

Teleworkers in Italy: Who are they? Do they earn more?

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Abstract

By defining *teleworkers* the employees working at home at least two days a week, we investigate theoretically and empirically the determinants of the probability of being a teleworker and the extent of earnings differentials between teleworkers and traditional employees. Our empirical results are based on the Italian labor force survey and suggest that teleworkers are mainly women, well educated individuals and employees occupying high level job positions. The empirical evidence, based on switching regression models that account for non-random participation to telework, points out that teleworkers face a wage premium of 10.7%. This result is mainly driven by white collars (12.7%), while there is no evidence of a wage differential between teleworkers and traditional workers employed as blue collars.

KEYWORDS: TELEWORKING, WAGE DIFFERENTIALS, ENDOGENOUS SWITCHING REGRESSION MODEL

JEL CODES: J22, J31, J81, C34, C14

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1 Introduction

Concepts as work-life balance, knowledge management, and lean organization have received increasing attention in labor and industrial organization. They generally lead firms to reconsider the traditional work context and often give rise to the phenomenon of *teleworking*, also called *smart working* or *telecommuting*, an innovative results-oriented approach based on a higher flexibility in the organization of labor. Many definitions of teleworking have been proposed in the sociological, psychological, and political literature, and they all relate to the overcoming of the traditional use of physical space and working hours, moving towards results-oriented rewards and letting people “work where and when as they wished as long as it delivered the right results” (Clapperton and Vanhoutte, 2014).¹

While the practice of telecommuting has long been spreading among wage and salary workers in the US, where 24% of employees did some work from home in 2015 (US Bureau of Labor Statistics, 2016), it has only recently started developing in the EU: the European Foundation for the Improvement of Living and Working Conditions (Eurofound, 2010) defines teleworkers as employees working with a personal computer away from the employer’s premises and computes both the share of employees (on total employment) teleworking at least 25% of the time and the share of those teleworking for the whole time. In the EU27 area, the averages of these two measures are 7% and 1.07%, respectively. The highest shares of teleworkers is documented for the Czech Republic, where 15.02% of employees telework for one fourth of the time, while 9.00% telework the whole time. Instead, Italy presents two of the lowest shares of teleworking in Europe, which amount to 2.03% and 0.05%, ranking Italy 25-th out of 27 surveyed countries.

The virtues and vices of teleworking have been investigated in the recent literature and it has been found to affect workers, employers and, ultimately, the whole society (see Potter, 2003; Allen et al., 2016, for recent reviews). On the one hand, telecommuting can lead employees working at home to professional isolation (Cooper and Kurland, 2002) and can negatively affect social interactions and friendship: “If telecommuting portends a trend that *individualizes* the workplace, it also *individualizes* society to a greater degree than in any time in our history” Potter (2003, page 81). On the other, salary and wage employees may gain a greater balance between time spent on the job and family care, may have a reduction in transportation time and costs,² and a higher productivity.³ More specifically, the literature has argued that the wage effect associated with teleworking can be the result of several mechanisms generating either positive or negative wage differentials between smart and traditional workers. A lower wage rate may be entailed by a lower disutility of telework with respect to traditional jobs, due to the possibility of attending child and elderly care, schedule flexibility, fewer distractions and lower commut-

¹In CISCO (2011), teleworking is defined as “an act of production performed independent of time and place. In its ultimate form, the office no longer exists and traditional work conventions such as work hours are irrelevant.” Veldhoen (2005) writes “Smart working is the methodology that allow us to be always connected with our information and with people we work with”.

²For example, for the residents of Bronx, New York, the commuting time saving would be an hour-and-a-half a day (Potter, 2003).

³Other than employees, firms may benefit from potential productivity gain, reduced absenteeism, lower costs for the physical space; the society as a whole may also benefit from the reduction of traffic and of air pollution (Allen et al., 2016).

ing costs (Bélanger, 1999). Similarly, workplace characteristics and job-specific tasks can be such that teleworking gives a lower hourly productivity than on-site working (Dutcher and Saral, 2012; Giovanis, 2015). On the contrary, assigning employees to work at home can lead to a significant lower office costs for firms, which may translate into a wage premia to incentive teleworking (Hill et al., 1998). Moreover, with asymmetric information, teleworking hampers monitoring by the employer, leading to a higher offered wage rate to disincentive shirking behavior (Gajendran and Harrison, 2007). Finally, higher wages may be paid to compensate the lower returns to experience for teleworkers, who may have a weaker link with the firm's management and experience a significantly lower learning (Clark, 2012).

In spite of the duality depicted by the above-mentioned literature, the available few empirical studies document a higher productivity and a significant positive wage differential in favor of teleworkers (Oettinger, 2004; Gariety and Shaffer, 2007).⁴ However, this evidence can only be regarded as descriptive since the estimation of the effect of telework on wages may be biased if the potentially non-random assignment is not accounted for. The literature shows that the job type and education, as opposed to age, tenure and computer skills, are two of the main determinants of participating in teleworking (Bélanger, 1999). In addition, a home-based job is especially attractive to women with young children, that can better balance work and family care (Edwards and Field-Hendrey, 2002).

Along with observable confounding characteristics, there may be several unobserved factors simultaneously affecting the assignment to telework and the wage rate. We argue that workers with a strong preference for a career/family based life-style may be less/more likely to work from home and, at the same time, perceive higher/lower earnings. In this case, neglected endogeneity leads to an understatement of the wage effect of teleworking. On the contrary, if teleworkers had a comparative advantage in the tasks that can be performed from home, the effect of teleworking on wages would be overestimated if such self-selection mechanism was not accounted for. Finally, a great variety of unobservable workplace characteristics and job-specific tasks can affect the magnitude of the wage premia in favor of teleworking. To the best of our knowledge, only Schroeder and Warren (2005) provide estimation results on the US Current Population Survey based on an empirical strategy that accounts for the endogenous participation in teleworking: they find a positive wage differential between smart and traditional workers, that increases in magnitude when endogeneity is accounted for.

In this work, we add to the scant empirical evidence on teleworking by investigating the extent of the wage differential faced by teleworkers compared to the traditional ones. We first ground our analysis on a formal theoretical framework depicting endogenous teleworking participation and the possible mechanisms generating wage differentials between smart and traditional workers, based on the efficiency wage and bargaining hypotheses. Secondly, we empirically investigate the determinants of the probability of teleworking and test the model predictions by estimating the effect of telework on earnings. We account for non-random participation to teleworking by estimating an endogenous switching regression model,

⁴The review by Bailey and Kurland (2002) list several descriptive studies containing results on a higher productivity for teleworkers. However, the Authors underline that most of these conclusion are derived from self-reported data on workers who requested to work at home and therefore fail to provide convincing evidence.

where the identification of the effect of interest relies on both a set of exclusion restrictions, built using information on the family composition, and on the normality assumption. The empirical analysis is based on the Italian Labor Force Survey (Rilevazione Continua sulle Forze di Lavoro, RCFL), issued by the Italian Institute of Statistics (ISTAT), where information on teleworking and wage rates is available for the waves from 2008 to 2013. In this respect, our work represents a further contribution to the extant literature, since the empirical evidence on teleworking in Italy is indeed scarce, despite the flexibility of labor organization has been making its way to the center of the political debate.⁵ Descriptive evidence on the incidence of teleworking is provided by the ISTAT 2008 with the *Usa del tempo* (time usage) survey, where a specific question on teleworking was included and from which it emerges that 0.7% of employees telework from home. Recently, Corso et al. (2013) carried out an ad-hoc firm survey concluding that telework is allowed by 20% of firms, but for only 10% of their workers.⁶ The above-mentioned studies, however, limit the analyses to the incidence teleworking and do not provide, at least on the employees' side, novel information neither on the main characteristics of teleworkers nor on potential wage differentials between smart and traditional workers.

Our results suggest that women have a higher probability of teleworking, as well as employees occupying high level job positions, and individuals who attained higher education. The results corroborate that teleworking is partly related to the employees household composition and concerns mainly workers who benefit from more time spent at home for family care, especially if the elderly retired are not part of the family. As for wage differentials, while OLS estimates point toward a modest wage premium of teleworking (3.2%), although not statistically significant for blue collars, our results reveal that neglecting endogeneity leads to an understatement of the wage effect of teleworking. We uncover that the resulting positive and statistically significant wage premium amounts to 10.7% and it is mainly driven by white collars (12.7%). Instead, there is still no evidence of a wage differential between teleworkers and traditional workers employed as blue collars nor of an endogeneity problem.

The remainder of the paper is organized as follows: Section 2 presents a theoretical model for telework participation and wage differentials. Section 3 describes the empirical strategy. Section 4 describes the dataset employed for our empirical analysis and Section 5 discusses the estimation results. Finally Section 6 concludes.

2 Some theoretical clues on telework

In this section we offer some theoretical hints to frame the key questions of the paper: who are the teleworkers and whether they face a wage differential with respect to traditional workers. We refer to a

⁵In 2016, the Italian Government approved the bill on *lavoro agile*, that allows for work to be carried out partly within the business premises and partly outside, just within the limits of the maximum duration of daily and weekly working hours, resulting from the law and collective bargaining.

⁶They also argue that 9.5 millions of Italian workers could operate using communication technologies; if this were the case, the increase in productivity could reach 5.5%.

job for which working at home: ⁷

- gives an hourly productivity slightly lower or equal to the one of on-site work⁸. We define γ_{ij}^N the hourly productivity of working on-site and with γ_{ij}^T the one of working at home, both depending on the workplace's characteristics (index j) and on worker's talent (index i);
- may entail a lower disutility of work than on-site working (Bélanger, 1999). We indicate it with τ_i , positive for on-site workers and nil for teleworkers, defined as disutility due to commuting hereafter;
- may reduce the firm's cost for the use of space (Hill et al., 1998). We define with c_j the cost for the use of space, assumed to be equal to zero for teleworkers;
- may affect the monitoring technologies and costs in contexts of asymmetric information (Gajendran and Harrison, 2007);
- may reduce the employee's career perspectives because it reduces the links between the employee and the firm's managers (Clark, 2012).

A key point of the model refers to the assumptions that must be made on wage determination. We consider *bargaining* in the case effort is perfectly observable, *efficiency wage* if effort is not perfectly observable and “monitoring and firing” is the tool used to motivate workers, *career perspective* in the case worker's motivation is based on expectations and the current wage is set at the reservation utility level.

We define with w_{ij} the wage rate of the employee i in the job j and with e_{ij} the employee's effort. We assume that e_{ij} depends on effort on the workplace (h_{ij}) and on effort due to commuting (τ_i , specific to the individual). We assume that risk neutral employees' utility functions are separable in wage and working time⁹ and given by:

$$u_{ij}^{\kappa} = w_{ij}^{\kappa} - f(h_{ij}^{\kappa}, \tau_i^{\kappa}) \quad \text{for } \kappa = T, N, \quad \tau_i^T = 0 \quad \tau_i^N = \tau$$

where the apex T refer to teleworkers and the apex N to on-site workers, and where $f'_e > 0$, $f''_{ee} \geq 0$.

⁷Many other differences between the two types of work could be obviously considered. We focus here on the ones that have received the greatest interest in the economic literature.

⁸In the case of a higher hourly productivity and according to the other hypotheses of the model, telework is always preferred. In the case of strongly lower productivity, telework would not even be considered. In our knowledge, the only empirical research on the relationship between labor productivity and teleworking is the one proposed by Giovanis (2015) that estimates a positive relationship between the two that “ holds for employees who have high influence on their job, while it becomes negative in the case of teleworkers who have low influence”. Nevertheless, according to the results of Dutcher and Saral (2012) page 16, “Both telecommuters and non-telecommuters believed that telecommuting would have a detrimental effect on productivity”.

⁹In the appendix 7 an implicit formulation of the utility function is analyzed, by assuming a continuous τ and $\gamma = \gamma(\tau)$, $c = c(\tau)$. We compute $\frac{dw}{d\tau}$, so that the reaction of the wage to change in time needed to commuting. The results are coherent with the one presented in the Eq. (2) that follows in the text. Therefore, we prefer to present a very simple model with a specific utility function, that allow us to compute the conditions that make telework the best strategy.

Firm's profits are given by:

$$\pi_{ij}^{\kappa} = \gamma_{ij}^{\kappa} h_{ij}^{\kappa} - w_{ij}^{\kappa} - c_j^{\kappa} \quad \text{for } \kappa = T, W \quad c_j^T = 0, \quad c_j^N = c$$

where γ_i^{κ} the individual specific hourly productivity. We define:

$$\Delta_{ij} = \gamma_{ij}^N - \gamma_{ij}^T$$

the expected hourly loss in productivity in a job position due to telework. Generally speaking, Δ_{ij} must depend on the characteristics of the workplace, but it can also depend on the characteristics of the employee. Working time is assumed to be equal for teleworkers and on site workers,¹⁰ $h_{ij}^{\kappa} = h$. In this case, the specific form assumed by the $f(h, \tau)$ function does not influences qualitatively the results and, in order to simplify the notation, we prefer to use a linear disutility function $f(e) = e$, so that $f(h, \tau) = h + \tau$ and $f(\tau) = \tau$.

The total surplus generated by a job is given by:

$$S_{ij}^{\kappa} = \gamma_{ij}^{\kappa} h - (h + \tau_i^{\kappa}) - c_j^{\kappa} \quad \kappa = T, W, \quad c_j^T = 0, \quad \tau_i^T = 0$$

and the difference in the total surplus generated by the two different types of job is positive, $S_{ij}^T > S_{ij}^N$, if:

$$[c_j - \Delta_{ij} h] + \tau > 0 \quad (1)$$

where the first addend represents the variation in firm's profit and the second one the reduction in the disutility in case of telework.¹¹

Eq. (1) states that telework is likely to be the best strategy for both parties if the cost due to space usage is relevant, the employee's disutility is strongly reduced by working at home, working time is low¹² the loss in hourly productivity is nil or low, so that it is more likely to be satisfied for those employees that perform relatively better working at home. They can be the "less talented" if we assume that the lost in production is proportional to talent $\left(\frac{d\Delta}{d\gamma^N} > 0\right)$. But they can also be the "most talented" ones if we assume that talent affect positively working at home more than working on site. Therefore, it is not easy to define the relationship between the talent of the employee (γ_i) and the likelihood to be a teleworker.

¹⁰By assuming that bargaining refers also to working time, we obtain that the number of hours worked is higher in the telework jobs; the other results are qualitatively similar to the ones obtained in the text. Given that our empirical estimates do not refers to working time (an issue leaved to future development of the paper), we prefer to not show the results.

¹¹Note that condition (1) always hold if $\Delta_{ij} = 0$, $\tau_i > 0$ and it can be respected even in the cases where $c_j \leq 0$. In this case, teleworking improves the profit and utility. Nevertheless, managers can loose some degree of control over the teleworkers and they could be reluctance to accept telework, as underlined by Cooper and Kurland (2002) "At the firm level, scholars have identified little beyond managerial reluctance as an inhibitor to telework adoption and diffusion".

¹²By considering the more general version of the $f(e)$ function, condition (1) becomes $[c_j - \Delta_{ij} h] + f(h, \tau) - f(\tau) > 0$. In that case, the condition $f'_h < \Delta$ is required to state that a shorter working time raise the likelihood of being a teleworker.

Assume now that the parties bargain on the wage. Assuming Nash bargaining and defining with β the bargaining power of the worker, so that

$$\beta = \frac{u_{ij}^\kappa}{\pi_{ij}^\kappa + u_{ij}^\kappa} \quad \kappa = T, W$$

The wage rates in the telework and on site position are given by:

$$w_{it}^T = \beta \gamma_{ij}^T h + (1 - \beta)h, \quad w_{it}^N = \beta(\gamma_{ij}^N h - c_j) + (1 - \beta)(h + \tau_i)$$

and the difference in the wage rate is given by:

$$w_{ij}^T - w_{ij}^N = \beta[c_j - \Delta_{ij}h] - (1 - \beta)\tau \quad (2)$$

Therefore¹³. teleworkers are likely to earn more than if they were assigned to on-site jobs if their bargaining power is high, the reduced cost for space usage is high, the loss in hourly productivity is low, the reduction in disutility due to telework is low.

Note that the difference in the wage rate, $w_i^T - w_i^N$ does not reflect differences in hourly productivity alone, but also depends of the higher rent in the telework jobs and on bargaining power, so that empirical analyses that conclude that teleworkers earn more do not imply that their productivity is higher.

In jobs where employees' working time and output are hardly measurable, the wage rate is set unilaterally by the firm in order to motivate workers, as in the standard Shapiro-Stiglitz model. Consider a job where effort on the workplace is subject to random monitoring. Defining λ the exogenous probability of lay-off, r the interest rate of workers, U the expected utility of the unemployed and q the exogenous monitoring probability, assumed to be lower for teleworkers than on-site ones, $q^T < q^N$. Shirkers (apex S) and non shirkers (apex NS) expected utilities are (we drop the index j for simplicity):

$$\begin{aligned} rV_i^S &= w_i^\kappa - \tau_i^\kappa + (\lambda + q)(U - V_i^S) & \kappa = T, N & \quad \tau_i^T = 0 \\ rV_i^{NS} &= w_i^\kappa - (\tau_i^\kappa + h) + \lambda(U - V_i^{NS}) & \kappa = T, N & \quad \tau_i^T = 0 \end{aligned}$$

where shirkers does not produce effort on the workplace but suffer because of commuting if they work on site. The efficiency wage that firm must pay in order to motivate the worker, so the one that solves

¹³If teleworkers are characterized by a lower bargaining power than on site workers (see Jackson and van der Wielen (1998), page 288 the difference of equation (2) is more likely to be negative. If the firm decides unilaterally the wages ($\beta = 0$), the wage premium due to telework is negative

$V_i^{NS} = V_i^N$ is:

$$w_i^\kappa = h + \tau_i^\kappa + rU + \frac{r + \lambda}{q_i^\kappa} h \quad \text{for } \kappa = T, W \quad \tau_i^T = 0$$

The difference in the wage rate between teleworker and on-site worker is:

$$w_i^T - w_i^N = (r + \lambda)h \frac{q_i^N - q_i^T}{q_i^N q_i^T} - \tau_i$$

As expected, if $q_i^N > q_i^T$, the difference in the wage between the two job positions can be positive or negative. It is more likely to be positive for workers with a low disutility coming from commuting time and in job positions where working at home reduces strongly the probability of being monitored¹⁴

Firm's profits are given by:

$$\pi_i^\kappa = \gamma_i^\kappa h - w_i^\kappa - c \quad \text{for } \kappa = T, W \quad c^T = 0$$

and telework is the best strategy of the firm if:

$$\pi_i^T - \pi_i^N = c - \Delta_i h + \tau_i - (r + \lambda)h \frac{q_i^N - q_i^T}{q_i^N q_i^T} \quad (3)$$

Note that this condition is more stringent than the one computed in Eq. ((1)). Telework is less likely to be the best strategy for the firm if telework is more difficult to be monitored than on site work.

Consider now the case where teleworking can influence negatively career perspectives and assume that the asset value of a job is given by:

$$rV_i^\kappa = w_i^\kappa - (h + \tau_i^\kappa) + b_i^\kappa (V_i^+ - V_i^\kappa) \quad \kappa = T, N \quad \tau_i^T = 0$$

the worker can be promoted to an upper hierarchical level with probability b , obtaining in that case an increase in the expected utility. Assume also that the firm must compensate the employee with a minimum level of expected utility, say V_0 , so that $V = V_0$. Computing the wage, we obtain:

$$w_i^\kappa = rV_0 + (h + \tau_i^\kappa) - b_i^\kappa (V_i^+ - V_0) \quad \kappa = T, N \quad \tau_i^T = 0$$

¹⁴Nevertheless, the difference in the expected utility utility is always positive, because $V^T - V^N = (r + \lambda)h \frac{q_i^N - q_i^T}{q_i^N q_i^T}$. Employees always prefer telework if the monitoring probability for workers at home is lower than the one for workers on site.

the difference in the wage rate between the two positions is given by:

$$w_i^T - w_i^N = (b_i^N - b_i^T)(V_i^+ - V_0) - \tau$$

Two opposite forces operate in determining teleworkers wage: the reduction in disutility (τ) reduces wages, the lower career probability ($b_i^N - b_i^T > 0$) would increase them. By substituting the wage rate in the profit function, we obtain that the difference in profits the firm obtain from the two positions is given by:

$$\pi_i^T - \pi_j^N = c - \Delta_i h + \tau_i - (b_i^N - b_i^T)(V_i^+ - V_0) \quad (4)$$

with respect to Eq. ((1)), the condition is more stringent and more likely to be respected in jobs where the career perspectives are less sensitive to the job location (low $b_i^N - b_i^T$).

The approaches presented above have not solved unilaterally the question “who teleworkers are” nor the question “do they earn more”. We need further assumptions on the differences between teleworkers and on-site ones. For instance, on the possible difference in the hourly productivity among the two positions and on the determinants of this difference. Is it higher for highly talented workers or low talented workers? There exist some relationship between the assumed higher difficulties to monitor teleworker and their talent?

Two different effects must be therefore faced empirically when comparing the wage between on-site and teleworker: the composition effect, because teleworkers are a non random sample of all workers, and the wage effect, because each employee can earn a higher or a lower wage in the telework position. Given that teleworkers should satisfy the condition of Eq. (1) (of Eq. (3) in the case of imperfect monitoring and of Eq. ((4) in the case of career perspectives), whereas on site workers does not, and that the actual assignment to the two different working positions can nevertheless be affected by a random shock with zero mean, we can define the expected probability of being a teleworker:

$$P_{ij} = \text{prob}([c_j - \Delta_{ij}h] + \tau_i - Z > 0)$$

where $Z = (r + \lambda)h \frac{q_i^N - q_i^T}{q_i^N q_i^T}$ or $Z = (b_i^N - b_i^T)(V_i^+ - V_0)$ indicates others events (due to imperfect monitoring and career perspective) that can affect the relative convenience of the telework position.

We can also compute the probability that the wage rate in the telework position is higher than the one of on-site position:

$$Q_{ij} = \text{prob}(w_{ij}^T - w_{ij}^N > 0)$$

Table 1 summarizes the theoretical results by computing the sign of the relationships between the above probabilities and the parameters of the model. The theoretical model concludes that telework is likely to be the best strategy for both the firm and the employee if the firm’s cost for the use of space is high, if worker’ utility greatly increases by working at home, if the loss in hourly productivity in the

case of telework is nil or low. Workers who have better performances working at home can be the most talented, if the talent is negatively correlated with the loss of hourly productivity, or the least talented, in the opposite case. But, if effort is not perfectly observable, they can also be the ones the firm trust the most or the ones that are less interested in future career. These workers' characteristics, obviously together with the (unobservable) workplace characteristics, affect the probability of being a teleworker.

The model also highlights that the difference in the wage rate between the telework position and the on-site position is more likely to be positive if the worker utility is little affected by the job's location, if the firm gets considerable savings by using teleworking, if the loss in hourly productivity is low and obviously if the bargaining power of employees is high.

Table 1: Probability of assignment to telework (P) and probability of a higher wage in the telework job (Q) as a function of model parameters

Assignment to TW	$\frac{dP}{d\tau}$	$\frac{dP}{dc}$	$\frac{dP}{d\Delta}$	$\frac{dP^*}{dh}$	$\frac{dP}{d\beta}$	$\frac{dP}{dZ}$
Bargaining	+	+	-	-	0	
Efficiency wage, career	+	+	-	-		-
Wage Difference	$\frac{dQ}{d\tau}$	$\frac{dQ}{dc}$	$\frac{dQ}{d\Delta}$	$\frac{dQ}{dh}$	$\frac{dQ}{d\gamma^N}$	$\frac{dQ}{dZ}$
Bargaining	-	+	-	-	+	
Efficiency wage, career	-	0	0	0		+

τ lower disutility due to telework;

c saving in space cost in case of telework;

Δ difference in hourly productivity between on-site workers and teleworkers;

h working time;

β worker bargaining power;

Z other factor affecting profits and wages;

* $f'_h(h) < \Delta$, $(1 - \beta)f'_h(h) < \beta\Delta$ (see footnote 12).

3 Empirical strategy

In order to identify the effect of teleworking on wages, we specify a linear switching regression model with endogenous treatment (Heckman, 1978; Maddala, 1983). The starting point is the wage equation:

$$\ln(w_i) = \beta t_i + \mathbf{x}'_i \boldsymbol{\alpha} + \varepsilon_i, \quad i = 1, \dots, n \quad (5)$$

where w_i is the hourly wage earned by worker i , t_i is a dummy variable equal to one if i is a teleworker and zero otherwise. The vector \mathbf{x}_i contains information on the workers' gender, age, education, occupation, years of tenure, log of hours worked, the number of children less than 15 years old, and the workplace location (a variable describing the location of the job with respect to worker residence). The set of explanatory variables also includes some firm's characteristics reported by the worker, such as

sector and dimension, along with region and year fixed-effects. Finally, ε_i is a zero-mean error term with variance σ^2 . The identification and consistent estimation of β is threatened by the possibly non-random assignment to teleworking. Let us define the participation equation as

$$t_i^* = \mathbf{z}_i' \boldsymbol{\gamma} + v_i \quad i = 1, \dots, n \quad (6)$$

where t_i^* is the latent propensity to participate in teleworking, \mathbf{z}_i is a set of regressors including \mathbf{x}_i in (5) and we assume v_i to be normally distributed with zero mean and unit variance. Whether individual i can be classified as a teleworker is determined by the indicator function $t_i = \mathbb{I}(t_i^* > 0)$.

Formally, an endogeneity problem arises if

$$E[\ln(w_i) | \mathbf{z}_i, t_i = s] = \beta t_i + \mathbf{x}_i' \boldsymbol{\alpha} + E[\varepsilon_i | \mathbf{z}_i, t_i = s], \quad E[\varepsilon_i | \mathbf{z}_i, t_i = s] \neq 0 \quad s = 0, 1$$

that is, the non-zero correlation between the error term in Equation (5) and t_i , and therefore v_i , in (6) generates an omitted variable problem. In other words, there may be unobservable factors that simultaneously affect the treatment participation and the outcome variable. We argue that there may be several interpretations for the presence of endogeneity and, therefore, the direction of the bias of the OLS estimator of β cannot be unequivocally determined. For instance, a worker with a strong preference for a career based life-style may be less willing to work from home and, at the same time, face higher wage rates because of the unobservable commitment to the job. By contrast, a worker with a high degree of attachment to family care may more likely be a teleworker and receive lower earnings. In these cases, neglecting endogeneity leads to an understatement of the wage effect of teleworking. On the contrary, if teleworkers had a comparative advantage in the tasks that can be performed from home, the effect of teleworking on wages would be overestimated if such self-selection mechanism was not accounted for. Finally, a great variety of unobservable workplace characteristics and job-specific tasks can affect the magnitude of the wage premia in favor of teleworking.

The linear switching regression model with endogenous treatment takes into account endogeneity by assuming joint normality of ε_i and v_i , with zero mean and covariance matrix

$$\Sigma = \begin{bmatrix} \sigma^2 & \\ \rho\sigma & 1 \end{bmatrix} \quad (7)$$

where their dependence structure is parametrized by the correlation coefficient ρ . The parameters of (5), (6), and (7) can then be estimated by implementing a two-step procedure. In the first step, a probit model for the parameters of (6) is estimated. The resulting coefficients are used to compute the inverse Mills ratio $\lambda(\mathbf{z}_i' \hat{\boldsymbol{\gamma}})$ as follows:

$$\lambda(\mathbf{z}'_i \hat{\gamma}) = \begin{cases} \varphi(\mathbf{z}'_i \hat{\gamma}) / \Phi(\mathbf{z}'_i \hat{\gamma}) & t_i = 1 \\ -\varphi(\mathbf{z}'_i \hat{\gamma}) / \Phi(-\mathbf{z}'_i \hat{\gamma}) & t_i = 0 \end{cases}$$

where $\varphi(\cdot)$ and $\Phi(\cdot)$ are the standard normal density and distribution functions, respectively. In the second step, the inverse Mills ratio is plugged into (5) resulting into the augmented wage equation

$$\ln(w_i) = \beta t_i + \mathbf{x}'_i \boldsymbol{\alpha} + \theta \lambda(\mathbf{z}'_i \hat{\gamma}) + \eta_i, \quad i = 1, \dots, n \quad (8)$$

where η_i is a zero-mean error term. The parameters of (8) can be consistently estimated by OLS (for the derivation of robust standard errors to heteroskedasticity and to the presence of generated regressors, see Maddala, 1983). From standard results on the multivariate normal distribution, the parameter θ is equal to $\rho\sigma$. The t -test for θ is a test for the exogeneity of teleworking, while the sign of θ can provide some insights on the nature of the endogeneity problem, since the over/under-estimation of β by OLS will be consistent with the positive/negative sign of ρ .

The identification of β relies on both the nonlinearity of $\lambda(\mathbf{z}'_i \hat{\gamma})$ under the joint normality assumption and on suitable exclusion restrictions contained only in the set of regressors bz_i . Namely, we use the logarithm of the labor income of other family members and a categorical variable for the family composition identifying: whether there are no children under the age of 14 and no retired family members, whether there are children but no retired, whether there are retired but no children, and whether there are both. As it will be illustrated in Section 5, these variables are jointly good predictors of the probability of teleworking and we believe that they are reasonably not related to earnings. Especially with respect to the family composition, it may be argued that it can significantly influence the earnings, due to the fact workers may be entailed to higher wages if they have non-earning family members in the household. However, we are confident that this possible correlation is captured by the number of young children in the family, that is included in the wage equation specification.

4 The data

The Italian labor force survey (RCFL), issued by the ISTAT, is a representative survey that collects information on the main characteristics of individuals such as age, gender, region of residence, education, with special reference to their careers and working conditions, namely occupation, sector of economic activity, wage, hours worked, type and duration of contracts. We extracted the cross-section referring to the second quarter of the year for the period 2008-2013.¹⁵ We selected civilian employees aged between

¹⁵In order to have a dataset with manageable size, we choose to keep only employees interviewed in the second quarter. We use the cross-section database of the RCFL because the panel database does not offer information on wages. Prior to 2008, data

25 and 54, working full time with a permanent contract in Italy. We further excluded “homeworkers”, that represent the 0.05% of the sample, because no information on their occupation is available, and we dropped workers who did not allow ISTAT to include the family identifier in the database. Once observations with missing data were dropped, we end up with a sample of 129, 594 observations. We identify teleworkers with the question “In the 4 weeks from ... to ... have you worked from home?”, to which the possible answers were “1) Yes, one day per week”, “2) Yes, two or more days per week”, “3) No”. We define as “teleworker” the individual who works from home at least 2 days per week, ending up with 1, 281 teleworkers in our sample.

Table 2 presents the sample composition, the average log-of hourly wage, the incidence of teleworkers, and the log-difference in the wage rate between teleworkers and on-site workers, by individual and family characteristics¹⁶ and workplace location. From the first column, it emerges that teleworking has a higher incidence among women, older and well educated workers, chief officers and managers. Not a clear pattern emerges considering the workplace location, whereas it seems that the presence of retired people inside the family reduces the likelihood of teleworking.

The third and fourth columns of Table 2 report the average log-hourly wage and the difference in the log-hourly wage between teleworkers and on-site workers, Δ_w , respectively. Smart workers face a wage premium estimated at 1.24 € per hour worked. The wage premium is significantly different from zero both for males and females, for high school and college graduated, for employees in any age category, for all workplaces (but decreasing with the distance between residence and place of work) and, with the exception of family with both kids and retired, for every category of family composition. Managers and above all white collars teleworkers earn more but, interestingly, the wage is significantly lower for teleworking as blue collars and apprentices. The strong differences in the wage distribution among teleworkers and on-site workers, disaggregated by occupation, emerge from Figure 1 where the kernel density estimates of the wage rate are presented.

Table 3 shows the same descriptives disaggregated by sectors and firm’s size. Telework is mainly employed in *Education and health*, *Information and communication*, and in large firms. The wage premium earned by teleworkers is statistically significant in most sectors. Interestingly, in *Financial services* telework gives a negative premium, although not significant. Finally, Table 4 presents descriptive statistics for the continuous variables used in in the model. Teleworkers have a longer tenure, seems to work less hours, and are characterized by a higher income coming from the other member of the family.

on wages were not available not even for the cross-section.

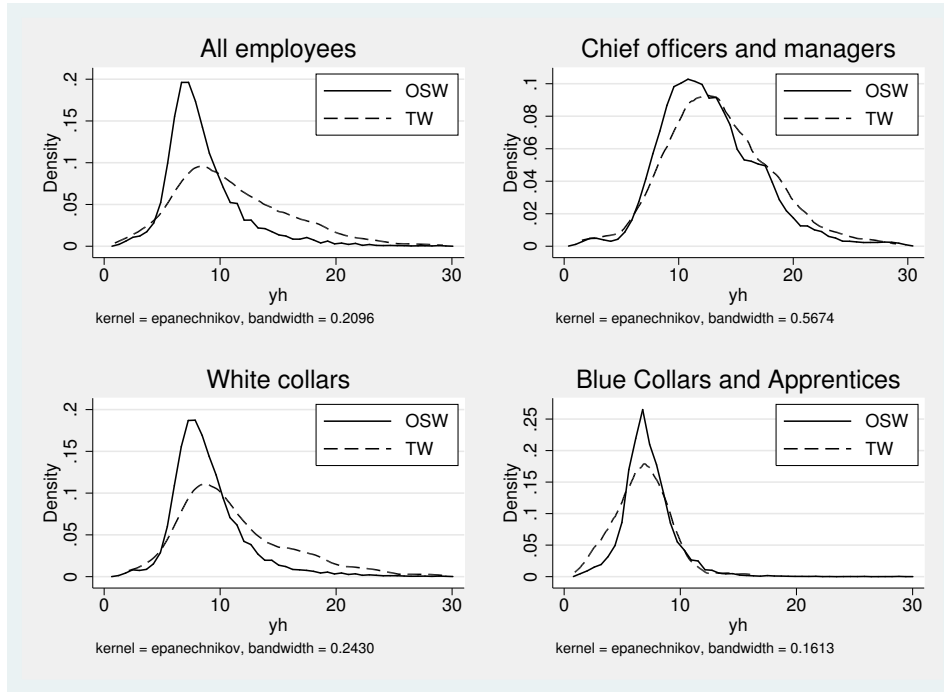
¹⁶*Family composition* is a variable that groups families according to the presence of kids and/or retired inside the family.

Table 2: Descriptive statistics: Teleworking (TW) and logarithm of hourly wage (w) by values of discrete workers' characteristics variables

	freq.	mean w	mean TW	Δ_w	t -test	p-value
Total	1.000	2.094	0.010	0.212	17.731	0.000
Gender						
Male	0.627	2.096	0.008	0.208	13.716	0.000
Female	0.373	2.092	0.014	0.213	11.766	0.000
Education						
No title, Elementary	0.033	1.867	0.004	-0.042	-0.416	0.677
Compulsory school	0.393	1.982	0.005	-0.023	-0.987	0.324
High School	0.399	2.111	0.009	0.114	6.118	0.000
Undergraduate	0.032	2.201	0.012	0.078	1.208	0.227
College, Master, PhD	0.142	2.387	0.028	0.119	7.524	0.000
Age						
Age 25-34	0.216	1.943	0.006	0.075	2.617	0.009
Age 35-44	0.375	2.092	0.010	0.179	9.165	0.000
Age 45-54	0.409	2.177	0.012	0.217	11.300	0.000
Occupation						
Chief officer	0.028	2.581	0.035	-0.026	-0.929	0.353
Manager	0.076	2.466	0.028	0.041	1.964	0.049
White collar	0.448	2.157	0.011	0.161	10.066	0.000
Blue collar	0.448	1.939	0.004	-0.061	-2.670	0.008
Workplace						
Same district	0.482	2.069	0.011	0.185	10.524	0.000
Same province	0.406	2.107	0.008	0.248	12.746	0.000
Same region	0.079	2.152	0.012	0.247	8.606	0.000
Other region	0.033	2.176	0.016	0.208	4.911	0.000
Family composition						
No Kids, no Retired	0.494	2.069	0.010	0.211	12.557	0.000
Kids, no Retired	0.406	2.146	0.011	0.215	12.362	0.000
Retired, no Kids	0.092	2.004	0.006	0.178	3.697	0.000
Kids & Retired	0.008	2.085	0.006	0.146	1.297	0.195

Sample size: 129, 594. The column Δ_w shows the difference of the log-hourly wage between teleworkers and regular workers: $\Delta_w = w_{TW=1} - w_{TW=0}$. The corresponding t -tests and p-values are reported in the last two columns.

Figure 1: Kernel Density estimates of the wage rate by occupation



OSW: On site workers; TW Teleworkers

Table 3: Descriptive statistics: Teleworking (TW) and logarithm of hourly wage (w) by firms characteristics variables

	freq.	mean w	mean TW	Δ_w	t -test	p-value
Sector						
Food and fishery	0.015	1.829	0.003	-0.087	-0.361	0.718
Manufacturing	0.142	2.099	0.005	0.130	3.611	0.000
Construction	0.176	2.020	0.006	0.162	5.226	0.000
Trade	0.091	1.974	0.005	0.221	4.978	0.000
Hotels and restaurants	0.074	1.928	0.006	0.120	2.535	0.011
Transports	0.044	2.014	0.006	0.163	3.198	0.001
Information and communication	0.049	2.115	0.012	0.106	2.476	0.013
Financial services	0.037	2.338	0.005	-0.067	-0.844	0.399
Real estate	0.065	2.010	0.009	0.073	1.584	0.113
Public administration	0.085	2.209	0.009	0.139	4.354	0.000
Education and health	0.176	2.322	0.024	0.174	11.302	0.000
Other	0.046	1.850	0.014	-0.219	-4.709	0.000
Number of employees						
Less than 10	0.242	1.927	0.007	-0.003	-0.107	0.915
11-15	0.107	2.036	0.006	0.228	4.980	0.000
16-19	0.058	2.100	0.010	0.170	3.686	0.000
20-49	0.182	2.138	0.010	0.258	10.058	0.000
50-249	0.240	2.193	0.013	0.250	13.970	0.000
More than 250	0.141	2.209	0.014	0.134	5.927	0.000
Don't know (>10)	0.030	2.050	0.006	0.029	0.346	0.729

Sample size: 129, 594. The column Δ_w shows the difference of the log-hourly wage between teleworkers and regular workers: $\Delta_w = w_{TW=1} - w_{TW=0}$. The corresponding t -tests and p-values are reported in the last two columns.

Table 4: Descriptive statistics: continuous explanatory variables

	All		Teleworkers		In site workers	
	mean	sd	mean	sd	mean	sd
Tenure	12.431	8.980	13.450	8.973	12.420	8.979
Log hours worked	3.618	0.244	3.562	0.389	3.619	0.242
N. of Children under 15	0.610	0.823	0.660	0.830	0.610	0.823
Log of other family members income	3.598	3.575	3.646	3.631	3.597	3.575
Sample size: 129,594						

5 Estimation results

5.1 The determinants of teleworking

In this section, we illustrate the results of the first-step estimation for the parameters of Equation (6) in Section 3, providing some insights on the main determinants of the probability of teleworking. Table 5 reports the estimation results relative to 3 different samples since, as documented by Table 3 and showed in Figure 1, the incidence of teleworking and the related wage patterns are strongly differentiated by occupation. Therefore, column (1) shows the results for the whole sample, ALL, column (2) refers to white collar employees, WHITE, and column (3) refers to blue collar employees, BLUE.

Coherently with the descriptive statistics on the incidence of teleworking, from Table 5 it emerges that female workers, older individuals and those with high level of educational attainment have a significantly high probability of being teleworkers, when we consider the whole sample and the subsample of white collars. Moreover, the difference in the probability of working at home rises with higher job positions.¹⁷ Interesting results emerge also from the variables used as exclusion restrictions, that are the family composition and the logarithm of the labor income of other family members. For the whole sample and white collars, teleworking is more likely to concern employees with young children in the family and where there are no retired family members to attend childcare. Notably, employees living in families with no young children and with individuals in retirement age are less likely to work at home. Furthermore, the labor income of the other family members reduces the probability of teleworking. These results support the hypothesis that telework primarily concerns those workers who give a high value to the time spent at home, i.e. those belonging to families with small children, where the grandparents are not present, and those who may have difficulties in buying care services on the market because of the low incomes of other family members.

Finally, the bottom part of the table shows that our chosen exclusion restricts are jointly statistically significant in all the sample considered, as per the results of the Wald test.

¹⁷Coefficients associated with the occupation are not reported for brevity but available upon request to the Authors.

Table 5: Probit model: Probability of teleworking

	ALL	WHITE	BLUE
Female	0.066*** (0.025)	0.020 (0.028)	0.154*** (0.048)
Ref: Age 25-34			
Age 35-44	-0.087** (0.039)	-0.140*** (0.047)	0.020 (0.059)
Age 45-54	-0.018 (0.028)	-0.018 (0.033)	0.011 (0.050)
Ref: No title, Elementary			
Compulsory school	0.081 (0.092)	-0.236* (0.141)	0.090 (0.094)
High school	0.239** (0.094)	-0.087 (0.140)	0.178* (0.099)
Undergraduate	0.140 (0.111)	-0.156 (0.153)	-0.074 (0.267)
College, Master, PhD	0.396*** (0.098)	0.090 (0.142)	0.152 (0.158)
Tenure	0.001 (0.005)	-0.005 (0.005)	0.008 (0.008)
Tenure sq.	0.000 (0.014)	0.019 (0.016)	-0.017 (0.025)
Log hours worked	0.124** (0.054)	0.072 (0.056)	0.378** (0.163)
N. Children under 15	-0.019 (0.028)	-0.007 (0.032)	-0.034 (0.051)
Ref: None			
Kids, no Retired	0.068 (0.046)	0.069 (0.053)	0.052 (0.084)
Retired, no Kids	-0.163*** (0.048)	-0.235*** (0.058)	0.006 (0.072)
Kids and Retired	-0.065 (0.147)	-0.016 (0.166)	-0.088 (0.244)
Other family income	-0.008** (0.003)	-0.006* (0.004)	-0.015** (0.006)
Wald test χ_4^2	6.385	2.905	6.530
<i>p</i> -value	0.012	0.088	0.011
Observations	129,594	55,746	54,382

Robust standard errors in parentheses

The model specification includes sector, occupation year and region fixed-effects, dummy variables for firm dimension and workplace location.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.2 Wage differentials

In the following, we provide the estimation results for the wage equations specified in Section 3. Specifically, the left panel of Table 6 reports the OLS estimates of β in Equation (5), whereas the right panel contains the second-step estimation results for the endogenous switching wage regression specified in Equation (8). As for the first-step estimation, we carry out the analysis for the whole sample and the subsamples of white and blue collars (see also Table 5).¹⁸

Coherently with the predictions of the theoretical framework illustrated in Section 2 and with most of the empirical evidence on the wage effects of teleworking, we find that employees working at home face a wage premium compared to traditional workers when using all the observations in our sample (Table 6, column (1)). However, while the descriptive evidence provided by OLS estimates point toward a modest positive differential in earnings of 0.032 log-points, accounting for the non-random teleworking participation in the endogenous switching regression model estimation yields to a higher wage premium that amounts to 0.107 log-points. The t -test associated to the inverse Mills ratio $\lambda(\cdot)$ in Equation (8), θ , leads to reject the null hypothesis of exogeneity. Moreover the coefficient's negative sign is consistent with the understatement of the wage effect of teleworking when endogeneity is neglected. As argued in Section 3 and in light of the findings on the determinants of the probability of teleworking illustrated earlier in this section, a possible interpretation for this source of endogeneity can be related to the workers' preferences for either a more labor market oriented or family based life-style.

In the simple OLS estimation, being a smart worker is significantly associated with a higher wage rate for white collars, with an elasticity of 4.2%, while it yields no significant wage differentials among blue collar employees. The results from the endogenous switching regression models confirm that failing to account for non-random participation to teleworking leads to biased results for white collars, for whom the premia now amounts to 12.7%. No evidence of endogeneity is found for blue collars, among which the average wage differentials between smart and regular workers is negligible.

Table 6: OLS and endogenous switching regression model: wage equation

	OLS			ENDOGENOUS SWITCHING REGRESSION		
	ALL	WHITE	BLUE	ALL	WHITE	BLUE
Teleworker	0.032*** (0.007)	0.042*** (0.011)	0.020 (0.015)	0.107*** (0.011)	0.127*** (0.017)	0.063 (0.039)
λ				-0.029*** (0.002)	-0.034*** (0.003)	-0.015 (0.012)
Observations	129594	55746	54382	129594	55746	54382

Standard errors in parentheses

The model specification includes: gender, age, education, tenure, tenure squared, hours worked, skill,

n. family dependent members, sector, occupation, year and region fixed-effects, firm dimension and job location.

Instruments: dummies for the presence of kids and/or retired in the family, Other family income

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

¹⁸The model specifications include all the explanatory variables listed in Section 3 and not reported here for brevity. The full set of estimation results is available upon request to the Authors.

5.3 Robustness checks

TO BE DONE

6 Conclusion

We provided novel empirical evidence, grounded on a rigorous theoretical framework, on teleworking in Italy by investigating the determinants of the probability of being a teleworker and the effect of telework on earnings. We account for non-random teleworking participation by estimating an endogenous switching regression model, where the identification of the effect of interest relies on both a set of exclusion restrictions, built using information on the family composition and earnings, and on the normality assumption. Our results are based on the Italian labor force survey and suggest that women have a higher probability of teleworking, as well as employees occupying high level job positions, and individuals who attained higher education. Also, teleworking is partly related to the employees household composition and concerns mainly workers who benefit from more time spent at home for family care, especially if the elderly retired are not part of the family. As for wage differentials, we uncover that resulting positive and statistically significant wage premia is driven by white collars. The wage premium for teleworking estimated by the endogenous switching regression model amounts to 0.107 log-points considering the whole sample, while it reaches 0.127 for white collar employees. With the use of these data, we also contributed to the scant empirical evidence on teleworking in Italy where, despite the willingness of the Italian Government to move beyond the traditional paradigms of labor organization in the country, assigning employees to teleworking is not yet a reality.

With respect to the empirical modeling of the wage effects of teleworking, we uncovered the importance of accounting for endogenous participation that, if neglected, can lead to discouraging results in terms of the rewards for the teleworker. Moreover this finding, together with the evidence on the main determinants of teleworking, is consistent with a “work-life” balance interpretation, suggesting that working from home may be sought out by individuals with a strong preference for family care and less inclined to career ambitions. However, the point identification of this effect is subject to the choice of suitable exclusion restrictions that may prove not to have the necessary strength in predicting the treatment participation. In addition, rather strong parametric assumptions were made in this context that, if violated, may yield to misleading conclusions.

In order to fully understand the determinants of teleworking and the effect of telework on wage and productivity, a panel database at firm level with information on workers’ characteristics, their place of work, and their wage would be required. Unfortunately, database of this type are not available for Italy.

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7 Appendix

7.1 Wage Bargaining and telework with implicit utility function

We assume that the time needed to commute from home to the firm, $0 \leq \tau \leq \bar{\tau}$, is a continuous variable and, as well as reduces utility, also affects the profits. In fact, a higher commuting time implies a higher share of the given amount of hours worked inside the firm. Therefore. τ :

- can affect positively the hourly productivity, $\gamma(\tau)$, with $\gamma'_\tau \geq 0$
- can increase the cost for space usage, $c(\tau)$, with $c'_\tau \geq 0$.

The profit function is:

$$\pi = \gamma(\tau)h - w - c(\tau) \quad \gamma'_\tau \geq 0 \quad c'_\tau \geq 0$$

and utility is given by:

$$u(w, h + \tau) \quad u'_w > 0 \quad u'_\tau < 0$$

The total surplus is the sum of the two:

$$S = \pi + u \quad S = \gamma(\tau)h - w - c(\tau) + u(w, h + \tau)$$

the derivative of the total surplus with respect to τ gives:

$$\frac{dS}{d\tau} = h\gamma'_\tau - c'_\tau + u'_\tau(h)$$

If the total surplus is a negative function of τ for all τ , so that the condition $\frac{dS}{d\tau} < 0$, the full telework is the preferred strategy ($\tau = 0$). Therefore, telework is more likely in jobs where:

$$c'_\tau - h\gamma'_\tau - u'_\tau(h) > 0 \quad (9)$$

that represents a generalization of equation 1 and gives the same qualitative results. Telework is more likely to be the best strategy in those job position where:

- γ'_τ is low, so in jobs where the hourly productivity is little affected by the job location;
- c'_τ is high, so that the cost for the use of space reacts strongly to telework usage.
- u'_τ , the marginal disutility due to commuting is high, so that in jobs with long working hours and for employees strongly concerned with family responsibilities.
- if $\gamma'_\tau + u''_{\tau h} > 0$ and h is high; if $\gamma'_\tau + u''_{\tau h} < 0$ and h is low;

Nash Bargaining on w define the bargained wage:

$$\text{Foc w} \quad \frac{\beta}{u} \frac{du}{dw} + \frac{1-\beta}{\pi} \frac{d\pi}{dw} = 0 \quad \rightarrow \quad \frac{\beta}{1-\beta} \frac{\pi}{\pi'_w} = -\frac{u}{u'_w}$$

Defining $B = \frac{\beta}{1-\beta}$, we can write:

$$-B[\gamma(\tau)h - w - c(\tau)] + \frac{u(w, h, \tau)}{u'_w(w, h, \tau)} = 0 \quad (10)$$

By differentiating Eq. 10 with respect to w and τ , we obtain:

$$\frac{\partial}{\partial w} = B + \frac{(u'_w)^2 - u''_{ww}u}{(u'_w)^2} \quad \frac{\partial}{\partial \tau} = -B(h\gamma'_\tau - c'_\tau) + \frac{u'_\tau u'_w - u''_{w\tau}u}{(u'_w)^2}$$

Therefore, the derivative of w with respect to τ is:

$$\frac{\partial w}{\partial \tau} = -\frac{\frac{\partial}{\partial \tau}}{\frac{\partial}{\partial w}} = -\frac{-B(h\gamma'_\tau - c'_\tau) + \frac{u'_\tau u'_w - u''_{w\tau}u}{(u'_w)^2}}{B + \frac{(u'_w)^2 - u''_{ww}u}{(u'_w)^2}}$$

that simplifies to:

$$\frac{\partial w}{\partial \tau} = \frac{(u'_w)^2 B(h\gamma'_\tau - c'_\tau) - u'_\tau u'_w + u''_{w\tau}u}{(u'_w)^2 B + (u'_w)^2 - u''_{ww}u} \quad (11)$$

In Eq. (11) the denominator is positive for risk averse and risk neutral individual, as we will assume. Given that τ reduces with telework implementation, then the wage rate surely reduces if:

$$\frac{\partial w}{\partial \tau} \geq 0 \quad \text{if} \quad u''_{w\tau} \geq 0 \quad h\gamma'_\tau \geq c'_\tau$$

We can define the conditions that make more likely an increase in the wage rate due to a higher usage of telework so due to a lower τ . By assuming $u''_{w\tau} = 0$ as in the text, and $h\gamma_\tau < c$, we obtain that:

$$\frac{\partial w}{\partial \tau} \leq 0 \quad \text{is more likely if:}$$

- $B = \frac{\beta}{1-\beta}$ is high, so that the bargaining power of workers is high.
- γ'_τ is low, so that a reduction in τ does not decrease strongly the hourly productivity;
- c'_τ is high, so that the cost for the use of space reacts strongly to telework usage.
- $u'_\tau u'_w$ is low; for a given u'_w , the marginal disutility due to commuting must be low.

This results¹⁹ all corroborate the condition displayed in equation Eq. (2)

¹⁹In the case of $u'_w = 1$ and $u''_{w\tau} = 0$, then $\frac{\partial w}{\partial \tau} < 0$ if $h\gamma'_\tau - c'_\tau - u'_\tau < 0$. Considering this result together with the one of equation 9, we obtain that a worker actually assigned to the telework position (a worker that respect the condition of equation 9) earns more if $c'_\tau > h\gamma'_\tau$.