

# **Part-time Work, Wages and Productivity: Evidence from Matched Panel Data**

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## **Abstract**

Using detailed matched employer-employee panel data for Belgium over the period 1999-2006, the authors investigate the relationship between working time, wages and productivity. More precisely, they are among the first to examine how changes in the proportions of short and long part-time workers affect the productivity of firms (measured by the value-added per hour worked) and to test for the presence of productivity-wage gaps. Their findings, controlled for a large range of individual and firm characteristics and robust to various econometric issues (including time-invariant unobserved firm heterogeneity, endogeneity and state dependence), suggest that long part-time workers are significantly more productive than short part-time and full-time workers. Their results further indicate that average hourly wages within firms do not significantly depend on the incidence of part-time jobs. Overall, this leads to the conclusion that short part-time workers are paid at their marginal productivity while long part-time workers appear to be “underpaid”.

**Key words:** Wages, productivity, part-time employment, matched panel data, GMM.

**JEL Codes:** J22, J24, J31.

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\* We would like to thank Statistics Belgium for giving access to the data. The usual disclaimer applies.

## **1 INTRODUCTION**

In the past two decades, part-time jobs have become a prominent feature of many structural changes that occurred on European labour markets. For instance, part time has been one of the main factors underpinning processes of labour market flexibilization (Branine 1999; Edwards and Robinson 2000). What is more, part time has risen sharply during the latest economic downturn. In an attempt to retain incumbent workers, many firms have preferred to reduce working hours over layoffs (Employment in Europe 2010). In other words, part-time arrangements appear to function as a buffer during critical stages of the business cycle (OECD 2010).

In light of this evolution, an accurate understanding of the different repercussions of part-time work has emerged as an increasingly salient problem. In particular, the impact of reduced working hours on different measures of labour market performance is still not properly understood. In this paper we address the following questions: i) Do part-time workers differ from full-time workers in terms of wages and productivity outcomes?, and ii) Are part-time workers paid at their marginal productivity?

A growing literature examines the impact of working time on workers' wages. Empirical results typically document a significant gap between hourly wages of part- and full-time workers. By and large, this gap has been attributed to substantial heterogeneity between jobs and/or between individuals (Hirsch, 2005; Manning and Petrongolo, 2008). Yet, for some countries a significant fraction of this gap remains unexplained after controlling for observable heterogeneity. This may point to other forms of labour market inequality or discrimination against part-time workers (Bardasi and Gornick 2008). Besides, few studies have focused on productivity differences between full-time and part-time workers. In fact, the relationship between working hours and productivity has not been clearly established: both extant theory and empirical results are inconclusive (Branine 2003; Lewis 2003; Nelen et al. 2011). Finally, as far as we know, there are no studies investigating whether part-time workers are paid at their marginal productivity using accurate information on both wages and productivity.

The present paper contributes to this literature by estimating the effect of part-time work on productivity, wages and productivity wage-gaps. More precisely, we are among the first to examine how changes in the proportions of short and long part-time workers affect the productivity of firms and test for the presence of productivity-wage gaps. To do so, we use detailed longitudinal matched employer-employee data covering the Belgian private sector

over the period 1999-2006. Our data offer several advantages. First, the panel provides accurate information on average productivity and wages within firms (i.e. on the average value added per hour worked and the mean hourly wage) and allows to control for a wide range of worker and firm characteristics (such as education, age, occupation, sex, type of contract, firm size, firm age and sector). Second, we are able to address important measurement issues such as firm-level fixed unobserved heterogeneity, endogeneity of working time and state dependence of firm productivity and wages. Hence, our data allows us to tackle various potential biases that are not always accounted for in the existing literature. Finally, it should be emphasized that the distinction between short and long part-time work, too often neglected in the literature, is an important feature of our study (Hirsch 2005; Russo and Hassink 2008). Indeed, the repercussions of part-time arrangements on wages and productivity are likely to differ substantially according to whether the individual is absent during much of the work week (e.g. an employee with peripheral tasks coming in only one or two days a week) or whether she is almost working full time (e.g. an employee that works like her full-time colleagues during the entire week but leaves the office on Friday noon).

## **2 REVIEW OF THE LITERATURE**

### ***2.1 Theoretical background***

Economic theory advances several possible explanations for differences in hourly pay and productivity between part-time and full-time workers. These explanations can be grouped into four main clusters that are not mutually exclusive but rather tend to overlap and reinforce each other.

The first cluster of reasons pertains to labour supply and demand interactions, the argument being that some categories of persons prefer to work part-time rather than full-time (and vice versa). This is particularly stated to be the case with regard to young workers (students), parents with heavy home responsibilities and older workers, all of whom may be seen to have a more marked preference for part-time employment and, for this reason, accept wages lower than those associated with full-time employment. Note, nevertheless, that such preferences in terms of work hours may just as well be constrained as free. However, differences in preferences for part-time employment are not enough to generate a part-time wage penalty. In order for this to occur, workers must be heterogeneous and it cannot be that employers are indifferent to the way they schedule work hours among workers. Hence, only a mix of workers' preferences, skill differences and employer preferences can generate a part-

time wage penalty. However, these same forces may also work in the opposite direction. Flexible working hours and other alternatives to the traditional full-time work schedule have been shown to increase productivity and, consequently, also wages (Shepard et al. 1996). A part-time wage premium is typically observed in industries that face seasonal or fluctuating demand for or supply of their output that cannot be managed through the carrying of inventories; employers then consent to pay high wages during peak periods when productivity is high to part-time workers willing to work short intensive shifts. Hence, if a firm has a particularly high labour demand during short intervals of time, and workers prefer to work long hours at a stretch rather than space out this working time, then part-time wages may exceed full-time wages, as there is not enough labour supply to meet labour demand. A lack of geographical mobility may also contribute to the part-time/full-time wage gap. Ermisch and Wright (1991) state that part-timers are more strongly bound by spatial constraints because they are less willing to pay high costs to commute to and from work the more so since they are often just secondary breadwinners in the household. Given this lack of labour supply elasticity, the local labour market is in the hands of firms practising monopsonistic power. Led by their rationality as profit-maximising economic agents, they tend to adjust part-time wages downwards.

The second cluster concerns the cost structure of firms. The existence of fixed costs – including the administrative costs of maintaining records for each employee, recruitment and firing costs and any components of fringe benefits that are independent of hours worked – means that firms' total labour costs do not increase proportionally with hours worked (Montgomery, 1988). As a result, part-time workers are relatively more costly to firms and may therefore receive lower wages. It can also be argued that part-time workers may generate coordination problems, especially in firms where their number is marginal in comparison with full timers (Lewis 2003). Furthermore, while part time can be easily managed in a Taylorist organisation in which workers can be substituted to each other, jobs that put a greater emphasis on task-specific skills are more difficult to manage on a part-time basis since outcomes such as the continuity of output or relationships with customers might be negatively affected (Bonamy and May 1997; Edward and Robinson 2004). In addition, managers might not always adjust correctly their expectations when employees are moving from full to part time, thus influencing the effectiveness of flexible work arrangement policies. For instance, working reduced hours might often mean having to deal in a shorter time with what effectively remains a full-time workload (Edwards and Robinson 2000; Lewis 2001, 2003).

The third cluster of factors that can account for a part-time wage penalty is directly related to workers' productivity. Several theories relate productivity to the number of hours worked. An argument in one direction is that, due to start-up effects, productivity rises slowly at the beginning of a working day. As a result, the worker's productivity during the last hour of work is above the average daily level of productivity (Barzel, 1973). Hence, part-time workers who work less hours are less productive and therefore paid lower wages. However, other authors contest this model and point out that tiredness associated with long working hours might significantly influence work ability so that part-time workers might perform better than full timers (Brewster and al. 1994). In addition, flexible working time arrangements and part-time jobs might allow individuals to make a better use of the circadian rhythm and may reduce the amount of stress, thus increasing the correspondence between their abilities and job requirements, potentially leading to higher performance (Pierce and Newstrom 1983; Baltes et al. 1999).

The fourth cluster of issues is related to the institutional settings in a specific region or country. Several studies have shown that part-timers have a lower level of union membership (Riley 1997). In a theoretical paper by Skåtun (1998), the higher demand for part-timers is explained by the individual bargaining process that allows the firm to increase the surplus from the bargain. Hence, part-timers are paid less as they have less power. Moreover, given the progressive tax structure in some countries, part-timers, who by definition earn a lower annual gross wage than full-timers, are taxed less and, therefore, union bargaining will often lead to a lower hourly gross wage for part-timers than for full-timers (Koskela and Vilmunen, 1996). This is the effect of unions tending to reason in terms of net wages. Indeed, unions will be less likely to push as hard for higher gross wages for part-timers than for full-timers as the former face a lower average tax rate. Also, the composition of income and payroll taxes may influence the wage difference between full-time and part-time workers (Koskela and Schöb 1999). However, payroll taxation is also found to decrease the wage rate with the number of hours worked. Vella (1993) argues that the "true" wage is held constant but that the hourly wage rate decreases and is replaced by fringe benefits that are not taxable. Finally, anti-discrimination legislation may also have a decisive effect on the existence or not of a pay penalty.

## ***2.2 Empirical background***

### **2.2.1 The impact on wages**

A growing literature offers some empirical evidence on the relationship between part-time work and wages. Bardasi and Gornick (2008), using micro-data of 1995 from the Luxembourg Income Study, find the presence of an hourly part-time pay penalty for women in a cross-country comparison among Canada, Germany, Italy, Sweden, the UK, and the US. With the exception of Sweden, the results of their analysis show that controlling for workers and job characteristics reduces the part-time pay penalty, which is mainly attributed to occupational components and segregation. However, part of the pay gap remains even after controlling for observable characteristics, which might be attributed to some form of discrimination or to unobservable differences between full timers and part timers. Analogous results for the UK labour market can be found in Manning and Petrongolo (2008) who use pooled data from the Labour Force Survey from 2001 to 2003 and show that differences in the types of jobs and occupational segregation are the main factors explaining the hourly part-time pay penalty among British women.

Hirsch (2005) uses level and longitudinal estimates of wages from the US Current Population Survey (1995-2002) and observes that the largest share of the hourly part-time penalty can be ascribed to differences in workers and jobs characteristics and that a great part of the remaining gap points to the heterogeneity of workers. Once full controls are included in the model, he finds that the part-time pay gap is very modest at the beginning of careers of men and women; it tends to increase to a certain extent with time, a phenomenon that might stem from a deficit of experience and human capital accumulation of part timers. Similar patterns are described in Russo and Hassink 2008, who use the pooled waves from 1999 and 2001 of the Working Conditions Survey for the Dutch labour market.

No hourly part-time wage gap is found by Hardoy and Schone (2006). Using pooled data for 1997 and 1998 from the Level of Living Surveys and controlling for observed characteristics, they record no wage differences between female part and full timers in Norway and no evidence of systematic selection bias. These patterns may be attributed to well-developed anti-discrimination policies and strong employment protection. Rodgers (2004) develops a cross-sectional analysis using the 2001 wave from the Household, Income and Labour Dynamics in Australia Survey and does not find significant hourly part-time pay gaps for Australian workers once selection into types of employment and worker- and job-specific characteristics are controlled for. Also Booth and Wood (2008), using a panel data of

the first four waves of the same survey (2001–2004), do not detect a part-time penalty in Australia - in fact they observe the opposite. Once unobserved individual heterogeneity is taken into account, they find a pay premium for part-time women and men. Among the hypothesized explanations for such a pay premium they cite the structure of the Australian tax system and the possibility that it is less likely for part-time than for full-time workers to do overtime hours (which reduces measured hourly wages). They also suggest that part timers might be more productive than full timers due to the fatigue effects we mentioned above. However, these results should be interpreted with caution given that the Australian study does not include information on productivity levels.

Few studies investigate wage differentials among part and full timers on the Belgian labour market. The analyses of Jepsen (2001) and O’Dorchai et al. (2007), based on data from the 1990s respectively from the Household Panel Survey and the Structure of Earnings Survey, show that the hourly wage gap between part-time and full-time workers almost disappears after controlling for observables. This result is attributed to the effective protection of part-time workers by Belgian anti-discrimination policies.

### **2.2.2 The impact on productivity**

Empirical evidence on the difference between part-time and full-time workers in terms of productivity outcomes is quite scarce. Moreover, results seem contradictory and difficult to compare due to the diversity in analytical methods (Lewis 2003). Extant studies rely both on quantitative and qualitative analyses in which measures of productivity range from objective (e.g., sales and gross revenue) to subjective indicators of performance (e.g., employment commitment and stress).

Some analyses are in line with the hypothesis that part time can be more effective than full time in improving workers performance and firm’s productivity. Hagemann et al. (1994), using a survey of 3,000 employees in five German companies from different industries, show that: i) standard part time (i.e. employees working fewer hours per day) increases motivation and reduces absenteeism; ii) cyclical part time allows to manage peaks and troughs in demand more efficiently (e.g. in industries such as tourism and banking); and iii) shift-based part time might extend firm operating hours, leading to a more intense use of capital. Perry-Smith and Blum (2000) focus on family-friendly practices. They apply uni- and multivariate analysis of covariance using cross-sectional data from the National Organizations Survey of U.S. firms and control for firm level characteristics, showing that the higher the incidence of such practices, the higher the level of perceived market and organizational performance, profits,

and sales growth. The analysis of Nelen et al. (2011) points in the same direction. They study a matched employer–employee cross-sectional dataset of Dutch pharmacies in 2008, applying internal instrumental variable analysis in order to assess causality and address potential endogeneity of employment shares while controlling for observable characteristics. Their results show that the larger the share of part-time employment, the higher the firm productivity when the latter is measured by the number of prescriptions delivered to customers.

Conversely, Arvanitis (2003) develops cross-section estimates on data from a survey among Swiss enterprises in the business sector and finds that part-time work correlates negatively with sales per employee (the study controls for technology, workplace organization, and industry affiliation). The study of Branine (2003) is based on data obtained from a questionnaire and interviews from hospitals in the UK, France, and Denmark and shows mixed results. Respondents stated that, on the one hand, part time work is usually associated with low absenteeism and less stress. On the other hand, it is also associated with higher turnover, lack of continuity of the service, low employment commitment, and relatively lower skills.

The difficulties associated with managing a part-time workforce have been recorded by Edwards and Robinson (2004). The latter study consists in a qualitative analysis of the UK nursing profession based on a questionnaire submitted to a sample of nurses and managers. Respondents claim that among the main advantages of part time work there is retention of mature staff, less stress, coverage of peaks in demand, less absenteeism, and harder work. Among the disadvantages they mention problems of communication, an increase in administrative costs, and overheads associated with training and difficulties with continuity of service. In addition, part-time nurses declare to be less satisfied than their full-time colleagues with better opportunities as regards qualification and promotion. Similar patterns emerged in Edwards and Robinson's (2000) study that presents a qualitative analysis of the metropolitan police service in the UK. Benefits from introducing part time are the retention of experienced people who would otherwise exit the labour force (especially women) and an increase in job satisfaction and commitment. Disadvantages are worsened communication and service continuity as well as the marginalization of part-time workers in terms of training and promotion. Difficulties with part-time practices are also documented in the case study of a London borough in 1995 by Stanworth (1999): interviews reveal that many part-time workers felt that they were doing a full-time job in part-time hours since managers did not correctly adjust expectations when workers moved from full to part time.



Finally, some analyses do not find any significant effect of part-time work on productivity. Stavrou (2005) uses data of all sectors of the economy for fourteen EU member states and estimates logistic regressions without finding any evidence of a relationship between part time and subjective measures of performance (as assessed by the highest ranking corporate officer). Similarly, according to the regression analysis of Valverde (2000), who draws on data from the Cranet-E dataset covering the manufacturing and service sectors of twelve countries, the effect of part time on the reported gross revenue of companies is not statistically significant.

### 3 METHODOLOGY

The empirical results presented in this article are based the separate estimation of a value-added function and a wage equation at the firm level. The value-added function yields parameter estimates for the average marginal product of each category of workers (short part-time workers, long part-time workers, full-time workers), while the wage equation estimates the respective impact of each group on the average wage paid by the firm. Estimating both equations with the same set of control variables allows to directly compare the parameters regarding the marginal product and the wage of each group of workers. This technique was pioneered by Hellerstein et al. (1999) and refined by Aubert and Crépon (2003), van Ours (2009), Göbel and Zwick (2009), van Ours and Stoeldraijer (2011), and others.

Equation (1) is a function linking a range of inputs of firm  $i$  to its added value  $Y_i$ .

$$Y_i = F(K_i, QL_i) \quad (1)$$

where  $K_i$  represents the firm's capital stock and  $QL_i$  is a quality of labour term. The latter allows introducing a heterogeneous labour force into the value-added function.

There is an abundant econometric literature on the estimation of relationships as the one depicted in Equation (1). Various authors have proposed different specifications, allowing e.g. for different elasticities of substitution between the factors of production, in order to reflect more accurately the production process inside the firm. However, our focus is not on the production process itself, but rather on the comparison between productivity and wage for different types of workers. We therefore use a simple Cobb-Douglas version of Equation (1), with substitution elasticities equal to one and the assumption of firms operating at the

efficiency frontier. Such assumptions do not appear problematic as previous firm-level studies have shown that productivity coefficients obtained with a Cobb-Douglas structure are robust to other functional specifications (see, e.g. Hellerstein and Neumark, 2004). Equation (2) is the basic (Cobb-Douglas) value-added function:

$$\log(Y_i) = \log(A_i) + \alpha \log(K_i) + \beta \log(QL_i) \quad (2)$$

where  $A_i$  is a constant. The parameters  $\alpha$  and  $\beta$  are the respective marginal productivities of each input factor.  $QL_i$  can be written as:

$$QL_i = L_i \left( 1 + (\theta_{i,j} - 1) \sum_{j=1}^G \frac{L_{i,j}}{L_i} \right) \quad (3)$$

where  $L_i$  is the total labour force of the firm  $i$  and  $L_{i,j}/L_i$  the proportion of group  $j$  in the total labour force. In our case, each group  $j$  includes all individuals on the same working time arrangement (i.e. short part-time, long part-time, full-time work). Substituting Equation (3) into (2) allows for different marginal productivities for each of the  $G$  working time categories. If for group  $j$  the parameter  $\theta_j$  is bigger (smaller) than unity, then this group has a higher (lower) marginal impact on productivity than the reference category, which, in our case, contains all individuals working 35 or more hours per week (i.e. all full-time workers). If all groups have  $\theta$ 's equal to one, then Equation (3) becomes  $QL_i = L_i$ , i.e. labour is perfectly homogeneous.

As for the wage equation, Aubert and Crépon (2003) show that the average wage of firm  $i$  can be expressed as:

$$\bar{w}_i = \frac{\sum_{j=1}^G w_{i,j} L_{i,j}}{\sum_{j=1}^G L_{i,j}} = w_{i,0} \left( \sum_{j=1}^G \frac{w_{i,j}}{w_{i,0}} \frac{L_{i,j}}{L_i} \right) = w_{i,0} \left( 1 + \sum_{j \neq 0} \left( \frac{w_{i,j}}{w_{i,0}} - 1 \right) \frac{L_{i,j}}{L_i} \right) \quad (4)$$

where  $w_{i,j}$  is the average wage of  $L_{i,j}$  and  $j = 0$  the reference working time category with the wage  $w_{i,0}$ . Similar to the interpretation of  $\theta$  in the production function, if the ratio  $w_j/w_0$  is bigger (smaller) than unity, then the marginal impact of group  $j$  on the average wage in the firm is higher (lower) compared to the reference category. Comparing marginal productivities

and wage differentials across groups boils down to comparing  $\theta_j$  with the corresponding  $w_j/w_0$ .

#### 4 DATA AND DESCRIPTIVE STATISTICS

Our empirical analysis is based on a combination of two large data sets covering the years 1999-2006. The first, carried out by Statistics Belgium, is the Structure of Earnings Survey (SES). It covers all firms operating in Belgium that employ at least 10 workers and with economic activities within sections C to K of the NACE Rev. 1 nomenclature.<sup>1</sup> The survey contains a wealth of information, provided by the management of firms, both on the characteristics of the latter (e.g. sector of activity, number of workers, level of collective wage bargaining) and on the individuals working there (e.g. age, education, tenure, gross earnings, paid hours, sex, occupation).<sup>2</sup> The SES provides no financial information. Therefore, it has been merged with a firm-level survey, the Structure of Business Survey (SBS). The SBS, also conducted by Statistics Belgium, provides information on financial variables such as firm-level value added and gross operating surplus per hour. The coverage of the SBS differs from the SES in that it does not include the whole financial sector (NACE J) but only Other Financial Intermediation (NACE 652) and Activities Auxiliary to Financial Intermediation (NACE 67). The merger of the SES and SBS datasets has been carried out by Statistics Belgium using firms' social security numbers.

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<sup>1</sup> It thus covers the following sectors: i) mining and quarrying (C), ii) manufacturing (D), iii) electricity, gas and water supply (E), iv) construction (F), v) wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods (G), vi) hotels and restaurants (H), vii) transport, storage and communication (I), viii) financial intermediation (J), and ix) real estate, renting and business activities (K).

<sup>2</sup> The SES is a stratified sample. The stratification criteria refer respectively to the region (NUTS-groups), the principal economic activity (NACE-groups) and the size of the firm. The sample size in each stratum depends on the size of the firm. Sampling percentages of firms are respectively equal to 10, 50 and 100 percent when the number of workers is lower than 50, between 50 and 99, and above 100. Within a firm, sampling percentages of employees also depend on size. Sampling percentages of employees reach respectively 100, 50, 25, 14.3 and 10 percent when the number of workers is lower than 20, between 20 and 50, between 50 and 99, between 100 and 199, and between 200 and 299. Firms employing 300 workers or more have to report information for an absolute number of employees. This number ranges between 30 (for firms with between 300 and 349 workers) and 200 (for firms with 12,000 workers or more). To guarantee that firms report information on a representative sample of their workers, they are asked to follow a specific procedure. First, they have to rank their employees in alphabetical order. Next, Statistics Belgium gives them a random letter (e.g. the letter O) from which they have to start when reporting information on their employees (following the alphabetical order of workers' names in their list). If they reach the letter Z and still have to provide information on some of their employees, they have to continue from the letter A in their list. Moreover, firms that employ different categories of workers, namely managers, blue- and/or white-collar workers, have to set up a separate alphabetical list for each of these categories and to report information on a number of workers in these different groups that is proportional to their share in total firm employment. For example, a firm with 300 employees (namely, 60 managers, 180 white-collar workers and 60 blue-collar workers) will have to report information on 30 workers (namely, 6 managers, 18 white-collar workers and 6 blue-collar workers). For more details see Demunter (2000).

Two filters have been applied to the original data set. Firstly, we deleted firms that are publicly controlled and/or operating in predominantly public sectors from our sample. This filter derives its rationale from neoclassical productivity theory, which relies on the assumption that prices are economically meaningful. All regressions are therefore applied to privately controlled firms only.<sup>3</sup> Secondly, we have eliminated firms with less than 10 observations. The reason for this is that we use average values at the firm level. In order to ascertain that averages are based on a minimum number of observations, we filtered out firms that provided information on less than 10 employees.<sup>4</sup>

Our final sample consists of an unbalanced panel of 9,225 firms yielding 20,537 firm-year-observations during the six year period (1999-2006), the exact number depending on the estimation method adopted. It is representative of all firms employing at least 10 employees within sections C to K of the NACE Rev. 1 nomenclature, with the exception of large parts of the financial sector (NACE J) and almost all the electricity, gas, and water supply industry (NACE E). However, given that the sampling percentages of firms in our data set increase with the size of the latter, medium-sized and large firms are over-represented in econometric specifications requiring firm information on several consecutive years.

The definition of earnings we use in the estimation corresponds to the total gross wages, including premia for overtime, weekend or night work, performance bonuses, commissions, and other premia. The work hours correspond to the total effective remunerated hours in the reference period (including paid overtime hours). The firm's value added per hour is measured at factor costs and calculated with the total number of hours effectively worked by the firm's employees. All variables in the SES-SBS are not self-reported by the employees but provided by the firm's management and therefore more precise compared to employee or household surveys.

The thresholds we use to distinguish between different working time regimes correspond to widely used practice in the literature. This being said, several definitions of part-time work exist. According to the ILO Part-Time Work Convention (1994; No. 175), a part-time worker is an “employed person whose normal hours of work are less than those of comparable full-time workers”, where the normal hours of work referred to may be calculated “weekly or on average over a given period of employment”. By the same token, many authors define part time with reference to national standard of full-time working hours (Bardasi and

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<sup>3</sup> More precisely, we eliminate firms for which public financial control exceeds 50%. This exclusion reduces the sample size by less than 4%.

<sup>4</sup> This selection is unlikely to affect our results as it leads to a small drop in sample size.

Gornick 2008; Manning and Petrongolo 2008). By contrast, some studies rely on subjective self-assessment to distinguish different work regimes (OECD, 2010). What is more, the definition of what constitutes part-time work might also vary across sectors and occupations.

In Belgium, the national statutory maximum working scheme consists of 38 hours per week and 8 hours per day. However, these thresholds are collectively renegotiated by social partners in most industries and/or firms. As a result, actual statutory maximum working hours are much closer to 35 hours per week and 7 hours per day. Working hours that exceed these thresholds are typically treated as overtime. Part-time work is defined as regular and voluntary work that is shorter than these thresholds. It cannot be shorter than three successive hours and, on a weekly basis, not less than a third of the working time of a full-time worker (O’Dorchai and Meulders 2009). In line with standard practice, we defined part-time work as less than 35 hours per week (as similar approach has been adopted in e.g. in Booth and Wood 2008; Rodgers 2004; Hirsch 2005). Yet, past research has highlighted considerable heterogeneity among part-time workers (Hirsch 2005; O’Dorchai et al. 2007; Russo and Hassink 2008). For instance, the repercussions of part-time arrangements might differ according to whether the individual is absent during much of the work week (e.g. an employee with peripheral tasks coming in only one or two days a week) or whether she is almost working full time (e.g. an employee that works like her full-time colleagues during the entire week but leaves the office on Friday noon). In order to capture these differences, we defined three groups of individuals: up to 25 hours (short part timers); between 25 and 35 hours (long part timers); and 35 or more working hours per week (full timers).<sup>5</sup>

[Insert Table 1 here]

Table 1 sets out the means and standard deviations of selected variables. We observe that firms have a mean value added per hour worked of 57.77 Euros and that workers’ mean gross hourly wage stands at 16.76 Euros. In all, 16 per cent of total hours are accumulated among people working up to 25 hours per week, 6 per cent of hours are due to the group between 25 and 35 hours per week, and 78 per cent of hours are worked by people with 35 hours or more

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<sup>5</sup> The proportion of workers receiving payments for over-time hours is relatively limited in our sample. Moreover, the mean number of over-time hours among these workers is generally not very large. Yet, robustness tests have been performed (not reported in the paper due to space constraints but available upon request) to make sure that econometrics results reported in section 5.2 are not biased do to the misclassification of workers in the long part-time or full-time categories due to the inclusion of overtime hours.

per week. We also find that 57 per cent of hours are worked by blue collar workers<sup>6</sup>, 36 per cent of hours by people with a low level of education (i.e. lower or lower secondary education at most), and 4 per cent of hours by people on non-standard employment contracts. Overall, 65 per cent of workers in our sample are employed in relatively big firms (i.e. firms with at least 100 employees) and are essentially concentrated in the manufacturing sector (52 percent), wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods (12 per cent), construction (13 per cent) and real estate, renting and business activities (12 per cent).

## 5 SPECIFICATION AND RESULTS

### 5.1 Functional specifications of the model

In this section we describe different specifications of the equations (2) and (4). The model formed by equations (5) and (6) is our baseline specification and similar to the model in Hellerstein et al. (1999). The  $\beta_j$  (with  $j = 1, 2$ ) in equation (5) is the relative marginal impact of workers' share  $j$  on average firm level hourly productivity [note that  $\beta_j$  corresponds to  $\theta_j - 1$  in equation (3)]. In equation (6),  $\beta_j^*$  is the relative marginal impact of workers' share  $j$  on the average firm level hourly wage ( $\beta_j^*$  corresponds to  $w_j/w_0 - 1$  in equation (4)). The terms  $\varepsilon_{i,t}$  and  $\varepsilon_{i,t}^*$  represent the error terms.

$$\log(\text{Value Added}/\text{Hours})_{i,t} = \alpha + \beta_1 A_{1i,t} + \beta_2 A_{2i,t} + \lambda X_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$\log(\text{Total Wages}/\text{Hours})_{i,t} = \alpha^* + \beta_1^* A_{1i,t} + \beta_2^* A_{2i,t} + \lambda^* X_{i,t} + \varepsilon_{i,t}^* \quad (6)$$

The dependent variable in equation (5) is firm  $i$ 's hourly value added, obtained by dividing the total value added by the firm  $i$  in period  $t$  by the total number of work hours (taking into account paid overtime hours) that have been declared for the same period. The dependent variable in equation (6) is firm  $i$ 's average hourly gross wage (including premia for overtime, weekend or night work, performance bonuses, commissions, and other premia). It is obtained by dividing the firm's total wage bill by the total number of work hours. Hence, the

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<sup>6</sup> Blue-collar occupations include “Craft and related trades workers”, “Plant and machine operators, and assemblers”, and “Elementary occupations”.

dependent variables in the estimated equations are firm averages of value added and wage on an hourly basis. The independent variables are also measured in terms of shares in total work hours (which means that part-time shares are measured in terms of the proportion of hours worked by part-time workers over the total amount of hours worked within the firm). The main variables of interest are the shares of hours worked by each of our three working time categories,  $(A_{1i,t}, A_{2i,t}, A_{3i,t})$ : up to 25 hours per week (short part time), between 25 and 35 hours per week (long part time) and more than 35 hours per week (full time); we consider the share of full-time workers ( $A_{3i,t}$ ) as our reference category.<sup>7</sup>

In addition to the shares in total work hours, we also included the vector  $X_{i,t}$ . It contains a set of variables controlling for observable characteristics of the firm and its labour force. More precisely, it includes four dummies for the size of the firm (i.e. the number of employees), respectively four and eight dummies for the educational and occupational composition of the workforce, the proportion of female employees, four dummies for workers' age (between 15 and 29, between 30 and 44, between 45 and 59 and over 60 years), the fraction of workers with a fixed-term employment contract and eight dummies for the years of observations. Since the firms' capital stock is not available in the SES-SBS data set, capital is proxied with dummy variables for nine economic sectors at the one-digit level of the NACE nomenclature. This is likely to compensate for the omission of capital since the latter tends to be correlated with the type of activity of the firm. Moreover, van Ours and Stoeldraijer (2011) argue on the basis of previous studies that including or not including capital stock doesn't seem to affect the parameter estimates of production functions based on firm-level micro survey data (see also Hellerstein et al. 1999; Aubert and Crépon 2003; Dostie 2011).<sup>8</sup>

Estimating equations (5) and (6) allows to gauge the effect of different working patterns on firm productivity and wages, but it does not allow to test directly whether the difference between the value added and the wage coefficients for a given group of workers is statistically significant. A simple method to obtain a test for the significance of productivity-wage gaps has been proposed by van Ours and Stoeldraijer (2011). We apply a similar approach and estimate a model in which the difference between firm  $i$ 's hourly value added and hourly wage is regressed on the same set of explanatory variables as in equations (5) and

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<sup>7</sup> As highlighted earlier, results reported in this paper are robust to the inclusion or exclusion of over-time hours.

<sup>8</sup> For the modalities of all control variables and corresponding descriptive statistics see table 1.

(6). This produces coefficients for the two part-time groups and measures directly the size and significance of their respective productivity-wage gaps.

We have estimated equations (5) and (6), as well as the productivity-wage gap, with three different methods. The baseline regression is a pooled Ordinary Least Squares (OLS) estimator with robust standard errors (we use a Huber/White/sandwich estimate of variance, i.e. the errors are robust to heteroscedasticity and serial correlation (see Wooldridge 2002)). This estimator is based on both the cross-section variability between firms and the longitudinal variability within firms over time.

Pooled OLS estimators of value added models have been criticized for their potential “heterogeneity bias” (Aubert and Crépon 2003: 116). This bias is due to the fact that firm productivity depends to a large extent on firm-specific, time-invariant characteristics that are not measured in micro-level surveys. As a consequence, the working time coefficients of these estimators might be biased since unobserved firm characteristics may affect simultaneously the firm's level of value added (or wage) and its workforce composition. This is referred to as a problem of spurious correlation and could be caused by factors such as an advantageous location, firm-specific assets like the ownership of a patent, or other firm idiosyncrasies. One way to deal with unobserved time-invariant heterogeneity of firms is to reformulate equations (5) and (6) as follows:

$$\log(\text{Value Added}/\text{Hours})_{i,t} = \alpha + \beta_1 A_{1i,t} + \beta_2 A_{2i,t} + \lambda X_{i,t} + \delta_i + \varepsilon_{i,t} \quad (7)$$

$$\log(\text{Total Wages}/\text{Hours})_{i,t} = \alpha^* + \beta_1^* A_{1i,t} + \beta_2^* A_{2i,t} + \lambda^* X_{i,t} + \delta_i + \varepsilon_{i,t}^* \quad (8)$$

where  $\delta_i$  is a dummy variable for each firm that captures time-invariant individual unobserved characteristics. In order to remove unobserved firm characteristics that remain unchanged during the observation period we use a fixed-effect model.

Next, the model is estimated using the dynamic system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). Such estimator allows us to address the endogeneity of our explanatory variables.<sup>9</sup> Share of part timers are likely to be endogenous for several reasons: firstly, workers might choose or accept to work either part time or full time according to their degree of job commitment; secondly, any shock in wages or in productivity levels might generate correlated changes in the firm's workforce and in

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<sup>9</sup> Technically, variables in the differenced equation are instrumented by their lagged levels and variables in the level equation are instrumented by their lagged differences.



labour productivity that are not due to changes in the firm's workforce composition per se: for instance, in periods of cyclical downturn firms might reduce workers' time schedules in order to save on labour costs. Furthermore, the dynamic GMM estimator allows us to control for the potential path dependency of firm-level productivity and wages. To this end, we add a one year lag of the dependent variables in Equations (5) and (6) to the set of explanatory variables:

$$\log(\text{Value Added / Hours})_{i,t} = \alpha + \phi \log(\text{Value Added / Hours})_{i,t-1} + \beta_1 A_{1i,t} + \beta_2 A_{2i,t} + \lambda X_{i,t} + \delta_i + \varepsilon_{i,t} \quad (9)$$

$$\log(\text{Total Wages / Hours})_{i,t} = \alpha^* + \phi^* \log(\text{Total Wages / Hours})_{i,t-1} + \beta_1^* A_{1i,t} + \beta_2^* A_{2i,t} + \lambda^* X_{i,t} + \delta_i + \varepsilon_{i,t}^* \quad (10)$$

## 5.2 Estimation results

We first estimate Equations (5) and (6), as well as the productivity wage gap with pooled OLS. In the first estimation we do include neither worker nor firm controls. Focusing at first on the productivity equation, Table 2 shows that short part timers and long part timers are significantly less productive than full timers. Indeed, the regression coefficient associated with short part time is equal to -1.16 and the coefficient associated to long part time is equal to -0.19. This means that if the fraction of long part-time workers within a firm increases by one unit (i.e. one percentage point), productivity decreases on average by 0.19 per cent (i.e.  $-0.19 * 0.01 = -0.0019 = 0.19$  per cent) and if the fraction of workers working short part time increases by one percentage point productivity decreases by 1.16 per cent. Regression coefficients can thus be roughly interpreted as elasticities between productivity and group shares. Yet, one should keep in mind that a change in one group of (short part-time, long part-time or full-time) workers modifies the incidence of workers in other groups. Turning to the relationship between part time and wages, results show that a one percentage point increase in short part timers decreases mean hourly wages within firms by 0.71 per cent and that mean hourly wage decreases by 0.08 per cent following a one percentage point increase in the fraction of long part timers. The comparison of estimates for the productivity and wage equations suggests that the productivity-wage gap is negative for both short and long part time. This means that, according to OLS estimates, the two categories are overpaid. Results from the productivity-wage gap regression support this finding. Indeed, the impact of short part-time and long part-time workers on the productivity-wage gap is found to be significantly negative (-0.44 and -0.11 respectively).

Introducing worker and firm controls in the regression modifies results as follows. As to the productivity equation, the sign of the coefficients remains the same but their magnitude is reduced: the coefficient for short part time drops to -0.40 and the coefficient for long part time to -0.08. Considering the wage equation, the right part of Table 2 illustrates that a relative increase in short part timers reduces mean hourly wages by 0.10 per cent and an increase in the share of long part timers increases it by 0.07 per cent. Turning to the productivity-wage gap, results are in line with the previous ones: both short and long part timers are found to be overpaid (the respective coefficients are -0.30 and -0.15).

[Insert Table 2 here]

Findings reported so far should be interpreted with caution given that they are subject to several methodological limitations. In particular, time-invariant unobserved workplace characteristics are not accounted for. The Breusch and Pagan (1980) Lagrangian multiplier (10441.58 for the value added and 10218.84 for the wage equation) indicates that we have to refute the adequateness of pooled OLS for the estimation of equations (5) and (6). In addition, the Hausman test (894.50 for the value added and 1792.59 for the wage equation) calls for a fixed-effects model.

Results based on a fixed-effect estimator are reported in Table 3 and substantially differ from OLS results. Regarding the value added equation, findings (not controlling for the lagged dependent variable) show that the share of part timers does not affect average productivity at the firm level since both the coefficients for short part time and long part time are positive but not significant (0.03 and 0.01, respectively). As to the wage equation, the coefficient for short part time turns out to be positive and equal to 0.13, while the coefficient for long part time remains positive but decreases to 0.05. Findings for the productivity-wage gap equation show that the gap is negative and significant both for short part time (-0.11) and for long part time (-0.04). Overall, once fixed effects are taken into account, results still indicate that short and long part time workers are slightly overpaid, but we do not find any negative effect of part time workers on average firm level productivity.<sup>10</sup>

[Insert Table 3 here]

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<sup>10</sup> Results are quite similar if the lagged dependent variable is controlled for (see the last three columns of Table 3), except that the productivity-wage gap for long part time is only significant at the 15 percent level.

Yet, it could still be argued that fixed-effects estimates are biased and inconsistent due to the endogeneity of the shares of short and long part-time workers. To address this issue, controlling at the same time for firm fixed effects and the state dependency of firm productivity and wages, we estimate our model using the dynamic system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). To examine the reliability of the corresponding estimates, we first apply the Hansen (1982) test of overidentifying restrictions and the Arellano-Bond's (1991) test for second-order autocorrelation in the first-difference errors. As shown in Table 4, they respectively do not reject the null hypothesis of valid instruments and of no autocorrelation. As expected, we also find that current productivity and mean wages at the firm level are significantly related to their past values.

[Insert Table 4 here]

Furthermore, estimates of the value added equation show a positive (0.01) but insignificant coefficient for short part time and a positive (0.14) and significant coefficient for long part time. Contrary to the theory of start-up costs (Barzel 1973), our estimates thus suggest that part time can be beneficial for firm productivity, at least if it exceeds 25 hours per week. In other words, it appears that certain part timers perform the equivalent of full-time jobs but within slightly fewer hours. This interpretation is supported by the literature arguing that, for various reasons, many part timers continue to be confronted with full-time workloads (Lewis 2001; Lewis 2003; Edwards and Robinson, 2000; Stanworth 1999). Yet, other theoretical explanations (e.g. reciprocity theories; the appropriateness of part time in light of the circadian rhythm; or end-of-the-day fatigue) are also in line with our results for long part time. As to the wage equation, neither the short nor the long part-time coefficient (0.05 and 0.02, respectively) is significantly different from zero. Results thus indicate that there is no part-time wage gap in the Belgian private sector when controlling for a large number of worker and firm characteristics (including firm fixed effects) and endogeneity issues. Finally, findings from the productivity-wage-gap regression indicate that short part timers are paid at their marginal productivity (the coefficient is negative (-0.04) but not significant), whereas long part-timers would be 'underpaid' (the coefficient is significant and equal to 0.12). Results for the productivity-wage gap, consistent with those obtained separately on the basis of productivity and wage regressions, suggest that anti-discriminatory policies on the Belgian labour market are more effective to protect short than long part-time workers.

## 6 CONCLUSION

During the last two decades, part time has become one of the main vectors of labour market flexibility in Europe and elsewhere. It has also risen sharply during the recent economic downturn (Employment in Europe 2010). In OECD countries, on average one in four women and one in ten men work part time (OECD 2010).

A growing literature examines the impact of working time on workers' wages. Empirical results typically document a significant gap between hourly wages of part- and full-time workers. By and large, this gap has been attributed to substantial heterogeneity between jobs and/or between individuals (Hirsch, 2005; Manning and Petrongolo, 2008). Yet, for some countries a significant fraction of this gap remains unexplained after controlling for observable heterogeneity. This may point to other forms of labour market inequality or discrimination against part-time workers (Bardasi and Gornick 2008). Besides, few studies have focused on productivity differences between full-time and part-time workers. In fact, the relationship between working hours and productivity has not been clearly established: both extant theory and empirical results are inconclusive (Branine 2003; Lewis 2003; Nelen et al. 2011). Finally, as far as we know, there are no studies investigating whether part-time workers are paid at their marginal productivity using accurate information on both wages and productivity.

The present paper contributes to this literature by estimating the effect of part-time work on productivity, wages and productivity wage-gaps. More precisely, we are among the first to compare the productivity and wage profiles of three groups of workers: those working less than 25 hours (short part time), between 30 and 35 hours (long part time), and more than 35 hours per week (full time). To do so, we used detailed longitudinal matched employer-employee data covering the Belgian private sector over the period 1999–2006. Our data allows to tackle a range of measurement issues that have not been addressed in the existing literature: the panel data provides precise information on average productivity and wages within firms; controls for a wide range of worker and firm characteristics; and permits to deal with time-invariant unobserved firm heterogeneity, the endogeneity of part-time shares, and the state dependence of firm productivity and wages. The distinction between short and long part-time workers, too often neglected in the literature, is an important feature of our study (Hirsch 2005; Russo and Hassink 2008). Indeed, the repercussions of part-time arrangements on wages and productivity are likely to differ according to whether the individual is absent during much of the work week (e.g. an employee with peripheral tasks coming in only one or

two days a week) or whether she is almost working full time (e.g. an employee that works like her full-time colleagues during the entire week but leaves the office on Friday noon).

Results from our preferred specification, based on the dynamic system GMM estimator, indicate that average hourly wages within firms do not significantly depend on the incidence of short and long part-time workers. They thus highlight the absence of any part-time wage gap. Nevertheless, results from the OLS model show that wage penalties associated to short part time employment are explained by differences in individual and job characteristics, meaning that individuals working less than 25 hours per week are concentrated in “low-paid” jobs. This segregation effect is less apparent for long part timers (the gross wage differentials in the OLS model is much smaller for this group).

Regarding productivity, GMM results indicate that a marginal increase in the share of short part-time workers does not affect average firm productivity. This could mean that the negative and positive effects of short part time on productivity that have been hypothesised in the theoretical literature either cancel each other or simply don't exist. On any account, short part time seems to be paid at marginal productivity and we find no signs of wage discrimination for this group. This result might be attributed to Belgium's relatively effective anti-discrimination policies that strive to protect part-time workers. As regards part time jobs that exceed 25 weekly working hours, however, GMM estimations indicate that a marginal increase in the share of long part time has a positive effect on firm productivity and we find that this group is paid below its marginal productivity.

Overall, our empirical results suggest that part time has no strongly detrimental effect on firm productivity. For part-time jobs with more than 25 weekly work hours the opposite seems to be the case. We argued that this could be due to workers in long part-time jobs facing what are effectively full-time workloads. In other words, individuals that work almost full time are effectively carrying out full-time jobs in part-time hours, for instance due to management not taking into account working time reductions when establishing work plans or performance expectations (Stanworth 1999; Edwards and Robinson, 2000; Lewis 2001, 2003). It should be noted, however, that other theoretical explanations are also in line with our results (e.g. reciprocity theories; the appropriateness of part time in light of the circadian rhythm; or end-of-the-day fatigue).

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TABLE 1. DESCRIPTIVE STATISTICS (1999-2006)

Variables:	Mean	Std. Dev.
Added value per hour (2006 Euros)	57.77	525.98
Hourly wage (2006 Euros)	16.76	5.57
Share of workers < 30 years	0.23	0.16
Share of workers between 30 and 44 years	0.49	0.16
Share of workers between 45 and 59 years	0.27	0.17
Share of workers $\geq$ 60 years	0.01	0.03
Education:		
Lower education	0.08	0.17
Lower secondary education	0.28	0.30
General upper secondary school	0.19	0.24
Technical/artistic/professional upper secondary school	0.21	0.25
Short higher education	0.15	0.18
Long higher education or university	0.09	0.15
Occupations:		
Managers	0.03	0.08
Professionals	0.10	0.19
Technicians and associate professionals	0.08	0.15
Clerical support workers	0.17	0.22
Service and sales workers	0.05	0.19
Craft and related trades workers	0.26	0.33
Plant and machine operators, and assemblers	0.22	0.30
Elementary occupations	0.09	0.20
Working time:		
Short Part time (< 25 work hours per week)	0.16	0.14
Long Part time (25 to 35 hours per week)	0.06	0.07
Full time ( $\geq$ 35 work hours per week)	0.78	0.19
Not standard (i.e. non open-ended) employment contract	0.04	0.10
Number of employees per firm:		
< = 19	0.03	
20 to 49	0.14	
50 to 99	0.18	
100 to 199	0.25	
200 to 499	0.26	
> = 500	0.14	
Sector (%):		
Mining and quarrying (C)	0.00	
Manufacturing (D)	0.52	
Electricity, gas and water supply (E)	0.00	
Construction (F)	0.13	
Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods (G)	0.12	
Hotels and restaurants (H)	0.02	
Transport, storage and communication (I)	0.08	
Financial intermediation (J)	0.01	
Real estate, renting and business activities (K)	0.12	
Number of observations		20,537
Number of firms		9,225

TABLE 2 – POOLED OLS ESTIMATES, 1999-2006

<i>Dependent variable:</i>	<i>Without control variables</i>			<i>With control variables</i> <sup>a</sup>		
	Value added per hour worked (ln)	Mean wage per hour worked (ln)	Value added- wage gap (ln)	Value added per hour worked (ln)	Mean wage per hour worked (ln)	Value added- wage gap (ln)
Short Part-time (0, 25)	-1.16*** (0.04)	-0.71*** (0.02)	-0.44*** (0.03)	-0.40*** (0.04)	-0.10*** (0.02)	-0.30*** (0.04)
Long Part-time [25, 35)	-0.19*** (0.03)	-0.08*** (0.02)	-0.11*** (0.02)	-0.08** (0.03)	0.07*** (0.01)	-0.15*** (0.03)
Sig. model (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
R <sup>2</sup>	0.06	0.08	0.01	0.25	0.65	0.05
Number of observations	20,537	20,537	20,537	20,537	20,537	20,537
Number of firms	9,225	9,225	9,225	9,225	9,225	9,225

*Notes:* \*\*\*/\*\*/\* significant at the 1, 5 and 10% level. Robust standard errors are reported between brackets.

<sup>a</sup> We control for workers characteristics that include the educational and occupational composition of the firm's workforce (4 and 8 categories, respectively), share of female employees, worker's age (4 categories), share of non-standard work contracts and worker's tenure. We control for firm characteristics that include size (4 dummies), industry (8 dummies) and year dummies (7).

TABLE 3 –FIXED EFFECTS ESTIMATES, 1999-2006

<i>Dependent variable:</i>	<i>Without lagged dependent variable</i>			<i>With lagged dependent variable</i>		
	Value added per hour worked (ln)	Mean wage per hour worked (ln)	Value added- wage gap (ln)	Value added per hour worked (ln)	Mean wage per hour worked (ln)	Value added- wage gap (ln)
Lagged dependent variable				0.11*	0.13***	0.08
				(0.06)	(0.02)	(0.06)
Short Part-time (0, 25)	0.03	0.13***	-0.11*	-0.09	0.12***	-0.21**
	(0.05)	(0.03)	(0.06)	(0.08)	(0.03)	(0.09)
Long Part-time [25, 35)	0.01	0.05***	-0.04*	-0.01	0.04***	-0.05
	(0.02)	(0.01)	(0.02)	(0.03)	(0.01)	(0.03)
Sig. model (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
Within R <sup>2</sup>	0.02	0.49	0.00	0.20	0.63	0.02
Number of observations	20,537	20,537	20,537	6,753	6,753	6,753
Number of firms	9,225	9,225	9,225	2,487	2,487	2,487

Notes: \*\*\*/\*\*/\* significant at the 1, 5 and 10% level. Robust standard errors are reported between brackets.

<sup>a</sup> We control for workers characteristics that include the educational and occupational composition of the firm's workforce (4 and 8 categories, respectively), share of female employees, worker's age (4 categories), share of non-standard work contracts and worker's tenure. We control for firm characteristics that include size (4 dummies), firm industry (8 dummies) and year dummies (7).

TABLE 4 – DYNAMIC SYSTEM GMM ESTIMATES, 1999-2006

<i>Dependent variable:</i>	Value added per hour worked (ln)	Mean wage per hour worked (ln)	Value added- wage gap (ln)
Lagged dependent variable	0.22** (0.11)	0.32*** (0.08)	0.20*** (0.05)
Short Part-time (0, 25)	0.01 (0.11)	0.05 (0.05)	-0.04 (0.14)
Long Part-time [25, 35)	0.14** (0.05)	0.02 (0.03)	0.12* (0.06)
Sig. model (p-value)	0.00	0.00	0.00
Arellano Bond test for AR(2) (p-value)	0.92	0.51	0.65
Hansen test (p-value)	0.53	0.16	0.45
Number of observations	6,753	6,753	6,753
Number of firms	2,487	2,487	2,487

*Notes:* \*\*\*/\*\*/\* significant at the 1, 5 and 10% level. Robust standard errors are reported between brackets.

We control for worker characteristics that include the educational and occupational composition of the firm's workforce (4 and 8 categories, respectively), share of female employees, worker's age (4 categories), share of non-standard work contracts and worker's tenure. We control for firm characteristics that include size (4 dummies), industry (8 dummies) and year dummies (7). First and second lags of explanatory variables, excluding time dummies, are used as instruments.