\frac{dQ^v}{\partial K_G} \;=\; 0$, (25) can be written as (7). Since $\frac{\partial Q^v(\cdot)}{\partial K_D} \;=\; -\,\theta$ and $\frac{\partial K_D}{\partial w}$ is not a function of θ, (26) can be written as:

$$[\,1 - \lambda_r\,] \int_{\underline{\theta}}^{\overline{\theta}} \theta\, K_D \; dF(\theta) - \lambda_r \left[\int_{\underline{\theta}}^{\overline{\theta}} \left(w - \frac{\partial C^G(\cdot)}{\partial Q^v} \right) \theta \, dF(\theta) + \frac{\partial T(\cdot)}{\partial K_D} \right] \frac{\partial K_D}{\partial w} \;=\; 0\,,$$

which implies that (11) holds. ■

Proof of Proposition 3 From (28), when Assumption 2 holds:

$$[\,\lambda_r - 1\,] \sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} X^j(r,\theta)\, dF(\theta)$$

$$+\ \lambda_r \sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left[r - c(K_G) - \sum_{i\,=\,2}^{n} i\, b_i \,(\, Q^v\,)^{i-1} \right] \frac{\partial X^j(\cdot)}{\partial r} \, dF(\theta) \;=\; 0$$

$$\Rightarrow \;\; \lambda_r \sum_{j\,\in\,\{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{r - c(K_G) - \sum_{i\,=\,2}^{n} i\, b_i \,(\, Q^v\,)^{i-1}}{r} \right] \frac{\partial X^j(\cdot)}{\partial r} \, \frac{r}{X^j(\cdot)} \, X^j(\cdot)\, dF(\theta)$$

$$= \; [\,1 - \lambda_r\,] \sum_{j \,\in\, \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} X^j(r,\theta)\, dF(\theta)$$

$$\Leftrightarrow \;\; \lambda_r \sum_{j \,\in\, \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{r - c(K_G) - \sum\limits_{i\,=\,2}^{n} i\, b_i\,(\,Q^v\,)^{i-1}}{r} \right] \alpha_j\, X^j(\cdot)\, dF(\theta)$$

$$= \; [\,1 - \lambda_r\,] \sum_{j \,\in\, \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} X^j(r,\theta)\, dF(\theta)\,. \qquad (29)$$

Assumption 1 implies $X^j(r,\theta) > 0$ for all r and θ. Therefore, (29) implies $\lambda_r \to 1$ as $\alpha_j \to 0$ for $j = D,\, N$.

When $\alpha_j = 0$ for $j = D, N$, (27) implies:

$$[\,\lambda_r - 1\,] \left[\sum_{j \,\in\, \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} X^j(\cdot)\, dF(\theta) \right] \; = \; 0 \quad \Rightarrow \quad \lambda_r \; = \; 1\,.$$

Since $\lambda_r = 1$, (26) implies that w is as specified in (8). (8) and (13) imply:

$$r \; > \; w \quad \Leftrightarrow \quad \frac{\int_{\underline{\theta}}^{\overline{\theta}} C^G(Q^v(\cdot,\theta), K_G)\; dF(\theta) + C^K(K_G) + T(K_G, K_D)}{\int_{\underline{\theta}}^{\overline{\theta}} X(\cdot,\theta)\, dF(\theta)}$$

$$> \; w \left[1 - \frac{\theta^E\, K_D}{\int_{\underline{\theta}}^{\overline{\theta}} X(\cdot,\theta)\, dF(\theta)} \right]$$

$$\Leftrightarrow \quad \int_{\underline{\theta}}^{\overline{\theta}} C^G(Q^v(\cdot,\theta), K_G)\; dF(\theta) + C^K(K_G) + T(K_G, K_D) \; > \; w\, E\,\{\, Q^v(\cdot)\,\}$$

$$\Leftrightarrow \quad \int_{\underline{\theta}}^{\overline{\theta}} C^G(Q^v(\cdot,\theta), K_G)\; dF(\theta) + C^K(K_G) + T(K_G, K_D)$$

$$> \; \frac{1}{\theta^E} \left[\int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial C^G(\cdot)}{\partial Q^v}\, \theta\, dF(\theta) - \frac{\partial T(\cdot)}{\partial K_D} \right] E\,\{\, Q^v(\cdot)\,\} \qquad (30)$$

$$\Leftrightarrow \quad \int_{\underline{\theta}}^{\overline{\theta}} \left(c(K_G)\, Q^v(\cdot) + \sum_{i\,=\,2}^{n} b_i [\, Q^v(\cdot)\,]^i \right) dF(\theta) + C^K(K_G) + T(K_G, K_D)$$

$$> \frac{1}{\theta^E} \left[\int_{\underline{\theta}}^{\overline{\theta}} \left(c(K_G) + \sum_{i=2}^{n} i\, b_i \,[\, Q^v(\cdot)\,]^{i-1} \right) \theta\, dF(\theta) \right] E\,\{\, Q^v(\cdot)\,\}$$

$$- \frac{1}{\theta^E} \left[\frac{\partial T(\cdot)}{\partial K_D} \right] E\,\{\, Q^v(\cdot)\,\}$$

$$\Leftrightarrow \quad c(K_G) \int_{\underline{\theta}}^{\overline{\theta}} Q^v(\cdot)\, dF(\theta) + \int_{\underline{\theta}}^{\overline{\theta}} \sum_{i=2}^{n} b_i \,[\, Q^v(\cdot)\,]^i\, dF(\theta) + C^K(K_G) + T(K_G, K_D)$$

$$> c(K_G)\, E\,\{\, Q^v(\cdot)\,\} + \frac{1}{\theta^E} \left[\int_{\underline{\theta}}^{\overline{\theta}} \sum_{j=2}^{n} i\, b_i \,[\, Q^v(\cdot)\,]^{i-1}\ \theta\, dF(\theta) \right] E\,\{\, Q^v(\cdot)\,\}$$

$$- \frac{1}{\theta^E} \left[\frac{\partial T(\cdot)}{\partial K_D} \right] E\,\{\, Q^v(\cdot)\,\}$$

$$\Leftrightarrow \quad C^K(K_G) + T(K_G, K_D) + \frac{1}{\theta^E} \left[\frac{\partial T(\cdot)}{\partial K_D} \right] E\,\{\, Q^v(\cdot)\,\}$$

$$> \frac{1}{\theta^E} \left[\int_{\underline{\theta}}^{\overline{\theta}} \sum_{i=2}^{n} i\, b_i \,[\, Q^v(\cdot)\,]^{i-1}\ \theta\, dF(\theta) \right] E\,\{\, Q^v(\cdot)\,\} - \int_{\underline{\theta}}^{\overline{\theta}} \sum_{i=2}^{n} b_i \,[\, Q^v(\cdot)\,]^i\, dF(\theta)\,. \tag{31}$$

As $b_i \to 0$ for all $i = 2, .., n$, inequality (31) holds if:

$$C^K(K_G) + T(K_G, K_D) + \frac{1}{\theta^E} \left[\frac{\partial T(\cdot)}{\partial K_D} \right] E\,\{\, Q^v(\cdot)\,\} \ > \ 0\,. \tag{32}$$

Each of the terms in (32) is positive, so the inequality holds.

It is apparent that the inequality in (31) also holds if $C^K(K_G) + T(K_G, K_D)$ is sufficiently large. ■

Proof of Proposition 4

Let $\lambda \geq 0$ denote the Lagrange multiplier associated with constraint (6). Then at an interior solution to [RP]:

$$w: \quad \int_{\underline{\theta}}^{\overline{\theta}} \theta\, K_D\ dF(\theta) - \int_{\underline{\theta}}^{\overline{\theta}} \left(\frac{\partial L(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial K_D} \frac{\partial K_D}{\partial w} + \frac{\partial L(\cdot)}{\partial Q^D} \frac{\partial Q^D}{\partial K_D} \frac{\partial K_D}{\partial w} \right) dF(\theta)$$

$$- \lambda \left[\int_{\underline{\theta}}^{\overline{\theta}} \theta\, K_D\ dF(\theta) \right.$$

$$\left. + \int_{\underline{\theta}}^{\overline{\theta}} \left(w\,\theta + \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial K_D} \right) \frac{\partial K_D}{\partial w}\, dF(\theta) + \frac{\partial T(\cdot)}{\partial K_D} \frac{\partial K_D}{\partial w} \right] \ = \ 0\,; \tag{33}$$

$$r: \quad \sum_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(\left[\frac{\partial V^j(X^j(\cdot))}{\partial X^j} - r \right] \frac{\partial X^j}{\partial r} - X^j(\cdot) \right) dF(\theta)$$

$$- \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial L(\cdot)}{\partial Q^v} \sum_{j \in \{D,N\}} \frac{\partial Q^v}{\partial X^j} \frac{\partial X^j}{\partial r} \, dF(\theta)$$

$$+ \lambda \left[\sum_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(r \frac{\partial X^j}{\partial r} + X^j(\cdot) \right) dF(\theta) \right.$$

$$\left. - \sum_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial X^j} \frac{\partial X^j}{\partial r} \, dF(\theta) \right] = 0 \, . \qquad (34)$$

Conditions (20) and (22) also hold at the solution to [RP].

Because $\lambda = 1$ from (22) and $\frac{\partial Q^v}{\partial X^j} = 1$, (34) can be written as (15). Since $\lambda = 1$ and $\frac{dQ^v}{\partial K_G} = 0$, (10) holds and (20) can be written as (7). Because $\lambda = 1$ and $\frac{\partial K_D}{\partial w}$ is not a function of θ, (33) can be written as:

$$\left[\int_{\underline{\theta}}^{\overline{\theta}} \left(w\,\theta + \frac{\partial C^G(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial K_D} + \frac{\partial L(\cdot)}{\partial Q^v} \frac{\partial Q^v}{\partial K_D} + \frac{\partial L(\cdot)}{\partial Q^D} \frac{\partial Q^D}{\partial K_D} \right) dF(\theta) \right.$$

$$\left. + \frac{\partial T(\cdot)}{\partial K_D} \right] \frac{\partial K_D}{\partial w} = 0 \, . \qquad (35)$$

Because $\frac{\partial Q^v(\cdot,\theta)}{\partial K_D} = -\,\theta$ and $\frac{\partial Q^D(\cdot,\theta)}{\partial K_D} = \theta$, (35) can be written as (14). ■

Proof of Corollary 3

From (15):

$$r = \frac{\sum_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(\frac{\partial C^G(\cdot)}{\partial Q^v} + \frac{\partial L(\cdot)}{\partial Q^v} \right) \frac{\partial X^j}{\partial r} \, dF(\theta)}{\sum_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial X^j}{\partial r} \, dF(\theta)} \, . \qquad (36)$$

(14) and (15) imply:

$$r > w \quad \Leftrightarrow \quad \frac{\sum_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(\frac{\partial C^G(\cdot)}{\partial Q^v} + \frac{\partial L(\cdot)}{\partial Q^v} \right) \frac{\partial X^j}{\partial r} \, dF(\theta)}{\sum_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial X^j}{\partial r} \, dF(\theta)}$$

$$> \frac{1}{\theta^E} \left[\int_{\underline{\theta}}^{\overline{\theta}} \left(\frac{\partial C^G(\cdot)}{\partial Q^v} + \frac{\partial L(\cdot)}{\partial Q^v} - \frac{\partial L(\cdot)}{\partial Q^D} \right) \theta \, dF(\theta) - \frac{\partial T(\cdot)}{\partial K_D} \right]$$

$$\Leftrightarrow \quad \frac{\partial T(\cdot)}{\partial K_D} > \int_{\underline{\theta}}^{\overline{\theta}} \left(\frac{\partial C^G(\cdot)}{\partial Q^v} + \frac{\partial L(\cdot)}{\partial Q^v} - \frac{\partial L(\cdot)}{\partial Q^D} \right) \theta \, dF(\theta)$$

$$- \frac{\theta^E \sum\limits_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \left(\frac{\partial C^G(\cdot)}{\partial Q^v} + \frac{\partial L(\cdot)}{\partial Q^v} \right) \frac{\partial X^j}{\partial r} \, dF(\theta)}{\sum\limits_{j \in \{D,N\}} \int_{\underline{\theta}}^{\overline{\theta}} \frac{\partial X^j}{\partial r} \, dF(\theta)} . \quad \blacksquare$$

Proof of Corollary 4

The proof follows immediately from (14) and (15). ■

Appendix B. Numerical Solutions – Small Market Setting

This Appendix presents a sensitivity analysis for the "smaller market setting." The figures that follow demonstrate how outcomes change as key model parameters change.[1] The values of parameters other than the one being changed remain fixed at their levels in the smaller market setting.

The Effects of Changes in the VIP's Variable Production Cost (b_v)

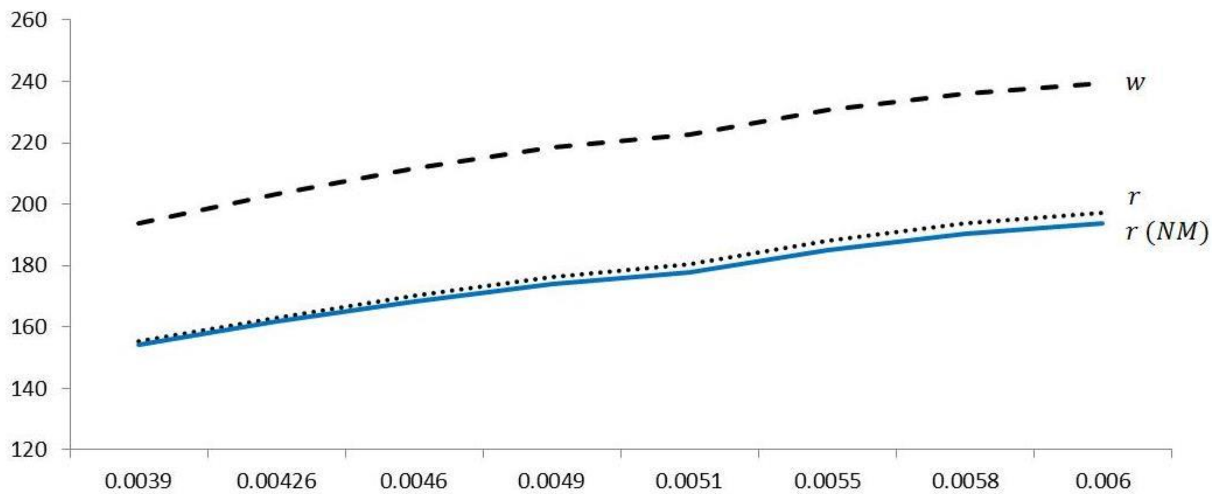

Figure B1. Impact of Changes in b_v on Retail Electricity Prices and DG Compensation

[1] Throughout the ensuing analysis, "(NM)" denotes the relevant variable under a net metering mandate (which requires $w = r$). Variables without the "(NM)" designation denote variables under the optimal policy when no net metering mandate is imposed.

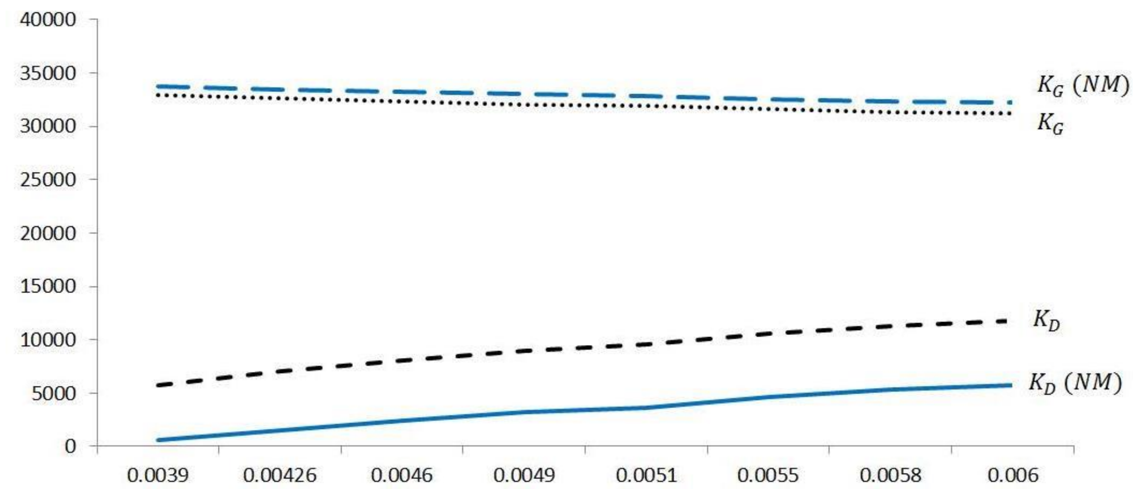

Figure B2. Impact of Changes in b_v on Capacity Investments

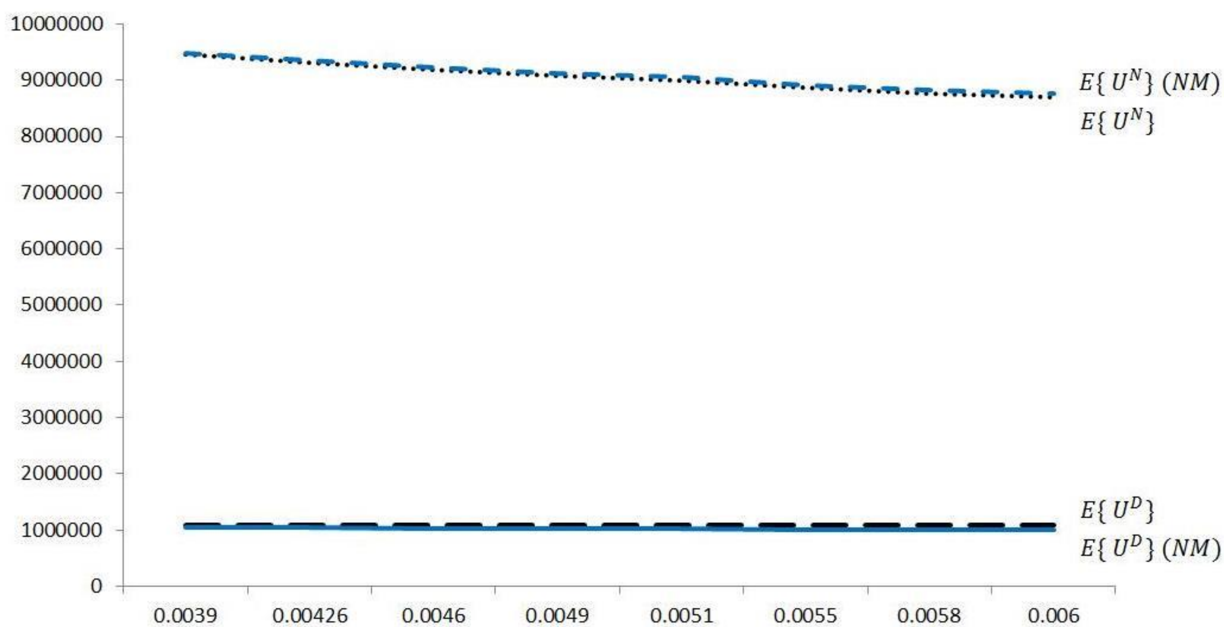

Figure B3. Impact of Changes in b_v on Consumer Welfare

As the VIP's variable cost (b_v) increases, the value of a unit of solar DG capacity increases. The regulator increases w to induce increased investment in DG capacity. r also increases in light of the increased marginal cost of generating electricity. The increase in r reduces the welfare of consumer N. The increase in w induces increased investment in DG capacity (K_D). Investment in centralized capacity (K_G) declines as b_v increases because the VIP produces less output as its variable cost increases. The net metering mandate reduces the unit price of electricity (and the unit DG compensation) below both r and w.

The Effects of Changes in the Cost of Centralized Capacity (b_K)

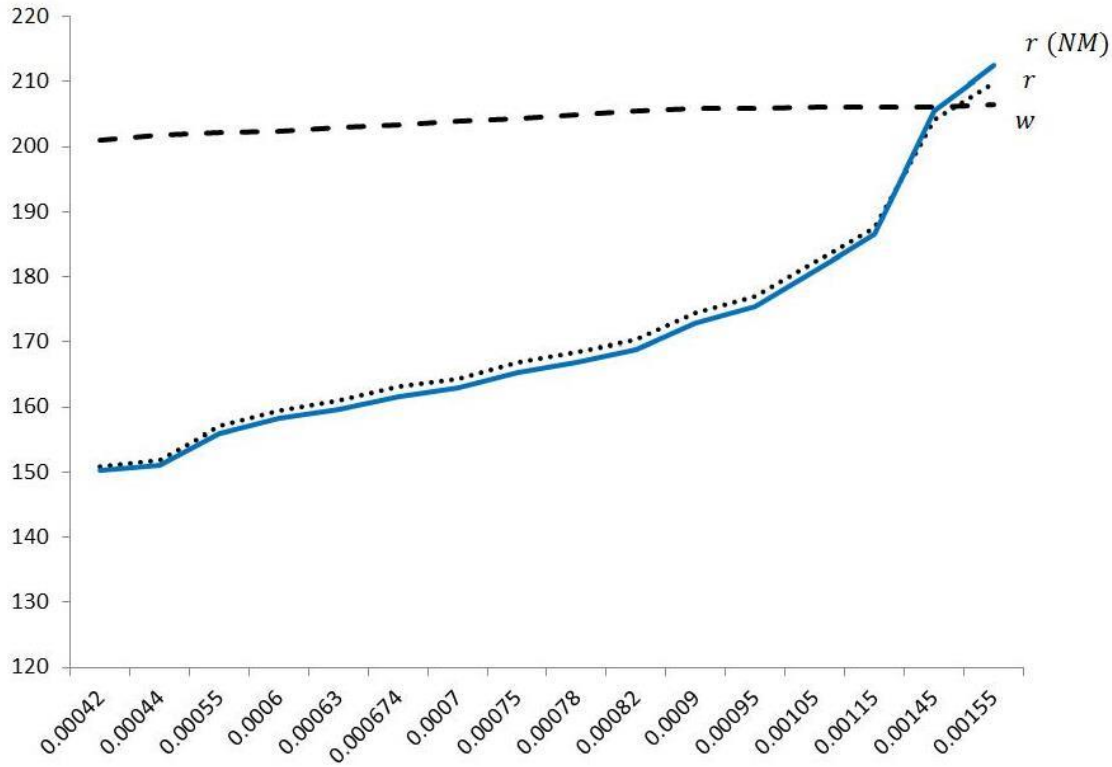

Figure B4. Impact of Changes in b_K on Retail Electricity Prices and DG Compensation

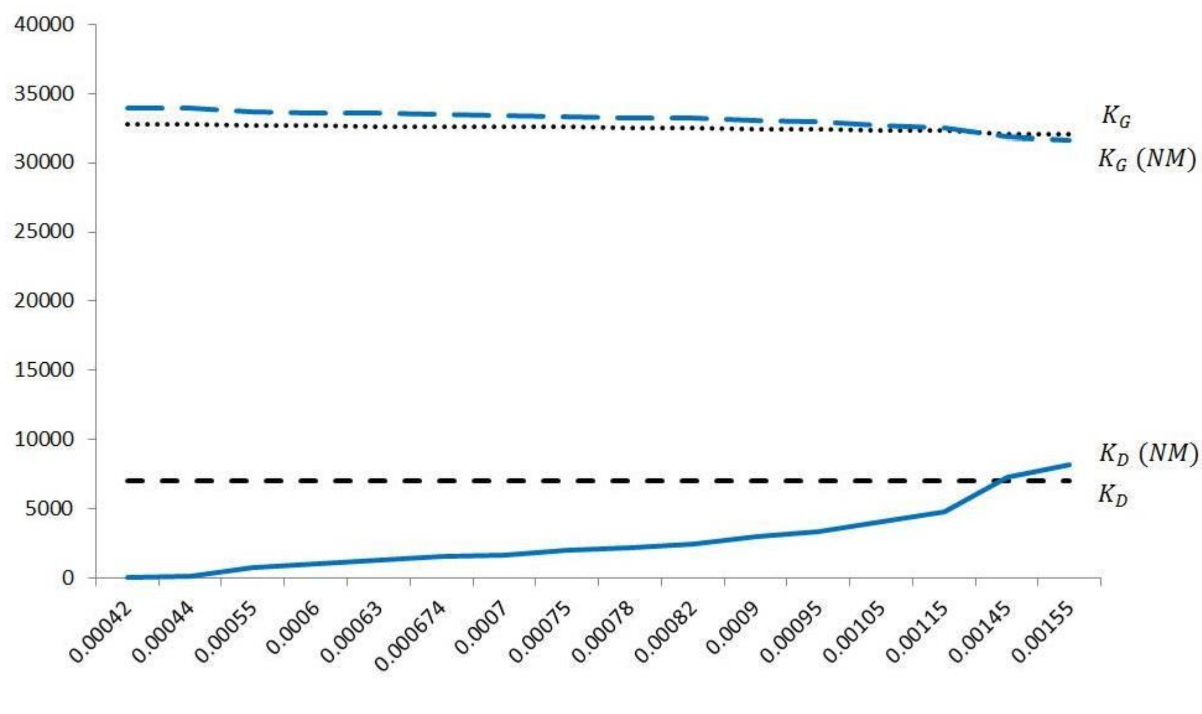

Figure B5. Impact of Changes in b_K on Capacity Investments

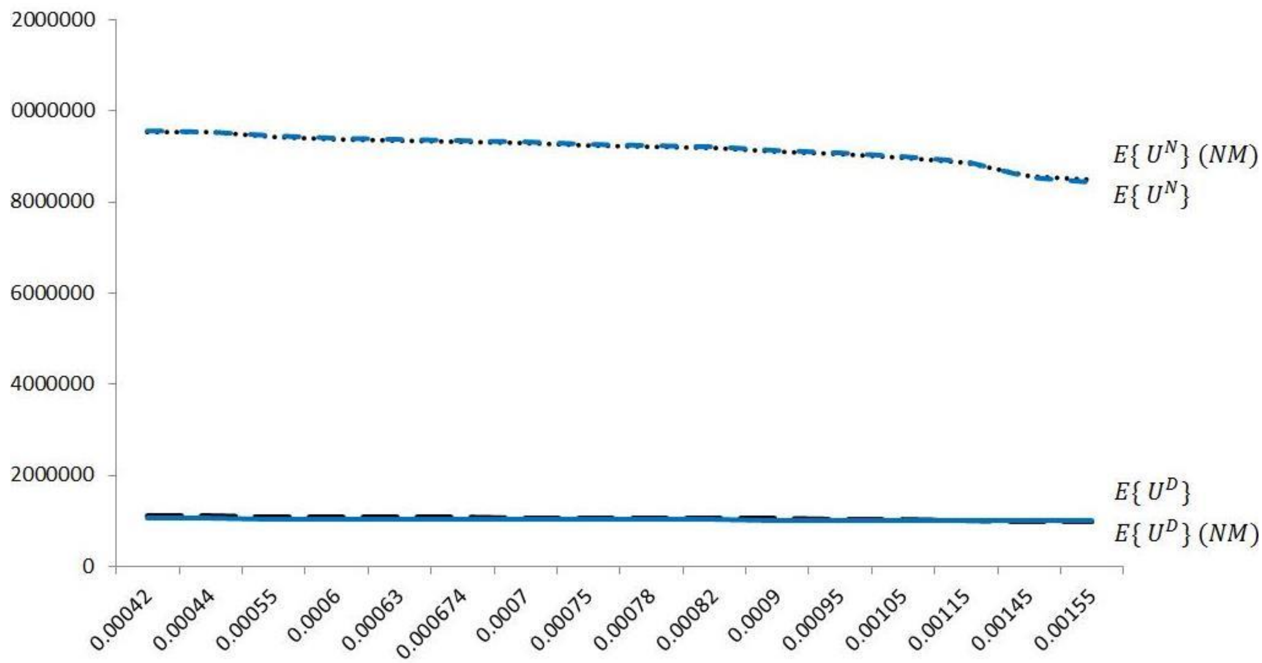

Figure B6. Impact of Changes in b_K on Consumer Welfare

As the cost of centralized capacity (b_K) increases, r is increased to ensure the VIP's solvency despite its increased operating costs. The increase in r reduces the welfare of consumer N. w is increased as centralized capacity becomes more expense to induce additional investment in DG capacity.

The Effects of Changes in the Cost of DG Capacity (b_D)

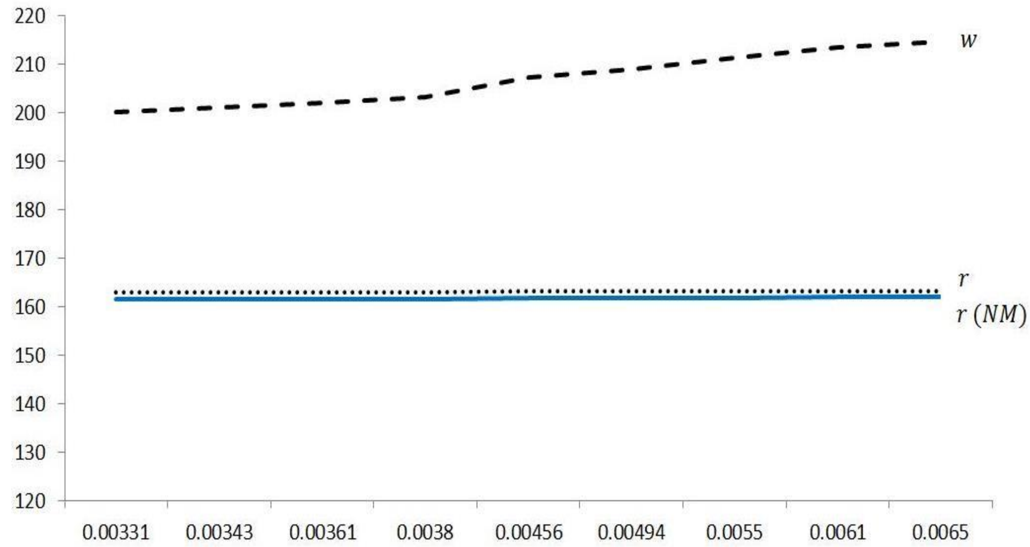

Figure B7. Impact of Changes in b_D on Retail Electricity Prices and DG Compensation

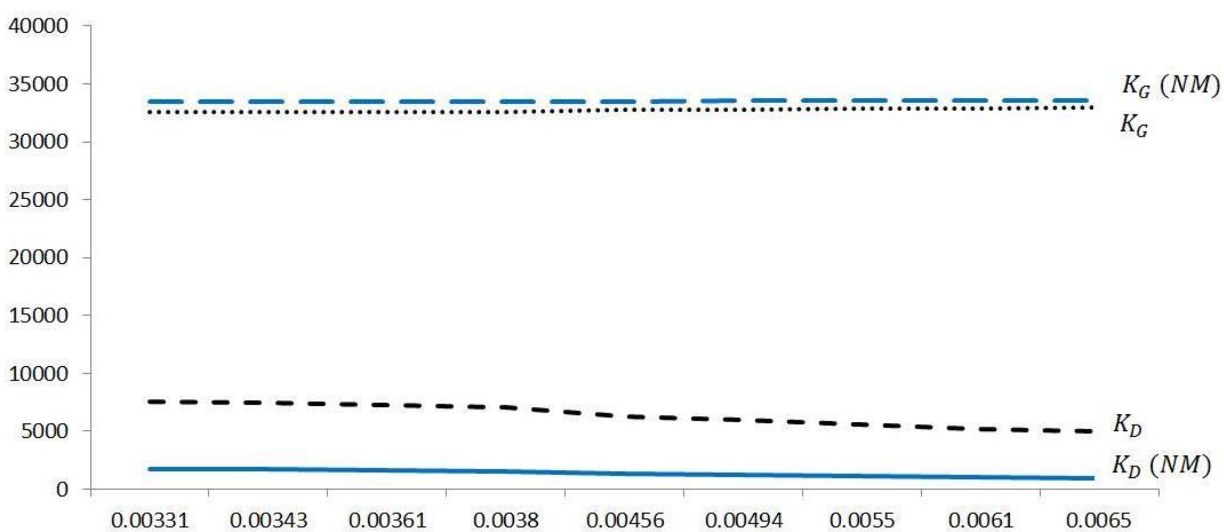

Figure B8. Impact of Changes in b_D on Capacity Investments

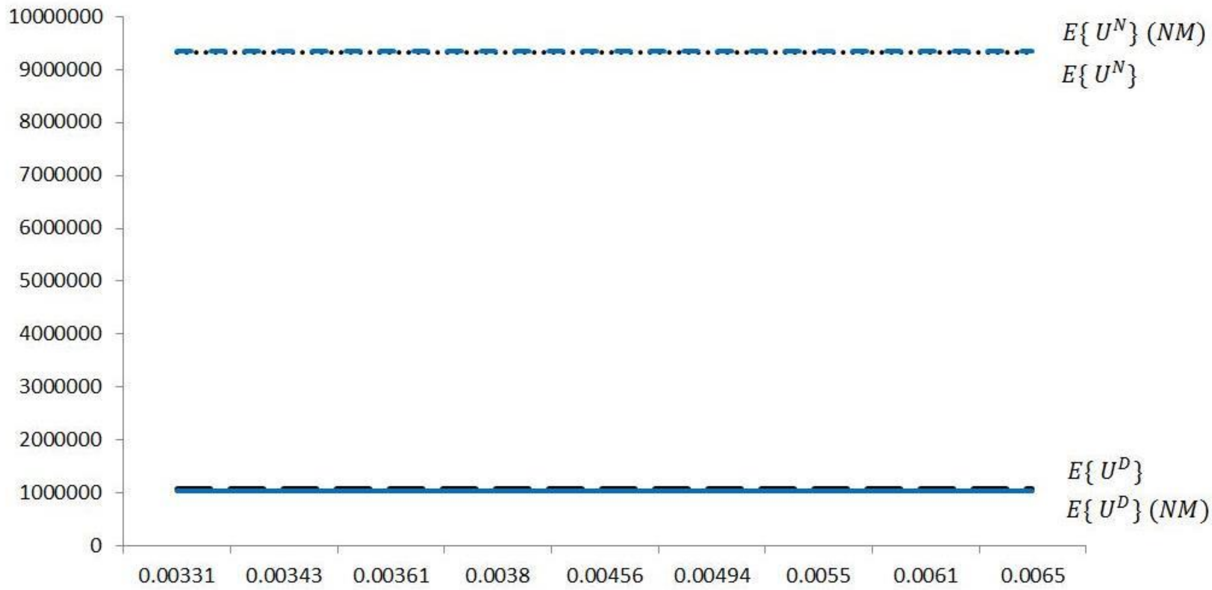

Figure B9. Impact of Changes in b_D on Consumer Welfare

As the cost of DG capacity (b_D) increases, the amount of DG capacity investment (K_D) decreases and the amount of centralized capacity (K_G) increases. The reduction in K_D arises despite an increase in w which is implemented to avoid an excessive reduction in DG capacity investment as its cost increases.

The Effects of Changes in TDM Costs (a_T^D)

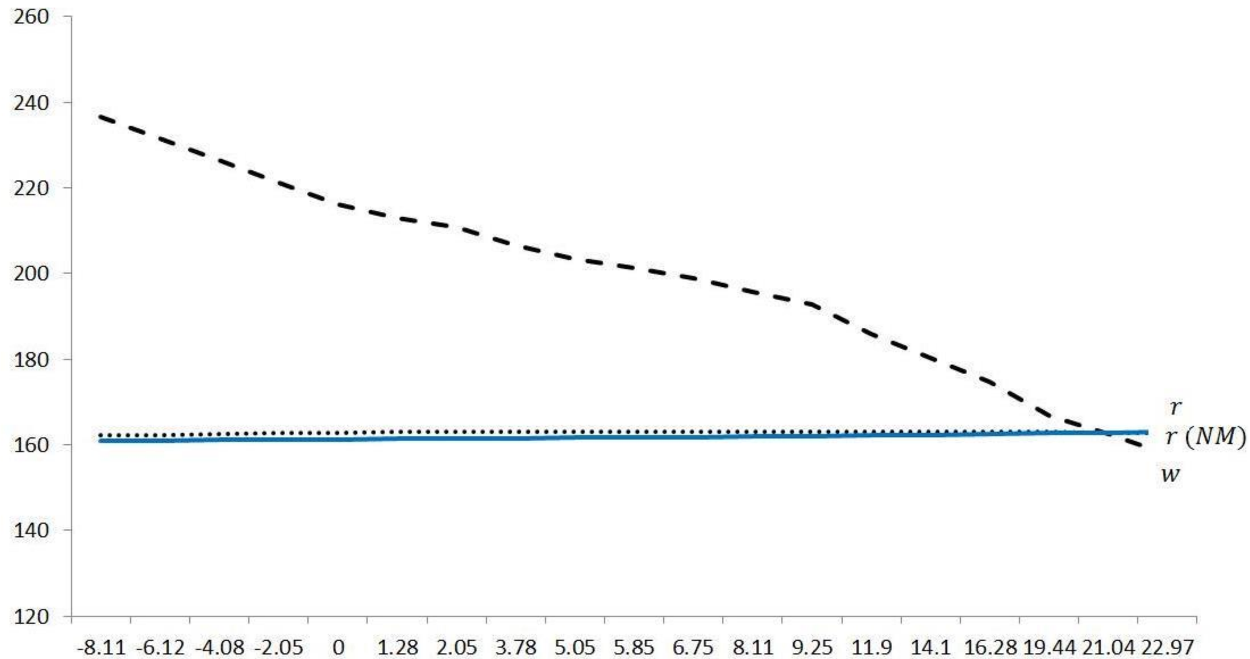

Figure B10. Impact of Changes in a_T^D on Retail Electricity Prices and DG Compensation

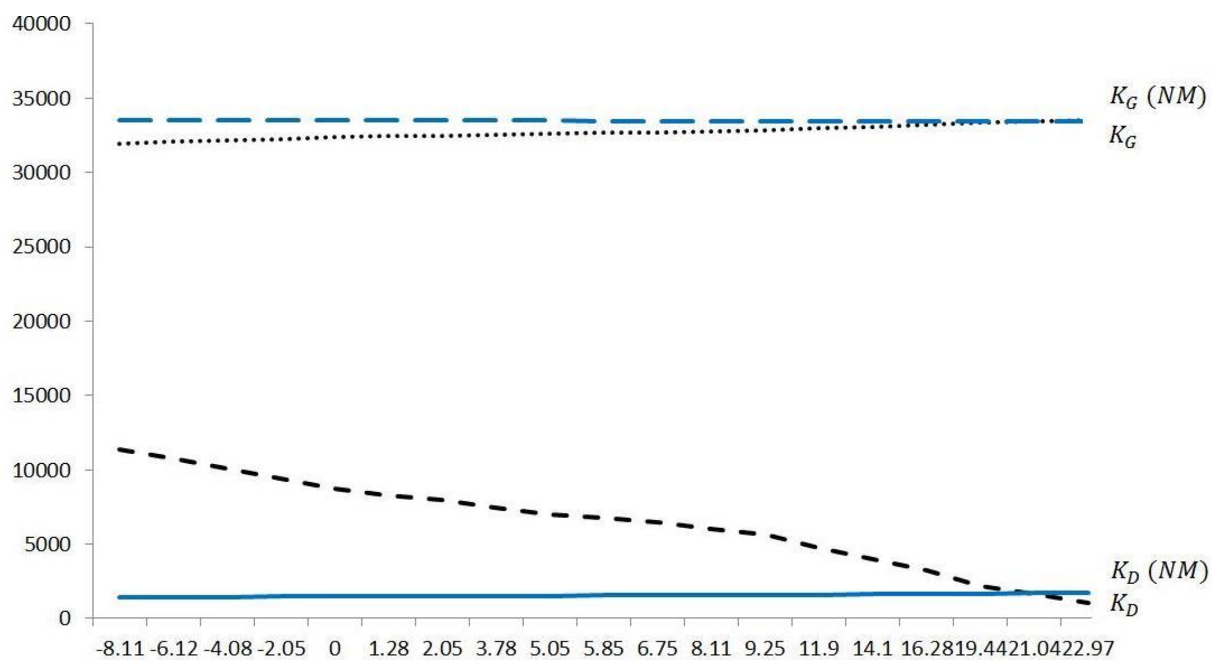

Figure B11. Impact of Changes in a_T^D on Capacity Investments

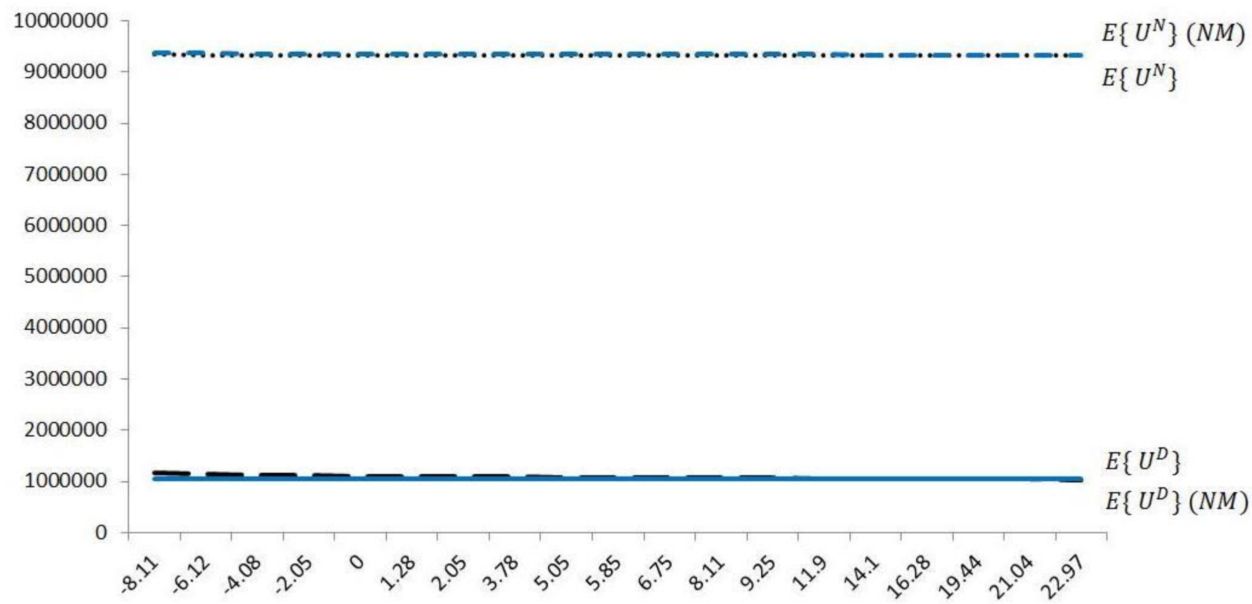

Figure B12. Impact of Changes in a_T^D on Consumer Welfare

As TDM costs (a_T^D) increase, w is reduced to induce less investment in DG capacity. Centralized capacity is increased as DG capacity declines. The impact of a change in a_T^D on capacity investment becomes less pronounced when net metering is mandated.

The Effects of Changes in Marginal Losses from Environmental Externalities (e_v)

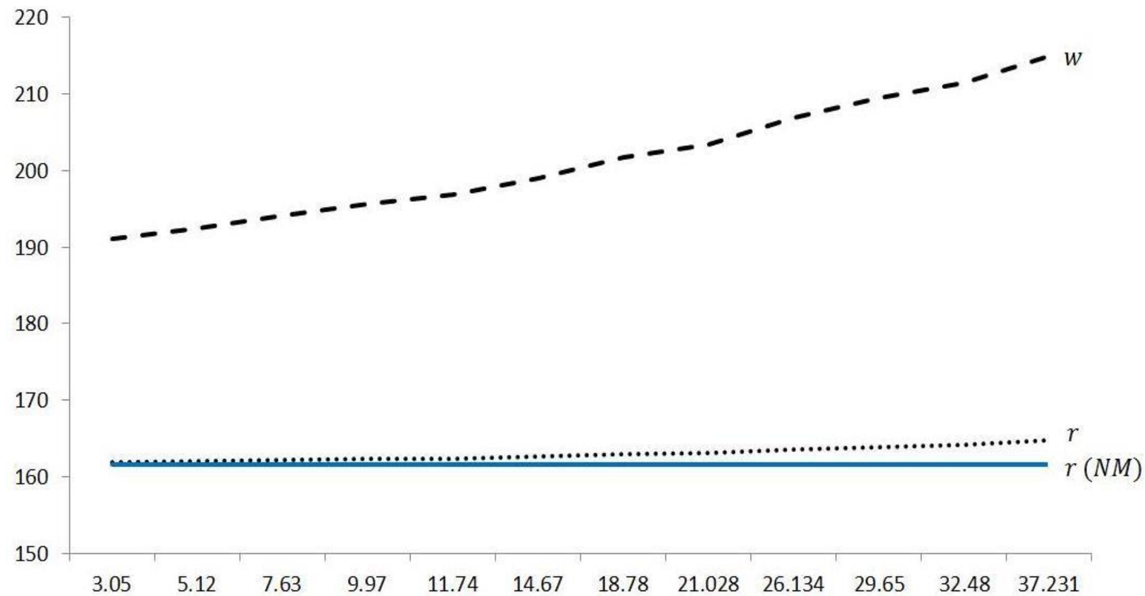

Figure B13. Impact of Changes in e_v on Retail Electricity Prices and DG Compensation

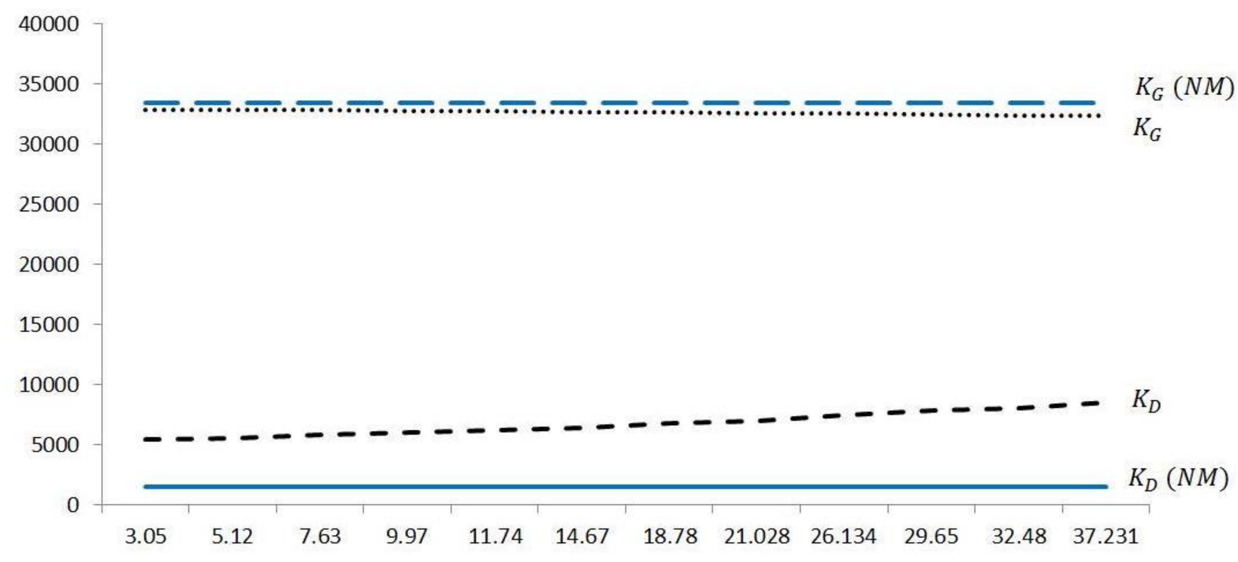

Figure B14. Impact of Changes in e_v on Capacity Investments

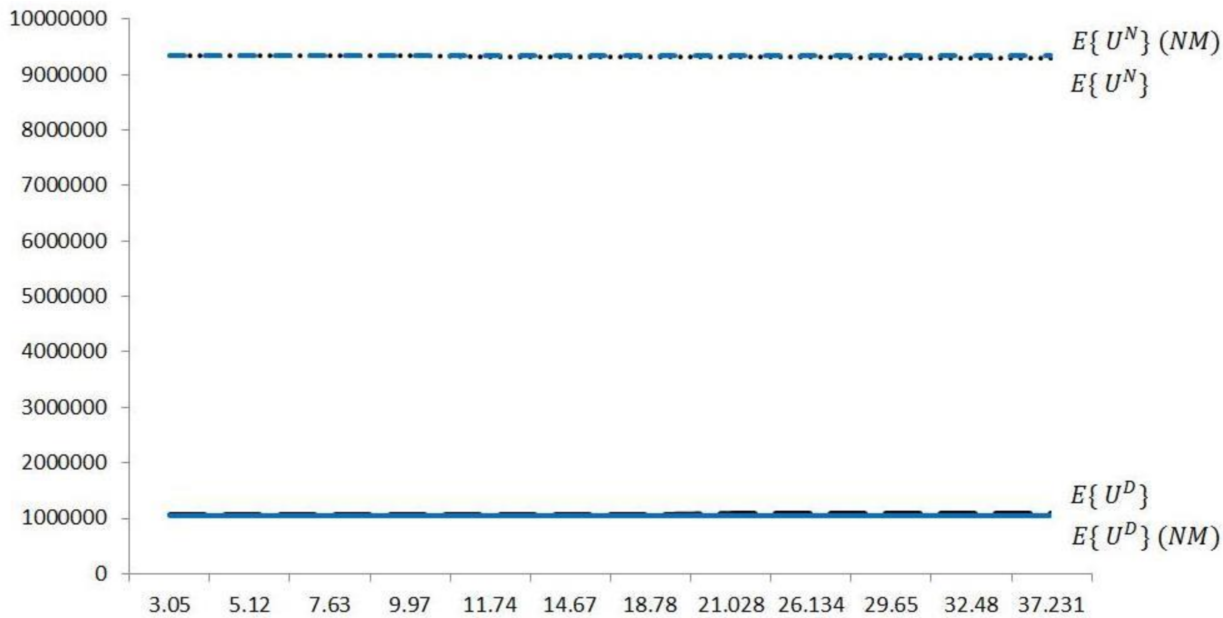

Figure B15. Impact of Changes in e_v on Consumer Welfare

As the marginal social loss due to environmental externalities from centralized production (e_v) increase, r is increased to reduce electricity consumption and w is increased to induce increased DG production. In addition, investment in DG capacity increases and investment in centralized capacity declines as e_v increases.