IS PART-TIME EMPLOYMENT BENEFICIAL FOR FIRM PRODUCTIVITY?

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January 2010

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Abstract

In this paper, we analyze whether firms' share of part-time employment affects productivity in service sector firms. We find that firms with a large part-time employment share are more productive than firms with a large full-time employment share. Additional analyses show that part-time employment enables firms to have a more efficient allocation of labor. First, firms with part-time workers can bridge the gap between operating hours and a full-time working week. Second, part-time employment makes it possible to cushion peak hours by enabling firms to deploy more workers during peak hours than during opening hours with relatively low customer demand. Our findings suggest that part-time employment is beneficial for service-sector firms that face fluctuations in customer demand during opening hours.

JEL-Codes: J24, L23, L25
Keywords: heterogeneous labor, matched employer-employee data, allocation of labor

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1 Introduction

The prevalence of part-time work is a distinctive feature of European countries such as the Netherlands, the United Kingdom and Germany. However, research on the effects of part-time work on firm productivity is scarce, and theoretical predictions are ambiguous with respect to the expected effects. On the one hand, human capital theory predicts a negative relationship between part-time employment and individual productivity. This is because part-time workers are expected to invest less in their human capital than full-timers, and is often reflected in lower hourly wages (e.g. Connolly and Gregory 2008; Aaronson and French 2004). On the other hand, literature on part-time labor demand suggests several scenario's in which part-time employment might be beneficial for firm productivity. Examples are larger operating hours than contracting hours or the existence of peak hours in customer demand (Mabert and Showalter 1990; Delsen 2006).

The aim of this paper is to analyze whether part-time employment is beneficial for firm productivity. For this purpose, we estimate a production function including heterogeneous employment shares (cf. Hellerstein et al., 1999; Dearden et al., 2006; Ilmakunnas and Malirante, 2005) based on employees' working hours. For reasons we make clear later, we distinguish

between part-time and full-time *core* workers, and the share of other employees.

Production function studies that include heterogenous labor shares, usually distinguish between high and low skilled workers (e.g. Ilmakunnas and Maliranta 2005; Iranzo, Schivardi, and Tosetti 2008). However, as far as we know, there are no studies which distinguish between part-time and full-time employment shares. Therefore, the implicit assumption of the standard production function is that part-time and full-time workers are equally productive in the hours they work, and that there are no allocation efficiencies in the use of part-time versus full-time workers. The lack of research on the effect of part-time employment on firm productivity, is probably due to data constraints. Identification of the effect of part-time employment on firm productivity requires three specific features of the data: (1) a homogeneous sector in terms of capital use and a homogeneous workforce in terms of education level, (2) information on the working hours of all employees within firms, and (3) an unambiguous physical or monetary measure of productivity.

We use a unique matched employer-employee dataset on Dutch pharmacies which fulfills all three requirements. In our analyzes, we focus on the core workers (Osterman 1994, 2000) – i.e. pharmacy assistants – , who account for 70% of total employment (measured in full-time equivalents). All pharmacy

assistants have the same educational background (level and field) required by law to be employed in this profession. We know the working hours of all employees in the sector. Moreover, firm productivity in the sector can be measured by the number of prescription lines delivered to customers.

We contribute to the literature by treating firms' part-time and full-time employment shares as heterogeneous employment shares, thereby allowing for productivity differentials between these two employment shares. We find that firms with a large part-time employment share are more productive than firms with a large full-time employment share. This appears to be related to allocation efficiencies. First, part-time employment is beneficial as operating hours exceed the full-time working week. Second, independent on whether part-time or full-time workers are most productive during the hours they work, part-time employees enable firms to cushion peak hours. Assuming that during peak hours more workers are deployed than during opening hours with low customer demand, allocation efficiencies provided by part-time employees make firms with a large share of part-time employees more productive than firms that employ more full-time employees.

The structure of the paper is as follows: the next section gives a brief review of related literature. Section 3, presents the empirical strategy. Section 4 describes the data and gives some sample statistics. Section 5 reports the

results and gives some robustness checks. Section 6 describes the allocation efficiency of part-time employment. Section 7 concludes.

2 Related Literature

Production function studies that include heterogenous employment shares based on skill levels, age and gender (e.g. Ilmakunnas and Maliranta 2005; Iranzo, Schivardi, and Tosetti 2008) implicitly assume part-time and full-time workers to be equally productive in the hours they work. This is however in sharp contrast to studies dealing with the effect of part-time employment on hourly wages. Relying on the assumption that wages reflect productivity, most studies found part-time workers to be less productive than full-timers in the hours they work (e.g. Ermisch and Wright 1993; Aaronson and French 2004; Hirsch 2005; Baffoe-Bonnie 2004). One exemption is Manning and Petrongolo (2008) who found that including information on workers' occupation almost fully closes the gap between hourly wages of part-time and full-time workers. Rosendaal (2003) related workers' working hours to other measures of individual performance: stakeholder satisfaction, self-assessed efficiency of one's work and satisfaction at the end of the working day. For the last two measures, Rosendaal (2003) found a negative relationship with working hours.

Next to these individual productivity effects, part-time employment might affect firm productivity. Research on the effect of part-time work on firm productivity is scarce and has mainly been limited to the inclusion of a part-time dummy for the presence or importance of part-time employment in firms.[1] Arvanitis (2005) constructed a dummy variable indicating whether part-time work is important within the firm. He found a negative relationship between the importance of part-time work and sales per full-time equivalent (FTE). Pérotin and Robinson (2000) included a variable measuring the fraction of part-time employment in their analyses. They did not find a significant relationship between the proportion of part-time employment and managers' self-assessed labor productivity.

Explanations for a possible productivity advantage at the firm level when employing part-time workers, can be found in the literature on part-time labor demand. In this stream of literature, several scenarios are described in which the demand for part-time employment is relatively high. An interesting study in this respect is Owen (1978). Owen argued that firms employ part-time labor in order to avoid hiring overlapping shifts of full-time workers in industries where operating hours exceed the 40-hour

[1] One exception is a study from Roux (2007) that looks at the effect of part-time labor shares relative to full-time labor shares on the *value added* of French firms and shows that for service sector firms, part-time labor shares are more productive than full-time labor shares. However, the reliability of value added as a productivity measure is questionable in labor intensive sectors.

working week. Furthermore, Owen hypothesized that employers will use part-timers when there are fluctuations in demand. His results indeed imply that in industries with an uneven distribution of temporal service demands, the relative demand for part-time labor is higher than in other industries. Mabert and Showalter (1990) also argued that the introduction of part-time employment implies efficiency gains in service-sector firms which face fluctuations in customer demand due to the accompanying reduction in the number of hours in which workers are inactive due to lack of demand. These scenarios suggest an allocation efficiency due to part-time employment. Existing production function studies ignore this possibility.

3 Empirical Approach

Our approach is inspired from three papers which model productivity effects of different employment shares (Hellerstein, Neumark, and Troske 1999; Ilmakunnas and Maliranta 2005; Dearden, Reed, and Van Reenen 2006).[2] The approach assumes that different types of employees are perfect substitutes, but may have different marginal productivities. The sector under scrutiny -

[2]Hellerstein, Neumark, and Troske (1999) distinguish employment shares by gender, race, marital status, age, education and occupation. Ilmakunnas and Maliranta (2005) include employment shares based on age, level and field of education, and gender. Dearden, Reed, and Van Reenen (2006) allow for productivity differentials by training participation, education, occupation, age, tenure and gender.

Dutch pharmacy sector (see Section 4 – employs a homogenous core workforce with respect to education and gender, which allows us to divide the workforce in three employment shares: part-time (PT) and full-time (FT) core workers, and other employees (OE). Taking the latter as our reference group, and normalizing its productivity to unity, the relative productivity of the part-time employment share equals γ_{pt} and the relative productivity of the full-time employment share equals γ_{ft}. If the $\gamma's$ are larger than unity, the relevant employment share is more productive than the share of other employees. The quality-adjusted labor input is therefore:

$$L^* = L[1 + (\gamma_{pt} - 1)\frac{PT}{L} + (\gamma_{ft} - 1)\frac{FT}{L}] \tag{1}$$

Under the assumption that $(\gamma_{pt} - 1)\frac{PT}{L}$ and $(\gamma_{ft} - 1)\frac{FT}{L}$ are 'small', we can simplify Equation 1, by the following approximation:[3]

$$ln[1 + (\gamma_{pt} - 1)\frac{PT}{L} + (\gamma_{ft} - 1)\frac{FT}{L}] \approx (\gamma_{pt} - 1)\frac{PT}{L} + (\gamma_{ft} - 1)\frac{FT}{L} \tag{2}$$

[3]Following Dearden, Reed, and Van Reenen (2006) and Ilmakunnas and Maliranta (2005), we make this assumption to simplify the estimation (OLS estimation is then possible). However, the assumption can be relaxed without affecting our main findings. Following Hellerstein, Neumark, and Troske (1999), we estimated a nonlinear least squares model. Our results are qualitatively similar, with the productivity differential between firms' share of part-time and full-time employees being statistically significant.

The part-time and full-time employment shares are thereby directly included in a log-form production function. Using the quality-adjusted labor input (L^*), the Cobb Douglas production function is written as follows:[4]

$$Y = AK^{\alpha}L^{*\beta} \tag{3}$$

In which output (Y), is a function of capital K and quality-adjusted labor L^*. Taking logs and using the approximation Equation 2 gives:

$$ln(Y) = ln(A) + \alpha ln(K) + \beta ln(L) + \beta(\gamma_{pt} - 1)\frac{PT}{L} + \beta(\gamma_{ft} - 1)\frac{PT}{L} \tag{4}$$

We follow Ilmakunnas and Maliranta (2005) in allowing for deviations from constant returns to scale. When using FTEs in stead of the number of workers L, the production function becomes:

$$\begin{aligned} ln(Y) = lnA + \alpha' ln(K) + (\alpha' + \beta' - 1)ln(FTE) + \\ \beta'(\gamma'_{pt} - 1)\frac{PT_{FTE}}{FTE} + \beta'(\gamma'_{ft} - 1)\frac{FT_{FTE}}{FTE} \end{aligned} \tag{5}$$

where PT_{FTE} and FT_{FTE} denote the number of part-time and full-time FTEs per firm.

[4]As later, we assume capital use to be homogeneous across firms and workers, we have only one production input, quality-adjusted labor, we cannot estimate a translog production function as Hellerstein, Neumark, and Troske (1999) did.

Contrary to the three other studies mentioned, our focus on one particular sector allows us to assume capital use to be homogeneous across firms. Therefore, the following production function will be estimated:

$$ln(Y) = \theta + \delta ln(FTE_i) + \phi_{pt} pt_i + \phi_{ft} ft_i + \varepsilon_i \tag{6}$$

where pt_i and ft_i denote firms' part-time and full-time employment shares as defined as $\frac{PT_{FTE}}{FTE}$ and $\frac{FT_{FTE}}{FTE}$. Moreover, θ is the constant term and includes lnA and α'. δ equals $(\alpha' + \beta' - 1)$. ϕ_{pt} and ϕ_{ft} denote $\beta'(\gamma'_{pt} - 1)$ and $\beta'(\gamma'_{ft} - 1)$ respectively. In case ϕ_{pt} is significantly larger than ϕ_{ft}, results would imply that firms with a large share of part-time workers are on average more productive than firms with a large share of full-time workers.

In alternative specifications, the model also controls for worker, pharmacist and firm characteristics, as well as external factors (see Section 4).

4 Data and Descriptive Statistics

We use a unique matched employer-employee dataset of Dutch pharmacies which fulfills all requirements to identify marginal productivities of part-time and full-time workers. This dataset includes three sources of information:

(1) administrative data[5], (2) employer survey and (3) employee survey. All datasets can be merged on the basis of a unique firm identifier. The employers from all 1,890 Dutch pharmacies were invited to participate in the employer survey in January 2008, with two reminders sent in February and March 2008. Our final sample consists of 224 firms.[6] Analyses related to the non-response showed that our sample is selective with respect to the geographical location of the pharmacy, but not with respect to other characteristics of the firm.[7] Therefore, we include region dummies in all analyses.

Dependent variable. Our dependent variable is firm productivity. This is measured in the employer survey by firms' number of prescription lines delivered to customers in 2007.[8] Every prescription line refers to a particular medicine which has been written out by a family doctor. In the Netherlands, this is the only possible way to obtain registered medicines. There is a close link between the number of prescription lines and sales of

[5]This dataset is provided by the pension fund of the pharmacy sector, (*PMA*) and contains information on all employed workers within the sector. The data is from January 2008.

[6]The dataset consists of 260 firms. 36 were dropped after data cleaning.

[7]Our sample is representative with respect to key variables in our analysis: The number of prescription lines delivered in 2007 and the hour distribution within firms. Whereas in our sample the average pharmacy delivered 77,889 prescription lines, the average number of prescription lines over the 1,890 pharmacies equals 78,000. Source: SFK (an independent foundation of the pharmacy sector which publishes key indicators for the sector). Moreover, our sample is representative with respect to the distribution of working hours among pharmacy assistants and other employees.

[8]De Grip and Sieben (2005) used the same measure of productivity in their analyses on productivity of pharmacy assistants.

the firm due to a fixed amount of 6.10 euros pharmacies receive for each prescription line, and because pharmacies have only a small market share in the sales of non-registered medicines.[9] The physical character of this productivity measure ensures a relatively 'hard' measure of firm productivity (Ichniowski, Kochan, Levine, Olson, and Strauss 1996). Table 1 reports sample statistics of our employer-employee sample. On average, firms delivered $exp(11.21)$ – 77,889 – prescription lines in 2007.

[Table 1 about here]

Explanatory variables. Our main variables of interest are firms' different employment shares in terms of FTEs. Therefore, we need to know the number of working hours for all workers within firms. Information on contractual working hours for pharmacy assistants and other supporting staff, is available in the administrative dataset. Information about the working hours of (second) pharmacists is available in the employer survey. With this data, we distinguish between firms' share of part-time core employees, full-time core employees and other employees. We focus on the core workers, i.e. phar-

[9] In the Netherlands, most non-registered medicines are bought in firms other than pharmacies, such as commercial drugstores and supermarkets: Commercial drugstores and supermarkets have a market share of 85% for non-registered medicines (source:IMS Health, $http://www.hbd.nl/view.cfm?page_id = 4288$).

macy assistants[10], because of the homogeneity among them with respect to several characteristics. Pharmacy assistants all have the same educational background required by law (both in terms of level and field). Moreover, the population of pharmacy assistants is homogenous with respect to gender; 99% is women. We compute firms' part-time and full-time (core) employment shares in the following way: $pt_i = \frac{FTE_{i,pt}}{FTE_{i,total}}$ and $ft_i = \frac{FTE_{i,ft}}{FTE_{i,total}}$.[11]

The standard full-time working week in the pharmacy sector being 36 hours, we define part-time workers as the *pharmacy assistants* with less than 24 contractual working hours, i.e. less than three working days. This definition differs from the definitions of part-time work usually used in the literature on part-time employment. Although there is no generally agreed standard, definitions ranging from 30 to 35 hours a week are most common (e.g. Manning and Petrongolo 2008; Connolly and Gregory 2008). However, within our context our definition is well suited. The Netherlands is known for its large share of part-time employment. Moreover, the pharmacy sector almost exclusively employs female pharmacy assistants with less than full-time working hours. Within the Netherlands as a whole, around 50% of all working women work less than 24 hours. Within the pharmacy sector, 42%

[10]Osterman (1994, 2000) defines these core workers as the largest group of non-supervisory, non-managerial workers at the establishment of a firm who are directly involved in making the product or providing the service.

[11]In the same way, firms' share of other employees is constructed: $oe_i = \frac{FTE_{i,oe}}{FTE_{i,total}}$.

works less than 24 hours a week.[12] Figure 1 shows the distribution of working hours of all core workers within the sample. Whereas working less than two days (16 hours) is uncommon in the sector, working part-time is not. Actually, the largest group of core workers works between 16 and 24 hours per week. Working weeks of 24 to 32 hours and 32 to 36 hours per week are also quite common within the sector. 20% of all pharmacy assistants works exactly 36 hours per week (not shown in the figure). In Section 5.2 we check the robustness of our findings using other definitions of part-time employment, and by dividing the core workers in more employment shares.

[Figure 1 about here]

In Table 1 the average size of firms' employment shares is reported. The table shows that firms' part-time employment share is on average equal to 0.19. Firms' full-time employment share is equal to 0.50. This large difference between firms' part-time and full-time employment share is due to its measurement in FTEs. Together, the core workers account for almost 70% of firms' total employment.

[12]The difference in percentage of working part-time is due a larger percentage of Dutch women (compared to Dutch pharmacy assistants) working in jobs with less than 16 hours a week. Source: OSA-Labour Supply Panel 2006.

Apart from these core workers, pharmacies employ pharmacists and other supporting staff. Most important among the latter are assistants' supporting staff and student pharmacy assistants. Assistants' supporting staff help pharmacy assistants in their activities related to the production process. Student pharmacy assistant are involved in a dual track combining work and study.[13] As can be seen in Table 1, the other employees altogether account for 31% of firms' total employment.

Control variables. As firm productivity might also be influenced by worker, pharmacist and firm characteristics, as well as by external factors, we control for several confounders. As we have seen, we include the total number of firms' employees in FTEs to take into account deviations from constant returns to scale. On average, firms' total number of FTEs equals 9.7.[14]Related to worker characteristics, we include average age and tenure of the core workers. This information is available from the administrative dataset. Table 1 shows that within firms, assistants are on average 38 years old and have a firm tenure of slightly more than 8 years.[15] We include the pharmacist's

[13]Due to the involvement of all employment types in the primary production process, all employees in the sector are substitutes.

[14]The table reports the logarithmic form because we will use the log-form in the analyses as well.

[15]As the majority of assistants is female and career breaks are common, we include both age and tenure in the analyses. As the correlation between age and tenure is 35%, including both variables will not cause any problems in the estimations.

tenure to control for productivity differences due to employers. On average, pharmacists have a tenure of 15 years. The firm characteristics we include in our analyses are pharmacy type (independent or not), the number of operating hours, and variables related to possible inefficiencies in the allocation of labor in the firm: a dummy variable equal to one when employers report excess labor, and a variable measuring absenteeism due to sickness leave by the fraction of workers calling sick in the last calender year. These variables are constructed from the employer survey. Table 1 shows that 42% of the pharmacies is characterized as an independent firm. The rest cooperates with other pharmacies either in terms of chains or franchises, or they are part of legalized partnerships. On average, pharmacies are open for around 50 hours a week, while the standard full-time working week for pharmacy assistants equals 36 hours. 13% of the firms report excess labor. The average absentee rate is 4% in 2007. Finally, we account for two external factors that could affect productivity: the demand for medicines and the degree of competition. We measure the demand for medicines by the percentage of elderly (60+) living within the postal code area (4 digits) of the pharmacy. Table 1 shows that on average, the percentage of elderly within a postal code equals 22%.[16] The degree of competition is measured by the number of competitors within

[16]This data is acquired through the online statistical database of Statistics Netherlands (CBS Statline).

a radius of 5 km. Using postal codes, we calculate the distances between each pharmacies within the sample, and all other pharmacies located in the same region.[17] These distances are used to compute the number of competitors within a radius of 5 km. Table 1 shows that the number of competitors differs considerable across firms. Whereas on average, firms have around 10 competitors, some firms have no competitors. The pharmacy facing most competition has 77 competitors within a radius of 5 km.

5 Results

5.1 Part-time Employment and Firms' Productivity

Figure 2 provides a first impression on the relationship between firms' part-time employment share and productivity. In the figure, we control for the size of the pharmacy by showing firms' productivity per FTE.[18] The figure shows that firms' part-time employment share is positively related to the productivity per FTE. It turns out that the average productivity of the firms having the 25% lowest share of part-time employment equals 8.9 in natural

[17] We use a standard classification of regions in the Netherlands (COROP). The Netherlands counts 40 COROP regions. Every COROP region has a central point (city) with a surrounding service area.

[18] Taking firms' productivity per FTE as our dependent variable in the analyses does, by definition, not change any of the coefficients except for the coefficient of $ln(FTE)$, which in that case will equal δ-1.

logs, whereas the average productivity of the firms with the 25% largest share of part-time employment have an average productivity of 9.1 in logs. This means a productivity difference of 1,294 prescription lines per FTE within one year. The figure thereby shows some first evidence for a possible relationship between part-time employment and firm productivity.

[Figure 2 and Table 2 about here]

Table 2 shows the estimation results of an OLS regression on firm productivity. In the first column, only the scale effect and the two employment shares are taken into account. Even though the coefficient on firms' part-time and full-time employment shares are significantly different from zero, we cannot conclude from this whether the marginal productivity of the core workers is larger than the marginal productivity of the other employees. Neither can we argue about the magnitude of the relative productivity of part-time versus full-time workers. However, looking at the statistical difference between the two coefficients, we can conclude whether part-time workers are more productive than full-time workers. The difference $\phi_{pt} - \phi_{ft}$ equals 0.368 and is significant at 1%. This implies that firms with a large share of part-time em-

ployees are more productive than firms with low share of part-time employees or a large share of full-time employees.

Column (2) reports the regression results when including worker, pharmacist and firm characteristics. The main results remain the same. However, the productivity differential is slightly smaller when including control variables. The finding that firms with a large share of part-time employees are more productive than firms with a large share of full-time employees still holds at the 3% level. The analysis reported in Table 2 reveals a number of other interesting findings. It shows that firms with on average younger core workers are more productive than those with an older workforce. There are several possible explanations. A human capital argument could be that younger workers have more up-to-date knowledge (Grund and Westergård-Nielsen 2009). This can increase individual workers' productivity, and by spill-over effects it might also effect productivity of all employees. Another reason for this effect might be that younger workers are more motivated than older ones (Grund and Westergård-Nielsen 2009). Moreover, it could be related to the relatively large group of workers with career breaks (Mincer and Ofek 1982). The average firm tenure of assistants is positively related to firm productivity. This might be due to the accumulation of (firm-specific) human capital. The pharmacists' tenure does not

seem to matter for firms' productivity.[19] Whether or not firms are independent or part of a chain is also unrelated to average productivity. We also do not find a significant relationship between the number of opening hours per week and productivity per FTE. Moreover, only one of the variables related to inefficiency is statistically significant: firms with excess labor are, *ceteris paribus*, less productive. This is as expected since excess labor decrease the workload per employee and thereby affects average firm productivity.

In Column (3) a set of external factors is included. The table shows that both the percentage of inhabitants aged at least 60 as well as the number of competitors does not influence firms' productivity. This implies that firms are well aware of their potential market and their competitors within this market, and build upon this awareness in the composition of their labor force. The finding that firms with a large share of part-time employment are more productive than firms with a large share of full-time employment is unaffected by the inclusion of a measure of demand and the degree of competition.[20]

[19] Replacing the pharmacist's tenure in years by a dummy indicating whether or not the tenure is at least 2 (or 5) years leaves the results unchanged.

[20] We tried several alternatives for both the measure for demand and competition, such as the number of inhabitants within a postal code area, the number of competitors within a radius of 10 km and the degree of urbanization.

5.2 Robustness Checks

In this section we present a series of robustness checks that address two particularly important decisions we made in the estimation of Equations 6: the definition of part-time employment and the division of core workers into two groups.

5.2.1 The definition of Part-Time Employment

We replicate our analyses using different thresholds for part-time employment. The estimation was then replicated using definitions of part-time employment ranging from 16 to 33 hours per week. In Figure 3, the coefficients of firms' part-time and full-time employment shares are reported, as well as their confidence intervals.[21] The figure shows several interesting findings: when a part-time working week is defined as less than 16 hours per week, i.e. less than two days a week, the coefficients on firms' share of part-time and full-time core workers are not significantly different from each other. This is due to the large confidence interval of the coefficient on firms' part-time employment share, which in turn might be due to the small variation in this variable. On average firms' part-time employment share when defining part-time employment as a working week of less than 16 hours per

[21] Based on analyses comparable to the one reported in Table 2, column (3).

week equals 0.017% (with a standard deviation equal to 0.032). When defining part-time employment as a working week of less than h hours a week with $h = [16, ..., 20]$ the same line of reasoning holds: despite a larger coefficient on firms' share of part-time employees compared to firms' share of full-time employees, unprecise estimations unable significant difference between the coefficients of firms' part-time and full-time employment shares.

[Figure 3 about here]

Furthermore, the figure shows that when part-time work is defined as a working week of less than 21 hours a week, the coefficient on the part-time employment share is significantly higher than that on the full-time employment share. This also holds when part-time work is defined as a working week smaller than 22, 23, or 24 hours per week. Finally, defining part-time employment as a working week of less than h hours a week with $h = [25, ..., 33]$, the coefficients of firms' part-time and full-time employment shares are not significantly different, thereby suggesting that firms' productivity is independent from the relative size of its share of part-time and full-time workers. Altogether, Figure 3 shows that firms with a large part-time employment

share are more productive – or at least equally productive, depending on the definition used – than firms with a large full-time employment share.

5.2.2 More shares of core employees

We also check the robustness of our results by introducing four groups of core workers: small, medium and large part-time jobs and full-time jobs. We define the groups as follows: employees in small part-time jobs work less than 16 hours. Employees in medium sized part-time jobs work 16 hours or more, but less than 24 hours per week. The group of workers described as full-time workers in Section 4 is now split up in large part-time jobs and full-time jobs. Large part-time jobs are jobs of 24 hours or more per week, but less than 32 hours. Employees working 32 hours per week or more are defined as full-time workers. We computed the employment share for these different groups of core workers and use, as previously, other employees as the reference group. Except for including two extra shares of employees, the estimation strategy remains the same. Table 3 reports the results.

As before, we can only compare the relative productivity of the different employment shares of core employees. The table shows no significant coefficients on firms' small part-time employment share.[22] Firms' medium

[22] Again, this is probable due to the small value of this variable and its small standard deviation as explained in Section 5.2.1.

part-time employment share has the largest coefficient. Moreover, Table 3 shows that the coefficient on firms' large part-time employment share is not significant. Most important is the finding that firms' medium part-time employment share is significantly more productive than firms' full-time employment share (at 10% level).

[Table 3 about here]

Concluding, our robust analyses show that firms with a large part-time employment share are more productive – or at least equally productive, depending on the definition used – than firms with a large full-time employment share. Defining part-time employment as a working week less than 21, 22, 23 or 24 hours per week even implies that firm productivity is larger for firms with a large share of part-time employees compared to firms with a large share of full-time employees. This turns out to hold especially for firms' share of core employees working at least 16 and less than 24 hours per week.

6 The allocation efficiency of part-time employment

The finding that firms with a large share of part-time employees are more productive than firms with a large share of full-time employees contradicts the very few other papers which relate (a dummy to indicate) part-time employment to firm productivity. Whereas Arvanitis (2005) found a negative relationship between part-time employment and productivity, Pérotin and Robinsion (2002) did not find any significant effect. A possible explanation for our different result is that we focus on a sector of industry with a homogenous workforce, thereby making it possible to disentangle the effect of part-time employment from capital intensity and skill level effects.

So, how can we explain our finding that firms with a large share of part-time employment are more productive than firms with a large share of full-time employment? From a human capital perspective, there are no grounds to expect that part-time workers are more productive than full-time workers. Conversely, due to lower investments in human capital, part-time workers would be less productive than full-timers. Additional analyses on our

employee survey (see Section 4) show that there is no statistical difference in the training participation between both groups of core workers. [23]

Our finding that firms with a large share of part-time employment are more productive than firms with a large share of full-time employment, is very likely to be due to an allocation efficiency offered by part-time employment. If this is true, part-time workers don't have to be more productive than full-time workers in the hours they work, but the use of part-time work increases productivity at the firm level. Especially in service-sector firms, part-time employment might be used for example to bridge the gap between operating hours and contractual working hours. This is also observed in the data. On average, firms are open around 50 hours a week, whereas full-time working week counts 36 hours (see Table 1). A second argument for part-time employment to have beneficial allocation effects is related to fluctuations in customer demand during opening hours. Due to these fluctuations in customer demand, part-time employment enables firms to cushion peak hours by deploying more workers during peak hours than during opening hours with lower customer demand. In principle there is no need to know whether part-time workers are less, equally or even more productive in the hours they work. It is the possibility to deploy more workers during peak hours that

[23] In a probit analysis we controlled for workers' age and tenure, pharmacy type, number of operating hours, region, excess labor, sickness leave within pharmacy and pharmacy size.

makes firms more productive. Under the assumption that part-time and full-time workers are equally productive in the hours they work, we expect the probability of part-time and full-time workers to be scheduled during peak hours to be equal as well. During times of relatively low customer demand, full-time workers have a higher probability to be scheduled because they have to work more hours than the number of peak hours. [24]

As soon as employers have an idea about whether part-time or full-time workers are most productive, they will deploy those workers during peak hours. In the following, we attempt to figure out which type of workers work most during peak hours by means of a task-based approach. As soon as we know whether part-time or full-time workers have larger probabilities to work during peak hours, we might suggest whether part-time workers are less, equally or even more productive than full-time workers in the hours they work.

Within the employee survey, additional information on the tasks performed by 1,177 core workers was collected. We asked employees to report

[24]Under the alternative assumption that full-time workers are more productive than part-time workers, full-time workers have a larger probability to work during peak hours. During the opening hours with relatively low customer demand, they will work their remaining contractual working hours. Then, part-time workers will bridge the time gap between operating hours and the full-time working week. Under a third assumption that part-time workers are more productive than full-time workers in the hours they work, part-time workers will be deployed during peak hours, and full-time workers will mainly work during opening hours with relatively low customer demand. However, independent of which scenario holds, part-time employees always make it possible to cushion peak hours.

the percentage of working time spent on several tasks that we group into demand-related and overhead tasks. The first category consists of tasks for which customers need to be in the pharmacy, such as delivering prescriptions, pharmaceutical advising and selling medicines. A pharmacy assistant performs these tasks when the customer is waiting for his or her medicines. Examples of overhead tasks are administrative tasks, controlling the stock of drugs and management tasks. These tasks can also be performed when there are no customers around.

Table 4 reports Tobit analyses on workers' time spent on demand-related tasks. Whereas in column (1) we include a dummy for working less than 24 hours per week, in column (2) we include a continuous measure of the number of working hours per week.

[Table 4 about here]

The table shows that both part-time and full-time workers spend a large percentage of working time on demand-related tasks. Whereas full-time workers spend on average 77.5% of their working time on demand-related tasks, part-time workers spend on average 81% of their working time on these tasks. This shows that for both types of workers, demand-related tasks are very impor-

tant, which is as expected in service firms. Nevertheless, part-timers spend on average 3.5 percentage points of their working time more on demand-related tasks than full-time workers. In column (2) of Table 4, a continuous measure of assistants' working week replaces the part-time dummy and leads to a similar conclusion. Each additional working hour is associated with a reduction of the percentage of working time spent on demand related tasks by 0.21%-points. These findings suggest that part-time workers are at least equally likely to work during peak hours. This implies that part-time and full-time workers are similarly productive. Our main finding that part-time employment is beneficial for firm productivity is thereby most probably due to allocation benefits provided by part-time employees.

7 Conclusion

In this paper, we analyzed whether part-time employment is beneficial for firm productivity. We contribute to the literature by analyzing firm productivity with a new form of heterogenous labor: heterogeneity in firms' employment shares based on employees' working hours. Using a production function with quality-adjusted labor, we divide firms' workforce into part-time and full-time core workers and other employees. Our focus on a particular occupation within the Netherlands that almost exclusively em-

ploys women, justifies our part-time definition of working less than 24 hours a week. We find that firms with a large share of part-time employees are more productive than firms with a large share of full-time employees.

This finding turns out to be robust with respect to several variations in the definition of part-time employment: Defining part-time employment as a working week less than 21, 22, 23, or 24 hours per week implies that firms' part-time employment share is more productive than firms' full-time employment share. When defining part-time employment otherwise, firms' part-time share turns out to be as productive as firms' full-time employment share. When dividing firms' core workforce in more than two employment shares, it turns out that firm productivity is especially large for firms with a large share of medium part-time employees (working between 16 and 24 hours a week). Overall, we can state that firms with a large part-time employment share are more productive - or at least equally productive, depending on the definition used - than firms with a large full-time employment share.

We find that the higher productivity of firms with a larger part-time employment share is probably due to allocation efficiencies. First, we observe that operating hours exceed the full-time working week in the sector. Part-time employment can bring an efficient solution in this discrepancy. Second, we argue that part-time workers increase firms' flexibility to de-

ploy more workers during peak hours, without being forced to deploy more workers than needed during opening hours with lower customer demand. Part-time workers can cushion these peak hours independent on whether part-time or full-time workers are more productive in the hours they work. Additional analyses show that part-time workers spend a larger percentage of their working time on demand-related tasks than full-timers. This suggests that part-time and full-time workers are equally productive in the hours they work, but that the allocation efficiencies provided by part-time employees makes firms with part-time employees more productive than firms that employ more full-time employees.

To conclude, our finding that part-time employment is beneficial for firm productivity can be generalized to all service-sector firms because in all service sectors firms face operating hours that exceed contractual working hours, as well as fluctuations in customer demand during the week. Part-time jobs enables firms to adjust the actual working hours to expected customer demand, which increases firm productivity. Therefore, even in the absence of equal human capital investments, we expect part-time work to be beneficial in other service-sector firms. This might also explain why countries as the Netherlands in which a relatively large share of the workforce works part-time, achieve a high labor productivity.

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Table 1: Sample Statistics of dependent and explanatory variables

	Mean	Std. Dev.	Min	Max
Dependent variable				
Number of prescription lines (ln)	11.21	0.35	8.89	11.98
Explanatory variables				
Firms' part-time employment share (in FTEs) *	0.19	0.11	0	0.51
Firms' full-time employment share (in FTEs) *	0.50	0.15	0.08	1
Control variables				
Firms' total number of FTEs (ln)	2.21	0.39	0.73	3.10
Assistants average age in years	38.08	4.42	22.50	50
Assistants average firm tenure in years	8.27	3.15	0.81	17.93
Pharmacist's tenure in years	15.84	8.56	0	39
Independent pharmacy (yes/no)	0.42	0.49	0	1
Number of operating hours per week	49.97	12.52	6	168
Excess labor (yes/no)	0.13	0.33	0	1
Absentee ratio	0.04	0.04	0	0.30
Percentage of elderly within postal code area	0.22	0.07	0	0.60
Number of competitors within a radius of 5 km	9.88	12.52	0	77

Note: * concerns pharmacy assistants only
Sample statistics are based on the final sample (224 pharmacies)

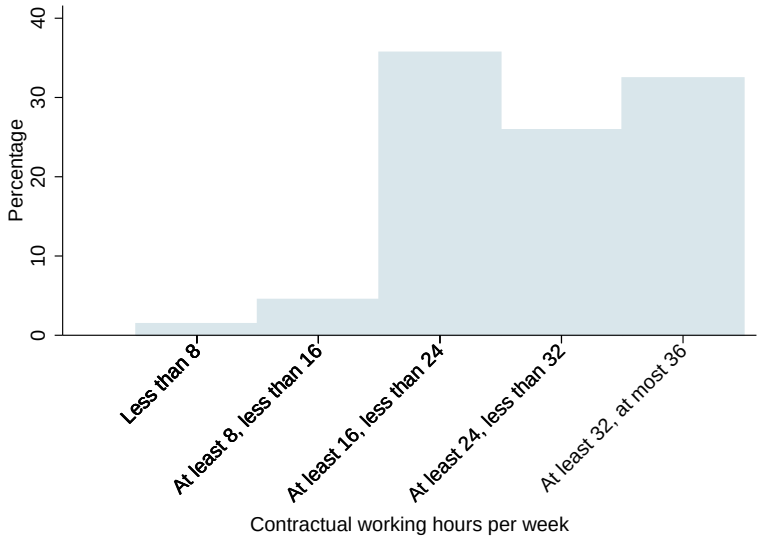

Figure 1: Distribution of Working Hours

Figure 2: Relationship between Part-Time Employment and Productivity

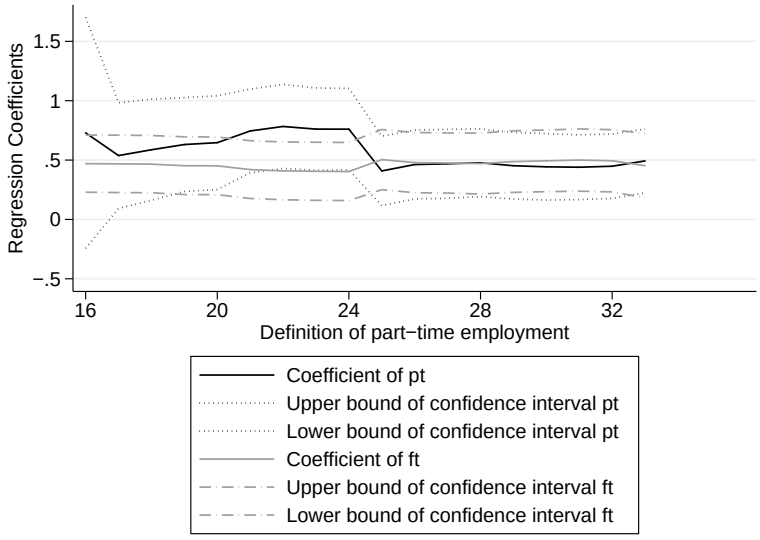

Figure 3: Effect of Part-Time Employment on Firm Productivity using different Definitions of Part-Time Employment

Notes: Figure reports coefficients of Equation 6 including additional control variables.

Table 2: Estimation Results of OLS regression on Firm Productivity

Dep. Variable: Productivity per FTE (logs)	(1)	(2)	(3)
Total amount of labour in FTEs (logs)	0.728***	0.724***	0.729***
	(0.038)	(0.040)	(0.041)
Firms' employment shares (other employees are reference group)			
Firms' part-time employment share in FTEs	0.806***	0.732***	0.760***
	(0.159)	(0.166)	(0.175)
Firms' full-time employment share in FTEs	0.437***	0.407***	0.402***
	(0.123)	(0.124)	(0.125)
Worker characteristics			
Assistants' average age in years		-0.008**	-0.008**
		(0.004)	(0.004)
Assistants' average firm tenure in years		0.015***	0.015***
		(0.005)	(0.006)
Pharmacy characteristics			
Pharmacist's tenure in years		0.000	-0.000
		(0.002)	(0.002)
Firm characteristics			
Independent pharmacy (yes/no)		-0.034	-0.034
		(0.030)	(0.030)
Number of operating hours per week		-0.001	-0.001
		(0.001)	(0.001)
Excess labor (yes/no)		-0.101**	-0.103**
		(0.045)	(0.046)
Sickness leave within firm (fraction)		0.011	-0.008
		(0.398)	(0.401)
Region dummies	yes	yes	yes
External factors			
Percentage of elderly (60plus) in postal code area			0.047
			(0.212)
Number of competitors within a radius of 5 km			0.001
			(0.001)
Constant	9.231***	9.496***	9.466***
	(0.131)	(0.195)	(0.205)
Adjusted-R-squared	0.623	0.642	0.639
N	224	224	224
Wald Tests: PT share = FT share	7.50	5.07	5.20
Prob ¿ F=	0.0067	0.0254	0.0236

Notes: Standard errors in parentheses; * p<0.1; ** p<0.05; *** p<0.01
Model: OLS

Table 3: Estimation Results of different shares of Part-Time Employment on Firm Productivity

Dep. Variable: Productivity per FTE (ln)		
Total amount of labour in FTEs (ln)		-0.278***
		(0.042)
Firms' small part-time employment share in FTEs		0.764
		(0.489)
Firms' medium part-time employment share in FTEs		0.763***
		(0.179)
Firms' large part-time employment share in FTEs		0.236
		(0.155)
Firms' full-time employment share in FTEs		0.482***
		(0.132)
Adjusted-R-squared		0.333
N		224
Wald Test:	F(1, 204)	Prob > F
Medium PT share =FT share	2.79	0.0967

Notes: Standard errors in parentheses;
* p<0.1; ** p<0.05; *** p<0.01
Same controls are included as in Table 2, column 3.
Model: OLS

Table 4: Job Content of Part-Time and Full-Time Workers

Dep. Variable: % of working time spent on demand related tasks	(1)	(2)
Part-time worker	3.545***	
	(0.860)	
Contractual working hours per week		-0.207***
		(0.051)
Constant	77.546***	85.017***
	(3.359)	(3.718)
Controls	yes	yes
Pseudo-R-squared	0.0126	0.0124
N	1177	1177
Uncensored N	1104	1104
Censored N	73	73

Notes: Standard errors in parentheses * p<0.1; ** p<0.05; *** p<0.01
Model: Tobit (right censored at 100)
Included controls: workers' age, workers' tenure, independent pharmacy, operating hours, employee surplus, sickness leave, pharmacy size, specialization and region dummies.