Product Market Competition and Agency Costs*

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Abstract

We model the effects of product market competition on managerial efficiency, and isolate the agency effect of competition, which is present only in firms subject to agency costs, from the direct pressure effect, which is present in all firms. Using a unique set of Canadian data which allows us to simultaneously observe the characteristics of firms as well as their employees, we then evaluate the empirical significance for these two effects. We find that competition has both a significant direct pressure effect, as well as a significant agency effect. Both effects increase the importance firms place on quality improvements and on cost reductions, as well as contractual incentives and employee effort.

Keywords: competition, incentives, agency costs, entrepreneurial firms vs. large corporations.

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1 Introduction

Economists have a “vague suspicion that competition is the enemy of sloth” (Caves, 1980, p. 88; cited in Nickell, 1996); yet the process through which competition improves managerial efficiency still is not fully understood. There are two primary ways to think about this process. Competition may put direct pressure on firms to increase quality (or decrease costs) - for example by increasing the marginal impact of such an increase in expected profits - a pressure that is passed on to agents through higher powered incentives. But competition may also reduce agency costs, making it “cheaper” for the principal to elicit more effort from the agent.\(^1\) These two processes are difficult to disentangle, because in both cases competition leads to stronger incentives and higher managerial effort. The purpose of this paper is twofold. Theoretically, we isolate the direct pressure effect from the agency effect. We then measure the empirical impact of these effects on firms’ strategic choices, contractual incentives, and managerial effort.

In our theoretical model,\(^2\) two firms are located at the extremities of a Hotelling (1929) line, and compete in quality and prices for consumers on that line. Competition is measured by the degree of substitutability between products, and agency problems arise as a result of a managerial wealth constraint. Both the direct pressure effect and the agency effect are themselves the result of the interaction between these two factors. First, competition reduces price-cost margins; we call this the rent reduction effect. Second, by making demand more elastic, competition increases the marginal (positive) impact of an increase in quality on the market share one can “steal” from a rival; we call this the business stealing effect.\(^3\)

We show that business stealing puts direct pressure on firms to increase quality, because it increases the marginal impact of a quality increase in expected profits. In the other hand, rent reduction lowers the marginal impact of a quality increase on expected profits, and hence puts direct pressure to reduce quality. In our model, in equilibrium, business stealing and rent reduction exactly offset each other, and the direct pressure effect of competition is null.

In contrast, business stealing and rent reduction reinforce each other in reducing the marginal

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\(^1\)We thank an anonymous referee for suggesting this motivation.

\(^2\)The theoretical model presented in this paper builds on Bettignies (2004), which studies the effects of product market competition on the boundaries of the firm in an incomplete contract framework. Here we show that somewhat similar results can be obtained in a simple principal-agent model.

\(^3\)The business stealing and rent reduction effects have been discussed previously in Anderson, de Palma and Thisse (1992, p. 230), Raith (2003), and de Bettignies (2004), in the context of a Logit framework, Salop (1979) circle, and Hotelling line, respectively.
agency cost of eliciting effort from the agent, which is the product of the increase in the fraction of expected profits that must be relinquished to the agent to elicit a marginal increase in effort, and expected profits. Business stealing has a motivating impact on the agent which reduces the first factor, while rent reduction, by lowering expected profits, reduces the second factor.

It then follows that:

1. When agency costs are nonexistent - as in small, entrepreneurial firms for example, where the owner and the manager are one and the same person - competition can only affect managerial incentives and effort through direct pressure, and has a zero net impact in equilibrium.

2. When agency costs are present - as in large or hierarchical firms for example, where the separation of ownership and control is likely to play an important role - two main results emerge. First, the importance firms (principals) place on quality improvements (or cost reductions), as well as managerial incentives and effort, are lower than in firms without agency costs. Second, and perhaps more interestingly, these variables increase with competition, via a decrease in the marginal agency cost of eliciting managerial effort.

Empirically, we exploit a detailed set of linked employer-employee data which allows us to observe simultaneously the presence (or absence) of agency costs in firms, the amount of competition firms face, the strategies they pursue, the types of contracts and incentives offered to their employees, as well as detailed information about individual employee effort. We isolate the agency effect of competition from the direct pressure effect, and determine their empirical significance. We find that:

a) The importance firms place on quality improvements and cost reductions, the presence of contractual incentives, and the number of unpaid overtime hours employees work (our main measure of effort), are all lower when agency costs are present than when they are not.

b) Competition does have positive direct pressure effect. Even in firms in which agency costs are absent, competition increases the importance firms place on quality improvements and cost reductions, incentives, and effort.

c) Competition also has an agency effect. The positive impact of competition on these variables is even larger for firms that are subject to agency costs.

This paper contributes to the theoretical literature on competition and “x-inefficiencies” (Liebenstein, 1966) in at least two ways. First, we provide a more “applied” theoretical framework which can be more easily tested empirically. Most of the previous theoretical work has derived an explanation for Caves’ “vague suspicion” without imposing much structure on the competitive environment. In-
stead competition has been defined simply in terms of its potential effects, such as increased aggregate supply and lower market price (Hart, 1983; Scharfstein, 1988), reduced profits and changes in the “relative-value-of-managerial-actions” (Hermalin, 1992; Schmidt, 1997), or increased probability of liquidation (Schmidt, 1997), for example. The result is a series of models resting on general assumptions, but which yield ambiguous predictions\(^4\) that are difficult to test empirically. In contrast, our model sacrifices generality to a small extent by imposing the competitive structure of a Hotelling line, but has the advantage of generating stark, unambiguous empirical predictions. In that regard, we follow Raith (2003) who also provides unambiguous predictions by adopting the competitive structure of a Salop (1979) circle.

Our second - but no less important - theoretical contribution comes from the fact that the papers cited above do not explicitly disentangle the effect of competition on agency costs from the direct pressure effect, and hence effectively treat them as one. Raith (2003), for example, elegantly shows that in a simple agency model with risk averse managers, competition affects incentives via changes in the equilibrium number of competitors in the industry. But it is not immediately clear whether this change in the number of rivals affects managerial incentives through a pure reduction in agency costs, or whether it affects firms even when agency costs are absent. Our model, by isolating agency effects from direct pressure effects, sheds light on the precise channels through which competition affects incentives.

The empirical literature does seem to confirm a positive impact of competition - measured in a variety of ways - on efficiency.\(^5\) Increased number of competitors and lower levels of rents (Nickell, 1996), as well as lower industry concentration (Haskel, 1991), for example, are shown to significantly increase total factor productivity growth. Industry concentration has also been shown to reduce technical efficiency\(^6\) (Caves and Barton, 1990; Green and Mayes, 1991; Caves et al., 1992). And Syverson (2001, 2003) recently showed that substitutability between products has a positive impact on average productivity levels.

Much less work has been done, however, to analyze empirically how - i.e. through which process -

\(4\)Models of competition with hidden information, pioneered by Hart (1983) and Scharfstein (1988), show opposite effects of competition on managerial incentives. While Hart showed that competition reduces agency costs, Scharfstein demonstrated that this result could be reversed with slightly different assumptions about managerial preferences. With hidden action models (Hermalin, 1992; Schmidt, 1997), a consensus does seem to emerge, that competition overall has ambiguous effects on agency costs.

\(5\)With the exception of Aghion et al. (2002), the related literature on competition and innovation seems also to find evidence of a positive relationship between the two (e.g. Geroski, 1990; Bertschek, 1995; Blundell et al., 1999).

\(6\)Farrell (1957) defines technical inefficiency as suboptimal use of a given combination of inputs in production, in contrast to allocative inefficiency, which is a suboptimal combination of inputs to be used in production.
competition affects efficiency. Several papers have looked at pieces of this puzzle, including Burgess and Metcalfe (2000), Santalo (2002), and Cunat and Guadalupe (2003), who find evidence of a link between competition and managerial incentives, and Griffith (2001) who shows that competition increases productivity and that this effect is larger in firms where agency costs are present. Exploiting a more recent version of the survey data used by Santalo (2002), which includes a richer set of variables to choose from, we contribute to the empirical literature by providing a more accurate picture of the precise channels (direct pressure and agency costs) through which competition affects not only efficiency and managerial incentives, but also effort.

The paper is structured as follows. Section 2 presents our theoretical model and results. We describe the data in section 3, our econometric methodology in section 4, and our empirical results in section 5. Section 6 concludes.

2 Theoretical Model

2.1 Basic Structure

Two firms 1 and 2 are positioned at each end of a Hotelling (1929) line, with locations \( x_1 = 0 \) and \( x_2 = 1 \), respectively. The two firms sell imperfectly substitutable products and compete on quality \( q \) and price \( p \). Marginal costs of production for both firms are normalized to zero. Each firm is composed of a principal and an agent, both of whom are risk-neutral. The principal-agent relationship could be interpreted as the relationship between a board of directors and the chief executive officer (CEO) of the firm, or between a divisional manager and her subordinate, for example. For convenience we refer to the principal as female and to the agent as male.

A unique consumer, who is uniformly distributed along the line, purchases one unit of the product from either firm 1 or firm 2. Firms 1 and 2 know the location distribution for the consumer, but they do not know the actual location on the line, until the end of the game that is, when demands are realized (see timing below). At location \( x \), the consumer incurs a transport cost \( tx \) for travelling to firm 1, and a cost \( t(1-x) \) to visit firm 2. The consumer enjoys conditional indirect utility \( U_1 = s + q_1 - p_1 - tx \) from product 1 and \( U_2 = s + q_2 - p_2 - t(1-x) \) from product 2 (where \( s \) represents income), and simply chooses the product which gives the highest utility. The timing of the game is as follows:

At date 0, principal \( i, i = 1, 2 \), makes a take-it-or-leave-it contractual offer to agent \( i \), who is wealth constrained with zero initial wealth and has a reservation wage of zero. Offer \( i \) is only observable to
agent $i$ (and not to agent $j$), a necessary assumption for the existence of equilibrium in our model. This assumption seems realistic: managers and employees typically do not know the exact conditions stipulated in the employment contract for the equivalent position in rival firms.

At date 1, agent $i$ exerts effort $e_i$ at cost $K(e_i) = \frac{1}{2}e_i^2$. Effort determines the level of innovation undertaken by firm $i$, and the product quality $q_i$ which results from it.\(^7\) For simplicity we set $q_i = e_i$; and hereafter we refer to $q_i$ using agent effort, innovation, or product quality, interchangeably.

At date 2, after observing qualities, principal $i$ chooses price $p_i$. This assumption is made for clarity purposes, and is without loss of generality: the same results apply if the pricing decision is given to the agent.

At date 3, the consumer chooses one of the products and demands are realized. Firm $i$ makes profits $\Pi_i$ which are split between the agent, who receives payoff $W_i$ according to the contract signed at date 0, and the principal, who keeps $\Pi_i - W_i$.

Transport cost $t$, which measures the degree of horizontal product differentiation, is an ideal parameter to represent toughness of competition (or rather lack thereof) in the industry, to use Sutton’s (1992, p.9) terminology, and throughout the paper, an increase in product market competition is represented by a decrease in $t$. We restrict our attention to value of $t \in \left(\frac{4/3}{9}, \frac{2}{3}\right]$, which ensures strict concavity of all maximization programs throughout the paper, and non-negative effort levels in both firms.

We assume that total revenues, and hence profits, are contractible. Demands and prices, on the other hand, are assumed not to be verifiable (though observable). This assumption helps us keep the analysis simple by generating second-best equilibrium contracts that are contingent only on profits,\(^8\) and is not unreasonable in our opinion. Indeed, in order for sales and price of a product to be verifiable in a court of law, the nature of that product must be described \emph{ex-ante} in a way which allows a judge to match products with sales and prices. In practice firms sell not one, but a variety of products, the nature of which changes enormously over time, depending on contingencies such as technological innovation or market conditions for example. We argue that these products cannot be unambiguously described \emph{ex-ante}, and hence contracts cannot be made contingent on associated sales or prices. For

\(^7\) All of the theoretical results of the paper still hold if we assume that effort reduces the marginal cost of production instead of increasing quality, or that it affects both cost and quality. This is confirmed empirically below, where we show that the results are similar for quality-enhancing and cost-reducing investments.

\(^8\) Relaxing this assumption, we may get optimal contracts that depends on realized demands as well as profits; a complication that brings no benefits. Given non-verifiable demands, non-verifiable prices are necessary for consistency: otherwise, demands could be deduced from revenue/profits.
similar reasons, product quality may or may not be verifiable, and we analyze both possibilities. In subsections 2.2 and 2.3, we characterize the Subgame Perfect Nash Equilibrium (SPNE) of the game (since in our duopoly setting there are simultaneous moves at every stage by the two rival firms) when quality is and is not verifiable, respectively.

Depending on the verifiability of quality, the optimal contract may thus be contingent on realized profits and/or product quality: \( W_i = W_i (\Pi_i, q_i) \). Three conditions must hold for any contract to be feasible:

1) Incentive Compatibility (IC) constraint: agent \( i \) exerts effort \( \hat{q}_i \) which maximizes his expected gross payoff \( w_i \) - which is a function of expected profits \( \pi_i (q_i) \) and/or quality - minus his cost of effort:

\[
\hat{q}_i \in \arg \max \left[ w_i (\pi_i (q_i), q_i) - K_i (q_i) \right].
\] (1)

2) Individual Rationality (IR) constraint: for the agent to participate, his expected net payoff must be weakly larger than his (zero) reservation wage:

\[
w_i (\pi_i (\hat{q}_i), \hat{q}_i) - K_i (\hat{q}_i) \geq 0.
\] (2)

3) Wealth (W) constraint: the agent is wealth constrained with zero initial wealth, and thus his realized payoff must be non-negative in all states of the world:

\[
W_i (\Pi_i, \hat{q}_i) \geq 0 \text{ for all realized values of profits } \Pi_i.
\] (3)

### 2.2 Benchmark Case: Verifiable Quality (First-Best)

When quality is contractible, principal \( i \) can elicit effort \( q_i^* \) from agent \( i \), by offering him the following simple contract at date 0: the agent is to receive wage \( W_i (q_i^*) = K (q_i^*) = \frac{1}{2} q_i^* \) at date 3 if quality is verified to be \( q_i = q_i^* \), and \( W_i = 0 \) otherwise. We determine the SPNE of the game by backward induction, and show that \( q_i^* \) is the first-best (FB) level effort, i.e. the level that would be exerted if the principal and the agent were one and the same person. Before proceeding, let us note that IC constraint (1), the IR constraint (2), and the W constraint (3) all hold under the conditions of this contract, which implies that the contract will be accepted by the agent, who will choose to exert the effort level \( q_i^* \) stipulated in the contract.

At date 3, principal \( i \) receives realized payoff \( \Pi_i (q_i, p_i, q_j, p_j, t) - W_i (q_i) \).
At date 2, principal $i$ chooses $p_i$ to maximize her expected payoff, taking qualities as given:

$$\max_{p_i} \pi_i(q_i, p_i, q_j, p_j, t) - W_i(q_i),$$

where expected profits $\pi_i(q_i, p_i, q_j, p_j, t) = p_i d_i(q_i, p_i, q_j, p_j, t)$ are the product of price and expected demand.\(^9\) Taking the first-order conditions (FOCs) with respect to price for $i = 1, 2$, and solving the resulting system of two equations yields the equilibrium price for firm $i$:

$$p_i = t + \frac{q_i - q_j}{3}.$$

Substituting equilibrium prices back into the expected demand, we obtain an expression for expected profit $\pi_i = \pi_i(q_i, q_j, t)$ for firm $i$, given qualities $q_i$ and $q_j$.

$$\pi_i(q_i, q_j, t) = \left[t + \frac{q_i - q_j}{3}\right] \left[\frac{1}{2} + \frac{q_i - q_j}{6t}\right],$$

where $d_i = \left[\frac{1}{2} + \frac{q_i - q_j}{6t}\right]$, is the equilibrium expected demand for firm $i$.

At date 1, agent $i$ exerts the effort level $q_i = q_i^*$ stipulated in the incentive compatible initial contract.

At date 0, principal $i$ simply chooses the level of effort $q_i^*$ which maximizes her expected net payoff (taking principal $j$’s contractual choice, and hence product $j$’s quality, as given), since the IC, IR, and W constraints all hold under this contract and can therefore be ignored. Replacing $w_i(q_i)$ by $K(q_i)$, the principal’s expected net payoff simplifies to $NP^F_i = \pi_i(q_i, q_j, t) - K(q_i)$. In other words, the principal’s maximization program is as if she and the agent were one and the same person: when quality is verifiable, agency problems can be circumvented, and the equilibrium effort level is the first-best level of effort. Taking the FOC, we obtain $q_i^*$ which solves:

$$\frac{\partial \pi_i(q_i, q_j, t)}{\partial q_i} = \frac{\partial K_i(q_i)}{\partial q_i}.$$

The intuition is simple: the principal elicits an effort level such that, given rival effort $q_j$, the marginal

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\(^9\) A consumer located at $x$ is indifferent between store 1 and 2 if and only if $U_1 = U_2$, or $q_1 - p_1 - tx = q_2 - p_2 - t(1 - x)$. Solving for $x$, we get the expected demand for firm 1:

$$d_1(q_1, p_1, q_2, p_2, t) = x = \left(\frac{1}{2} + \frac{(p_2 - p_1) + (q_1 - q_2)}{2t}\right).$$

Expected demand for firm 2 is $d_2(q_2, p_2, q_1, p_1, t) = (1 - x)$. 

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impact of an increase in effort on expected profits exactly equals the agent’s marginal cost of effort. The FOCs for principals $i$ and $j$ form a system of two equations in two unknowns, which can be readily solved. The unique solution is the symmetric equilibrium in which principals $i$ and $j$ elicit effort level $q_i^* = q_j^* = \frac{1}{3} = q^*$ from their agent.

Thus, in the first-best, the SPNE is the following. At date 0, both principals propose the contract described above, requiring effort $q^* = \frac{1}{3}$ from the agents, who choose to exert that level of effort at date 1. At date 2, prices are chosen following (6), which yields $p_i^* = p_j^* = t$. Finally, demands are realized and profits are distributed according to the original contract.

**Product Market Competition in the First-Best**

It is quite clear from the above that in the first-best equilibrium, an increase in competition (a fall in $t$) has no impact on managerial effort, which at $\frac{1}{3}$ is independent of $t$ (as expected, however, competition does reduces prices). To understand this, let us go back to condition (8). The principal’s marginal cost of eliciting effort, which in the FB equals the agent’s marginal cost of effort, $\frac{\partial K(q_i)}{\partial q_i} = q_i$, is independent of $t$ and unaffected by competition.

The marginal benefit from inducing effort - which corresponds to the marginal product of effort $\frac{\partial \pi_i}{\partial q_i}$ - can be expressed as follows:

$$\frac{\partial \pi_i}{\partial q_i} = p_i \frac{\partial d_i}{\partial q_i} + d_i \frac{\partial p_i}{\partial q_i} = p_i \frac{1}{6t} + d_i \frac{1}{3}.$$  

(9)

Increasing effort/quality had two effects on expected profits, *ceteris paribus*: it increases the firms expected demand ($\frac{\partial d_i}{\partial q_i} p_i > 0$), and it enables the firm to charge a higher price, to account for the higher quality ($\frac{\partial p_i}{\partial q_i} d_i > 0$).

Differentiating the marginal product of effort with respect to $t$ yields $\frac{\partial^2 \pi_i}{\partial q_i \partial t} = \frac{\partial d_i}{\partial t} \frac{\partial d_i}{\partial q_i} + p_i \frac{\partial^2 d_i}{\partial q_i \partial t} + \frac{\partial d_i}{\partial t} \frac{\partial p_i}{\partial q_i} + d_i \frac{\partial^2 p_i}{\partial q_i \partial t}$. In equilibrium (when, as shown above, firms choose identical strategies), this simplifies to:

$$\frac{\partial^2 \pi_i}{\partial q_i \partial t} = \frac{\partial p_i}{\partial t} \frac{\partial d_i}{\partial q_i} + \frac{\partial^2 d_i}{\partial q_i \partial t} p_i.$$  

(10)

An increase in product market competition has two effects here. First, it lowers firms’ price-cost margins, a measure of their market power. As the transport cost $t$ falls and consumers can travel more easily, they become more sensitive to prices and qualities, thus forcing firms to compete more fiercely and to lower their margins. We call this the *rent-reduction effect* of competition. This effect of competition, represented by $\frac{\partial p_i}{\partial t} \frac{\partial d_i}{\partial q_i} = \frac{1}{6t} > 0$, has a negative impact on the marginal product of
effort. Competition also generates a business stealing effect, represented by $\frac{\partial^2 d_i}{\partial q_i \partial t} P_i$ in (10). By making demand more elastic, competition increases the (positive) marginal impact of an increase in quality on the market share one can “steal” from a rival: $\frac{\partial^2 d_i}{\partial q_i \partial t} P_i = -\frac{1}{\alpha_t} < 0$. This has a positive effect on the marginal product of effort.

Thus, rent-reduction and business stealing affect the marginal product of effort in opposite ways. In this model these two effects exactly offset each other, and competition has no impact on the marginal product of effort. These results are summarized in the following proposition:

**Proposition 1** In the first-best, product market competition has no impact on principal $i$’s $(i = 1, 2)$ net marginal benefit from eliciting an increase in effort by agent $i$. As a result, the equilibrium levels of effort/quality are independent of competition.

**Proof.** Follows directly from above. ■

### 2.3 Introducing Agency Costs: Non-Verifiable Quality

If product quality, though observable, is not verifiable,\(^\text{10}\) it cannot be contracted upon, and the optimal contract can be only be made contingent on profits. We focus on linear contracts where the agent’s payoff is of the form $W = \alpha \Pi + \beta$, and characterize the SPNE of the game.

At date 3, principal $i$ receives the following payoff: $(1 - \alpha_i) \Pi_i (q_i, p_i, q_j, p_j, t) - \beta_i$.

At date 2, principal $i$ chooses $p_i$ to maximize her expected payoff, $(1 - \alpha_i) \pi_i (q_i, p_i, q_j, p_j, t) - \beta_i$, taking qualities as given. This maximization yields the same equilibrium prices as the maximization described in (4), and hence expected profits as a function of product qualities correspond to (7).

At date 1, agent $i$ chooses $q_i$ so as to maximize his expected payoff $\alpha_i \pi_i (q_i, q_j, t) + \beta_i - K_i (q_i)$, taking $q_j$ as given. The agent choice of $q_i$ defines the IC constraint:

$$\sum_{i} \alpha_i \frac{\partial \pi_i (q_i, q_j, t)}{\partial q_i} = \frac{\partial K_i (q_i)}{\partial q_i}. \quad (11)$$

\(^{10}\)This assumption of observable quality is necessary in our model: it can be shown that no second-best equilibrium exists if we assume non-observable quality instead. Hermalin and Katz (1991) have shown that in the classic principal-agent model - in which the agent is risk averse and the principal must trade off the benefit from providing more incentives to her agent against the cost that these incentives impose on the agent in terms of risk - even if effort is non-verifiable and hence cannot be contracted upon ex-ante, the first-best outcome can be reached when effort is observable. The reason is that the principal can design an initial contract giving optimal incentives, which is then renegotiated after effort exertion, in an attempt to eliminate compensation risk for the agent. Although in our model quality (effort) is observable but not verifiable, the renegotiation proposed by Hermalin and Katz cannot occur. In our model, agency arises due to agent wealth constraint rather than risk aversion. Here agents are risk neutral and the provision of insurance in renegotiation would have no impact on ex-ante effort choices.
At date 0, principal $i$ offers contract $(\alpha_i, \beta_i)$ to agent $i$. To determine the optimal contract, the principal maximizes the following program:

$$\max_{q_i, \alpha_i, \beta_i} \pi_i - (\alpha_i\pi_i + \beta_i), \text{ subject to constraints (2), (3), and (11).} \quad (12)$$

This optimization can be simplified as follows. First, $\alpha_i$ and $\beta_i$ must be non-negative. If $\alpha_i$ were strictly negative the agent would choose zero effort. And the wealth constraint (3) - which can be expressed here as $\alpha_i\Pi_i + \beta_i \geq 0$ for all $\Pi_i$ - simplifies to $\beta_i \geq 0$ since it must hold even when the consumer does not buy the product and realized profits $\Pi_i$ are zero. Second, with $\alpha_i \geq 0$ and $\beta_i \geq 0$, the agent’s participation constraint (2) always holds, since the equilibrium expected payoff of the agent is larger than what he would get with zero effort, which itself is non-negative: $\alpha_i\pi_i(0, q_j, t) + \beta_i \geq 0$. The IR constraint can therefore be ignored. Third, since $\beta_i$ has a negative effect on the principal’s objective function and does not affect the IC, it is optimal to set as low as possible, i.e. such that the wealth constraint binds: $\beta_i = 0$. The wealth constraint can thus be replaced by $\beta_i = 0$ in the maximization program. Finally, the IC constraint (11) can be used to determine $\alpha_i^*(q_i^*, q_j, t) = \frac{\partial K_i(q_i^*, t)}{\partial q_i} + q_j$, the value of $\alpha_i^*$ necessary to elicit an effort $q_i^*$ from the agent. Substituting $\alpha_i^*(q_i^*, q_j, t)$ into the objective function, the maximization program simplifies to:

$$\max_{q_i} NP_{i}^{SB} \text{ with } NP_{i}^{SB} = \pi_i(q_i, q_j, t) - a_i^*(q_i, q_j, t)\pi_i(q_i, q_j, t).$$

Taking the FOC, the principal chooses effort level $q_i^*$ such that her marginal benefit from eliciting an increase in effort by the agent exactly equals her marginal cost of inducing such an increase:

$$\frac{\partial \pi_i(q_i^*, q_j, t)}{\partial q_i} = \frac{\partial \left[ \pi_i(q_i^*, q_j, t)\pi_i(q_i^*, q_j, t) \right]}{\partial q_i}. \quad (13)$$

It can be shown that $\frac{\partial^2 NP_{i}^{SB}}{\partial q_{i}^2} + \left| \frac{\partial^2 NP_{i}^{SB}}{\partial q_{i} \partial q_{j}} \right| < 0$ for all $t > \frac{43}{9}$, which ensures existence of a unique Nash equilibrium in effort (Vives, 1999, pp. 47-48). For all $t > \frac{43}{9}$, the symmetric equilibrium, provided it exists, must therefore be the unique equilibrium of this game. Substituting $q_i^* = q_j^* = q^*$ into (13), we obtain $q^* = \frac{2}{3} - 3t$.

Thus, in the second best the SPNE is as follows. Both principals choose to induce their own agent

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\footnote{Another way of solving this program is to solve (11) for $q_i^*(\alpha_i, q_j)$, to substitute $q_i^*(\alpha_i, q_j)$ into the objective function, and to maximize with respect to $\alpha_i$: $\max_{\alpha_i} \pi_i(q_i^*(\alpha_i, q_j), q_j, t) - \alpha_i\pi_i(q_i^*(\alpha_i, q_j), q_j, t)$. While the two methods are formally equivalent, here we use the former because it presents the SB problem in terms of optimal effort to be elicited from the agent, which can more easily be compared with the optimal effort elicited in the FB. In contrast, presenting the equilibrium results in terms of optimal share of profits to be allocated to the agent is not conducive to comparisons between FB and SB, since in the FB there are no $\alpha$’s (the principals contract directly on effort).}
to exert effort \( q^{**} = \frac{2}{3} - 3t \). To do that they offer a profit sharing contract which gives a fraction \( \alpha^{**} = 3q^{**} (t) \) to the agent. As a consequence, both agents choose effort \( q^{**} \). Prices are chosen following (6), which yields \( p_{i}^{**} = p_{j}^{**} = t \). Demands and profits are then realized, and the initial contract is honored.

**Second-Best Versus First-Best Effort**

One direct implication of the above analysis is that equilibrium effort/quality is lower in the second-best than in the first-best. To understand the intuition behind this result, let us express condition (13) as \( \frac{\partial \pi_i}{\partial q_i} = \alpha_i^{**} \frac{\partial \pi_i}{\partial q_i} + \frac{\partial \alpha_i^{**}}{\partial q_i} \pi_i \), which simplifies to:

\[
\frac{\partial \pi_i}{\partial q_i} = \frac{\partial K_i}{\partial q_i} + \frac{\partial \alpha_i^{**}}{\partial q_i} \pi_i. \tag{14}
\]

Comparing (14) with (8), we note that the principal’s marginal benefit from eliciting an increase in effort is the same in the FB and in the SB: in both case it is simply the marginal product of effort \( \frac{\partial \pi_i}{\partial q_i} \). We also note that the marginal cost of eliciting an increase in effort is higher in the second-best. Indeed, the SB marginal cost is the sum of the FB marginal cost, \( \frac{\partial K_i}{\partial q_i} \) and another factor, \( \frac{\partial \alpha_i^{**}}{\partial q_i} \pi_i \), which can be shown to be strictly positive. This second factor is the marginal agency cost of inducing effort: it measures the increase in the fraction of profits which must be paid out to the agent to induce him to increase effort.

Thus, taking effort \( q_j \) as given, for principal \( i \) the net marginal benefit from eliciting an increase in effort is lower in the second-best than in the first-best, and hence the optimal effort principal \( i \) chooses to induce her agent to exert is lower. In other words, principal \( i \)’s reaction curve shifts down. Principal \( j \)’s reaction curve shifts in the same way, and in our symmetric equilibrium the two principals induce a lower effort from their agents. We summarize these results in the following proposition:

**Proposition 2** For any given rival effort/quality \( q_j \), principal \( i \)’s net marginal benefit from eliciting an increase in effort is lower in the second-best than in the first-best. As a result, in the symmetric equilibrium both principals elicit an effort/quality level that lower in the second-best than in the first-best: \( q^{**} < q^* \) for all \( t \in \left( \frac{4}{9}, \frac{2}{9} \right) \).

**Proof.** Follows directly from above. ■

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\[\text{To see why } \alpha_i^{**} \frac{\partial \pi_i}{\partial q_i} = \frac{\partial K_i}{\partial q_i}, \text{ recall that } \alpha_i^{**} = \frac{\partial K_i}{\partial q_i} / \frac{\partial \pi_i}{\partial q_i}. \text{ Substituting this into } \alpha_i^{**} \frac{\partial \pi_i}{\partial q_i} \text{ gives the stated result.}
\]

\[\text{This expression easily simplifies to } (3t - q_j)/2. \text{ Writing out } \alpha_i^{**} (q_i^{**}, q_j, t) \text{ as } \alpha_i^{**} = \frac{9q_i^{**}}{3 \sigma(q_i^{**} - q_j)}, \text{ we see that 3t - q_j > 0, otherwise, } \alpha_i^{**} > 1 \text{ for all } t \in \left( \frac{4}{9}, \frac{2}{9} \right), \text{ which is not feasible.}\]
Product Market Competition in the Second-Best

Consider expression (14). The effects of competition on principal i’s net marginal benefit from an increase in effort must occur via the marginal agency cost $\frac{\partial \alpha^*_i}{\partial q_i}$, since we already know from our analysis of the effects of competition in the first-best that neither the marginal product of effort $\frac{\partial \pi_i}{\partial q_i}$, nor the agent’s marginal cost of effort $\frac{\partial K_i}{\partial q_i}$ are affected by competition.

The marginal agency cost is the increase in the fraction of profits that must be relinquished to the agent to elicit an increase in effort, $\partial \alpha^*_i/\partial q_i$, weighted by expected profits, $\pi_i$. The impact of competition on expected profits can be readily understood. Looking back at (7) we see that both price and expected demand depend on $t$: $\frac{\partial \pi_i}{\partial t} = \frac{\partial p_i}{\partial t} d_i + \frac{\partial d_i}{\partial t} p_i$, where the first and second factors represent rent-reduction and business stealing effects, respectively. Since in equilibrium both firms offer the same quality, the business stealing effect disappears, and only rent reduction, which tends to decrease profits, remains: $\frac{\partial \pi_i}{\partial t} = \frac{\partial p_i}{\partial t} d_i = \frac{1}{2} > 0$.

To understand the impact of competition on $\partial \alpha^*_i/\partial q_i$, recall the IC condition: $\alpha_i \frac{\partial \pi_i}{\partial q_i} = \partial K_i/\partial q_i$. The agent chooses his effort such that his marginal cost of effort, $\partial K_i/\partial q_i$, exactly equals his expected marginal benefit from exerting that effort, $\alpha_i \frac{\partial \pi_i}{\partial q_i}$. Inducing an increase in effort means that the agent’s marginal cost of effort rises by $\partial^2 K_i/\partial q_i^2$, and hence his expected marginal benefit must rise by the same amount. This can only happen if the principal increases incentives $\alpha_i$, and $\partial \alpha^*_i/\partial q_i$ represents that increase.

The size of this necessary increase, $\partial \alpha^*_i/\partial q_i$, depends on the convexity of expected profits, $\partial^2 \pi_i/\partial q_i^2$, relative to that of the cost of effort, $\partial^2 K_i/\partial q_i^2$. Indeed, when increasing effort, the agent is compensated for the increase in marginal cost of effort in two ways. First, the market “rewards” the agent directly through an increase in the marginal product of effort, and this is measured by $\partial^2 \pi_i/\partial q_i^2$. This does not compensate the agent fully for the increase in marginal cost, and hence he must also be compensated through an increase in incentives, measured by $\partial \alpha^*_i/\partial q_i$. Clearly, ceteris paribus, the more convex the expected profits function, the larger the market reward for increasing effort, and the smaller the increase in incentives needed to elicit more effort. In other words, as the convexity of profits increases, the agent essentially substitutes explicit incentives from the principal for direct market reward, and hence $\partial \alpha^*_i/\partial q_i$ falls: it becomes cheaper for the principal to elicit an increase in

\begin{itemize}
  \item Since 1) $\alpha_i < 1$, and 2) the FB second-order condition implies that $\partial^2 \pi_i/\partial q_i^2 < \partial^2 K_i/\partial q_i^2$, the only way $\alpha_i \frac{\partial \pi_i}{\partial q_i}$ can be increased by an amount equal to $\partial^2 K_i/\partial q_i^2$ is by increasing $\alpha_i$.
  \item Recall from (15) that expected profits are convex in effort.
  \item More formally, using the implicit function theorem it can be shown that $\frac{\partial \alpha^*_i}{\partial q_i} = -\frac{\alpha_i^* \partial^2 \pi_i/\partial q_i^2 - \partial^2 K_i/\partial q_i^2}{\partial \pi_i/\partial q_i}$. 
\end{itemize}
Competition reduces $\partial \alpha_i^{**}/\partial q_i$ because it increases the convexity of expected profits as a function of effort. To see this, simply differentiate (9) with respect to $q_i$:

$$\frac{\partial^2 \pi_i}{\partial q_i^2} = \frac{\partial p_i}{\partial q_i} \frac{\partial d_i}{\partial q_i} + p_i \frac{\partial^2 d_i}{\partial q_i^2} + \frac{\partial d_i}{\partial q_i} \frac{\partial p_i}{\partial q_i} + d_i \frac{\partial^2 p_i}{\partial q_i^2} = 2 \frac{\partial d_i}{\partial q_i} \frac{\partial p_i}{\partial q_i} > 0,$$

(15)

since, looking back at (7), we see that $\frac{\partial p_i}{\partial q_i} = \frac{1}{3}$, $\frac{\partial d_i}{\partial q_i} = \frac{1}{6t}$, and $\frac{\partial^2 d_i}{\partial q_i^2} = \frac{\partial^2 p_i}{\partial q_i^2} = 0$. Clearly, since the marginal impact of an increase in effort on price, $\frac{\partial p_i}{\partial q_i}$, and on expected demand, $\frac{\partial d_i}{\partial q_i}$, are positive, profits must be a convex function of effort. Moreover, while $\frac{\partial p_i}{\partial q_i}$ is independent of $t$, the business stealing effect of competition increases $\frac{\partial d_i}{\partial q_i}$, and hence $\frac{\partial^2 \pi_i}{\partial q_i^2}$. Formally, $\frac{\partial^3 \pi_i}{\partial q_i^3} = -\frac{1}{9t^2} < 0$.

Both $\pi_i$ and $\partial \alpha_i^{**}/\partial q_i$ fall with competition, reducing the principal’s marginal agency cost of eliciting effort. For a given rival effort/quality $q_j$, competition reduces principal $i$’s marginal agency cost of eliciting an increase in effort, and hence increases the net marginal benefit from a quality increase. As a result, the optimal effort she chooses to elicit is higher. In other words, principal $i$’s reaction curve shifts up. In our symmetric equilibrium, principal $j$’s reaction curve shifts up in the same way, and in equilibrium the two principals induce a higher effort from their agents. We summarize these results in the following proposition:

**Proposition 3** For any given rival effort/quality $q_j$, principal $i$’s net marginal benefit from eliciting an increase in effort increases with competition. As a result, in the symmetric equilibrium both principals elicit higher effort/quality when competition intensifies: $\frac{\partial \alpha_i^{**}}{\partial t} = -3 < 0$ for all $t \in \left(\frac{4/3}{9}, \frac{2}{3}\right)$.

**Proof.** Follows directly from the above. ■

The key intuition for proposition 3 can be captured simply as follows. When the principal elicits an increase in effort, the agent’s marginal cost of effort rises and he must be compensated. The agent, who is paid a fraction of profits, is compensated for his higher marginal cost in two ways: partially through a rise in $\alpha$, and partially through a rise in the marginal impact of his effort on expected profits. The business stealing effect of competition, by increasing the impact of an effort increase on the agent’s marginal product of effort, rewards the agent directly, and hence reduces the compensation

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17 This dependence on second-order differentials (convexity) is not surprising. In the SB, the principal’s maximization program is subject to the agent’s IC constraint, which itself is the result of a maximization, and hence contains first-order differentials. Including that constraint into the principal’s program and differentiating for optimization therefore generates second-order differentials.
that must come from the principal in the form of a higher $\alpha_i$.\textsuperscript{18} Thus, eliciting an increase in quality becomes cheaper for the principal, and competition yields higher quality/effort in equilibrium.

### 2.4 Discussion of the Theoretical Results and Empirical Implications

Three stark, unambiguous empirical predictions emerge from our model (they are represented graphically in figure 1):

**Prediction 1:** Proposition 2 implies that the importance firms place on quality improvements and effort exerted by agents should be lower in firms that are plagued by agency costs than in firms that are not.

**Prediction 2:** Proposition 1 implies that in firms where agency costs are absent, competition has no impact on the importance firms place on quality improvements and hence on incentives and effort. In other words, the direct pressure effect of competition is null.

**Prediction 3:** Proposition 3 implies that, in firms that are plagued by agency costs, competition reduces the marginal agency cost associated with increased effort. In increases net marginal benefit from increased effort, and leads to increases in incentives, effort, and quality.

These predictions, and the key theoretical results of the paper, hinge on 4 conditions.\textsuperscript{19}

1) The direct pressure effect of competition is a function of the effect of competition on the marginal impact of effort on expected profits, $\frac{\partial^2 \pi_i}{\partial q_i \partial t}$. In our Hotelling model, $\frac{\partial^2 \pi_i}{\partial q_i \partial t} = 0$ in equilibrium (condition 1), and this is why the direct pressure effect is null. As shown in recent work by Vives (2004) on competition and innovation (without agency costs), the direct pressure effect is also null in Salop circle and Logit models, but positive in linear\textsuperscript{20}, CES, and constant expenditure models. This positive impact is not inconsistent with the more general implication of our model; it suggests that in these demand systems, $\frac{\partial^2 \pi_i}{\partial q_i \partial t} < 0$, which is likely due to the dominance of business stealing over rent reduction in these other demand specifications.

2) For the agency cost effect of competition to have a positive impact on managerial effort, three conditions must be met: i) Competition must increase the convexity of expected profits as a function

18Note that this effect of competition is not dependent on the convexity of expected profits with respect to effort, but rather on the positive impact of business stealing on that convexity. The same effect would obtain with concave expected profits, as long as competition reduces the concavity (i.e. increases the convexity) of expected profits.

19This is conditional on the existence and uniqueness of a SPNE, which in our model requires $t \in \left(\frac{4/3}{9t}, \frac{2}{9t}\right)$, and assumptions about non-observability of the rival contractual offer, and observability of quality (see footnotes 9 and 19 for details).

20To be precise, Vives finds a positive impact of competition with Shapley/Shubik linear demands, but a negative impact with Bowley linear demands.
of effort, $\frac{\partial^3 \pi_i}{\partial q_i \partial \theta}$ < 0. ii) Competition must decrease expected profits, $\frac{\partial \pi_i}{\partial T}$ > 0. And iii), the agent’s compensation must be contingent on realized profits. Conditions 2i), 2ii), and 2iii) ensure that competition reduces the marginal agency cost of an effort increase, via the “market reward” to the agent.

As mentioned in the introduction, other papers in the literature do not explicitly isolate the agency effect of competition from the direct pressure effect, and can therefore neither confirm nor contradict our empirical predictions. Aside from that, these models differ mainly in that they do not verify the conditions just presented. Hart (1983), Scharfstein (1988), and Hermalin (1992), for example, use very different models of agency and competition, and none of the above 4 conditions hold. While Hart’s (1983) and Scharfstein’s (1988) models have the interesting particularity of relying on hidden information rather than hidden action, Hermalin (1992) looks at the effect of competition when the manager, rather than the shareholders, have ex-ante bargaining power.

Schmidt (1997) uses a model similar to ours, with a risk-neutral but wealth constrained agent, but offers different results for two reasons. First, due to the generality of his assumptions about the competitive environment, he cannot sign his “relative-value-of-managerial-actions” effect, which is related to our direct pressure effect. More importantly, his model does not yield an agency effect of competition, because in his binomial framework, the agent’s compensation is contingent on the state of the world (good or bad) rather than on realized profits, and hence condition 2iii) stated above does not hold.

Raith (2003) also offers different predictions, despite a similar model of competition (Salop circle) which satisfies our conditions 1 ($\frac{\partial^2 \pi_i}{\partial q_i \partial \theta} = 0$), 2i) and 2ii). In his model, the effects of competition occur exclusively through a change in the number of rivals in the industry, and hence require the assumption of free entry. If instead our (implicit) assumption of barriers to entry and a fixed number of firms is made, competition has no impact in his framework. This may result from his use of a “classic” agency model with risk-averse agents and a tradeoff between incentives and insurance. But it is likely also due to his assumption that the agent’s effort affects cost and that agent compensation is cost-contingent rather than profit-contingent; i.e. to the fact that our condition 2iii) does not hold in his model.21

We now turn to the data and test the empirical validity of the predictions of our model.

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21Note that in our model the agency effect of competition would still arise even if the agent’s effort affects the cost of production as in Raith, as long as costs are assumed to be non-verifiable and the agent’s compensation must be made contingent on profits.
3 Data

We are fortunate to have access to a unique dataset that includes several measures of product market competition, indications of firm’s choices of quality, the structure of employee contracts and employee level measures of effort, providing us with an excellent opportunity to test our theoretical predictions. The Workplace and Employee Survey (WES) - conducted by Statistics Canada with the support of Human Resources Development Canada – is a very rich longitudinal data set that consists of two components. 1) The workplace survey of approximately 6300 firms provides information on work organization and organizational change, competitive environment, business strategy, innovation, and firm performance. 2) The employee survey of approximately 25000 employees in the same workplaces, which contains information on compensation, human capital, training, work hours and arrangements, and promotions. Taken together, these two components generate approximately 1000 firm and employee specific variables and an unprecedented opportunity to examine the connection between competition, contractual incentives and effort. To the best of our knowledge, a comparable data set does not exist anywhere in the world. The WES data is relatively new, and to date has been predominantly used within Statistics Canada and by a small group of labour economists, though its potential for other applications is tremendous.

WES was first conducted in 1999 and re-administering annually to the selected cohort of firms for the next six years. WES is a linked employer-employee file. Employers are sampled by physical locations and employees are then sampled from employer-provided lists within each location. The survey covers all industries except farming, fishing, trapping and public administration and all regions of Canada with the exception of the arctic territories (the Yukon, Northwest Territories and Nunavut). Currently, data for 1999, 2000 and 2001 are available for analysis, and the response rate for workplaces in each of these years is over 95%. The questions about firm strategy, which are used to construct our measures of the emphasis firms place on quality improvements, were asked in 1999 and 2001 but not in 2000. In addition, our empirical model incorporates control variables from t-1, eliminating the use of strategy responses from 1999 as dependent variables. As a result, our main set of dependent variables is derived from the 2001 WES, with independent variables drawn from both 2001 and 2000.

The process of sample selection for WES stratified businesses in Canada into relatively homogeneous groups which were then used for sample allocation and selection. Businesses were classified by fourteen industry classifications, six regional classifications and three employment size categories,
resulting in 252 possible strata. The strata were constructed so as to maximize variation between strata and minimize variation within strata. Firms are sampled using Neyman allocation, meaning firms are sampled randomly from within each strata, however, the choice of how many firms to sample from each strata depends not just on how many firms are in the strata (a strata with 10% of the population does not necessarily have 10% of the sample) but on how much variation there is within the strata. More firms are sampled from strata with higher variances and fewer from strata with lower variances. To compensate for the uneven number sampled, each sampled units is assigned a sampling weight based on its probability of selection. For example, if three workplaces were selected at random and with equal probability from a population of thirty workplaces, then the selected workplaces would represent ten units in the population and be assigned a sampling weight of ten. Using these strata and weighting techniques, the survey was designed in such a way as to make it possible to estimate unbiased parameters which reflect the underlying population, despite the fact that each workplace in Canada did not have an equal probability of selection.  

All of our analysis is conducted with techniques expressly designed for surveys. We control econometrically for selection as each observation did not have an equal probability of being sampled. We control for clustering since observations at the employee level are not sampled independently from the population of Canadian workers, they are chosen from within the surveyed firms. And we control for stratification, in our case firms were sampled from 252 strata based on size, region and industry, and sampling within each strata was random, but unequal across strata. Statistics Canada has calculated survey weights for each observation based on probability of selection, sample clustering and stratification, and these weights are used in all of our analysis. In addition, in all regressions, bootstrapping is used to correct standard errors for the survey design.  

This paper uses survey data which has many advantages, but suffers from some lack of objectivity. While the considerable care and attention that went into the construction and validation of WES has minimized many of the problems faced by surveys conducted without the expertise and financial backing of a national statistical agency, this may not have resolved all possible forms of bias. A common criticism of this type of data is that firm’s self reports will be systematically biased - over

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22 see the Guide to the Analysis of the Workplace and Employment Survey for further details

23 To compute the variances for estimates based on samples coming from finite populations, it is important to account for the sample design. Estimation using only weights, without accounting for design, results in the underestimation of the variance. This could have dire consequences for hypothesis testing and for constructing confidence intervals. Accordingly, a bootstrapping procedure is required. This technique is based on re-sampling. Using the original sample, from which a simple random sample is selected with replacement of as many units there were at the outset. This procedure is repeated many times to guarantee consistency. We use these bootstrap weights in all analysis.
reporting profits and under reporting costs, for example. While this may well be the case, we find no reason to suggest that an upward bias in, for example, the firm’s self report of the importance of quality improvements, would be correlated with our measures of competition. Another potential bias introduced by the use of survey data occurs because the individuals completing the survey have different scaling attitudes. Some tend to consistently use higher ratings and others lower ratings - this increases the “noise” in our data and likely inflates our standard errors. Following Cooper and Emory (1995), we note that differences in scaling attitudes do not introduce a systematic bias, and if anything, by increasing standard errors, lead to more conservative results.

4 Methodology

4.1 Firm Strategy

The theoretical structure developed above suggests that competition affects firms’ strategies by changing the net marginal benefit from eliciting an increase in effort (quality) from their employees; and this in turn leads to higher powered incentives and to higher employee effort. In this subsection we examine the first step, i.e. the impact of competition on the net marginal benefit from a quality increase, and the resulting impact on incentives and effort is analyzed in the next subsection. Consider the basic regression equation:

\[
QUAL = \lambda_0 + \lambda_1 COMP + \lambda_2 AGENCY + \lambda_3 COMP \times AGENCY + \lambda_4 CONTROL + \epsilon. \quad (16)
\]

Variable \(QUAL\) represents the importance a firm places on quality improvements, \(COMP\) describes the degree of competition in that firm’s product market, where \(COMP\) is akin to our competition measure \(\frac{1}{2}\) from the previous section, \(AGENCY\) measures whether or not agency costs are present in the firm, \(CONTROL\) is a vector of control variables and \(\epsilon\) is an error term. Equation (16) allows us to look at how competition affects the firms’ provision of quality, and whether that effect is tempered by the presence or absence of agency costs. We are particularly interested in the sign and significance of \(\lambda_3\) which will indicate how agency costs temper the effects of competition. In our theoretical model, competition only alters quality via a reduction in agency costs, so we expect the direct effect of competition (\(\lambda_1\)) to be insignificant, but the indirect effect, \(\lambda_3\), (via agency costs) to be positive.
and significant. We obtain measures of all variables from the WES data set.

**Importance of Quality Improvements (and of Cost Reductions)**

Variable $QUAL$ is measured using a question asking firms to rank the relative *importance* of improving product or service quality in their workplace’s general business strategy. Firms rank the importance of quality as either 1 for “not applicable,” or describe the strategy’s importance on a scale of 2 to 6 where 2 is “not important” and 6 is “crucial.” To test our theoretical model, we would like a measure that indicates a firms’ net marginal benefit from eliciting an increase quality. The higher the principal’s net marginal benefit from a quality increase, the more important that quality increase will be for her. Assuming that the principals’ choices permeate throughout the firm, and that strategic priorities at the level of the firm reflect these choices, then “the importance firms place on a quality improvement” should be a good measure of principals net benefit from a quality increase.

As noted in subsection 2.2, our the model predicts the same effects of competition on cost reduction as it does on quality improvement. The same question is asked with regards to the importance of quality is also asked regarding the importance of cost reductions and we use these questions to test both outcomes. In some of our specifications, $QUAL$ is replaced by the importance of cost reductions ($COST$). The specific wording of these, and all other questions used in this paper, can be found in the appendix.

**Product Market Competition**

Recall from our theory section that in markets with lower unit transport cost $t$, products are more substitutable - indicating more intense competition. We are fortunate that WES provides us with a measure of competition which closely mirrors our theoretical structure. We measure competition using firm’s self report as to what extent different classifications of firms offer “significant” competition (again on a scale of 2 to 6) to their business, where significant competition refers to “a situation where other firms market products/services similar to your own which might be purchased by your customers.” Rating competition using the similarity or your products those of other firms, and the possibility that these other products might be purchased instead of your own, is a good proxy for the substitutability of your products vis a vis competitors. Firms are asked to rank the significance of competition, as described above, from four types of firms: i) locally owned, ii) Canadian owned, iii) American owned, and iv) internationally owned firms. The value of $COMP$ is set to one for firms indicating they face no competition from other firms. For all other firms, $COMP$ is set to the *maximum* level of competition indicated from any type of firm. For example, if a firm indicates no competition from American or
Internationally owned firms, but indicates that the competition created by Canadian owned firms is “important” (4) and that competition from locally owned firms is “crucially” significant (6), then that firm’s value of \( COMP \) is 6.\(^{24}\)

Our theoretical model gives no indication that the source of competition, in terms of the geographic ownership of competing firms, should alter the effects of competition. We are interested in the substitutability of products and services, regardless of who owns the firms producing those products/services. Accordingly, we use the firm’s rating of competition from \( \text{any} \) type of competitor. Similarly, it does not matter which firms, or how many types of firms, offer little competition. We are interested in the general level of competition faced by the firm, which we must infer from the four WES questions regarding competition from firms of ownership types i-iv described above. If firms were asked the more general question: “To what extent do you face significant competition to your business,” we would expect firms to report the competition level they faced based on their most important competitors. Accordingly, we measure competition as the maximum reported level rather than the mean, median, or some other measure.\(^{25}\)

**Agency Costs**

The measurement of agency costs is notoriously difficult. While recognizing that we do not have a perfect measure of agency costs, the WES data set does provide us with some excellent proxies for the importance of agency costs within a firm (variable \( AGENCY \) in equation (16)). Our primary measure is a variable which equals 1 if the firm has more than one employee and 0 if the firm has only one person working at the company. In this manner, we separate entrepreneurial firms, where the owner, manager and employee are one in the same, from larger firms where decisions are made by at least one person in addition to the owner.\(^{26}\) This effectively divides our sample into firms with no agency costs and firms with at least some agency costs, consistent with our theoretical model where agency costs are either present in or absent from the firm. 6% of firms (which represents approximately 335

\(^{24}\)While competition is a categorical variable (equaling 1, 2, 3, 4, 5 or 6), it has been included directly on the right hand side rather than as a set of dummy variables for ease of interpretation. However, all specifications were re-estimated with dummy variables and our results were consistent with the slope suggested by the direct inclusion of the categorical competition variable.

\(^{25}\)All of our specifications were also estimated with alternative measures of competition, including the average level of competition faced by a firm across all markets and firms and the median level of competition. To provide a more objective measure of competition, we used another Statistics Canada data source, the T2-LEAP file, to construct a CR4 by industry and region. In all cases, the results were consistent with those reported below.

\(^{26}\)All firms in our sample have at least one "employee", defined as at least one person "working at the business". We can not be certain this one person is in fact the owner, however, we would expect that most firms with only one person performing tasks, would be sole proprietorships. Even if a small number of firms indicating one worker were in fact firms owned by an individual who does not work in the business, and the worker in question was an employee in the classical sense, we would still expect these firms to have extremely low agency costs relative to larger firms.
firms) in our sample have only one employee, while the remainder have more than one employee.

Recognizing that agency costs are difficult to capture, we used alternative measures to evaluate the robustness of our criteria. Following Jensen and Meckling (1976), increased equity ownership by insiders reduces agency costs. In the finance literature, a commonly used measure of agency costs is the ratio of internal equity to external equity. While our data does directly indicate the quantity of firm equity owned by employees (insiders), we do know whether or not employees have stock purchase plans as part of their compensation package. We assume that firms with such a package are more likely to have a greater share of insider ownership (lower agency costs) than those that do not use equity in their compensation packages. Accordingly, we develop an alternative measure of agency costs as a categorical variable equalling 1 if employees do not have stock purchase plans and 0 if they do. 17% of firms in our sample have stock purchase plans as a part of employee compensation.

**Firm level control variables**

The firm level control variables, are included to compensate for a number of alternative influences on the quality and cost choices of a firm. We control for the size of the firm using the natural log of employees as we may expect scale to influence strategic choices. Note that while we use the same underlying data source (number of employees) to develop our dummy variable measure of agency costs, we exploit the nonlinear features of the data to capture in our functional form both the threshold effect (existence or non-existence of agency costs) and control for the log effect (economies of scale) separately. Firm profits are included as the availability of cash may influence investments in quality improvements, or alter the urgency of cost reductions. We also control for “industry leaders” - defined as the one third of firm’s whose self report of productivity is “better” or “much better” than their competitors. For tractability reasons, our theoretical model assumed symmetric firms with identical productivity levels. However, it could easily be shown that with asymmetric firms, the productivity “leader” would place more importance on quality than its less productive competitor, and accordingly we control for relative productivity.

**4.2 Incentives and Effort**

Our theoretical model suggests that as a result of its impact on principals’ net marginal benefit from quality improvements, firms offer stronger incentives to their employees (agents), who in turn exert more effort. In this subsection we examine the impact of competition on contractual incentives and

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27See for example: Capozza and Seguin (2003).
employee effort. We are fortunate to be able to match our firm level quality and cost data to employee level data for incentives and effort to test these predictions as well. Modifying equation (16) for estimation at the employee level gives:

\[ INCEN = \lambda_0 + \lambda_1 \text{COMP} + \lambda_2 \text{AGENCY} + \lambda_3 \text{COMP} \times \text{AGENCY} + \lambda_4 \text{CONTROL} + \epsilon, \]  

(17)

where \( INCEN \) in this case represents the incentives offered to employees. In later specifications, our dependent variable \( INCEN \) is replaced with \( EFFORT \), a measure of employee effort.

Incentives

We measure the incentives offered to agents as the share of total renumeration each employee derives from “variable” sources. These variable sources include commissions, tips, profit sharing, productivity bonuses and piecework. This incentive measure captures the intensity of incentive based pay in an employee’s total renumeration. It depends on both the structure of the contract offered to the agent, as well as the performance of the firm and industry. Ideally, to correspond with our theoretical model, we would have a measure of incentives that reflected only the intensity of incentives offered to the agent in his or her contract rather than the realization of incentives which is influenced by both the contract and other factors. This type of measurement error is common in the incentives and compensation literature.\(^{28}\) We compensate for the effect of firm and industry on realized incentives by controlling for firm level performance (profits) and with industry fixed effects. We examine the robustness of our results by replacing the dependent variable with a dummy variable equaling 1 if the employee reported any variable pay and 0 otherwise (estimation by probit), as well as a firm level regression where the dependent variable equals 1 if the firm offers any type of incentive based contracts and 0 otherwise. In all cases, the results for competition, agency costs, and the interaction between competition and agency are of the same sign, significance and relative magnitude as those reported with our main measure.

Effort

Any measure of the amount of effort an employee exerts in his or her job is by nature somewhat subjective. We choose to measure the effort exerted by an agent using the most objective measure available to us - the employee’s self report of the number of hours of \textit{unpaid} overtime, he or she usually

\(^{28}\)See for example: Baker and Hall (2004) and Bushman and Smith (2001).
worked per week. Admittedly, “effort” and “number of hours” are not necessarily equivalent. An employee does not need to work for more hours to work harder, however, we would expect considerable positive correlation between effort and hours of unpaid overtime. Unpaid overtime is predominantly voluntary, and not contracted by the employer. Employees who choose to work overtime hours for which they are not paid, are effectively choosing to put more effort into their job. Accordingly, we view the number of hours of unpaid overtime worked as a reasonable proxy for effort. In our sample, 24% of employees report some unpaid overtime, with the remainder indicating no hours of unpaid overtime. For robustness, we repeated our estimation using only those employees that worked unpaid overtime. We also replaced the dependent variable with a dummy variable equaling 1 if the employee reported any unpaid overtime and 0 otherwise (estimation by probit), as well as using the total number of hours an employee worked as the dependent variable. Our results were consistent.

**Employee specific control variables**

The employee specific control variables, are included to compensate individual characteristics which may influence effort or variable pay. We control for the employees level of education, age, gender, marital status and whether he or she has dependent children. We also control for whether he or she supervises other employees, or is a member of a collective bargaining agreement.

**Endogeneity Issues**

One of the key difficulties in determining the effects of competition on firm strategy or performance is that these effects are to some degree endogeneous. We expect that not only will competition affect firm behaviour, but that in some cases, the behaviour of firms will have some affect on the amount of competition in the product market. We have compensated for this issue in estimation in several ways. First and foremost, our measure of competition both theoretically and empirically captures the degree of substitutability between products, not the competitive behaviour of the firm. While the importance of quality improvements, incentives, and effort may lead to a more or less aggressive competitive behaviour amongst rivals, it is less clear that they will affect the degree of substitutability between products.

Second, we have used measures of the level of competition in the previous year to determine strategies, incentives and effort in the current year. While it is certainly possible that a firm’s quality improvements in one year will affect the level of competition in future periods, it is much less clear that quality in the current year affects competition in the previous year.

Third, we have used industry and regional fixed effects in all specifications. This controls for any
industry specific trends which might influence competition - for example industries which, as a result of some external factor, have similar incentive based pay systems across firms, or an industry wide trend toward cost reduction.

Fourth, our sample is composed primarily of small firms operating in large markets. Some 40% of the firms in our sample have more than 20 competitors in their local market, and 72% of firms report that at least one ownership grouping of firms offering “important” competition to their businesses. In addition, 43% of firms in our sample have less than 20 employees and 70% have less than 100 employees. Small firms are less likely to have significant market power, particularly in more competitive markets, and it is accordingly less likely for the actions of those firms to significantly affect the amount of competition in the product market. Since this type of firm dominates our sample, we expect fewer issues of engogeneity at the firm level. To further confirm the robustness of our results, we re-ran all of our specifications for the subsample of firms with less than 20 employees and more than 20 firms in their local market, and our findings were consistent with those reported above.

Despite our best efforts, it remains a possibility that our competition measure is somewhat upwardly biased due to endogeneity. It is possible that the importance of quality improvements and of cost reductions lead to more competition or that more incentives and effort may also increase competition amongst firms. While our results should be viewed with some caution as a result, we remain confident that the precautions described above have to a large degree compensated for endogeneity.

5 Main Empirical Results

Some descriptive statistics for our main variables of interest can be found in Table 1. The table is self explanatory; but note however that both the number of employees and profits are highly skewed, resulting in our use of the log of these variables empirically.
5.1 Competition and Firm Strategy

We begin by estimating equation (16) by ordered probit, with each observation weighted using the survey weights described in the previous section, to provide unbiased point estimates. Our main empirical results can be found in Table 2. Ordered probit is used as our dependent variable is categorical - taking on values from 2 to 6, and ordinal - the importance of quality improvements (or cost reductions) increases with higher numbers. Columns 1 and 3 refer to specifications with the dependent variable being the importance of quality improvements and columns 2 and 4 use the importance of cost reductions as the dependent variable. Columns 1 and 2 use our base measure of agency, while columns 3 and 4 use the existence of employee stock purchase plans.

Effects of Competition

To analyze the effect of a change in competition on the importance firms place on quality improvements and cost reduction, we differentiate $QUAL$ with respect to $COMP$ in (16). This gives:

$$\frac{\partial QUAL}{\partial COMP} = \lambda_1 + \lambda_3 * AGENCY.$$  

Since both of our measures of agency costs used in columns 1-4 are dummy variables, the empirical predictions of our theoretical model, concerning the effects of competition, can be neatly cast in terms of the coefficients $\lambda_1$ and $\lambda_3$.

Prediction 2 states that, due to a zero direct pressure effect, when agency costs are absent ($AGENCY = 0$) competition should have no impact on the importance firms place on quality improvements and cost reductions. The implication in our specification is therefore that $\lambda_1$ should not
| Dependent Variable                                      | Quality 1 | Quality 2 | Quality 3 | Quality 4 | | Cost 1 | Cost 2 | Cost 3 | Cost 4 |
|--------------------------------------------------------|-----------|-----------|-----------|-----------|---|---|---|---|
| Level of Competition                                   | 0.240**   | 0.227**   | 0.261**   | 0.102**   | (0.084) | (0.077) | (0.085) | (0.022) |
| =intensity of competition (scale of 2 to 6)             |           |           |           |           |   |   |   |   |
| Agency Cost                                            | -0.789**  | -1.712**  |           |           | (0.296) | (0.588) |       |       |
| =1 if firm has more than one employee, 0 otherwise     |           |           |           |           |   |   |   |   |
| Competition * Agency                                    | 0.122*    | 0.157**   |           |           | (0.060) | (0.046) |       |       |
| =level of competition * agency cost                     |           |           |           |           |   |   |   |   |
| Employee Stock Ownership                                |           |           |           |           | -0.297** | -0.932* |       |       |
| =1 if employee(s) do not have a stock purchase plan    |           |           |           |           | (0.151) | (0.449) |       |       |
| 0 otherwise                                            |           |           |           |           |   |   |   |   |
| Competition * Employee Stock                           |           |           |           |           | 0.054* | 0.179* |       |       |
| =level of competition * employee stock ownership       |           |           |           |           | (0.023) | (0.086) |       |       |
| Firm Size                                              | 0.208**   | 0.133**   | 0.196**   | 0.148**   | (0.031) | (0.035) | (0.030) | (0.031) |
| =ln(total employees)                                   |           |           |           |           |   |   |   |   |
| Profits                                                | 0.001     | 0.002*    | 0.001*    | 0.001     | (0.001) | (0.001) | (0.0004) | (0.001) |
| =ln(revenues less expenditures)                        |           |           |           |           |   |   |   |   |
| Industry Leader                                        | 0.395**   | 0.044     | 0.390**   | 0.040     | (0.076) | (0.086) | (0.075) | (0.086) |
| =1 if productivity in top third of firms               |           |           |           |           |   |   |   |   |
| 0 otherwise                                            |           |           |           |           |   |   |   |   |
| Industry and Region Fixed Effects                      | YES       | YES       | YES       | YES       |       |   |   |   |
| Number of Observations                                 | 4732      | 4541      | 4732      | 4541      |       |   |   |   |

** = significant at 1%, * = significant at 5%. Standard errors in parentheses.
be significantly different from zero. This prediction is not supported by the data: the coefficient of the level of competition variable is significantly positive at the 1% level in all four specifications, which suggests that empirically the direct pressure effect of competition is positive, rather than null.

We conjecture that the discrepancy between the prediction 2 and the data comes from the specificity of the Hotelling model. As discussed in subsection 2.4, our theoretical framework can be readily generalized to other demand systems in which the direct pressure effect of competition, which depends on the marginal impact of managerial effort on expected profits, is positive. This is the case, for example, of some linear models, as well as CES, and constant expenditure models (Vives, 2004). Thus, the positive significance of $\lambda_1$ is not necessarily inconsistent with the more general implication of our model. It may result from a positive marginal impact of effort on profits, likely due to the dominance of business stealing over rent reduction, and perhaps better captured in other demand systems such as the ones mentioned above.

Prediction 3 of our theoretical model states that there exists a positive agency effect of competition which appears only in firms plagued by agency costs. In other words, $\lambda_3$ should be significantly positive. Prediction 3 is consistent with the data. The coefficient of the competition/agency interaction in table 2 is positive and significant at least at the 5% level in all columns.

Note that previous theoretical literature, since it does not disentangle the agency effect from the direct pressure effect of competition, remains silent about the sign of $\lambda_1$ and $\lambda_3$.

Effects of Agency

Turning to the effect of agency on the importance firms place on quality improvements and cost reduction, we differentiate $QUAL$ with respect to $AGENCY$ in (16). This gives: $\frac{\partial QUAL}{\partial AGENCY} = \lambda_2 + \lambda_3 * COMP$.

Prediction 1 from our theoretical model states that the importance firms place on quality improvement and on cost reductions should be lower in firms that are subject to agency costs than in firms that are not. This “direct effect” of agency costs is perhaps best captured by $\lambda_2$, and consistent with the prediction, the coefficient of the agency dummy, is negative and significant at least at the 5% level in all columns.

Prediction 1 also implies that the impact of agency costs should be true for any given degree of competition in the industry. Empirically, this implies that the sum $\lambda_2 + \lambda_3 * COMP$ should be significantly negative for possible values of $COMP$ (from 1 to 6). In other words, the direct negative impact of agency costs $\lambda_2$ should always dominate the positive indirect impact of agency through
competition, $\lambda_3 \ast COMP$. Looking back at table 2, this prediction is consistent with the data in specifications 1 and 2, where the total impact of agency costs $\lambda_2 + \lambda_3 \ast COMP$ is negative for all possible values of $COMP$. In specifications 3 and 4, the total impact of agency is negative at low levels of competition, but does not appear to be significantly different from zero when $COMP$ is high. In other words, empirically the positive impact of competition on $QUAL$ when agency costs are present is so strong that at high level of competition it may offset the direct negative impact of agency. Note that these results hold both when controlling for firm size, and when the natural log of employees is omitted from the right hand side (not reported).

**Control Variables**

In terms of control variables, profits have a positive impact on the importance firms place on quality improvements and cost reductions, though this effect is significantly different from 0 at the 5% level only in columns 2 and 3. Relative to weaker firms, the importance of quality improvement in a firm’s business strategy is higher “industry leaders”. The same result holds if industry leader is measured by sales or profit performance instead of productivity. These results are consistent with theoretical predictions of de Bettignies (2004) for example.

### 5.2 Competition, Incentives and Effort

So far, our empirical results have indicated a link between competition and the importance firms place on quality improvements and cost reductions, and supported a theoretical structure which includes agency costs. To further test our theory, we now turn our attention to testing the consequences of the impact of competition on the importance of such strategies, namely contractual incentives and agent effort.

We estimate equation (17), where the dependent variable is either the share of pay derived from variable sources ($INCEN$), or the number of hours of unpaid overtime an employee worked ($EFFORT$). Estimation is by GLS, with standard errors robust clustered at the firm level, again adjusted for survey data. The results are found in Table 3, which represents incentives in columns 1 and 2, and effort in columns 3 and 4. Columns 1 and 3, use the base measure of agency costs and columns 2 and 4 use employee stock purchase.

**Effects of Competition**

When compared with the results in Table 2, the coefficients of our main variables of interest are consistent in sign and significance in all 4 specifications. We confirm that competition has a positive
impact on the intensity of incentive based compensation and the amount of unpaid overtime agents work, and again see that these effects are larger for firms with agency costs. This suggests that empirically, the impact of competition on incentives and effort is channeled through both an agency cost effect (which is consistent with prediction 3), and a direct pressure effect (which is not directly consistent with prediction 2, but could perhaps be explained if our model were applied to other demand systems).

**Effects of Agency**

The impact of agency costs on incentives and effort are also similar to their effects on firms’ strategic priorities depicted in table 2, even stronger: in all 4 specifications the direct agency effect $\lambda_2$ on incentives and effort is significantly negative, and the total impact of agency costs, $\lambda_2 + \lambda_3 \times COMP$, is negative for all levels of competition. Employees working for firms subject to agency costs worked fewer hours of unpaid overtime and earned a lower share of their income from variable than workers in firms without agency costs. Moreover, this holds for all levels of competition. This again is perfectly consistent with prediction 1 of our model.

**Control Variables**

Control variables in table 3 also suggest a number of interesting implications. First, firm profits, and the relative productivity level of the firm, have a significant positive effect on the share of variable pay in total pay but an insignificant effect on unpaid overtime.

Moreover, firm size, measured by the natural log of total employees, is insignificant in determining variable pay, consistent with Baker and Hall (2004) who find that the CEO incentives are either unrelated or slightly negatively related to size. We find a similar result looking at the intensity of incentives for all types of employees. In contrast, firm size has positive impact on unpaid overtime, even though this effect is significant only in column 4.

Incentives are positively affected by unionization, and not significantly related to education, age, gender or supervisory roles. Unpaid overtime significantly increases with age and education, and is also higher for employees that supervise others. However, it decreases if the employee is a member of a collective bargaining agreement and if the employee is female.

All of the specifications in Table 3 were re-estimated using different control variables, various subsets of employees and variations in the dependent variables. We also re-ran all regressions using only the subset of employees who were managers, as well as managers and professionals. In all cases, the results for competition, agency cost or reduction in agency cost and the interaction between
## Table 3
### Incentives & Effort: Share of Variable Pay and Hours of Unpaid Overtime

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Variable 1</th>
<th>Variable 2</th>
<th>Unpaid Overtime 1</th>
<th>Unpaid Overtime 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Competition</td>
<td>0.038*</td>
<td>0.021*</td>
<td>0.113*</td>
<td>0.719*</td>
</tr>
<tr>
<td>Agency Cost</td>
<td>-0.186**</td>
<td>-0.169*</td>
<td>-1.193**</td>
<td>-6.339**</td>
</tr>
<tr>
<td>Competition*Agency</td>
<td>0.025*</td>
<td>0.081*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee Stock Ownership</td>
<td>-0.122*</td>
<td>-6.339**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competition*Employee Stock</td>
<td>0.035*</td>
<td>1.109**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm Size</td>
<td>0.002</td>
<td>0.006</td>
<td>0.107</td>
<td>0.875*</td>
</tr>
<tr>
<td>Profits</td>
<td>0.001*</td>
<td>0.001**</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Industry Leader</td>
<td>0.078**</td>
<td>0.076**</td>
<td>0.124</td>
<td>1.789</td>
</tr>
<tr>
<td>Supervisor</td>
<td>0.004</td>
<td>0.004</td>
<td>1.754**</td>
<td>1.693**</td>
</tr>
<tr>
<td>Education</td>
<td>0.005</td>
<td>0.004</td>
<td>0.404**</td>
<td>0.421**</td>
</tr>
<tr>
<td>Unionized</td>
<td>0.045*</td>
<td>0.041</td>
<td>-0.748**</td>
<td>-0.422**</td>
</tr>
<tr>
<td>Age</td>
<td>-0.001</td>
<td>-0.001</td>
<td>0.015**</td>
<td>0.022**</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.003</td>
<td>-0.001</td>
<td>-0.546**</td>
<td>-0.618**</td>
</tr>
<tr>
<td>Industry &amp; Region Fixed Effects</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

R²: 0.03 0.03 0.09 0.12
Number of Observations: 19147 19147 19147 19147

** = significant at 1%, * = significant at 5%. Standard errors in parentheses.
competition and agency are of the same sign, significance and relative magnitude as those reported in Table 3.

5.3 Discussion of Empirical Results

Our results from Table 2 - on the positive impact of competition on the importance of quality improvements and cost reductions - are broadly consistent with the empirical literatures on competition and productivity, and on competition and innovation discussed in the introduction, with the exception of Aghion et al. (2002), who find an inverted U relationship.

Similarly, our results on contractual incentives are consistent with, among others, Cunat and Guadalupe (2003), who find that competition increases the steepness of performance pay contracts, and Burgess and Metcalfe (2000), who find the likelihood of performance related pay increases with competition. Burgess and Metcalfe (2000) use a British survey similar to the WES, and measure competition using a firm’s qualitative rating of the “degree of competition” they face, making their results directly comparable to, and consistent with, ours.

Santalo (2002) finds a negative correlation between the number of competitors and incentives, and we pay particular attention to these results as he also uses a portion of the WES data set. Our empirical methodology and results differ sharply from his for several reasons. First, he uses the 1999 version of WES data set, data we do not use, because our dependent variables are lagged to compensate for endogeneity, and because for our purpose later years offer a richer set of variables to choose from. Second, our measure of competition, which is based on the degree of substitutability between products, is quite different from his measure, number of competitors. Substitutability between products has the advantage of being a better proxy for our theoretical measure of competition. It is also less vulnerable to assumptions about barriers to entry, and (as discussed in subsection 4.2) to endogeneity issues. Finally, our empirical approach differs from Santalo’s, as well as from the papers cited above, in our use of a reliable proxy for agency costs, which allows us to empirically isolate the agency costs effects of competition from the direct pressure effects. To our knowledge, this is one of the first empirical studies to isolate these factors. In that regard, our paper is closer to Griffith (2001) who finds that competition has no impact on efficiency in plants without agency costs, and a positive impact in plants with agency costs. Interestingly, her results suggest a zero direct pressure effect of competition.

29 As a measure of competition, number of competitors is difficult to interpret. In markets with free entry, as in Raith’s (2003) model which Santalo is testing, competition is usually associated with a decrease in competitors. In contrast, it is associated with an increase in the number of rivals in market with barriers to entry (Vives, 2004). Moreover, the number of competitor may itself be endogenous, thus making the econometric specification vulnerable to endogeneity.
and hence are even more consistent with our theoretical predictions than our own empirical analysis. Griffith (2001) however looks exclusively at productivity and is silent about contractual incentives and effort.

6 Conclusion

Despite much interest in the subject, the belief that “competition is the enemy of sloth” has proved difficult to justify theoretically. The model developed in this paper provides a simple justification for this belief, by isolating the agency effect of competition from the direct pressure effect.

Using a unique set of Canadian data which allows us to simultaneously observe the characteristics of firms as well as their employees, we then evaluate the empirical significance for these two effects. We find that competition has a significant direct pressure effect which occurs whether or not firms are subject to agency costs, as well as a significant agency effect, which occurs only in firms plagued by agency. Both effects increase the importance firms place on quality improvements and on cost reductions, as well as contractual incentives and employee effort.

Our results yield an interesting policy implication: governments should (continue to) focus their competition policy effort on large corporations in which agency problems play a large role, and where the impact of their policies is likely to be larger.

7 Data Appendix

What follows are the specific wordings of the questions in WES used to construct our dependent and independent variables:

**Firm Strategy** is measured using these 15 questions, each of which was ranked by the firm as: 1: Not Applicable; 2: Not Important; 3: Slightly Important; 4: Important; 5: Very Important; 6: Crucial.

*Please rate the following factors with respect to their relative importance in your workplace’s general business strategy:*


**Competition** was measured using these 4 questions, each of which was ranked by firms as:
To what extent do these firms offer significant competition to your business? Significant competition refers to a situation where other firms market products/services similar to your own which might be purchased by your customers:
1. Locally-owned firms; 2. Canadian-owned firms;

**Firm size, and which firms had only one employee**, was measured using the following question:
*In the last pay period of March this year, how many people were employed at this location?*

**Profits** were measured as the difference between revenues and expenditures as derived from these two questions: *For this fiscal year, what was the gross operating revenue from the sale or rental of all products and services for this location? What were the gross operating expenditures for this location for the most recently completed fiscal year?*

**The existence of incentive based compensation at the firm level** was measured using the following 4 questions, each of which was answered "yes" or "no" by the firm. If a firm answered "yes" to any ONE question they were coded as having incentive based compensation.
*Does your compensation system include the following incentives?*
1. Individual incentive systems (bonuses, piece rate, commissions and stock options). 2. Productivity/quality gain sharing and other group incentives (benefits to employees for gains realized by increased productivity). Commonly, these benefits can be in the form of money payments in the primary industries. 3. Profit sharing plan (any plan by which employees receive a share of the profits from the workplace). 4. Merit pay and skill based pay (a reward or honour given for superior qualities, great abilities or expertise that comes from training, practice, etc.).

**The share of incentive based pay in total pay at the employee level** was constructed using these four questions:
1. *In your current job, what is your usual wage or salary before taxes and other deductions?*
2. *In the past twelve months did you earn any commissions, tips, bonuses, paid overtime or any other types of variable pay such as profit sharing, productivity bonuses (gain sharing), or piecework?*
3. *Where these commissions, tips, bonuses, paid overtime or other types of variable pay included in the wage or salary reported in (question 1)?*
4. *What were your total earnings from commissions, tips, bonuses or variable pay in the past 12 months?*

**The number of hours of unpaid overtime employees worked** was measured using the following question: *How many hours of unpaid overtime do you usually work per week?*

The following questions were used to measure the **number of hours employees worked** in robustness checks:
1. *Excluding all overtime, how many paid hours do you usually work per week at this job?*
2. *How many hours of paid overtime do you usually work per week?*
3. *Not counting overtime, how many paid hours on average do you work per week at this job?*
4. *Over the past 12 months, not counting overtime, what was the maximum number of paid hours you worked per week at this job?*
5. *Over the past 12 months, not counting overtime, what was the minimum number of paid hours you worked per week at this job (exclude the hours when you were on paid vacation or sick leave)?*
The following questions from the employee portion of the survey were used as controls in the employee level regressions:

1. In what year were you born?
2. Gender (check box for male or female).
3. What is your current legal marital status?
   1: Legally married (and not separated); 2: Legally married and separated; 3: Divorced;
4. Are you currently living with a common-law partner? (yes/no)
5. Do you have any dependent children? (yes/no)
6. About how many people do you directly and indirectly supervise on a day to day basis?
7. Did you graduate from highschool?
8. In your current job, are you a member of a union or covered by a collective bargaining agreement?
9. Have you received any other education? What was that education?
   1. Trade or vocational diploma or certificate;
   2. Some college, CEGEP, Inst. of techn. or Nursing school;
   3. Some University; 4. Teacher’s College; 5. University certificate or diploma below bachelor
   level;
   6. Bachelor or undergraduate degree; 7. University certificate or diploma above bachelor level;
   8. Master’s degree; 9. Degree in Medicine, Dentistry, Veterinary Medicine, Law, Optometry
   or Theology,
   or 1-year B.Ed after another bachelor’s degree;
   10. Earned Doctorate.

**Employee Stock Purchase Plan** was measured using: In your current job are you included in a stock purchase plan?

References


Figure 1: Equilibrium Effort Levels

Figure 1: Represents first-best and second-best marginal benefit and marginal costs, in equilibrium (i.e. when quality for the two principals are the same). Point A represents the FB equilibrium, while points B and C, as well as the points between them, represent SB outcomes for values of t between t(min) and t(max). As expected, SB outcomes all yield a lower quality than in the FB (prediction 1). Moreover, as competition increases the SB equilibrium gradually moves from B to C and quality improves (prediction 3), while the FB equilibrium remains unchanged at A (prediction 2).