# Bonuses versus Commissions: A Field Study

Sunil Kishore
Raghunath Singh Rao
Om Narasimhan
George John

## WEB APPENDIX

This appendix consists of two parts. The first part (Part A) contains the details of the theoretical model presented in the paper. The second part (Part B) contains data details, a discussion of identification issues, and a series of robustness checks performed by us. To keep this Web Appendix self-contained, we have reproduced some of the material from the paper.

### WEB APPENDIX A: DETAILS OF THEORETICAL MODEL

*INCENTIVE PAY AND PRODUCTIVITY*

*Summary of notation*

---

$e_i$ : Effort exerted by salesperson i.
$y_i$: Output of salesperson i
$\psi_i$: Innate "ability" of salesperson i
M~ [$\psi_{min}$, $\psi_{max}$]: Distribution of the abilities of salespeople (assumed to be uniform)
Θ: Cost (of effort) parameter
W: Fixed salary of the wage component
B: Lump sum bonus
$Q_B$: Bonus Quota
α: Commission rate
$Q_c$: Commission quota

---

*Preliminaries*

For salesperson i exerting effort $e_i$ , sales are given by: $y_i=\psi_i e_i$, where $\psi_i>0$ and $e_i\geq 0$. $\psi_i$ represents the innate "ability" of salesperson I; a salesperson with higher ability realizes higher output than a salesperson with lower ability, for the same level of effort.

The utility of a salesperson with ability $\psi_i$ when she earns a wage F and puts in effort e is given by: $u(\psi_i;e_i)=F-(\Theta e_i^2)/2$, where , $\Theta>0$, represents the cost (of effort) parameter assumed to be common across salespersons. A quota-based bonus scheme is given as:

$$F_B = \begin{cases} W & if\ 0 \le y_i < Q_B \\ W + B & if\ \ y_i \ge Q_B \end{cases},$$

Because of the heterogeneity in abilities, salespersons would require different levels of efforts to reach the bonus quota threshold given by: $e_{iB}=Q_B/\psi_i$.

This threshold level of ability, denoted by $\psi_B$, can be derived as:

$W + B - \frac{\theta(Q_B / \psi_B)^2}{2} = W$ . This yields: $\psi_B{}^2 = \frac{\theta Q_B{}^2}{2B}$.

Similarly, a quota-based commission scheme with commission rate $0<\alpha<1$ is given by:

$$F_C = \begin{cases} W & if\ 0 \le y_i < Q_C \\ W + \alpha(y_i - Q_C) & if\ \ y_i \ge Q_C \end{cases}.$$

As before, we can derive the threshold ability of the salesperson who is indifferent between earning a fixed wage and a positive level of commission as: $\psi_c= (\Theta e_c^2+2\alpha Q_c)/(2\alpha e_c)$.

A salesperson who (optimally) exerts more than minimum effort solves:

$\underset{e_i}{\arg\max}\ \alpha(y_i - Q_C) - (\frac{\theta e_i^2}{2})$, which yields the optimal effort level: $e_i^* = \frac{\alpha\psi_i}{\theta}$ .

This yields: $\psi_c^2 = (2\Theta Q_c)/\alpha$.

We define a bonus scheme as “equivalent” to a commission scheme if, for an output $Q_B$, both schemes result in the same pay. Hence, the condition for the equivalency of two schemes is given by: $W+B=W+ \alpha (Q_B-Q_c)$.

**Result 1**: *Under equivalent bonus and commission schemes, the salesperson who is indifferent between earning a positive level of commission and a fixed salary is of lower ability compared to the salesperson who is indifferent between earning a bonus and a fixed salary. In other words, $\psi_c< \psi_B$.*

**Proof:** From the expressions in the preceding paragraph, to prove the result we need to show:

$\Theta Q_B^2/2B> (2\Theta Q_c)/\alpha$. (T.1)

Note that since the schemes are equivalent, we have: $B=\alpha (Q_B-Q_c)$.

Inserting this into T.1 leads to:

$Q_B^2>4Q_BQ_C-4Q_C^2$, => $(QB- 2Q_C)^2>0$. This is obviously true. Q.E.D.

*Summary of notation*

$y_t$: Sales in period t
$v_t$: Value added to firm in time t
$T_{dt}$: Time spent on doctor visits in period t
$T_{pt}$: Time spent on pharmacy visits in period t
$h_d$: Marginal product of doctor visits on observed output
$h_p$: Marginal product of pharmacy visits on observed output
$f_d$ : Marginal product of doctor visits on firm value
$f_p$: Marginal product of pharmacy visits on firm value
T: Total time spent on doctor and pharmacy visits in any period
$\lambda$: Variable denoting extent of gaming

*Preliminaries*

In any given period t (month), the output (without any gaming) is given by: $y_t = h_d T_{dt} + h_p T_{pt} + \phi$. The time spent is a proxy for effort substitution across these activities and $\phi$ represents mean zero random noise[1].

The value added to the firm because of the time spent on these activities is given by: $v_t = f_d T_{dt} + f_p T_{pt} + \varepsilon$. We assume, $f_d > f_p$ and $h_p > h_d$ creates the classic multi-tasking problem, wherein the activities that enhance the firm's welfare are valued less by the salesperson because of their smaller impact on observable output. The salesperson cannot be compensated based on $v_t$ because it is virtually impossible to quantify an individual agent's contribution to the value of the firm. As is standard in models of multi-tasking, (e.g., Holmstrom and Milgrom 1991)) we assume that the firm makes some sunk investments to ensure a minimum level of effort provision in the activity that has lower return on the observable output. The total time spent on the two activities, T, is fixed in a given period t (salespeople are assumed to work a certain fixed number of hours in a month), and $T = T_{dt} + T_{pt}$ with the minimum number of doctor visits in any period fixed at $T_{d\min}$. (Note that this assumption means that effort levels don't really vary with the 'type' of the salesperson. This is obviously different

[1] Furthermore, assume that $\Phi$ is distributed symmetrically around mean zero with cumulative density function G with lower and upper support of $-\Phi_m<0$ and $+\Phi_m>0$ respectively, $+\Phi_m$ is sufficiently small that a positive shock by itself will not lead to quota realization, and $-\Phi_m$ is sufficiently small that a negative shock will not lead to negative sales in any period. G is assumed to be concave, strictly increasing with positive density and twice differentiable.

from the assumption made in the earlier model. We do this to keep the focus on one aspect in each of the models, viz., effort choice in the first model and multi-tasking concerns (given effort) in the second model.)

In the bonus plan, in quarter 1, the salesperson is compensated W+B if $y_1 + y_2 \geq Q_B$, otherwise she gets W[2]. Similarly, in quarter 2, if $y_3 + y_4 \geq Q_B$, she makes W+B, else W (note that this is akin to $e_B$ in the last section). In the commissions plan, the salesperson makes W+ $\alpha(y_1 + y_2 - Q_C)$ if $y_1 + y_2 \geq Q_C$ with 0< $\alpha$ <1, otherwise she gets W. The same scheme applies in quarter 2. Notice that, as before, the equivalence of schemes requires $\alpha(Q_B - Q_C) = B$ and trivially, $Q_B > Q_C$.

In period 2 of quarter 1, the salesperson could potentially game the system by either pulling in sales from period 3 or pushing out sales to period 3. Both these activities are costly (to the firm). We model this gaming through a variable $0 < \lambda < 2$, where $\lambda$ =1 implies a "natural" level of sales while $\lambda > 1$ indicates pull-in and $\lambda < 1$ indicates push-out. Finally, we assume that when a salesperson is indifferent between carrying out either doctor or pharmacy visits, she focuses upon doctor visits[3].

For the purpose of the exposition of the model henceforth, let us redefine the total doctor visits in terms of pharmacy visits:

$$\begin{aligned} &T_{dt} = T - T_{pt}, \\ &T_{dt} \geq T_{d\min} > 0 \end{aligned} \tag{T.2}$$

The observed output and the contribution to firm value by the salesperson in each of the four periods can be written as:

<u>Period 1:</u>

$$\begin{aligned} &y_1 = h_d T_{d1} + h_p T_{p1} + \phi \\ &v_1 = f_d T_{d1} + f_p T_{p1} + \varepsilon \end{aligned} \tag{T.3}$$

Rewriting the above using (T.2) and defining:

[2] $W$ can be thought of as the sum of the fixed salaries across two periods (months).

[3] One way to think about this assumption is that the salesperson is given a fiat to focus upon doctor visits and she will obey this fiat and substitute away from pharmacy visits if she has nothing to lose from this substitution.

$\Delta h \equiv (h_p - h_d)$
$\Delta f \equiv (f_p - f_d)$

Since $f_d > f_p$ *and* $h_p > h_d$,

$\Delta h$ >0 and $\Delta f < 0$. Then, (T.3) can be rewritten as:

$$y_1 = h_d T + (\Delta h) T_{p1} + \phi$$

$$v_1 = f_d T + (\Delta f) T_{p1} + \varepsilon \tag{T.4}$$

Hence, as the numbers of pharmacy visits go up, the observable output goes up but the firm value goes down.

We can similarly write the output and firm value at the end of each period, taking into account the possibility of gaming in period 2 and its carryover effect in period 3.

<u>Period 2:</u>

$$y_2 = \lambda(h_d T + (\Delta h) T_{p2} + \phi)$$

$$v_2 = f_d T + (\Delta f) T_{p2} - (1/2)k(\lambda - 1)^2 + \varepsilon \tag{T.5}$$

where *k*>0, so the cost incurred by the firm due to the gaming is convex and both push in and push out are equally costly[4].

<u>Period 3:</u>

$$y_3 = (2 - \lambda)(h_d T + (\Delta h) T_{p3} + \phi)$$

$$v_3 = f_d T + (\Delta f) T_{p3} + \varepsilon \tag{T.6}$$

Notice that if pull-in occurs in period 2 ( $\lambda > 1$) then sales drop in period 3; with a push-out ( $\lambda < 1$), sales go up.

<u>Period 4:</u>

$$y_4 = h_d T + (\Delta h) T_{p4} + \phi$$

$$v_4 = f_d T + (\Delta f) T_{p4} + \varepsilon \tag{T.7}$$

---

[4] The timing distortion is also costly to the salesperson (if detected by the firm) and carries a fixed penalty. The penalty is assumed to be (sufficiently) lower than the bonus and the probability of detection increases with the level of “gaming” (see Technical Appendix for details).

*Constructing the salesperson's optimization problem*

We start backwards with the quarter 2. Consider a salesperson under the bonus scheme who is at the end of period 3 in quarter 2 and has realized a sale of $y_3$ (but still not reached the quota). Note that period 3 is the first period in quarter 2. Now, this salesperson's sales will reach or exceed the quota, if $h_d T + (\Delta h)T_{p4} + \phi \geq Q_B - y_3$. This implies:

$\phi \geq Q_B - y_3 - h_d T - (\Delta h)T_{p4}$, and given the distribution of $\phi$, we can state the probability of salesperson reaching or exceeding quota as: $1 - G(Q_B - y_3 - h_d T - (\Delta h)T_{p4})$,

and the probability that she finishes below quota as $G(Q_B - y_3 - h_d T - (\Delta h)T_{p4})$. So the expected compensation to the salesperson in quarter 2 is given as:

$G(Q_B - y_3 - h_d T - (\Delta h)T_{p4}) * W + (1 - G(Q_B - y_3 - h_d T - (\Delta h)T_{p4})) * (W + B)$.

This can be compactly written as:

$$E(F_2) = W + (1 - G(S_{Q_{2B}} - h_d T - (\Delta h)T_{p4})) * (B) \qquad \text{(T.8)}$$

where $S_{Q_{2B}} \equiv Q_B - y_3$ denotes the distance from quota in quarter 2 after the end of period 3.

Coming to quarter 1, suppose our salesperson is at the end of period 1 and has realized an output of $y_1$ (and has still not reached the first quarter quota) and will exceed the quota at the end of the quarter 1 if:

$\lambda(h_d T + (\Delta h)T_{p2} + \phi) \geq Q_B - y_1$. Defining, $S_{Q_{1B}} \equiv Q_B - y_1$, the expected compensation to the salesperson in quarter 1 is given as:

$$E(F_1) = W + (1 - G(\frac{S_{Q_{1B}}}{\lambda} - h_d T - (\Delta h)T_{p4})) * (B) \qquad \text{(T.9)}$$

Note that gaming sales could also potentially hurt if such gaming gets detected by the firm. We model this expected cost as $\mu(\lambda - 1)^2$ D, where 0< $\mu$ <1 is the probability of gaming being detected by the firm, which is increasing in the extent of distortion of sales ( $\lambda$ ), and D>0 is the level of penalty imposed if gaming is discovered. We assume that D is sufficiently small (that is, the agent has limited liability) so as to not completely eliminate gaming. Armed with this, the optimization problem facing a salesperson who has realized sales of $y_1$ translates into a state variable $S_{Q_{1B}}$ as (we can ignore *W* since it is not affected by output):

$$\arg\max_{\lambda,T_{p2}} (1-G(\frac{S_{Q_{1B}}}{\lambda}-h_dT-(\Delta h)T_{p2}))*B+\beta E((1-G(S_{Q_{2B}}-h_dT-(\Delta h)T_{p4}))*B-\mu(\lambda-1)^2 D$$

(T.10)

Where, $0<\beta<1$ is the discount factor between the quarters and $S_{Q_{2B}} \equiv Q_B - y_3$ .

The bracketed term in the first term (second) in (T.10) is the probability of reaching the bonus quota in period 1 (period 2), and the last term represents the cost of gaming.

Similarly, in the commissions regime, the optimization problem facing a salesperson can be written as:

$$\begin{aligned}&\arg\max_{\lambda,T_{p2}} (1-G(\frac{S_{Q_{1C}}}{\lambda}-h_dT-(\Delta h)T_{p2}))*E(\alpha(y_1+y_2-Q_{1C}))+\\&\beta E((1-G(S_{Q_{2C}}-h_dT-(\Delta h)T_{p4}))*(\alpha(y_3+y_4-Q_{2C}))-\mu(\lambda-1)^2 D\end{aligned} \qquad \text{(T.11)}$$

Where, $S_{Q_{1C}} \equiv Q_C - y_1$ and $S_{Q_{2C}} \equiv Q_C - y_3$. This can be re-written as:

$$\begin{aligned}&\arg\max_{\lambda,T_{p2}} (1-G(\frac{S_{Q_{1C}}}{\lambda}-h_dT-(\Delta h)T_{p2}))*(\alpha(\lambda(h_dT+(\Delta h)T_{p2})-S_{Q_{1C}}))+\\&\beta((1-G(S_{Q_{2C}}-h_dT-(\Delta h)T_{p4}))*\alpha(h_dT+(\Delta h)T_{p4}-S_{Q_{2C}}))-\mu(\lambda-1)^2 D\end{aligned} \qquad \text{(T.12)}$$

Where, the first bracket in the first term (second term) represents the probability of reaching commission quota in quarter 1 (quarter 2) while the second bracket in first term (second term) the expected commissions in quarter 1 (quarter 2). The third term is the cost of gaming.

The expressions T.10 and T.12 have been reported in the Table 2 in the paper.

*Definitions*

After period 1, a salesperson is in one of the following four states:

***Def. 1***: A salesperson is "Too Far" from quota (FAR) at the end of the period 1 if:

$$Q_{j\in\{B,C\}} - y_1 \geq 2(h_dT_{d\min} + h_p(T - T_{d\min})) \qquad \text{(T.12)}$$

The RHS of T.12 represents the maximum possible expected sales in period 2 at the expense of severe multi-tasking concerns (minimum doctor visits) as well as maximum pull-in from period 3 ( $\lambda$ =2); the salesperson is not expected to make the quota.

***Def. 2***: A salesperson is "Far" (STRETCH) from quota at the end of the period 1 if there exists a $\lambda \in (1,2]$, that satisfies:

$$Q_{j\in\{B,C\}} - y_1 = \lambda(h_d T_{d\min} + h_p(T - T_{d\min})) \tag{T.13}$$

The RHS of T.13 shows that when the salesperson is far, she is expected to reach quota through a combination of a level of pull-in and neglect of doctor visits.

***Def. 3***: A salesperson is "Near" (NEAR) quota at the end of period 1 if there exists a $T^2_d \in [T_{d0}, T)$, that satisfies:

$$Q_{j\in\{B,C\}} - y_1 = (h_d T_{d2} + h_p(T - T_{d2})) \tag{T.14}$$

Hence, when the salesperson is near, she is expected to make it to quota with some multi-tasking distortion but without a need for timing games.

***Def. 4***: A salesperson has "achieved" quota (EXCEEDED) at the end of the period 1 if:

$$Q_{j\in\{B,C\}} \leq y_1$$

*Key Results*

**Corollary 1**: *In period 1, under both bonus and commission regimes, the salesperson will focus largely on pharmacy visits while keeping doctor visits at the minimum level, resulting in the amplification of multi-tasking concerns.*

The above result is fairly intuitive and follows from the simple fact that pharmacy visits provide higher marginal return on observable output than doctor visits.

**Result 3**: *If at the end of period 1, the quota for bonus has been achieved (we label this "EXCEEDED" in the empirical analysis) then*

a) *The salesperson will push sales out to period 3.*
b) *The salesperson will focus largely on doctor visits resulting in the attenuation of multi-tasking concerns.*

*If the quota for commissions has been achieved then*

c) *The salesperson will pull sales in from period 3.*
d) *The salesperson will focus largely on pharmacy visits while keeping doctor visits at the minimum level, resulting in the amplification of multi-tasking concerns.*

Sketch of Proof:

Bonus regime: The probability of meeting the quota is 1, so any additional output has zero marginal return (first term in T.10). On the other hand, "push-out" ( $\lambda$ <1), implies a higher probability of meeting the quota in the next period (second term in T.10):

$$\frac{\partial(1-G(S_{Q_{2B}}-h_dT-(\Delta h)T_{p4}))*B)}{\partial\lambda}<0$$

. To see that this holds, note that:

$$S_{Q_{2B}} \equiv Q_B - y_3 \quad and \; E(y_3)=(2-\lambda)(h_dT+(\Delta h)T_{p3}) .$$

So, $(1-G(S_{Q_{2B}}-h_dT-(\Delta h)T_{p4}))=(1-G(Q_B-(2-\lambda)(h_dT+(\Delta h)T_{p3})-h_dT-(\Delta h)T_{p4}))$ and this increases as $\lambda$ goes down and hence "push-out" will occur. A focus on pharmacy visits improves current sales but provides no current or future benefits once the quota has already been met, so doctor visits will go up.

Commissions Regime: Again, the probability of meeting the quota is 1. However, since marginal returns through commissions are accrued only on sales above the quota, and since the quota has already been met, the "natural level" of sales would also lead to positive commissions (first term in T.7). A "pull-in" will occur, since the probability of reaching the quota is uncertain in the next quarter and the salesperson wants to earn as much commission as possible in the current quarter. Since output responds positively to pharmacy visits and current output improves earnings $\left(\frac{\partial(\alpha(\lambda(h_dT+(\Delta h)T_{p2})-S_{Q_{1C}}))}{\partial T_{p2}}>0\right)$, the salesperson will focus on pharmacy visits leading to an amplification of multi-tasking concerns.

## WEB APPENDIX B: DATA DETAILS, IDENTIFICATION ISSUES AND ROBUSTNESS CHECKS

In this section, we discuss some of the identification issues with estimation and limitations of our data and a number of robustness tests carried out by us.

*Before-after-Design.* We have a before-after-design with an exogenous intervention in the middle of the observation period (without a control group of territories). This requires us to come up with additional controls to rule out productivity trends being simply driven by an underlying time-trend or productivity shocks in the market. Towards that end, in the main monthly regression report in the paper (Table 5), we included territory fixed effects, month-year dummies as well as the quarterly target set by the firm as controls. The territory fixed effects control for the unobserved territory potential as well as for the intrinsic ability of sales rep(s) within the territory (more on this later), while month-year dummies estimate within month effects across 458 territories. The variable quarterly target controls for unobserved (to the econometrician) market/territory effects observed by management that affect the output of a territory and drive their quota setting. Another potential empirical control is the use of aggregate industry sales of the product category - our results remain largely unchanged with the use of this control as well[5].

*Contrasting single versus multiple salesperson territories*. Recall that in our theoretical model we assumed that all salespeople are compensated individually and act in their self-interest. Our data contains individual as well as group territories and all the members of a multi-member group receive the same compensation based on the overall output of the group. It is well-known that such a scheme sets up free-riding and coordination problems (Alchian and Demsetz 1972; Holmstrom 1982), although some evidence shows that these issues could be potentially overcome through mutual monitoring or peer pressure among group members (Hamilton, Nickerson and Owan 2003; Knez and Simester 2001). Our analysis so far has been done on data combining individual and group territories, with a variable controlling for the sales group size. We rerun the key analyses separately on individual and group territories to check if the results differ, and find that they do not. (For example, the estimated effect of the regime change is

[5] The estimate of industry sales in the productivity regression is likely to be biased because both the average productivity of sales teams and industry sales are likely to be correlated with the unobserved demand shocks. While we do not use this control in the main body of the paper, we have included this in Table B3 in Appendix to get a conservative estimate of our key effect.

.210, $p<0.01$ within single person territories while it is .156, $p<0.01$ for multi-person territories after including the full set of controls and running the regressions at the quarterly level.) Other results on sales variation and multi-tasking are very similar to the ones reported in the main body of the paper and available from authors upon request.

*Quota-updating and ratcheting.* We mention in the main body of the paper that we abstract away from another timing issue, namely ratcheting (Misra and Nair 2011). Ratcheting arises when quota updating is endogenous, the current year's performance is a signal of territory potential/salesperson ability, and the firm takes advantage of this signal to set up the quota in the next period. This could potentially result in salespeople reducing their current effort in order to garner lower quotas in the next period. The theoretical solution to this problem involves (see Gibbons 1987) salespersons getting higher pay in the initial period compared to the later period resulting in higher efforts - a solution rarely observed in practice. In our context, the firm relies upon three data points to update a quota: a) Expected industry growth in the therapeutic category (through market intelligence that uses past industry growth among other factors); b) Companywide aggregate realized sales and growth projections; c) Territory specific factors (Pharmacies, registered doctors, hospitals, population etc.) including past performance. Of these, a) and b) are clearly beyond the control of an individual territory, while a part of c) that relies upon past performance could make future quotas (weakly) endogenous to current sales. We went back and talked to both managers and salespersons in the focal firm on this issue. Both parties displayed a keen awareness of 'ratcheting' concerns, and management was quick to point out that they took a great deal of care to ensure that salespersons did not feel that quotas were subject to ratcheting. While reassuring, we would like to make two additional points in this regard.

1. While we have not modeled the quota setting process endogenously, our theoretical prediction on the behavior of salespeople in response to their distance from quota is *not dependent* upon whether the quota setting and updating is endogenous. For example, we predict an increase in doctor visits if a *given quota* is met under bonuses, irrespective of the underlying quota setting and updating process.
2. We empirically estimate the firm's ratcheting policy parameters following Misra and Nair (2011) - see their Table 2, pp. 244. Essentially, this is a reduced form regression wherein

authors project the quota in period *t* using a flexible function of agents' sales and quotas in period (*t*-1). Our estimates of this specification are reported in Table B1. The key estimate of interest is the impact of $Q_{t-1}$ (past sales) upon the current quota[6]. This estimate is negative but statistically insignificant (-.0173, $p=0.754$) while the estimate of the past quota ($a_{t-1}$) is positive and statistically significant (.518, $p<0.01$). In other words there is persistence in quota updating but it is not being driven by the past sales. Hence this provides evidence that to a large extent, ratcheting does not seem to be an issue in our set-up. These results are opposite of what Misra and Nair find: they find a positive and significant impact of the past sales estimate and a statistically insignificant impact of past quota.

*Selection and quits and group-size variation*. A sales group composition could witness change if:

1) A salesperson(s) quits and is replaced by newly hired salesperson
2) A salesperson(s) quits and the vacancy remain unfilled, leading to a smaller group size
3) A new salesperson(s) is hired leading to a larger group size
4) A salesperson (s) is assigned to a different group changing the composition of both the groups

In our focal firm, sales rep reassignment to different territories is very rare and in the 36 months of our data, there was not even a single instance of this. Hence most composition change is either through "quits" or "new hires" (we refer to both these as "turnover" in our context for the sake of brevity)[7]. No territory was "unmanned" for more than two weeks, and this implies that in single-person territories, as soon as a person quit, he was almost immediately replaced by a new hire. A total of 66 out of 458 territories witnessed any turnover - of these 29 were single person territories and 37 were multi-person territories. In other words, about 86% of the territories in our data witnessed no change in sales group composition.

[6] Notice that to facilitate consistency with Misra and Nair, "Q" represents sales variable in this regression and "a" represents quota. This is not to be confused with the symbol "Q" used in the theory section of our paper that represents quota.

[7] The re-assignment occurs in the middle and top management (often accompanied by a promotion). Analysis of this is beyond the scope of this study. See Figure B1 for average sales group size over time.

Nevertheless, our intervention analysis is compromised if employees quit on account of the intervention. We examined employee turnover in sales groups to see if it was significantly impacted by the incentive plan and if so, then potentially the productivity change could be due to the differential turnover rates. Specifically, we examined if the productivity increase in the new plan could be due to employee turnover, which is referred to as the “sorting” or “selection” effect of an incentive plan (Lazear 2000). For example, it could be that poorly performing employees quit the firm in the new plan, and employees with higher ability join the firm in the new plan. This would then suggest that sorting effects drive the observed productivity increase. To address this concern, we checked for turnover rates by plan. We turnover data for all territories and these are reported in Table B2. We observe that employee turnover occurs in a total of 66 of 458 territories (at 14.4%). Of the individual territories, only 29 of the 268 individual territories (about 11%) witnessed a turnover while 37 of 190 multi-person territories (about 19%) witnessed a turnover. A higher turnover among multi-person teams is not surprising since they have more sales reps and the likelihood of at least one of these quitting is higher compared to individual territories. Further, there is no marked increase in turnover by plan, which suggests that there are no significant sorting issues in our context. Additionally, we ran the following additional analyses:

1) We re-ran the entire analysis excluding those territories that experience turnover. See the column 1 of the Table B3 for the productivity analysis- our results remain qualitatively unchanged. The estimate of the productivity gain is .327 ($p$<0.01).
2) We re-ran the entire analysis, by constructing fixed effects at the territory-team level rather than just at the territory level. For example, if a sales group had 12 members during first 14 months, 10 members during the next 6 months (due to quits) and 13 members during the last 16 months (due to 3 new members joining ), then each of these three territory-team pairs were given three distinct IDs and were estimated as distinct fixed effects in the analysis[8]. These results are reported in the paper in Table 5 (Columns 4, 5 and 6).

*Impact of pharmacy and doctor visits on output.* Our key results in multi-tasking hinge upon the institutional fact that pharmacy (doctor) visits do (not) translate into immediate sales gain. This was confirmed by our extensive conversations with the management as well as our perusal of

[8] This resulted in a total of 528 territory-team IDs.

field visits. Nevertheless, we test this by running a regression of monthly sales against pharmacy and doctor visits and other controls. The results are reported in Table B4. Indeed, we find the estimate of pharmacy visits to be positive (.0603, $p<0.01$) while the estimate of doctor visits is negative but statistically insignificant (-.139, $p=0.659$)[9].

*Serial Correlation*. In our data, it is possible that the sales groups' error terms in the sales productivity regressions are correlated across time. If the errors are serially correlated, our earlier fixed effects regression estimates are still consistent but the standard errors may be biased. To account for this we use the Newey-West estimator to estimate the sales productivity and timing regressions assuming a heteroskedastic error structure. This method permits arbitrary auto correlation of type MA (q) (see Cameron and Trivedi 2005 for details) and computes the standard errors using the method of Newey and West (1987). We estimate the models with both one and two lags. Second, we estimate the sales productivity and timing regressions assuming that the error structure is heteroskedastic, contemporaneously correlated across panels, and auto correlated of type AR(1) (Beck and Katz 1995, Cameron and Trivedi 2005). Again, the results from these models are directionally consistent and similar in magnitude with the results from our earlier analysis. To save space, these results are not reported here but are available from authors upon request.

[9] If the total number of visits are fixed (as in the theory model), then one might question, how the effect of doctor and pharmacy visits are separately identified. The identification comes from the fact that we do observe some variation in total visits across groups as well as over time.

## Table B1: Estimates of Ratcheting Policy

| **Variable** | |
|---|---|
| Constant | 40.04(2.43)*** |
| $a_{t-1}$ (Past quota) | .52(0.052)*** |
| $Q_{t-1}$ (Past sales) | -.017(0.055) |
| $a_{t-1}^2$ | -.002(0.0002)*** |
| $Q_{t-1}^2$ | -.001(0.0002)*** |
| $a_{t-1}^3$ | $2.91 \times 10^{-6}(2.44 \times 10^{-7})$*** |
| $Q_{t-1}^3$ | $2.03 \times 10^{-6}(3.10 \times 10^{-7})$*** |
| Territory fixed effects | Yes |
| Quarter-year fixed effects | Yes |
| $R^2$ | .9405 |

**Notes**:

1. This specification is the same as Table 2, p.244 in Misra and Nair (2011)
2. Bruesch-Godfrey tests reject presence of 1st and 2nd order serial correlations in the presence of lagged dependent variable
3. Standard errors in the parentheses and *** (*p*<0.01).

**Table B2: Turnover Details**

| Regime | Territories with Turnover | % Turnover |
|---|---|---|
| *Single Person Territories (268)* | | |
| Bonus | 13 | 4.8% |
| Commissions | 16 | 5.9% |
| Both Regimes | 29 | 10.8% |
| *Multi-person Territories (190)* | | |
| Bonus | 17 | 8.9% |
| Commissions | 20 | 10.5% |
| Both Regimes | 37 | 19.4% |
| All *Territories (458)* | | |
| Bonus | 30 | 6.5% |
| Commissions | 36 | 7.9% |
| Both Regimes | 66 | 14.4% |

**Table B3: Monthly Productivity Results**

Dependent Variable = log (Monthly Productivity)

| Variable | |
|---|---|
| New Plan | .327*** (.078) |
| Group Size | -.080*** (.013) |
| log(Qtr Target) | .176*** (.019) |
| log (industry Sales) | .397** (0.166) |
| Constant | -.866 (.856) |
| Territory-team Fixed Effects | Included |
| Month-Year Fixed Effects | Included |
| Observations | 12,222 |
| R-squared | .6651 |
| Groups (Clusters) | 392 |

**Notes:**

Column 1 includes only territories that experienced no turnover. In this regression, the "territory-team" and "territory" dummies are the same (by definition).

***p<0.01, **p<0.05,*p<0.1, Standard errors in parentheses, clustered by territory

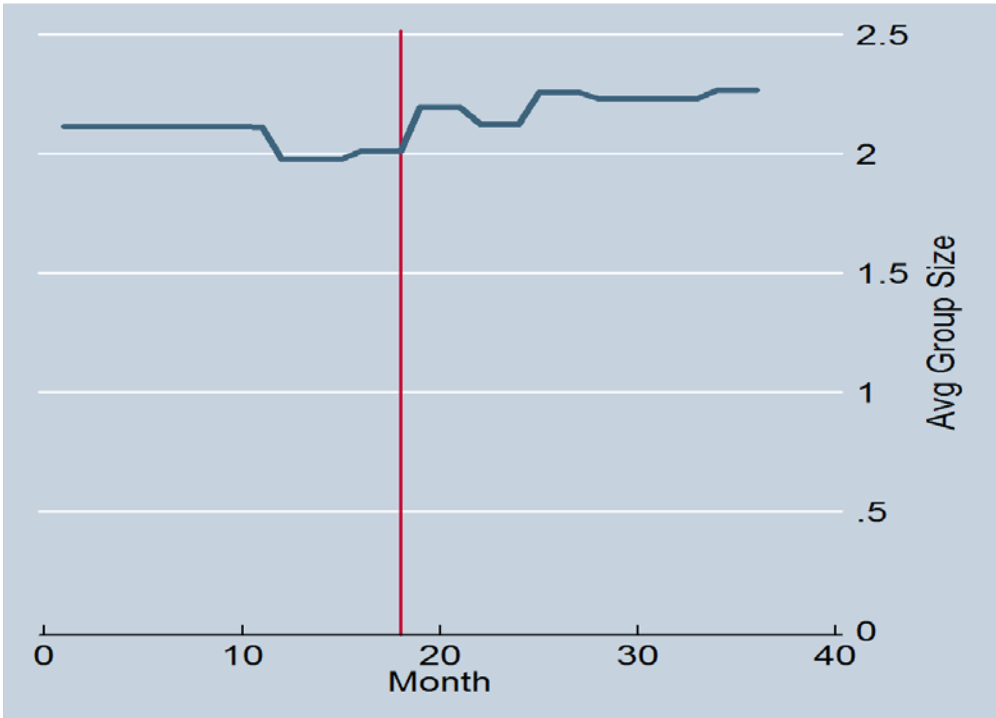
**Table B4: Salesperson Activities and Sales Output**

Dependent Variable: log (Monthly Sales)

| **VARIABLES** | |
|---|---|
| log(pharmacy visits) | .0603*** |
| | (.0164) |
| log(doctor visits) | -.007 |
| | (0.0159) |
| log (Qtr Target) | .211*** |
| | (0.0171) |
| Group Size | .0181** |
| | (.009) |
| Constant | 1.448*** |
| | (.0802) |
| Territory Fixed Effects | Included |
| Month-Year Effects | Included |
| Observations | 14,449 |
| Clusters | 458 |
| R-squared | .8313 |

**Note:** ****p<0.01, **p<0.05,*p<0.1*, Standard errors in parentheses, clustered by territory

**Figure B1: Average Group Size over Time**




**REFERENCES**[10]

Beck, Nathaniel, and Jonathan N. Katz (1995), "What to Do (and Not to Do) with Time-Series Cross-Section Data", *American Political Science Review*, 89: 634-647

Cameron, A. C. and P. K. Trivedi (2005), *Microeconometrics: Methods and Applications*. Cambridge: Cambridge University Press

Newey, W. K. & West, K. D. (1987),"A simple, positive definite, heteroskedasticity and autocorrelation consistent covariance matrix," *Econometrica* 55, 703-8.

[10] This list includes only the references unique to this appendix.