The Costs and Benefits of Multi-tasking

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Abstract

We investigate the individual productivity effects of multi-tasking using a unique data set from a call center in Germany with daily performance data of 477 agents over a period of 19 months. At different times in their career agents are acquiring new skills allowing them to carry out additional tasks, for instance, dealing with different types of consumers, and providing information about and selling different types of services. Individual productivity is measured in the duration of calls (shorter calls being better) and the sales quota. We show that multi-tasking decreases individual productivity, both in a statistical and economic sense, but it also increases the capacity utilization rates of agents who are faced with volatile consumer demands. There hence exists a trade-off between increasing the capacity utilization rates of workers and their individual productivity. To our knowledge, the paper is the first to show this trade-off, which goes back to Adam Smith's reflections on the gains of specialisation, and how the extent of the market constrains the scope of specialisation.

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Introduction

Individual productivity and, hence, the wealth of nations depends on how the production process is organized. This fundamental insight was established by Adam Smith when he remarked that a pin factory was able to reap 2,400-fold productivity gains by dissecting the production process in its essential components and assigning each to one or several higly specialized workers (Smith, 1776).[1] The proponents of scientific management, Taylor and Fayol, were equally strong believers in productivity gains by specialisation as their contemporaries in industry such as Henry Ford. Following the job design ideas of Hackman and Oldham (1976) and a large literature that followed it was argued that workers who would carry out more than on task could be more productive. Carrying out more than one task would respond to growth, motivational and psychological needs such as being part of the entire process, would increase job satisfaction, and help avoid fatigue.

Whether or not working on more than one task is good for individual productivity thus seems to be an open issue we try to address in this paper. To avoid confusion, we will use the term multi-tasking[2] for an organization of the production process in which people switch between different tasks, compared to a situation in which they always carry out the same task. We investigate individual productivity effects of multi-tasking using a unique data set from a large call center in Germany with daily performance data of 477 agents over a period of 19 months. Individual productivity is measured in the duration of calls (shorter calls being better) and the sales quota. We show that multi-tasking decreases individual productivity, both in a statistical and economic sense, resulting in six-digit Euro losses in individual productivity in a highly competitive business operating under low margins. We show that the firm trains the better workers to become multi-task agents, such that selection effects lead to an underestimation of the effects.

We also carry out a numerous robustness checks, controlling for task-specific experience, personal characteristics or location effects. We also investigate the channels through which multi-tasking decreases individual productivity. We find evidence that the potential fatigue from multi-tasking cannot explain the productivity losses. We can exclude that there is an effort substitution effect in the sense of Holmström and Milgrom (1991).

[1] *I have seen a small manufactory …Each person…making four thousand eight hundred pins in a day. But if they had all wrought separately and independently, and without … having been educated to this peculiar business, they …could not …have made twenty, perhaps not one pin in a day.*

[2] In the narrow sense as used by the psychology literature (c.f. Kahnemann, 2011) this is not multi-tasking, but should rather be called sequential-(multi)-tasking.

However, we cannot reject the related hypothesis that multi-tasking blurs performance measurement, leading to lower performance.

The fact that individual performance suffers from multi-tasking begs the question why a company would want to use it, rather than keeping people specialised. The answer lies in the nature of demand in a call center. The call center is part of a transportation company that deals with different consumers (business vs. tourism, frequent travellers and bonus cardholders) and different types of services (regular passenger trips, specially priced trips, and freight transportation), leading to a large number of quite different tasks for the agents. As the demand for these tasks is highly volatile, multi-tasking is widely used to cut slack of the agents[3] who are on fixed-wage contracts, and whose shift planning is made well in advance. We thus establish that the choice between multi-tasking is governed by a trade-off between increasing utilization rates of workers, and decreasing their individual productivity when they work. To our knowledge, the paper is the first to establish and show this trade-off with individual performance data over a long period.

There is a substantial literature, both in economics and management on the effects of letting people multi-task, or employing people with wider skill sets. Empirical studies show the productivity effects of alternative human resource practices on workers' productivity.[4] For instance, Ichniowski et al. (1997) find out that, among others, multi-task oriented job assignment increases plants' productivity by using a data set of 36 homogenous steel production lines. However, they look at entire sets of HR practices and do not identify the isolated effect of multi-tasking on individual productivity, keeping other things constant. Park (1996) presents evidence that firms with multi-skilled workers perform, in some dimensions, better than firms with single-skilled workers. However, in contrast to our data, this evidence and the one of Ichniowski et al (1997) concerns the effect of task variety on performance at the plant level, not at the individual level as in our case.

There is a large management and industrial psychology literature on skill-based pay systems,[5] but this literature does not have use hard performance data. Rather, performance is self- or management-reported. However, we are using the same data that management uses to steer its production. We thus contribute to a growing literature on what has been called

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[3]Multi-skilled resources (or multi-tasking of agents) is a widely known concept in the operations literature (Gans et al. 2003; Atlason et al. 2004; Cezik and L'Ecuyer, 2008); call centers are often trying to multi-skill their agents as much as possible to increase utilization rates and reduce slack.

[4] See Bloom and Van Reenen (2011) for a survey.

[5] See Lawler and Ledford (1985), Lawler et al. (1993) for an overview.

insider-econometrics (see the survey of Ichniowski and Shaw, 2009): studying the determinants of organizational performance by using the "real" data that management uses in optimizing use of its human resources, and the insider insights of managers about how the firm operates. We thus relate to a number of studies who investigate the effects of human resource policies on individual productivity, most notably Lazear (2000) on the impact of monetary incentives on effort and self-selection, Bandiera, et al. (2005, 2009) who look at how the introduction of incentive pay affects productivity when people have social preferences, Mas and Morretti (2009) on the impact of peer effects.

The paper that is closest to ours is by Coviello, et al. (2010) who look at the productivity effect of task "juggling", i.e. judges working on many cases by the same time. They find that task juggling slows down case completion. Our data show that similar effects are true for a quite different production function which allows day-to-day measurement of productivity, a much simpler type of tasks, and less qualified workers. Furthermore, while in the paper by Coviello et al (2010) the reason for task juggling is an inefficiency, namely the lobbying of people who want to see their case completed, in our paper the losses in individual productivity stem endogenously from the firm's optimization behavior which balances individual productivity losses against lower slack (i.e. better utilization of human resources). Finally, we do not find a u-shaped influence of multi-tasking on productivity as in the paper by Aral et al (2010), who, however, use self-reported information on multi-tasking, and not hard production data.

The next section explains work in the call center, the implicit incentives agents are subject to, the data, and our identification strategy, which is based on random allocation of calls to agents with different skills and a selection of the better agents into multi-tasking. The second section discusses the main results in terms of individual productivity. The third section looks at the channels through which multi-tasking may decrease productivity. The fourth section investigates the effect of multi-tasking on individual and plant-level slack, and presents a number of robustness checks.

1. Data and organizational background

Our data cover the period from May 2007 to December 2008. The data stem from a large call center in Germany that operates in four different locations. In each location, agents are organized in teams and each team is supervised and trained by one team leader. The locations

are connected by a complex computer system; hence, they form a virtually integrated call center in which calls are randomly allocated to the agents at different location. The call center is part of a large transportation company who operates different transportation modes, transports both parcels and passengers, and has quite different types of customers, tourists, and business-people, people with different types of bonus cards or rebates.

Calls are initiated by the customers and routed via the computer system to an agent who has been idle for the longest time. The fundamental term to be clear about in this paper is the “task”. A task is well-defined in our context, as a customer who in a computerized dialogue and routing system has declared to have a certain type of demand. Customers may want information about different types of service, they may already know precisely the service they want to buy, say a ticket from A to B, and just book and pay it. They may also have more detailed questions about bonus programs or voice a complaint. Because the call center deals with a broad set of services and clients, agents must have diverse skills. This includes the ability of an agent to provide information for specific areas, which requires detailed knowledge about different computer-based information services, protocols to follow etc.

Not every agent possesses all skills necessary for coping with all these different services. The portfolio of skills that a given agent possesses depends on her ability and tenure. Each agent starts with a basic skill and task and can accumulate more skills and tasks during her length of employment. Employees log into the system with a personal identification number that permits the system to route each call to an agent who has the skill of handling it. The computer system captures very accurate and detailed information about employees’ productivity, time spent at the work place, login, logout, and break time.

1.1 Incentives

The call center does not employ any explicit incentive such as bonuses for service sold, or numbers of calls dealt with. Rather, a fixed payment is regulated through a collective agreement by the parent company and the call center. Within the collective agreement, employees of the call center are categorized by wage groups and are graded by salary. Nonetheless, there are substantial implicit incentives.

[FIGURE 1 ABOUT HERE]

First of all there is the incentive of keeping the job as pay is much higher than the market pay. Figure 1 shows that a trainee starts with a wage of 16,000 Euro per year, and an

advanced agent receives a wage between 19.000 and 20.000 Euro, while average market wages for call center agents are between 14.040 and 18.700 Euro depending on location. Furthermore high unemployment rates (between 13 and 20 percent) in the largest three of the locations in the relevant time span are a motivator to exert effort while shirking may end up in losing the job.

Second, there are career incentives. More tenure leads to higher fixed payment for the agent. Since an agent starts in one wage group, she has the opportunity to attain more tenure that leads to an increase in wages while remaining in the same wage group. Nevertheless, there are also opportunities for increasing skill levels, which leads to insertion in higher wage groups. Most importantly, many of members of the back office started as call center agents, and internal promotion is possible and seen as an attractive career opportunity.

[FIGURE 2 ABOUT HERE]

Figure 2 illustrates the internal labor market of the company. A basic agent starts in wage group two while a trainee starts in wage group one. If an agent gathers more skills, she is promoted to wage group three, if she becomes an agent with special tasks she is classified into wage group four. A team leader belongs to wage group seven. Employees who work in the back office with administrative tasks and have the relevant professional education are classified from wage group five upwards. Location managers who are responsible for one location of the call center belongs to wage group ten.

To notice who of the agents should be promoted, team leaders monitor the performance of the agents. Two dimensions characterise performance: quantitative and qualitative. The quantitative dimension is identified by length of calls and sales quota per day: the average duration of the calls they handle should be less than 214 seconds, and at least 17% of their calls should lead to a sale.

Team leaders receive information about their team members' performance through the computer system. The system saves data about quantitative performance measurements and the actions of agents, for instance, how long agents are on duty or waiting for a call. Team leaders provide agents with performance information about one shift at the beginning of the next shift, so that every agent is informed about her daily performance. In addition to the daily feedback team leaders also discus with their agents the particular performance once a week. The agent gets to know how she performs within their team. Approximately once a month a team meeting takes place. In this meeting, all agents of a team are informed by their

leader about their team performance in comparison to other teams in their location. Team leaders are the primary interface between operations and management. They have to make sure that all performance targets are known to their agents and assign the requirements of further trainings. Moreover, they function as a supporter for the daily business and are responsible for the performance of their team.

Any deviation from set targets is discussed with the agents' team leader. In case those targets are not reached, the respective employee might be required to participate in additional training sessions. This may also lower the agents' chances for a promotion. The agents are confronted with their performance on a regular basis: daily, weekly and monthly. The regular feedbacks provide a third non-monetary source of motivation: to avoid pressure of the team-leader and team-mates, and to avoid additional trainings that bear the stigma of being allocated to the low performers only, and are according to interviews we carried out considered unpleasant.

1.2 The data

Our data contain three types of information. First, there are the output variables: *average call duration*, that is, the average time spent on an incoming call an agent receives in a given shift, and *sales quota*, that is, the proportion incoming calls that lead to a sale. Importantly, call durations are registered separately for each task by the computer, while sales quota are only registered and reported as an average over all different tasks the agent has performed in a given shift. Second, we know each worker's personal characteristics including gender, age, tenured employees[6], and location at which a person works. Finally, important controls are the numbers of different calls ("tasks") that an employee carries out in a given shift, and the proportion of time spent on these different tasks; the shift employees work in the day, weekdays and weeks. In total, there are 69,192 observations; one observation represents one agent at one shift. Each observation includes the number, and duration of calls, and sales quota, and the time the agent is idle during a shift. In total there are 46 different tasks. To carry out a task agents must have the respective skill, so that, the number of skills an agent could in principle acquire is a total of 46.

It is important for the design of our research that each agent in each shift works in task-1, a basic information service. It is precisely that fact that allows us for looking how

[6] For historical reasons, the company has tenured employees who cannot be fired.

changing the numbers of skills/tasks of an agent affects the productivity for the initial task. This will be made clearer below. Each agent starts her career in the call center with task-1 a basic information call service. Management chooses agents who perform well and offers them training sessions to acquire additional skills. They receive higher wages when they have acquired the respective skill.

[TABLE 1 ABOUT HERE]

Table 1 provides an overview of the employees' individual characteristics in the call center. We observe in total 477 individuals who work on related services, providing information and carrying out sales. Unfortunately, we have information about personal characteristics only from 434 individuals. The average age is about 40 years, and 79 percent of the employees are female. An average employee has been working since six and a half years in the call center. Additionally, there are 12.7 percent tenured employees.

[TABLE 2 ABOUT HERE]

Table 2 provides information about the different types tasks. In each of our observations (i.e., a given shift for a given person), we do have information about average call duration for the basic information task-1 that allows us to carry out our research design, namely, investigate to what extent people who handle more tasks do better in terms of the call duration in the basic task. Table 2 also shows the percentage of total time spent on the different tasks. We have information about percentage of total time spent on different tasks relative to overall time spent, so that we observe 71 percent of the time used for the calls in the basic task. Time spent for other tasks varies in a small band from slightly above zero to about six percent. Additionally, Table 2 shows the proportion of the numbers of observations, which are calculated dividing the numbers of observations in a queue over total numbers of observations in overall queues. For instance, all employees work in the basic task therefore the ratio of task-1 is 100 percent. Table 2 summarizes the small tasks in the category "other tasks" which contains 34 different tasks namely 17.11 percent of the observations.

[TABLE 3 ABOUT HERE]

Table 3 provides information about the distribution of different combinations of tasks. On the left hand side of the table, we show basic statistics for the numbers of tasks an agent works on. The proportion of the agents who carry out only one task, namely task-1, is 10.2 percent. The proportion of agents working on two different tasks in a given shift is 23.9 percent; for three tasks it is 29.4 percent, and so forth. In case an agent works at least on two

tasks in a shift, she combines the first task with another task from other possible tasks. Management decides who can acquire new skills and then has the possibility to carry out the respective tasks, and does so on grounds of its information about current and future demand for different skills. On the right hand side of the table, we show the possible task combinations of agents. It becomes clear that there are a few very important task combinations. Finally, Figure 1 plots the skill distribution in the call center.

[FIGURE 3 ABOUT HERE]

2. Empirical strategy and results

We now investigate whether multi-tasking increases or decreases individual performance. To identify the effects causally it is crucial that first, agents have no influence on what new skill they can acquire; indeed, this is the decision of management taken depending on the staffing and skill needs of the firm. Second, an agent has no influence at all on what type of call she deals with at any moment in time, as the calls are allocated through the computer system, given the skill set of the agent. Thus, agents have no influence on the task that they carry out, once they have acquired the skill needed.

A third point for identification is equally important and more involved: clearly, there will be a selection bias. If it were the case that the call center management selected the *less* productive agents, we would not be able to separate the effect of multi-tasking. However, the only agents with good prior performance are invited to acquire new skills. As promotions and pay grades depend on the skill set, it can be assumed that all agents who plan to stay in the firm have an incentive to acquire new skills if they can. We will check below econometrically that it is indeed the case that agents with better past performance are more likely to acquire new skills. Consequently, the negative effect about multi-tasking that we identify will be a lower bound of the true effects.

Given this identification strategy, our baseline regression is simple. Let y_{it} be the productivity measurement of employee i in day t at the call center. A worker's daily productivity is modelled as

$$y_{it} = \alpha + \boldsymbol{X}_{it}\beta + \gamma C_{it} + \varepsilon_{it};\ i = 1, \dots, N;\ t = 1, \dots, T, \qquad (1)$$

where the indicator variable $\boldsymbol{X}_{it}$ contains the information about how many skill has an employee i at the observation date t. The variable C_{it} consists of the control variables such as

shifts, calendar weeks, weekdays and the time an agent spends at a given day on different tasks. We control for time effects and shifts to reflect different demand conditions (employees work mainly in three different shifts: early, intermediate and late shifts). Furthermore, we control for the time spent in different task in order to control task specific effects on productivity. Additionally, we control for fixed-effects[7]. In the fixed-effect analysis the composite error is $\varepsilon_{it} = c_i + \epsilon_{it}$, where c_i represents the unobserved characteristics that influence the productivity of employee i. The error term is assumed to be independently and identically distributed. Estimating the first equation produces estimates of the impact of skill acquisitions on productivity of each employee.

In the first set of regressions, we will investigate how multi-tasking, that is, adding additional tasks to the basic task-1 affects the performance in task-1, measured in average call duration. Here, shorter is better, as explained in Section 2.

[TABLE 4 ABOUT HERE]

In Table 4 we present the results for our baseline regression. We run the logarithm of call duration in task-1 on the number of tasks an agent carries out in one shift, omitting the category one task. We include important technological controls such as total time spent on each task, times of shifts, weekdays and weeks in all regressions, and use robust standard errors. The parameter estimates can be interpreted as percentage effects, as we use logarithm of call duration. A clear picture emerges: when an agent carries out two tasks rather than one, the call duration in task-1 increases by two percent. The effect is positive for three, four, five, six and more tasks and increases monotonically up to almost 8 percent. The inclusion of experience in the job in specification 2 does not change the picture.

In the third specification, we control for the most important two-, three-, and four task-combinations to see whether the effects may be driven by only a few of the combinations. The dummies two-task to six-and more-tasks remain significant, and it turns out that all of the most frequent combinations are significant. There is some, but not much heterogeneity. The fourth specification deals with concerns about skill-specific learning curves. We allow for skill-specific learning curves. We find what one should expect: over time agents become more efficient in dealing with the effects of multi-tasking. The point estimates of the task-variables are slightly reduced compared to the baseline regression, but remain highly significant.

[7] We perform the Hausman test and affirm that the fixed-effect estimation is the convenient one.

[FIGURE 4 ABOUT HERE]

Figure 4 presents an interesting fact about the relative capacity of men and women in dealing with the effects of multi-tasking. We run the first specification of Table 4 for men and women separately and find that except for six tasks or more, and in contradiction to what one may expect, men seem to be better in multi-tasking, at least with respect to call duration in the basic task. However it should be noted that the effect is only statistically significant for the three-task estimates.

[TABLE 5 ABOUT HERE]

Having established that the effect of multi-tasking on call duration in the basic task is negative (i.e. calls last longer), an important robustness check is whether this extends to situations in which people move from two-tasks combinations to combinations of three or four tasks. Our data indeed allow doing so for the most frequent task combinations. For example, in the first line we estimate the effect of adding the additional task-4 to the combination of tasks-1-6, and the effect of adding task-4 and task-13 to the initial combination. All estimates are positive and most are significant and in similar (if not larger) ranges as the estimates in the preceding analysis of single vs. multi-tasking. It hence seems that the effect identified are robust, whether one considers single-task agents that move into multi-tasking, or agents who work on two tasks and move to three or four tasks.

[TABLES 6a,b ABOUT HERE]

We now turn to an important question that could jeopardize our identification strategy, the selection of agents to learn new skills. Table 6a shows the results of ordered probit regressions with the number of tasks as the dependent variable from one to six. Ordered probits has some advantages compared to OLS in estimating categorical variables, for instance, possible heteroscedasticity is avoided, and it uses maximum likelihood estimation that is more efficient and consistent (Green, 2003). In each interval of the dependent variable a constant is calculated. Because we have six different categories for tasks, five different constant points are calculated for the regressions. Most importantly, the regression shows that agents are more likely to be trained and assigned new tasks when (i) they have lower call durations, and (b) higher sales quota. Table 6b shows the regression for the move from single to two tasks only. In both cases, as intuition would tell us, selection effects are positive, and our estimates are thus a lower bound for the real effects of multi-tasking on call duration.

We have carried out additional analyses, contained in Tables 12 to 19 in the Appendix. In Tables 12a, b, c we look at the effect of multitasking on another output dimension, the quality of calls. Quality is monitored by team leaders and a quality department (either open, that is, the agent knows that he or she is monitored, or closed). There are three ways quality can be measured, by total, fatal, and non-fatal errors. While there are some negative parameter estimates for the total occurrence of errors, this is not systematic; more importantly, multi-tasking has no significant effect on the fatal errors. Table 13 investigates whether the effect highlighted could be owing to the fact that more qualified agents receive a larger number of calls that take longer time. We try to control for this idea by running a regression controlling for the number of forwarded calls, but find no important effects. We also look, in Tables 14 and 15, for call duration and sales quota, respectively, at different locations to exclude that the results are driven by one unit, but all results are robust. The same is true for a regression that looks at slack (Table 16). Table 17 analyses the effect of multi-tasking on individual performance on the three dependent variables; call duration, sales quota and slack time. In these regressions, we replace the fixed effect by an array of personal characteristics (and again cluster for individual heterogeneity). In terms of call duration, and slack time, we find quite similar effects, but the coefficient for sales is positive, which indicates that there are important unobservable personal characteristics. Tables 18 and 19 look at tenured (i.e. agents with long-term contracts that cannot be fired) vs. non-tenured personnel. Again, results are robust.

3. Channels

What channels could explain the performance-decreasing effect of multi-tasking on call duration that we identified? First, when agents are assigned more than one task, there is the possibility of reallocating effort from task-1 towards other tasks, in particular, when it is perceived that other tasks are more important for the career; this is an *effort substitution* effect related to the multi-task model of Holmström and Milgrom (1991). Second, there should be a *biological or technological channel*. Agents will incur switching costs, which will result in fatigue.[8]

[8] At the risk of stretching Smith's view on specialisation a bit, consider the following quote from the Wealth of Nations (page 113), Smith writes that besides the increased dexterity by specialisation, there is *secondly, the advantage which is gained by saving the time commonly lost in passing from one sort of work to another…*

To look at the first channel, we can use the second quantitative performance measurement, the sales quota. Sales quota are computed as the total sales in all tasks divided by the number of calls and the target is 17%. Notice that the sales quota is not broken down by task, and hence is a composite and noisier measure of performance. Agents may be tempted to work harder on increasing their over-all sales quota rather than reducing the call duration in task-1 to impress their supervisors. This would be particularly the case if the new tasks would be inherently more likely to end up in a sale (which we checked and is not the case). If the effort substitution story would be driving our results, we should observe multi-tasking to affect positively the sales quota.

[TABLE 7 ABOUT HERE]

Table 7 presents the results of a regression that employs similar specifications as the ones in the call duration regressions. In no specification, we find any positive and statistically significant effects of multi-tasking on sales, but quite a few are negative, in particular for two or three tasks. Thus effort substitution does not seem to be the driving force here.

What about the biological and technological channels? Our data are not optimal to look at this channel, but we can construct the following argument. Fatigue through multi-tasking should be strongest where people are working hardest, i.e., in shifts in which agents have very little slack. Slack levels, i.e., the share of time agents spend waiting for a call in a given shift are quite substantial, as Table 8 shows. Here, individual slack levels are broken down by one- to six-or-more tasks. Averages are between 15% and 17%, with quite large standard deviations.

[TABLES 8, 9, 10 ABOUT HERE]

Using the information about slack, we carry out in Table 9, regressions by slack quintiles from quintile 1 (lowest slack level) to quintile 5 (highest slack level), with the dependent variable call duration. If fatigue was the main channel, then the effects of multi-tasking should be strongest where slack is lowest and the coefficients of the two to six-or-more tasks levels should be largest in the first column, and should decrease when going to the right. This, however, is not the case; rather it seems that the coefficients follow a U-form, suggesting that multi-task has most bite in the lowest and highest quintiles. In Table 10, we run the same regression on sales quota. Surprisingly, we find the opposite of what the fatigue hypothesis would posit: the only slack quintile in which multi-tasking produces positive effects on sales quota is the one for which it would be least expected that sales quota could

increase, quintile 1, with the lowest slack. We thus do not seem much evidence for the bio-technological explanation.

[FIGURE 3 ABOUT HERE]

A third channel is related to blurred performance measurement, see for instance, Baker (2000). The internal reporting of individual performance (Figure 3) gives precise information about the call duration for each task, but only breaks down sales quota by groups of tasks. Agents who only carry out one task can be fully compared to each other (recall that allocation of calls to agents is random. The sales performance of agents with different task combinations is thus not fully comparable to each other as sales quota are not-reported for each single task. This may explain part of the lower performance.

4. Why does the firm use multi-tasking?

The individual productivity effects highlighted are quite substantial, as a back-of-the envelope calculation makes clear. Consider the increased call duration per person per year, and take the lower bound of our estimations: 0.018 * 360 (minutes = average duration of a shift)* 0.7 (approx. average total call time)* 180 shifts (per person per year) = 816 minutes lost because of an increase of one task. This adds up to direct costs per year of 816 * 477 (persons) * 0.385 Euro (the labor cost per minute) = 149,854 Euros.

Notice that this is most likely a very conservative estimate, because there are more than one additional task per person per year. Also, we do not take into account the training costs, the underestimated call duration effects, because the more productive agents are chosen for multi-tasking. Finally, we do not take into account the reduction in the sales quota. Even so, the number of 150,000 Euros is quite substantial for a business that is highly competitive and has very low price cost-margins.

Given that individual productivity suffers when the firm uses multi-tasking, we may ask whether the firm gets it wrong? We actually argue that the firm may get it right. Notice that the call center faces stochastic demand for its services, and that the human resources of the firm are a quasi-fixed resource, as there are no piece rates, much monthly salaries. Consequently, when staffing, the firm faces a trade-off between the costs of idle resources (under-utilization of capacity) vs. the costs of foregone revenue, a problem well-known in operations management (Whitt, 2006), but rarely considered in economics (Friedman and Pauly, 1981). Call centers are very human resource intensive businesses and the risk of agents

to be idle is both large and very costly. So, what are the effects of multi-tasking on slack time, the inverse of capacity utilization?

From the descriptive statistics in Table 8, it does not seem that slack and the number of tasks correlate negatively, but the picture looks quite different when controlling for important factors such as shifts, week days, weeks etc.

[TABLE 11 ABOUT HERE]

In Table 11 we summarize the results of a regression of slack time on these and other explanatory variables and the task dummies. In all specifications, we obtain the results that are expected given that the demand for different skills is stochastic: the more tasks an agent carries out, the smaller is the proportion of slack time. The effect becomes even stronger when the level of analysis is shifted from the individual to the group of agents active in one shift.

[FIGURE 5 ABOUT HERE]

In Figure 5, we plot the regression coefficients of slack time against the sum of tasks carried out by all agents in a shift. It becomes clear that the more versatile a group of agents in a shift, the smaller is the overall slack time of that group. Notice that the magnitude of the negative effect of tasks on slack time is considerably higher than on the individual level. This group or shift effect actually makes it difficult to come up with a back–of–the envelope calculation of the benefits of multi-tasking; but we plan to calibrate both costs and benefits in further work.

5. Concluding remarks

The main contribution of the paper is to show that there exists a trade-off between distorting the individual productivity by multi-tasking, but increasing capacity utilization. This shows that it is important to investigate agency problems of firms as being embedded in the competitive environment. Our analysis would identify multi-tasking as value destroying in isolation, but once capacity utilization under volatile demand is taken into account, the picture becomes much more subtle.

We have begun our paper with a citation from Smith's Wealth of Nations, and would like to conclude with yet another one that is very close to the nature of the trade-off we identify. Smith writes

> *...the extent of this division* (of labor, *GF) must always be limited by the ... extent of the market. When the market is very small, no person can have any encouragement to dedicate himself entirely to one employment.. There are some sorts of industry… which can be carried on nowhere but in a great town.*

Smith's argument is put in a different, spatial, context, but it nonetheless bears a lot of resemblance with our findings that specialisation would be optimal from an individual point of view, but that may well be impossible given that capacity utilisation is key for call centers as agents` wages are fixed costs.

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Appendix

FIGURE 1-PROMOTION LADDER IN THE CALL CENTER

FIGURE 2-COMPENSATION-INCENTIVE SCHEME IN THE CALL CENTER

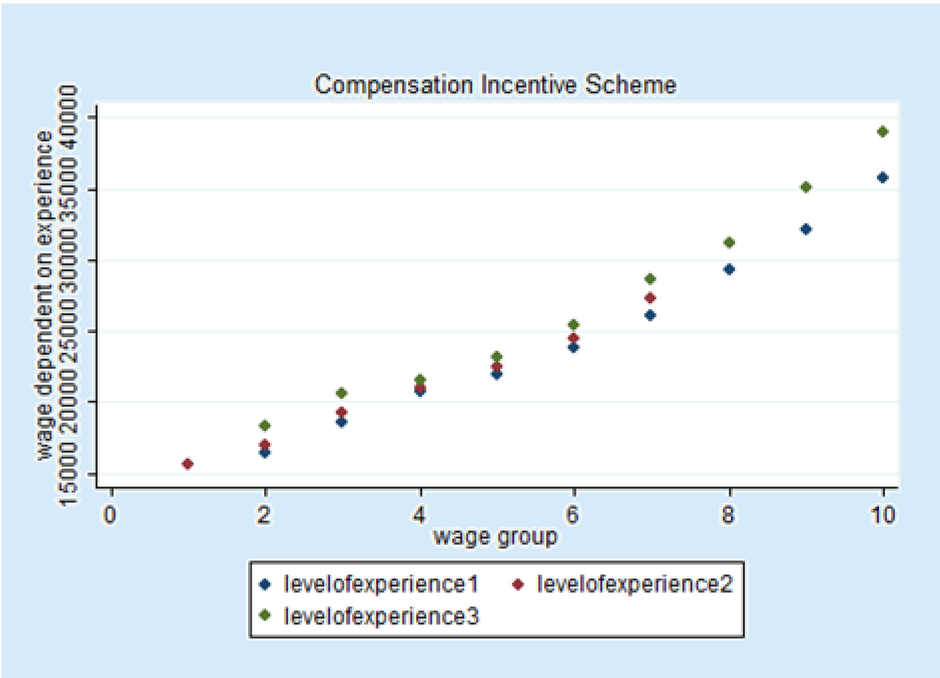

FIGURE 3-DISTRIBUTION OF NUMBERS OF SKILLS

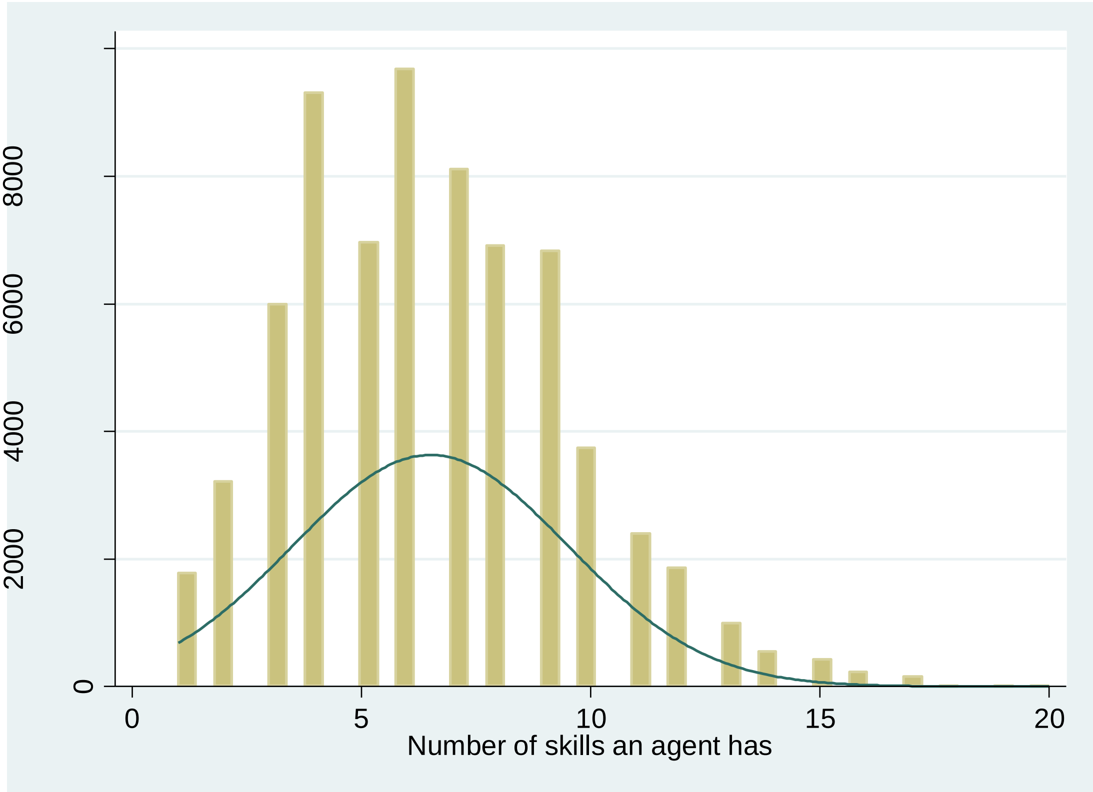

Figure 3 shows the number of skills of agents. The skill variable thus measures the capability to carry out a task, but this task is not necessarily carried out in a given person-shift observation. The skill level reaches up to twenty.

FIGURE 4-INTERNAL INDIVIDUAL PERFORMANCE REPORT

[redacted] (29.05.2008)

Skill	bearbeitete Anrufe	Gesprächs-zeit	Nacharbeits-zeit	Outbound	Calls unter 10 sec	Wartefeld Timeout	Wartefeld	Läut- zeit	Weiterl. Quote	Kodierungs-quote	Verkäufe	Verkaufs-quote	Verkaufs-quote AC
	Anzahl	Ø in sec	Ø in sec	Anzahl	Anzahl	Anzahl	Anzahl	Ø in sec.	%	%	Anzahl	%	%
[redacted]	41	282	0	0	0				0,00%	100,00%	7	17,07%	17,07%
[redacted]	4	377	1	0	0				0,00%	100,00%	0	0,00%	0,00%
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]				18,18%	100,00%	5	45,45%	45,45%

[redacted]

FIGURE 5-EFFECTS OF MULTI-TASKING ON SLACK TIME, ALL AGENTS IN A GIVEN SHIFT

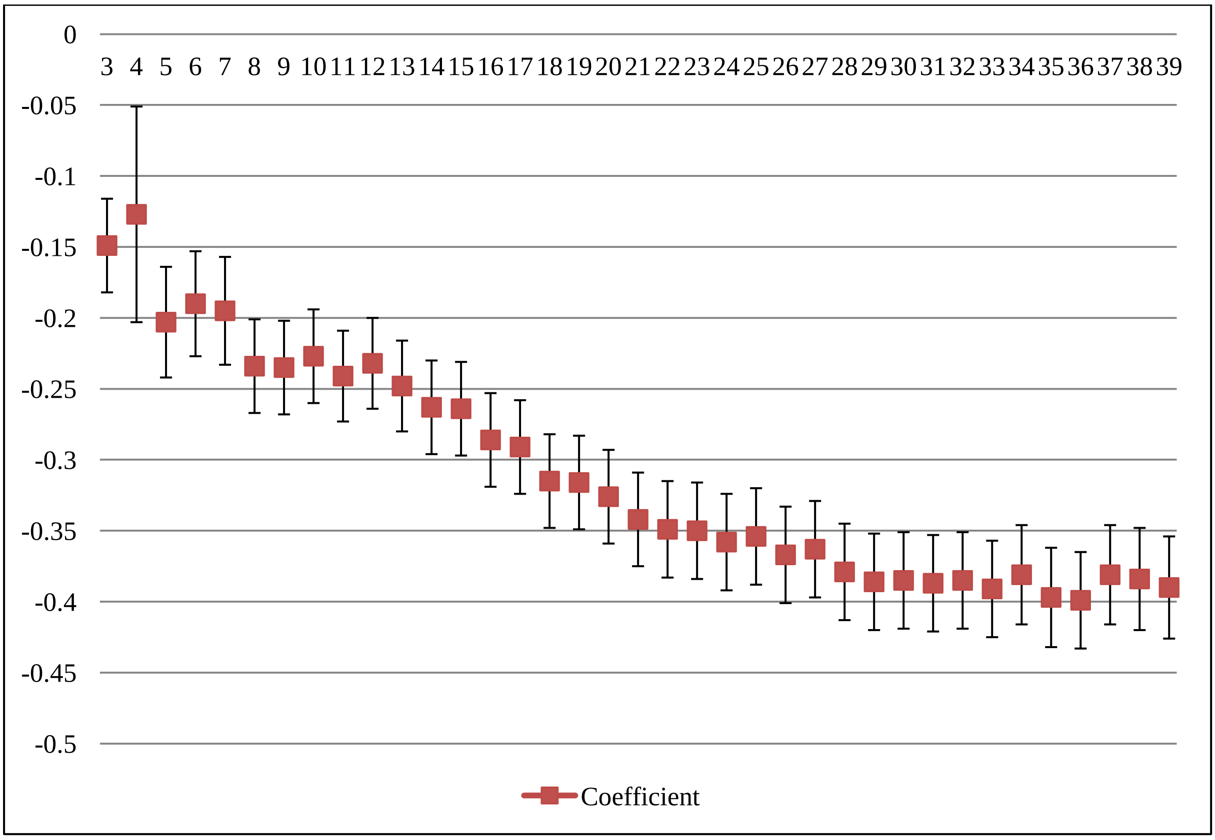

Figure 5 plots the regression coefficients of slack time against the sum of tasks carried out by all agents in a shift (X –axis).

TABLE 1-WORK FORCE IN THE CALL CENTER, MEANS AND STANDARD DEVIATIONS

Number of individuals	Age (in years)	Female (in percent)	Experience (in days)	Tenured employees (in percent)
434	40.59	78.57	2,313.82	12.67
	(10.72)		(1,038.48)	

TABLE 2-TASK DISTRIBUTIONS

Variables	Number of observations	Relative share of the number of observations	Average call duration	Share of total time spent
Task 1	69,192	1	217.25	0.7131
			(74.34)	(0.255)
Task 4	6,873	0.0993	130.60	0.0091
			(49.35)	(0.035)
Task 6	17,027	0.2461	273.49	0.0590
			(118.57)	(0.125)
Task 7	4,097	0.0592	422.93	0.0026
			(317.12)	(0.016)
Task 13	7,309	0.1056	138.75	0.0094
			(83.24)	(0.040)
Task 16	4,682	0.0677	245.52	0.0197
			(114.45)	(0.090)
Task 22	27,149	0.3924	296.17	0.0305
			(312.42)	(0.061)
Task 23	2,500	0.0361	409.98	0.0011
			(330.11)	(0.008)
Task 27	29,170	0.4216	347.44	0.0648
			(174.53)	(0.112)
Task 29	20,586	0.2975	392.55	0.0171
			(228.92)	(0.044)
Task 39	11,114	0.1606	92.67	0.0386
			(74.79)	(0.144)
Task 43	4,774	0.0690	419.65	0.0121
			(211.96)	(0.063)
Other tasks	11,840	0.1711	215.67	0.0229
			(165.09)	(0.010)

In total there are 46 different tasks. Person

In Pvi11.ons pa79(46)-n hes, 2

TABLE 3-TASK COMBINATIONS

	N	Percent	Task combinations	N	Percent
Single task	7,094	10.2	combination1	7,094	10.2
Two tasks	16,580	23.9	combination1-6	1,910	2.76
			combination1-22	3,443	4.98
			combination1-27	4,103	5.93
			combination1-29	2,037	2.94
			combination1-39	2,798	4.04
Three tasks	20,349	29.4	combination1-4-6	2,278	3.29
			combination1-22-27	4,533	6.55
			combination1-22-29	1,969	2.85
			combination1-27-29	1,501	2.17
Four tasks	15,902	22.9	combination1-4-6-13	918	1.33
			combination1-6-22-27	829	1.20
			combination1-22-27-29	3,615	5.22
Five tasks	6,930	10.0	Omitted		
Six or more tasks	2,337	3.4	Omitted		
Summary	69,192	100		37,028	53.46

The unit of analysis is a person-shift observation. There are overall 69,192 person-shift observations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Agents work at most on eleven tasks in a shift. We summarize all observations from six to eleven tasks into one variable. On the right hand side of the table, two-, three- and four-task observations are broken down by different combinations. Low frequency combinations are not displayed; task combinations are only shown when they represent 5% of observations. There are 54 task combinations that contain between 1% and 5% of the observations, summing up to about 30%, and the remaining task combinations sum up to less than 1% of overall observations.

TABLE 4-EFFECTS OF MULTI-TASKING ON AVERAGE CALL DURATION IN TASK-1

	(1)	(2)	(3)	(4)
Two tasks	0.023***	0.024***	0.058***	0.017***
	(0.004)	(0.005)	(0.008)	(0.004)
Three tasks	0.050***	0.051***	0.061***	0.040***
	(0.006)	(0.006)	(0.006)	(0.006)
Four tasks	0.070***	0.070***	0.079***	0.058***
	(0.006)	(0.006)	(0.007)	(0.006)
Five tasks	0.078***	0.079***	0.091***	0.068***
	(0.007)	(0.007)	(0.008)	(0.007)
Six or more tasks	0.079***	0.079***	0.092***	0.070***
	(0.009)	(0.009)	(0.010)	(0.009)
Experience in log		-0.148	-0.160	-0.174
		(0.108)	(0.105)	(0.110)
Experience^2 in log		0.008	0.009	0.010
		(0.010)	(0.010)	(0.010)
Combinations 1_6			0.061***	
Combinations 1_22			0.008	
Combinations 1_27			0.033***	
Combinations 1_29			0.013**	
Combinations 1_39			0.010*	
Combinations 1_2_46			0.078***	
Combinations 1_22_27			0.067***	
Combinations 1_22_29			0.018**	
Combinations 1_27_29			0.054***	
Combinations 1_4_6_13			0.085***	
Combinations 1_6_22_27			0.082***	
Combinations 1_22_27_29			0.087***	
Constant	5.236***	5.910***	5.931***	5.982***
	(0.074)	(0.275)	(0.264)	(0.285)
R-squared	0.160	0.162	0.164	0.166
No. Observations	69,192	67,842	67,842	67,842
No. Individuals	477	434	434	434

All models are fixed-effect estimations. The dependent variable is the logarithm of average call duration of a single employee during one shift in the basic types of information call (Task-1). The unit of analysis is a person-shift. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the "One task". Controls not reported are the share of total time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 4 (CONTINUED)-EFFECTS OF MULTI-TASKING ON AVERAGE CALL DURATION IN TASK-1

	(4)-continued
Time*skill1	-0.028***
	(0.007)
Time*skill2	-0.017***
	(0.003)
Time*skill3	-0.005***
	(0.001)
Time*skill4	-0.003***
	(0.001)
Time*skill5	-0.003**
	(0.001)
Time*skill6	0.002***
	(0.001)
Time*skill7	0.000
	(0.001)
Time*skill8	-0.003**
	(0.001)
Time*skill9	-0.000
	(0.001)
Time*skill10	-0.004***
	(0.001)
Constant	5.982***
	(0.285)
R-squared	0.166
N	67,842

Time*skill variables stand for skill-specific experience in weeks. We report the estimates for the high-frequency skill variables only. Thus, estimates for skills from eleven to twenty are not reported and almost all were insignificant. We also omitted the regression coefficients of $Time^2$*skill variables from one to twenty due to lack of significance.

TABLE 5-EFFECTS OF MULTI-TASKING ON AVERAGE CALL DURATION IN TASK-1; MOVES FROM TWO- TO THREE- OR FOUR-TASK COMBINATIONS

Combinations from \ to		1-4-6/ 1-4-6-13	1-22-27/ 1-22-29/ 1-6-22-27/ 1-22-27-29	1-22-27/ 1-6-22-27/ 1-22-27-29	1-22-29/ 1-27-29/ 1-22-27-29
1-6	Three tasks	0.028 (0.021)			
	Four tasks	0.059 (0.025)**			
	R-squared	0.187			
N=1,910	N	3,766			
1-22	Three tasks		0.079 (0.025)***		
	Four tasks		0.119 (0.029)***		
	R-squared		0.236		
N=3,443	N		1,250		
1-27	Three tasks			0.006 (0.018)	
	Four tasks			0.037 (0.019)*	
	R-squared			0.238	
N=4,103	N			3,401	
1-29	Three tasks				0.023 (0.017)
	Four tasks				0.121 (0.030)***
	R-squared				0.221
N=2,037	N				1,016

All models are fixed-effect estimations; all estimations are grouped for individuals. The dependent variable is the logarithm of average call duration of a single employee during one shift. The data restricted only for the combinations used above. Models are designed only for those tasks combinations that have high frequency and changed from two tasks to three tasks or four tasks. The estimations show the effect of an additional task if an agent works in two tasks and receive an additional third task or fourth task. For instance, first specification tests the productivity effect of adding task number 4 or task number 4 and 13 into the two-task combinations 1-6. The unit of analysis is a person-shift. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “two tasks”. Controls not reported are the share of total time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 6A-PROBABILITY OF ADDITIONAL TASK, GIVEN PRIOR PERFORMANCE

	(1)	(2)	(3)	(4)
Call duration	-0.319***	-0.249***	-0.262***	-0.241***
	(0.077)	(0.073)	(0.073)	(0.082)
Sales quota	2.172***	2.124***	2.130***	1.943***
	(0.216)	(0.220)	(0.219)	(0.224)
Controls:				
Location	No	Yes	Yes	Yes
Shift	No	No	Yes	Yes
Time	No	No	No	Yes
Cut1 constant	-2.669***	-2.243***	-2.131***	-0.809*
	(0.389)	(0.386)	(0.421)	(0.463)
Cut2 constant	-1.797***	-1.317***	-1.202***	0.183
	(0.388)	(0.384)	(0.419)	(0.462)
Cut3 constant	-1.029***	-0.507	-0.391	1.039**
	(0.389)	(0.386)	(0.419)	(0.463)
Cut4 constant	-0.255	0.297	0.415	1.888***
	(0.389)	(0.386)	(0.419)	(0.464)
Cut5 constant	0.479	1.052***	1.171***	2.687***
	(0.390)	(0.386)	(0.419)	(0.464)
Pseudo R-squared	0.0094	0.0371	0.0385	0.0715
N	69,192	69,192	69,192	69,192

All estimations are grouped for 477 individuals. Dependent variable is number of tasks agents have. It is defined from one to six. The variable is equal to one if agents do one-task, it is two if agents do two-tasks, it is three if agents do three-tasks etc. Controls not reported are the locations, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for 477 clusters in individuals. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 6B-PROBABILITY OF GETTING ADDITIONAL TASK; GIVEN PRIOR PERFORMANCE: FROM ONE TO TWO TASKS

	(1)	(2)	(3)	(4)
Call duration	-0.217***	-0.172**	-0.182**	-0.200**
	(0.082)	(0.079)	(0.080)	(0.100)
Sales quota	0.760***	0.768***	0.770***	1.146***
	(0.215)	(0.215)	(0.216)	(0.258)
Controls:				
Location	No	Yes	Yes	Yes
Shift	No	No	Yes	Yes
Time	No	No	No	Yes
Cut1 constant	-1.583***	-1.226***	-1.230***	-1.211**
	(0.428)	(0.429)	(0.432)	(0.517)
Pseudo R-squared	0.0021	0.0180	0.0195	0.0585
N	23,674	23,674	23,674	23,674

Four different models are reported for ordered probit regression. Here it is equivalent to probit regression; all estimations are grouped for 420 individuals. Dependent variable is number of tasks agents have and it varies from one to two. Die variable is one if agents do one-task and two if agents do two-tasks. Controls not reported are the locations, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for 420 clusters in individuals. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 7-THE EFFECTS OF MULTI-TASKING ON SALES QUOTA

	(1)	(2)	(3)	(4)
Two tasks	-0.006***	-0.005***	-0.004	-0.006***
	(0.001)	(0.001)	(0.003)	(0.002)
Three tasks	-0.006***	-0.005***	-0.003	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
Four tasks	-0.004*	-0.004*	-0.002	-0.005**
	(0.002)	(0.002)	(0.003)	(0.002)
Five tasks	0.003	0.004	0.004	0.003
	(0.003)	(0.003)	(0.003)	(0.003)
Six or more tasks	0.002	0.002	0.004	0.002
	(0.003)	(0.003)	(0.004)	(0.003)
Experience in log		-0.032	-0.034	-0.031
		(0.029)	(0.029)	(0.030)
$Experience^2$ in log		0.004	0.004	0.004
		(0.003)	(0.003)	(0.003)
Combinations 1_6			0.004	
Combinations 1_22			0.001	
Combinations 1_27			-0.002	
Combinations 1_29			-0.003	
Combinations 1_39			-0.005	
Combinations 1_2_46			0.004	
Combinations 1_22_27			-0.003	
Combinations 1_22_29			-0.005*	
Combinations 1_27_29			-0.014***	
Combinations 1_4_6_13			-0.002	
Combinations 1_6_22_27			0.003	
Combinations 1_22_27_29			-0.007***	
Constant	0.108***	0.150***	0.158***	0.145***
	(0.021)	(0.045)	(0.047)	(0.045)
R-squared	0.128	0.129	0.130	0.130
No. Observations	69,192	67,842	67,842	67,842
No. Individuals	477	434	434	434

Four different models are reported for fixed-effect regressions; all estimations are grouped for individuals, the dependent variable is sales quota (in percent) of a single employee during one shift. Sales quota is formed as an average of the five tasks. The unit of analysis is a person-shift. There are overall 69,192 person-shift observations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the "One task". Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 7 (CONTINUED)-THE EFFECTS OF MULTI-TASKING ON SALES QUOTA

	(4)-continued
Time*skill1	-0.002
	(0.002)
Time*skill2	0.000
	(0.001)
Time*skill3	-0.000
	(0.000)
Time*skill4	0.000
	(0.000)
Time*skill5	0.000
	(0.000)
Time*skill6	0.000
	(0.000)
Time*skill7	0.000
	(0.000)
Time*skill8	-0.000
	(0.000)
Time*skill9	0.001**
	(0.000)
Time*skill10	-0.000
	(0.001)
Constant	0.145***
	(0.045)
R-squared	0.130
N	67,842

Time*skill variables stand for skill-specific experience in weeks. We report the estimates for the high-frequency skill variables only. Thus, estimates for skills from eleven to twenty are not reported and almost all were insignificant. We also omitted the regression coefficients of $Time^2$*skill variables from one to twenty due to lack of significance.

TABLE 8-SLACK TIME BY NUMBER OF TASKS IN A SHIFT

	One Task	Two tasks	Three tasks	Four tasks	Five tasks	Six or more tasks
No. observations	6,681	16,067	19,986	15,524	6,814	2,302
Mean	0.1527	0.1494	0.1604	0.1690	0.1663	0.1605
Std. Dev.	(0.151)	(0.133)	(0.128)	(0.119)	(0.113)	(0.111)

Slack time is the share of the time spent that an agent waits for a call relative to total time spent in a given shift in the workplace. Agents work at most on eleven tasks in a shift. We summarize all observations from six to eleven tasks in the last column. Standard deviations are in parentheses.

TABLE 9-EFFECTS OF MULTI-TASKING ON CALL DURATION IN DIFFERENT SLACK QUINTILES

	Quintile-1 (Lowest)		Quintile-2		Quintile-3		Quintile-4		Quintile-5 (Highest)	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Number of tasks	0.026***		0.018***		0.010***		0.008**		0.017***	
	(0.003)		(0.003		(0.003)		(0.003)		(0.004)	
Two tasks		0.032***		0.016**		0.005		0.015**		0.039***
		(0.009)		(0.006)		(0.007)		(0.007)		(0.014)
Three tasks		0.060***		0.044***		0.027***		0.031***		0.050***
		(0.011)		(0.008)		(0.009)		(0.009)		(0.016)
Four tasks		0.088***		0.064***		0.038***		0.048***		0.073***
		(0.013)		(0.01)		(0.011)		(0.011)		(0.016)
Five tasks		0.111***		0.080***		0.052***		0.037***		0.084***
		(0.016)		(0.013)		(0.013)		(0.013)		(0.019)
Six or more tasks		0.124***		0.065***		0.034*		0.027		0.094***
		(0.019)		(0.016)		(0.017)		(0.018)		(0.028)
Constant	5.203***	5.224***	5.412***	5.434***	5.216***	5.229***	5.072***	5.073***	5.258***	5.255***
	(0.195)	(0.196)	(0.174)	(0.173)	(0.114)	(0.112)	(0.043)	(0.039)	(0.137)	(0.134)
R-squared	0.158	0.158	0.163	0.164	0.140	0.141	0.121	0.122	0.143	0.143
N	13,415	13,415	13,416	13,416	13,415	13,415	13,416	13,416	13,415	13,415

Fixed effect regressions models are reported for different quintile in slack time. Slack time is the share of the time spent that an agent waits idly for a call relative to total time spent in a given shift in the workplace. Slack time is a continuous variable between zero and one. Quintile-1 is the lowest quintile in which slack is very low and Quintile-5 is the highest quintile in which slack is the highest. The dependent variable is log of call duration of a single employee during one shift. The unit of analysis is a person-shift. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “One task”. Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 10-EFFECTS OF MULTI-TASKING ON SALES QUOTA IN DIFFERENT SLACK QUINTILES

	Quintile-1 (Lowest)		Quintile-2		Quintile-3		Quintile-4		Quintile-5 (Highest)	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Number of tasks	0.005***		0.001		0.001		-0.001		0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
Two tasks		-0.003		-0.005**		-0.005**		-0.004*		-0.006
		(0.003)		(0.002)		(0.002)		(0.002)		(0.005)
Three tasks		0.002		-0.007**		-0.005*		-0.007**		-0.009*
		(0.004)		(0.003)		(0.003)		(0.003)		(0.005)
Four tasks		0.008*		-0.003		-0.007*		-0.008**		-0.008
		(0.004)		(0.004)		(0.004)		(0.004)		(0.006)
Five tasks		0.018***		0.004		0.003		-0.002		-0.003
		(0.005)		(0.005)		(0.005)		(0.005)		(0.007)
Six or more tasks		0.020***		-0.002		-0.001		-0.011*		0.006
		(0.007)		(0.006)		(0.006)		(0.006)		(0.008)
Constant	0.132***	0.143***	0.048**	0.054**	0.129***	0.134***	0.043**	0.044**	0.104**	0.112***
	(0.016)	(0.016)	(0.022)	(0.022)	(0.046)	(0.046)	(0.021)	(0.021)	(0.041)	(0.043)
R-squared	0.094	0.094	0.118	0.119	0.139	0.140	0.154	0.154	0.175	0.176
N	13,415	13,415	13,416	13,416	13,415	13,415	13,416	13,416	13,415	13,415

Fixed effect regressions models are reported for different quintile in slack time. Slack time is the share of the time spent that an agent waits idly for a call relative to total time spent in a given shift in the workplace. Slack time is a continuous variable between zero and one. Quintile-1 is the lowest quintile in which slack is very low and Quintile-5 is the highest quintile in which slack is the highest. The dependent variable is sales quota (in percent) of a single employee during one shift. Sales quota is formed as an average of the five tasks. The unit of analysis is a person-shift. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the "One task". Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 11-THE EFFECTS OF MULTI-TASKING ON SLACK TIME

	(1)	(2)	(3)	(4)
Two tasks	-0.023***	-0.024***	-0.000	-0.021***
	(0.003)	(0.003)	(0.005)	(0.003)
Three tasks	-0.034***	-0.035***	-0.032***	-0.033***
	(0.004)	(0.004)	(0.004)	(0.004)
Four tasks	-0.044***	-0.045***	-0.044***	-0.043***
	(0.004)	(0.004)	(0.004)	(0.005)
Five tasks	-0.055***	-0.056***	-0.056***	-0.054***
	(0.005)	(0.005)	(0.005)	(0.005)
Six or more tasks	-0.067***	-0.068***	-0.068***	-0.065***
	(0.005)	(0.005)	(0.006)	(0.006)
Experience in log		-0.032	-0.039	-0.044
		(0.041)	(0.040)	(0.040)
Experience^2 in log		0.005	0.005	0.006
		(0.004)	(0.004)	(0.004)
Combinations 1_6			-0.022***	
Combinations 1_22			-0.020***	
Combinations 1_27			-0.036***	
Combinations 1_29			-0.025***	
Combinations 1_39			-0.030***	
Combinations 1_2_46			-0.012***	
Combinations 1_22_27			-0.013***	
Combinations 1_22_29			0.002	
Combinations 1_27_29			0.005	
Combinations 1_4_6_13			-0.010***	
Combinations 1_6_22_27			-0.017***	
Combinations 1_22_27_29			0.002	
Constant	0.292***	0.251**	0.272***	0.264***
	(0.037)	(0.098)	(0.096)	(0.097)
R-squared	0.326	0.329	0.332	0.331
No. Observations	67,077	65,747	65,747	65,747
No. Individuals	476	433	433	433

Four different models are reported for fixed-effect regressions; all estimations are grouped for individuals, the dependent variable is slack time. Slack time is the share of the time spent that an agent waits idly for a call relative to total time spent in a given shift in the workplace. Slack time is a continuous variable between zero and one. The unit of analysis is a person-shift. There are overall 67,077 person-shift observations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “One task”. Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 11 (CONTINUED)-THE EFFECTS OF MULTI-TASKING ON SLACK TIME

	(4)-continued
Time*skill1	0.010***
	(0.004)
Time*skill2	-0.001
	(0.001)
Time*skill3	-0.001**
	(0.001)
Time*skill4	-0.000
	(0.001)
Time*skill5	-0.000
	(0.000)
Time*skill6	0.001**
	(0.000)
Time*skill7	-0.000
	(0.000)
Time*skill8	-0.000
	(0.000)
Time*skill9	0.000
	(0.000)
Time*skill10	0.001
	(0.001)
Constant	0.264***
	(0.097)
R-squared	0.331
N	65,747

Time*skill variables stand for skill-specific experience in weeks. We report the estimates for the high-frequency skill variables only. Thus, estimates for skills from eleven to twenty are not reported and almost all were insignificant. We also omitted the regression coefficients of $Time^2$*skill variables from one to twenty due to lack of significance.

TABLE 12A-EFFECT OF MULTI-TASKING ON MAKING ERRORS DURING A CALL

	(1)	(2)	(3)	(4)	(5)
Silent listening	0.032***	0.032***	0.031***	0.031***	0.032***
	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)
Call duration	-0.024	-0.023			-0.021
	(0.015)	(0.015)			(0.020)
Sales quota			-0.043	-0.046	-0.013
			(0.038)	(0.037)	(0.051)
Number of tasks	-0.003		-0.003		
	(0.004)		(0.004)		
Two tasks		-0.027		-0.026	-0.027
		(0.022)		(0.022)	(0.022)
Three tasks		-0.052**		-0.051**	-0.051**
		(0.022)		(0.022)	(0.022)
Four tasks		-0.021		-0.020	-0.021
		(0.024)		(0.024)	(0.024)
Five tasks		-0.029		-0.027	-0.028
		(0.024)		(0.024)	(0.025)
Six or more tasks		-0.052**		-0.051*	-0.052**
		(0.026)		(0.026)	(0.026)
Constant	0.181**	0.199**	0.057***	0.080***	0.188*
	(0.085)	(0.087)	(0.018)	(0.022)	(0.107)
R-squared	0.008	0.015	0.007	0.015	0.015
N	1,650	1,650	1,650	1,650	1,650

Five different models are reported for fixed-effect regressions; all estimations are grouped for 341 individuals, the dependent variable is proportion of error made during call. There are overall 1,650 person-shift observations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “One task”. Robust standard errors are in parentheses and adjusted for 341 clusters in individuals. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 12B-EFFECT OF MULTI-TASKING ON FATAL ERRORS DURING A CALL

	(1)	(2)	(3)	(4)	(5)
Silent listening	0.027***	0.028***	0.027***	0.027***	0.028***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Call duration	-0.009	-0.009			-0.005
	(0.012)	(0.012)			(0.013)
Sales quota			-0.028	-0.030	-0.022
			(0.032)	(0.032)	(0.037)
Number of tasks	0.005		0.005		
	(0.004)		(0.004)		
Two tasks		0.008		0.008	0.008
		(0.013)		(0.013)	(0.014)
Three tasks		0.005		0.004	0.004
		(0.015)		(0.015)	(0.015)
Four tasks		0.013		0.013	0.013
		(0.018)		(0.018)	(0.018)
Five tasks		0.020		0.020	0.020
		(0.019)		(0.020)	(0.019)
Six or more tasks		0.030		0.029	0.030
		(0.022)		(0.022)	(0.022)
Constant	0.016	0.021	-0.027	-0.022	0.002
	(0.067)	(0.070)	(0.027)	(0.029)	(0.076)
R-squared	0.427	0.426	0.427	0.426	0.426
N	1,616	1,616	1,616	1,616	1,616

Five different models are reported for fixed-effect regressions; all estimations are grouped for 340 individuals, the dependent variable is proportion of fatal error made during call. There are overall 1,616 person-shift observations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “One task”. Robust standard errors are in parentheses and adjusted for 340 clusters in individuals. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 12C-EFFECT OF MULTI-TASKING ON NON-FATAL ERRORS DURING A CALL

	(1)	(2)	(3)	(4)	(5)
Silent listening	0.014**	0.014**	0.013**	0.013**	0.014**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Call duration	-0.015	-0.015			-0.019*
	(0.011)	(0.011)			(0.011)
Sales quota			-0.008	-0.008	0.023
			(0.032)	(0.032)	(0.034)
Number of tasks	0.004		0.004		
	(0.003)		(0.003)		
Two tasks		-0.007		-0.007	-0.007
		(0.009)		(0.009)	(0.009)
Three tasks		-0.007		-0.007	-0.007
		(0.009)		(0.009)	(0.009)
Four tasks		0.004		0.004	0.005
		(0.012)		(0.012)	(0.012)
Five tasks		0.008		0.008	0.008
		(0.015)		(0.015)	(0.015)
Six or more tasks		-0.001		-0.002	-0.000
		(0.017)		(0.017)	(0.017)
Constant	0.084	0.094	0.005	0.016	0.113*
	(0.059)	(0.060)	(0.020)	(0.021)	(0.062)
R-squared	0.610	0.610	0.609	0.609	0.610
N	1,616	1,616	1,616	1,616	1,616

Five different models are reported for fixed-effect regressions; all estimations are grouped for 340 individuals, the dependent variable is proportion of non-fatal error made during call. There are overall 1,616 person-shift observations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the "One task". Robust standard errors are in parentheses and adjusted for 340 clusters in individuals. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE-13-PERFORMANCE, CONTROLLING FOR NUMBER OF FORWARDED CALLS

	(1)	(2)	(3)	(4)	(5	(6)
	Call duration		Sales quota		Slack time	
Number of tasks	0.019***		0.002***		-0.012***	
	(0.001)		(0.001)		(0.001)	
Number of call forwarded	-0.018***	-0.018***	-0.003***	-0.003***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Two tasks		0.036***		-0.003**		-0.022***
		(0.005)		(0.001)		(0.003)
Three tasks		0.059***		-0.004**		-0.033***
		(0.005)		(0.002)		(0.004)
Four tasks		0.079***		-0.003		-0.043***
		(0.006)		(0.002)		(0.004)
Five tasks		0.091***		0.005**		-0.053***
		(0.007)		(0.003)		(0.004)
Six and more tasks		0.092***		0.004		-0.065***
		(0.009)		(0.003)		(0.005)
Constant	5.216***	5.221***	0.100***	0.106***	0.296***	0.291***
	(0.072)	(0.071)	(0.021)	(0.021)	(0.036)	(0.036)
R-squared	0.191	0.191	0.133	0.134	0.327	0.328
N	69,192	69,192	69,192	69,192	67,077	67,077

Six different models are reported for fixed-effect estimations; all estimations are grouped for individuals, the dependent variables are call duration in models (1) and (2), sales quota in models (3) and (4), and the slack time (in percent) of a single employee during one shift in models (5) and (6). The unit of analysis is a person-shift. Omitted variable is the "One task". Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for clusters in individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 14-EFFECT OF MULTI-TASKING ON CALL DURATION IN DIFFERENT LOCATIONS

	(1) Location-1	(2) Location-2	(3) Location-3	(4) Location-4
Two tasks	0.033***	0.009	0.009	0.026***
	(0.012)	(0.007)	(0.008)	(0.010)
Three tasks	0.053***	0.029***	0.034***	0.043***
	(0.014)	(0.010)	(0.010)	(0.010)
Four tasks	0.089***	0.051***	0.050***	0.059***
	(0.019)	(0.014)	(0.010)	(0.010)
Five tasks	0.112***	0.066***	0.060***	0.067***
	(0.020)	(0.020)	(0.012)	(0.012)
Six or more tasks	0.120***	0.080***	0.090***	0.063***
	(0.022)	(0.024)	(0.020)	(0.014)
Constant	5.363***	5.264***	5.185***	5.302***
	(0.153)	(0.015)	(0.016)	(0.072)
R-squared	0.177	0.224	0.180	0.156
N	9,427	12,518	18,007	29,240

Four different models are reported for fixed-effect estimations; all estimations are grouped for individuals, the dependent variable is call duration. The unit of analysis is a person-shift. The sample is split to four different locations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “One task”. Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for clusters in individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 15-EFFECT OF MULTI-TASKING ON SALES QUOTA IN DIFFERENT LOCATIONS

	(1) Location-1	(2) Location-2	(3) Location-3	(4) Location-4
Two tasks	-0.000	-0.003	-0.005*	-0.012***
	(0.004)	(0.002)	(0.003)	(0.004)
Three tasks	-0.001	-0.003	-0.007**	-0.009**
	(0.005)	(0.005)	(0.003)	(0.004)
Four tasks	0.009	0.004	-0.006	-0.009**
	(0.006)	(0.007)	(0.004)	(0.004)
Five tasks	0.011*	0.009	0.003	-0.001
	(0.006)	(0.008)	(0.004)	(0.004)
Six or more tasks	0.014*	0.016*	0.000	-0.002
	(0.007)	(0.010)	(0.009)	(0.005)
Constant	0.139***	0.145***	0.130***	0.112***
	(0.044)	(0.005)	(0.007)	(0.020)
R-squared	0.118	0.153	0.129	0.134
N	9,427	12,518	18,007	29,240

Four different models are reported for fixed-effect estimations; all estimations are grouped for individuals, the dependent variable is sales quota. Sales quota is formed as an average of the five tasks. The unit of analysis is a person-shift. The sample is split to four different locations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “One task”. Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for clusters in individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 16-EFFECT OF MULTI-TASKING ON SLACK TIME IN DIFFERENT LOCATIONS

	(1) Location-1	(2) Location-2	(3) Location-3	(4) Location-4
Two tasks	-0.031***	-0.016***	-0.011***	-0.028***
	(0.009)	(0.003)	(0.003)	(0.007)
Three tasks	-0.042***	-0.010**	-0.018***	-0.047***
	(0.012)	(0.004)	(0.004)	(0.008)
Four tasks	-0.046***	-0.011*	-0.019***	-0.059***
	(0.013)	(0.005)	(0.005)	(0.008)
Five tasks	-0.046***	-0.014	-0.024***	-0.070***
	(0.014)	(0.008)	(0.006)	(0.008)
Six or more tasks	-0.051***	-0.005	-0.031***	-0.085***
	(0.014)	(0.015)	(0.008)	(0.009)
Constant	0.412***	0.205***	0.216***	0.190***
	(0.043)	(0.007)	(0.008)	(0.024)
R-squared	0.239	0.376	0.293	0.386
N	9,304	12,312	17,588	27,873

Four different models are reported for fixed-effect estimations; all estimations are grouped for individuals, the dependent variable is the slack time (in percent) of a single employee during one shift. The unit of analysis is a person-shift. The sample is split to four different locations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “One task”. Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for clusters in individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 17-THE EFFECT OF MULTI-TASKING WITH PERSONAL CHARACTERISTICS

	Call duration	Sales quota	Slack time
Female	0.008	0.007*	-0.008**
	(0.024)	(0.004)	(0.003)
Tenured	-0.048	0.002	0.005
	(0.033)	(0.005)	(0.004)
Age	0.015**	0.001	-0.003**
	(0.007)	(0.001)	(0.001)
Age^2	-0.000	-0.000	0.000*
	(0.000)	(0.000)	(0.000)
Experience	-0.000**	-0.000**	0.000
	(0.000)	(0.000)	(0.000)
$Experience^2$	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Two tasks	0.021**	0.001	-0.022***
	(0.010)	(0.002)	(0.003)
Three tasks	0.045***	0.005*	-0.030***
	(0.014)	(0.003)	(0.004)
Four tasks	0.059***	0.007**	-0.038***
	(0.016)	(0.003)	(0.004)
Five tasks	0.055***	0.015***	-0.047***
	(0.018)	(0.004)	(0.005)
Six or more tasks	0.050**	0.014***	-0.059***
	(0.022)	(0.005)	(0.006)
Constant	4.907***	0.070**	0.370***
	(0.160)	(0.033)	(0.049)
R-squared	0.143	0.142	0.371
N	67,865	67,865	65,769

Three different OLS estimations for the dependent variables call duration; sales quota and slack time are reported. All estimations are clustered for individual heterogeneity. The unit of analysis is a person-shift. Omitted variable is the "One task". Controls not reported are the share of time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parenthesis. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 18-THE EFFECT OF MULTI-TASKING ON CALL DURATION DIFFERENCE BETWEEN TENURED AND NON-TENURED SUBJECTS

	(1) Non-tenured	(2) Non-tenured	(3) Tenured	(4) Tenured
Number of tasks	0.017***		0.015***	
	(0.002)		(0.004)	
Two tasks		0.024***		0.006
		(0.005)		(0.010)
Three tasks		0.050***		0.022*
		(0.006)		(0.012)
Four tasks		0.068***		0.042***
		(0.007)		(0.013)
Five tasks		0.079***		0.044***
		(0.008)		(0.014)
Six or more tasks		0.078***		0.077***
		(0.010)		(0.025)
Constant	5.256***	5.266***	5.082***	5.101***
	(0.080)	(0.079)	(0.019)	(0.020)
R-squared	0.160	0.161	0.195	0.195
N	57,346	57,346	10,519	10,519

Four different fixed-effect regressions models are reported for tenured and non-tenured subjects; all estimations are grouped for individuals, the dependent variable is the logarithm of average call duration of a single employee during one shift in the basic types of information call (Task-1). The unit of analysis is a person-shift. There are overall 67,865 person-shift observations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the "One task". Controls not reported are the share of total time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.

TABLE 19-THE EFFECT OF MULTI-TASKING ON SALES QUOTA DIFFERENCE BETWEEN TENURED AND NON-TENURED SUBJECTS

	(1) Non-tenured	(2) Non-tenured	(3) Tenured	(4) Tenured
Number of tasks	0.002**		0.000	
	(0.001)		(0.001)	
Two tasks		-0.005***		-0.007**
		(0.002)		(0.003)
Three tasks		-0.006**		-0.009**
		(0.002)		(0.004)
Four tasks		-0.005*		-0.006
		(0.003)		(0.004)
Five tasks		0.003		-0.001
		(0.003)		(0.005)
Six or more tasks		0.004		-0.014
		(0.003)		(0.015)
Constant	0.109***	0.116***	0.113***	0.117***
	(0.023)	(0.023)	(0.008)	(0.008)
R-squared	0.129	0.130	0.138	0.139
N	57,346	57,346	10,519	10,519

Four different fixed-effect regressions models are reported for tenured and non-tenured subjects; all estimations are grouped for individuals, the dependent variable is the sales quota of a single employee during one shift. The unit of analysis is a person-shift. Sales quota is formed as an average of the five tasks. There are overall 67,865 person-shift observations. Person-shift observations are calculated only for employees who work more than three and less than ten hours. Omitted variable is the “One task”. Controls not reported are the share of total time spent in each task, times of shifts, weekdays, and weeks of the year. Robust standard errors are in parentheses and adjusted for individual heterogeneity. Statistical significance: *p<0.10, **p<0.05, ***p<0.01.