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Fixed-term contracts and firm productivity: Do workers' skills and firm conversion rates from fixed-term to permanent contracts matter?

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Abstract

Purpose – We aim to elucidate the relationship between fixed-term employment and firm productivity by examining workers' skills and considering how firm-level conversion rates influence this relationship.

Design/methodology/approach – We use longitudinal employer-employee data between 2011 and 2017 in the Netherlands to estimate a nonlinear regression derived from a production function proposed by Addessi (2014) and Castellani *et al.* (2020).

Findings – The contribution of fixed-term contracts to firm-level productivity is less than that of permanent contracts. However, this contribution is greater when firms exhibit a high conversion rate from fixed-term to permanent positions. The effect of the conversion rate is more substantial for high-skilled fixed-term workers than for low-skilled ones.

Originality/value – Our results suggest the extent to which firms benefit from fixed-term contracts when these are used for screening high-skilled workers for permanent employment.

Keywords Productivity, Firm-level TFP, Labour contracts, Screening, Conversion rate, Worker skills, Panel data

Paper type Research paper

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1. Introduction

In recent decades, many European countries have experienced a rise in fixed-term contracts. This trend and its potential impacts on firms and workers have drawn considerable interest from policymakers and researchers. Some argue that the use of fixed-term contracts offers firms the needed flexibility to adjust their workforce to market changes, allowing them to respond quickly to technological changes and new opportunities offered by the market (e.g. Atkinson, 1984; Kalleberg, 2001). Nevertheless, the use of fixed-term contracts can lead to some disadvantages. For example, fixed-term contracts are associated with low job security, low pay and low job quality, resulting in low labour commitment (Booth *et al.*, 2002; Millward and Hopkins, 1998), which in turn may decrease firm performance.

The empirical literature on fixed-term contracts and their impact on firm performance provides mixed evidence. Some report a positive relationship (e.g. Arvanitis, 2005; Garnero *et al.*, 2016), while others show a negative one (e.g. Cappellari *et al.*, 2012; Michie and Sheehan, 2003). However, none of the aforementioned studies appears to consider firms' strategies for employing fixed-term workers. In this paper, we argue that the impact of fixed-term contracts on firm performance crucially depends on the firm's strategies for using these contracts. Specifically, firms may use such contracts as a buffer against demand fluctuations (Devicienti *et al.*, 2018), or as a screening device to select workers who will be the best fit for the firm (Booth *et al.*, 2002) [1]. Whereas the former allows firms to adjust their labour force to economic shocks in the short run (Vella, 2018; Vela-Jiménez *et al.*, 2014), the latter may increase firms' long-term growth prospects because of better job matches (Faccini, 2014).

Firms' use of fixed-term contracts, either to buffer demand fluctuations or to screen workers, may depend on the expected short-term and long-term (net) benefits of using these contracts. If firms have no difficulty observing workers' quality or monitoring workers' efforts, and if the work requires no relation-specific investments, the potential negative impact of using fixed-term contracts to avoid labour hoarding will be negligible. This is more likely for low-skilled work than for high-skilled work: First, the work of low-skilled workers is better observable and hence, it is more easily monitored than the work of high-skilled workers (e.g. Parker *et al.* (2017)). Second, low-skilled work is likely to demand less investment in additional (firm-specific) training, compared with the high-skilled one (Becker, 1975).

Previous research has documented a strong relationship between firms' screening strategies and firm-level conversion rates from fixed-term to permanent contracts. Firms with screening strategies are likely to use fixed-term contracts to assess workers' quality and offer these workers permanent contracts upon confirmation of the worker's quality (Mattijssen *et al.*, 2022). Accordingly, firms which use fixed-term contracts as a screening tool are likely to have higher conversion rates than firms that use these contracts to flexibly adjust their employment to economic fluctuations (Masui, 2020). Our research examines the influence of firm conversion rates from fixed-term to permanent contracts, used as a proxy for screening strategies, on the relationship between fixed-term employment and firm productivity. By considering both firm conversion rates and workers' skills, we contribute to the literature on the impact of fixed-term employment on firm productivity through analysing how much productivity differences between high- and low-skilled fixed-term workers are driven by the conversion rate from fixed-term to permanent contracts.

The Netherlands is one of the European countries with a rapid rise in fixed-term contracts over time (Eurostat, 2021). Furthermore, the increased use of fixed-term contracts in the Netherlands is observed not only for low-skilled workers but also for high-skilled ones, making it a compelling country to study fixed-term employment. We conduct our research by utilising a rich longitudinal employer-employee dataset from Statistics Netherlands that includes 66,432 Dutch enterprises in private sectors between 2011 and 2017. We follow the empirical approach of Addessi (2014) and Castellani *et al.* (2020) that captures the dynamic efficiency of labour markets.

Our findings show that the contribution of fixed-term contracts to firm productivity is less than that of permanent contracts. However, this contribution increases when firms show a high conversion rate from fixed-term to permanent positions. Notably, the effect of the conversion rate is more substantial for high-skilled fixed-term workers than for low-skilled ones. Our results suggest that firms benefit more from fixed-term contracts when they use such contracts to screen high-skilled workers for permanent employment. We checked the robustness of our results by using firms' shares of long fixed-term contracts as an alternative specification for firm screening strategies and obtained similar findings. However, firm conversion rates may be endogenous due to reverse causality, i.e. highly productive firms tend to convert fixed-term to permanent contracts, or unobserved factors influencing both firm productivity and firms' motives to offer fixed-term workers permanent contracts. To examine how much the endogeneity of firm conversion rates may affect our results, we perform several supplementary analyses. First, we control for firm characteristics that are likely to affect the firm's hiring and selection of workers. Second, we replace the firm conversion rates with sectoral rates of temporary contracts with the prospect of permanent employment. Third, we replicate our analyses on a sample that matches high-conversion-rate firms with low-conversion-rate ones based on relatively similar characteristics. The results of our supplementary analyses align with those obtained from the main analyses.

We proceed as follows. In Section 2, we review the literature on fixed-term contracts, screening strategies and firm performance. We then present our empirical estimation in Section 3 and report the main results and supplementary analyses in Sections 4 and 5. Finally, we discuss our findings, the limitations of our research and directions for future research in Section 6.

2. Literature review

2.1 Fixed-term contracts and firm performance

The theoretical literature presents arguments for both positive and negative effects of fixed-term contracts on firm performance. On the one hand, it is argued that these contracts bring the benefits of labour flexibility and cost savings to firms (Abraham and Taylor, 1996; Matusik and Charles, 1998). Specifically, by lowering recruitment and dismissal costs (Blanchard and Landier, 2002), fixed-term contracts may reduce labour hoarding and improve firm productivity (Vella, 2018; Portugal and Varejão, 2009). These contracts enable firms to adapt their workforce in response to unexpected fluctuations in demand or production (Devicienti *et al.*, 2018; Hagen, 2003).

On the other hand, neither the firm nor the worker is likely to invest in firm-specific training if the employment is expected to be short-duration. After all, neither party will be able to recover the benefits of such an investment if that relationship ends. The resulting gap in firm-specific knowledge and skills may negatively impact firm performance. This might be especially the case for high-skilled work as it requires more firm-specific knowledge (Becker, 1975; Fouarge *et al.*, 2012).

Furthermore, fixed-term workers who have no prospect of a renewal or extension of their employment contract might have little job motivation and little commitment to the organisation which may negatively influence productivity (Engellandt and Riphahn, 2005). Again, this may be more detrimental to high-skilled workers than to low-skilled ones, as the tasks of low-skilled workers are more observable and easier to monitor than the complex tasks performed by their high-skilled counterparts (Parker *et al.*, 2017). There might also be an adverse spillover effect on permanent workers as the use of fixed-term contracts might curtail the stability in the work environment (Battisti and Vallanti, 2013), which may lead to indirect unfavourable influences on firm productivity.

Altogether, the theoretical literature does not provide conclusive predictions about the effect of fixed-term contracts on firm productivity. Regarding empirical research, evidence on the relationship between fixed-term employment and firm performance is also inconsistent. Some studies show that fixed-term contracts can improve firms' productivity, profits and product innovation (Garnero *et al.*, 2016; Arvanitis, 2005). In contrast, Michie and Sheehan (2003) find evidence for a negative effect of fixed-term contracts on firms' process innovation and the probability of innovating. Other studies find a non-linear relationship (i.e. inverted U-shape) between fixed-term work and firm performance (e.g. De Stefano *et al.*, 2019; Altuzarra and Serrano, 2010). These papers reveal that whether a firm can reap the benefits of fixed-term employment may depend on its firm-specific context.

Another strand of the empirical literature discusses the relative productivity differential between fixed-term and permanent contracts in firms' production function (Addessi, 2014; Aguirregabiria and Alonso-Borrego, 2014; Caggese and Cuñat, 2008; Castellani *et al.*, 2020). Several main findings are drawn from these studies: First, different types of labour contracts generate static and/or dynamic differences in labour productivity; second, fixed-term workers are relatively less productive than permanent workers; and third, fixed-term contracts may increase the employment level but at the expense of lowering firm productivity.

2.2 Screening strategy and the conversion from fixed-term to permanent contracts

Whether these potential positive or negative effects of using fixed-term contracts materialise is likely to depend on the firm's strategies for employing workers on such contracts. Specifically, firms may use fixed-term contracts to deal with changes in economic conditions (Devicienti *et al.*, 2018; Hagen, 2003), or to screen out employees with undesirable characteristics and select those that most fit into the firms (e.g. Boockmann and Hagen (2008)). Whereas the former might trap fixed-term workers in low-paid jobs or unemployment, the latter provides these workers with better internal career opportunities (Booth *et al.*, 2002; Mattijssen *et al.*, 2020). Thus, if firms use fixed-term contracts to screen workers for permanent employment, the potential negative effects due to a lack of training investment and low job motivation might not hold. Employing fixed-term workers with screening strategies not only improves the job match of future permanent workers by allowing firms to learn about the worker's quality (Faccini, 2014), but it also incentivises fixed-term workers to put more effort into work to obtain permanent contracts (Engellandt and Riphahn, 2005).

Research indicates that the expectation of gaining a permanent contract encourages fixed-term workers to invest in on-the-job learning more intensively and work harder than their counterparts in permanent employment (Engellandt and Riphahn, 2005; Ferreira Sequeda *et al.*, 2018). Furthermore, both the firm and the worker will be more willing to invest in firm-specific knowledge if the employment relationship is expected to become permanent (Fouarge *et al.*, 2012). As a result, firms with screening strategies are inclined to use fixed-term contracts to gauge workers' abilities and offer permanent contracts if the workers prove their quality (Mattijssen *et al.*, 2022). Therefore, firms which use fixed-term contracts as a screening tool tend to have higher conversion rates than firms that use these contracts to adapt their workforce to economic fluctuations (Masui, 2020). Dolado *et al.* (2016) suggest that an increase in the conversion rates may boost firm productivity through facilitating fixed-term workers' efforts at work and encouraging firms to invest more in training these workers.

Overall, our research builds on the empirical work of Addessi (2014) and Castellani *et al.* (2020). Castellani *et al.* (2020) suggest that the lower productivity of fixed-term contracts, compared with permanent contracts, might stem from fixed-term employment often being dead-end jobs aimed at cost-reduction rather than screening purposes, nonetheless, they were unable to test this. Therefore, our research complements the work of Castellani *et al.* (2020) by examining the impact of firm conversion rates from fixed-term to permanent

contracts, used as a proxy for screening strategies, on fixed-term workers' contribution to firm productivity. Furthermore, we add to the research of Dolado *et al.* (2016), which proposes that worker effort is a mechanism through which conversion rates may affect productivity, by incorporating a critical factor: workers' skills. Since skills are an important determinant of employee performance (e.g. Nollen and Gaertner (1991)), we examine the role of worker skills in relation to screening and productivity. Our study contributes to the empirical literature on the relationship between fixed-term employment and firm productivity (e.g. Addessi, 2014; Aguirregabiria and Alonso-Borrego, 2014; Caggese and Cuñat, 2008; Castellani *et al.*, 2020) by investigating this relationship through a nuanced analysis of both firm conversion rates as a proxy for screening and worker skills.

3. Empirical estimation

3.1 Models

To estimate the effect of fixed-term versus permanent contracts on firm productivity, we estimate a regression derived from a production function proposed by Addessi (2014) and Castellani *et al.* (2020). This function adopts the estimation procedure from Ackerberg *et al.* (2015) (hereafter ACF) with the insight that optimal input choices hold information about unobserved productivity.

Labour L_{it} is defined as:

$$L_{it} = P_{it} + sF_{it}, with\, s > 0 \tag{1}$$

with $t = 1, \ldots, T$ indicating periods, and $i = 1, \ldots, N$ indicating firms. P_{it} is the number of permanent contracts and F_{it} represents the number of fixed-term contracts. The elasticity of productivity with respect to permanent contracts is normalised to one, hence s shows the elasticity of productivity with respect to fixed-term contracts compared to that of permanent contracts [2]. If $s < 1$, the elasticity of productivity with respect to fixed-term contracts is smaller than that of permanent contracts.

We consider the following log-linear production function:

$$y_{it} = \omega_{it} + \beta_K k_{it} + \beta_L \ln(P_{it} + sF_{it}) + \eta_{it} \tag{2}$$

where y_{it} and k_{it} are log transformations of value-added (Y_{it}) and capital (K_{it}) respectively, β_K and β_L are the output elasticities with respect to capital and labour, η_{it} is an idiosyncratic error term. It is assumed that Total Factor Productivity (ω_{it}) follows an endogenous first-order Markov chain process where a firm's labour contract composition is lagged with one period to affect future productivity.

Following Castellani *et al.* (2020), the production function is estimated using a three-step procedure as follows.

In the first stage, we define $\varnothing_{it}$:

$$\varnothing_{it} = \omega_{it} + \beta_K k_{it} + \beta_L \ln(P_{it} + sF_{it}) \tag{3}$$

Then we apply the correction of ACF's method for the functional dependence problems of the estimated input coefficients with the Levinsohn–Petrin approach (Levinsohn and Petrin, 2003) which uses intermediate inputs to estimate the production function [3]. Accordingly, demand for intermediate inputs (m_{it}) is assumed to be strictly monotonic in productivity (ω_{it}) conditional on the included variables:

$$m_{it} = f(\omega_{it}, x_{it}, p_{it}, k_{it}) \tag{4}$$

where x_{it} and p_{it} are log transformations of X_{it} (the share of permanent contracts in total contracts) and P_{it} (the number of permanent contracts), respectively. Since *f(.)* is monotonic, we define productivity as a function of observables: $\omega_{it} = f^{-1}(m_{it}, x_{it}, p_{it}, k_{it})$

We rewrite Equation (3) as:

$$\varnothing_{it} = f^{-1}(m_{it}, x_{it}, p_{it}, k_{it}) + \beta_K k_{it} + \beta_L \ln(P_{it} + sF_{it}) = \varnothing_{it}(m_{it}, x_{it}, p_{it}, k_{it}) \tag{5}$$

Substituting (5) into (2), the production function becomes:

$$y_{it} = \varnothing_{it}(m_{it}, x_{it}, p_{it}, k_{it}) + \eta_{it} \tag{6}$$

We run a non-parametric regression of y_{it} on $\varnothing_{it}(.)$ and estimate $\varnothing_{it}(.) = y_{it} - \eta_{it}$.

In the second stage, we estimate the probability of survival to control for the selection bias by using a probit model of a survival dummy on $m_{i,t-1}, x_{i,t-1}, p_{i,t-1}, k_{i,t-1}$ and denote the predicted probabilities from this step as $\widehat{Pr}_{it}$, following Castellani *et al.* (2020).

In the third stage, we estimate input coefficients. Because $\omega_{it} = E(\omega_{it}|\Omega_{i,t-1}) + \varepsilon_{it} = E(\omega_{it}|\omega_{i,t-1}, X_{i,t-1}) + \varepsilon_{it} = g(\omega_{i,t-1}) + \gamma X_{i,t-1} + \varepsilon_{it}$, where $\varepsilon_{it} = \sim N(0, \sigma_\varepsilon^2)$, we estimate the firm's Total Factor Productivity (TFP) on its lagged value and the lagged value of labour contract composition using a nonlinear least squares regression.

Our basic model is:

$$\begin{aligned}\widehat{\varnothing}_{it} = {} & \beta_K k_{it} + \beta_L \ln(P_{it} + sF_{it}) + g(\widehat{\varnothing}_{i,t-1} - \beta_K k_{i,t-1} - \beta_L \ln(P_{i,t-1} + sF_{i,t-1}), \widehat{Pr}_{it}) \\ & + \gamma X_{i,t-1} + \varepsilon_{it}\end{aligned} \tag{7}$$

where *g(.)* is a non-linear function of the fourth order connecting firm TFP to its previous value; γ represents the impact of the lagged share of permanent contracts in total contracts ($X_{i,t-1}$) on productivity dynamics and $X_{i,t-1}$ is instrumented with its lag; and $\varepsilon_{it} = \sim N(0, \sigma_\varepsilon^2)$.

Next, to investigate the role of worker skills, following Castellani *et al.* (2020), we divide fixed-term and permanent workers into high-skilled and low-skilled:

$$L_{it} = P_{it}^{HS} + s^{P,LS} P_{it}^{LS} + s^{F,HS} F_{it}^{HS} + s^{F,LS} F_{it}^{LS}, \text{with } s^{P,LS} > 0, s^{F,HS} > 0, s^{F,LS} > 0 \tag{8}$$

where the elasticity of productivity with respect to high-skilled permanent workers (P_{it}^{HS}) is normalised to one. $s^{P,LS}$, $s^{F,HS}$, $s^{F,LS}$ are the elasticity of productivity with respect to low-skilled permanent workers (P_{it}^{LS}), high-skilled fixed-term workers (F_{it}^{HS}) and low-skilled fixed-term workers (F_{it}^{LS}), respectively, compared with that of high-skilled permanent workers.

Following the same steps as in the basic model, we estimate TFP in **a model with skill composition**:

$$\begin{aligned}\widehat{\varnothing}_{it} = {} & \beta_K k_{it} + \beta_L \ln\left(P_{it}^{HS} + s^{P,LS} P_{it}^{LS} + s^{F,HS} F_{it}^{HS} + s^{F,LS} F_{it}^{LS}\right) \\ & + g\left(\widehat{\varnothing}_{i,t-1} - \beta_K k_{i,t-1} - \beta_L \ln\left(P_{i,t-1}^{HS} + s^{P,LS} P_{i,t-1}^{LS} + s^{F,HS} F_{i,t-1}^{HS} + s^{F,LS} F_{i,t-1}^{LS}\right), \widehat{Pr}_{it}\right) \\ & + \gamma^{P,HS} X_{i,t-1}^{P,HS} + \gamma^{P,LS} X_{i,t-1}^{P,LS} + \varepsilon_{it}\end{aligned} \tag{9}$$

where $\gamma^{P,HS}$ represents the impact of the lagged share of high-skilled permanent workers in all high-skilled workers ($X_{i,t-1}^{P,HS}$) on productivity dynamics, and $\gamma^{P,LS}$ represents the impact of

the lagged share of low-skilled permanent workers in all low-skilled workers ($X_{i,t-1}^{P,LS}$) on productivity dynamics.

3.2 Data and variables

We use longitudinal employer-employee data between 2011 and 2017 from Statistics Netherlands. Specifically, data on workers are from the Registration on Wages and Taxes ("Polisadministratie"), which is a part of the System of Social Statistical Datasets from Statistics Netherlands. These datasets offer longitudinal information on individual jobs across firms, including start and end dates, types of contracts and wages. By aggregating employee information into firm-level information, we obtain yearly information on the firm's workforce composition. Next, we use firm-level data on value-added (Y), nominal sales, the book value of tangible assets (as a proxy for capital K), intermediate inputs (M), number of employees (L), depreciation of tangible assets and the sector in which a firm operates its business activities in the Netherlands [4]. Intermediate consumption (M) is measured by the difference between a firm's nominal sales and its value-added. Investments are calculated as the difference between the current and lagged values of capital after deducting depreciation in capital. We convert nominal values into inflation-adjusted values for output, intermediate inputs and capital using 2-digit industry Producer Price Index deflators from the National Accounts Statistics for the Netherlands supplied by Statistic Netherlands.

Our data include all manufacturing and service enterprises in the private sector [5]. We distinguish between fixed-term and permanent workers by whether their contract is fixed-term or open-ended. The yearly conversion rate in a firm is measured by the share of fixed-term contracts converted to permanent contracts in all fixed-term contracts of the firm each year. If a firm's conversion rate in a given year is greater than the median rate of firms active in the same sector, we classify the firm as having a high conversion rate. Since we do not have information on the educational level of all workers, we use individual basic hourly wages as a proxy for workers' skill levels. If a worker's wage falls within the 75th percentile of the wage distribution for their age cohort (<30 years, 31–40 years, 41–50 years, >50 years), within the same sector in the same year, the worker is considered highly skilled (e.g. Laursen *et al.* (2020)) [6].

Next, following Castellani *et al.* (2020), we excluded observations in the top and bottom 1% of value-added and those that show more than 400% growth from one year to another in total labour. We also exclude firms that have less than 10 employees. We count all workers who are present in a firm's wage bills during a calendar year, including those who have worked for the whole year and those whose jobs started or ended within that year. Table 1 shows that, on average, a firm has 46 workers [7] with 20 of them having fixed-term contracts. Regarding high-skilled labour, a firm has, on average, 5 high-skilled permanent workers and 2 high-skilled fixed-term workers. The average firm conversion rate from fixed-term to permanent contracts is 36.3%.

4. Results

Table 2 illustrates the results of the estimation of the basic model [8]. In model A (for the whole sample), s is 0.387 ($p < 0.01$), showing that the elasticity of productivity with respect to fixed-term contracts is significantly lower than that of permanent contracts. This reveals a lower contribution of fixed-term workers to firm productivity, compared with their permanent counterparts. This result is consistent with the empirical findings from Aguirregabiria and Alonso-Borrego (2014), Addessi (2014) and Castellani *et al.* (2020).

To examine the effect of screening, we split firms into two groups according to their conversion rates (models B&C, Table 2). Models B&C indicate that when the firm conversion rate is high, the elasticity of productivity with respect to fixed-term contracts is more substantial than when it is low (0.455 > 0.336). These results uncover the important effect of screening on the linkage between fixed-term contracts and firm productivity. Particularly, fixed-term workers contribute more to firm productivity when the firm has a high (rather low) conversion rate. In Table 2, γ is significantly positive in models A and C, but significantly negative in model B. This indicates that the lagged share of permanent workers positively impacts firm productivity, but this effect turns negative when a firm's conversion rate is high, suggesting a potential adverse influence of screening on incumbent permanent workers. One possible explanation is that when fixed-term workers have more opportunities to transition to permanent status, permanent workers might perceive a rise in internal competition for jobs (Broschak and Davis-Blake, 2006). This may result in an unstable work environment which undermines permanent workers' motivation and effort at work (Battisti and Vallanti, 2013). Additionally, permanent workers who transitioned from fixed-term positions are likely to experience higher workloads during their first year after the transition (Mauno *et al.*, 2012), potentially reducing their productivity contribution.

To examine the role of workers' skills, we turn to Table 3. We find that the elasticity of productivity with respect to high-skilled fixed-term workers ($s^{F,HS}$) is higher than that of low-

Variables	Mean	Std. Dev
1. Value added (in logarithm)	13.599	1.206
2. Capital (in logarithm)	12.198	2.568
3. Total workers	46.476	166.352
4. Workers with permanent contracts	25.834	88.021
a. Low-skilled permanent workers	20.324	64.139
b. High-skilled permanent workers	5.510	32.397
5. Workers with fixed-term contracts	20.641	111.533
a. Low-skilled fixed-term workers	17.991	98.394
b. High-skilled fixed-term workers	2.650	23.886
6. Firm conversion rate from fixed term to permanent contracts	0.363	0.439

Source(s): Authors' own work

Table 1. Summary statistics (firm-year observations = 180,560)

	All firms	Conversion rate	
	(A)	High (B)	Low (C)
(1) β_K	0.208***	0.218***	0.201***
	(0.004)	(0.007)	(0.005)
(2) β_L	0.558***	0.581***	0.547***
	(0.014)	(0.018)	(0.020)
(3) s	0.387***	0.455***	0.336***
	(0.012)	(0.017)	(0.016)
(4) γ	0.016***	−0.024***	0.040***
	(0.005)	(0.008)	(0.006)
Observations	180,560	77,594	102,966

Note(s): Estimations of the basic model. Robust standard errors in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01

Source(s): Authors' own work

Table 2. Firm productivity and fixed-term contracts

		All firms	Firm conversion rate	
			High	Low
		(A)	(B)	(C)
(1)	β_K	0.211***	0.223***	0.203***
		(0.004)	(0.007)	(0.005)
(2)	β_L	0.498***	0.502***	0.500***
		(0.013)	(0.017)	(0.019)
(3)	$s^{P,LS}$	0.248***	0.224***	0.281***
		(0.007)	(0.009)	(0.012)
(4)	$s^{F,HS}$	0.235***	0.266***	0.226***
		(0.013)	(0.021)	(0.017)
(5)	$s^{F,LS}$	0.126***	0.133***	0.123***
		(0.006)	(0.008)	(0.008)
(6)	$\gamma^{P,HS}$	0.042***	0.046***	0.035***
		(0.005)	(0.007)	(0.006)
(7)	$\gamma^{P,LS}$	−0.015***	−0.059***	0.012*
		(0.005)	(0.008)	(0.007)
Observation		180,560	77,594	102,966

Note(s): Estimations of the skill model. Robust standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$
Source(s): Authors' own work

Table 3.
Firm productivity and fixed-term contracts differentiating by worker skill levels

skilled fixed-term workers ($s^{F,LS}$) across all models in Table 3, indicating a greater contribution to firm productivity of high-skilled fixed-term workers compared to their low-skilled counterparts. To investigate the screening effect, we compare the elasticity of productivity with respect to fixed-term workers by skill level between the high- and low-conversion-rate firms (models B&C, Table 3). The results show that both high- and low-skilled fixed-term workers contribute more to firm productivity when the firm conversion rate is higher. However, the screening effect is larger for high-skilled fixed-term workers than for those with low skills. Specifically, high-skilled fixed-term workers' productivity increases by 17,7% (from 0.226 to 0.266) when the firm conversion rate is high, while such an increase in low-skilled fixed-term workers' productivity is only 8,1% (from 0.123 to 0.133).

Turning to the past employment of permanent workers in Table 3, while the lagged share of low-skilled permanent workers ($\gamma^{P,LS}$) shows a significantly negative effect on productivity growth in the whole sample (model A) and in the sample of firms with high conversion rates (model B), the lagged share of high-skilled ones ($\gamma^{P,HS}$) significantly and positively impacts productivity dynamics across models. This suggests that while screening may not affect the positive contribution of existing high-skilled permanent workers to firm productivity, it could reduce low-skilled permanent workers' productivity. This finding aligns with Broschak and Davis-Blake (2006) who suggest that the negative influence of increased internal competition resulting from allowing more fixed-term workers to convert to permanent contracts tends to be stronger for permanent workers in low-level jobs, rather than in high-level jobs.

5. Supplementary analyses

5.1 Alternative specification of screening

We check the robustness of our main analysis with an alternative specification of firms' screening strategies. Because firms' screening strategies aim to select workers who are the best fit for the firm, we argue that the conversion from fixed-term into permanent contracts

should be based on the process in which the firm can observe fixed-term workers' productivity. During this process, the firm-worker relation and labour commitments are strengthened, allowing fixed-term workers to accumulate more firm-specific knowledge, as well as enabling firms to learn about fixed-term workers' abilities (e.g. Wang and Weiss, 1998; Faccini, 2014). As a result, firms that employ fixed-term workers with the screening strategies mostly offer longer duration contracts (e.g. >1 year) because more time is needed to get information about workers' capabilities. For example, Gagliarducci (2005) shows that the probability of converting from fixed-term to permanent jobs increases with the duration of the contract. On the contrary, firms that employ fixed-term workers with workforce flexibility or cost reduction motives mainly offer short-duration contracts (Mattijssen *et al.*, 2022). Therefore, firms following screening strategies are likely to have a higher conversion rate and a higher share of long-duration contracts (Mattijssen *et al.*, 2022). Thus, we use a firm's share of fixed-term workers with a long labour relationship (>1 year) as an alternative proxy for screening. We found results consistent with those obtained by using the firm conversion rate (see Table 4). Our findings not only support the link between employment duration and firm productivity (Gagliardi *et al.*, 2023), but also align with the argument that a longer labour relation is associated with more organisational commitments and more effort at work (Gächter and Falk, 2002), resulting in more opportunities to switch from fixed-term to permanent jobs.

5.2 Endogeneity of the firm conversion rate

We address the endogeneity issues of firm conversion rates through several supplementary analyses. *First,* a firm conversion rate may be endogenous as it is derived from the firm's internal choices of which fixed-term workers will be offered a permanent contract. These

		Basic model Share of long fixed-term contracts		Skill model Share of long fixed-term contracts	
		High	Low	High	Low
(1)	β_K	0.222***	0.190***	0.228***	0.190***
		(0.006)	(0.006)	(0.006)	(0.006)
(2)	β_L	0.629***	0.503***	0.509***	0.486***
		(0.024)	(0.017)	(0.021)	(0.017)
(3)	s	0.629***	0.235***		
		(0.020)	(0.013)		
(4)	$s^{P,LS}$			0.211***	0.365***
				(0.011)	(0.014)
(5)	$s^{F,HS}$			0.337***	0.193***
				(0.019)	(0.018)
(6)	$s^{F,LS}$			0.174***	0.105***
				(0.011)	(0.007)
(7)	γ	−0.032***	0.091***		
		(0.008)	(0.008)		
(8)	$\gamma^{P,HS}$			0.030***	0.046***
				(0.006)	(0.007)
(9)	$\gamma^{P,LS}$			−0.049***	0.050***
				(0.008)	(0.009)
Observation		100,935	79,625	100,935	79,625

Note(s): Estimations of the basic model and the skill model. Robust standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Source(s): Authors' own work

Table 4. Firm productivity and fixed-term contracts differentiating by the share of long fixed-term contracts

choices are inherent in the firm's unobserved strategic planning for its human capital investments and hiring strategies. However, such strategies are likely to correlate with firm characteristics such as size, age and knowledge intensity (Portugal and Varejão, 2022; Kleinknecht *et al.*, 2006). As a result, we control for firm characteristics in our models. We measure firm size by the number of workers in a firm (in natural logarithm). Firm age is a dummy being 1 if a firm has operated for >5 years and 0 otherwise. We measure a firm's knowledge intensity by its share of high-skilled personnel in total employment. Moreover, since the use of fixed-term contracts is likely to be sector-specific (Hirsch and Mueller, 2012), we include sector dummies in our models. We obtain results comparable to those in the main analysis (see Table 5).

Second, while keeping firm characteristics in the models, we replace the firm conversion rate with sectoral information on screening as the latter is exogenous to firm performance. This information is taken from Statistics Netherlands for the period between 2015 and 2017. It includes data on sectoral rates of temporary contracts with an additional, though not binding, agreement that the contract will become permanent if the temporary worker is a good match for the firm (Houwing and Kösters, 2013) [9]. We refer to this type of contract as a "probationary" contract.

To construct a proxy for sector-level screening, we calculate the ratio of probationary temporary workers to all temporary workers across sectors for 2015–2017. As this

		Basic model Firm conversion rate		Skill model Firm conversion rate	
		High	Low	High	Low
(1)	β_K	0.217***	0.201***	0.222***	0.204***
		(0.007)	(0.005)	(0.007)	(0.005)
(2)	β_L	0.577***	0.556***	0.479***	0.509***
		(0.019)	(0.021)	(0.019)	(0.021)
(3)	s	0.447***	0.347***		
		(0.018)	(0.017)		
(4)	$s^{P,LS}$			0.209***	0.287***
				(0.010)	(0.013)
(5)	$s^{F,HS}$			0.256***	0.249***
				(0.022)	(0.018)
(6)	$s^{F,LS}$			0.119***	0.129***
				(0.009)	(0.009)
(7)	γ	−0.013	0.047***		
		(0.009)	(0.007)		
(8)	$\gamma^{P,HS}$			0.038***	0.032***
				(0.008)	(0.007)
(9)	$\gamma^{P,LS}$			−0.048***	0.021***
				(0.009)	(0.008)
Control variables					
(10)	Firm size	−0.000	−0.000***	0.000**	−0.000***
		(0.000)	(0.000)	(0.000)	(0.000)
(11)	Firm age	−0.019***	−0.010	−0.018**	−0.008
		(0.007)	(0.006)	(0.007)	(0.006)
(12)	Share of high-skilled workers	0.036***	0.031***	0.012	0.020**
		(0.011)	(0.009)	(0.011)	(0.009)
(13)	Sector dummies	Yes	Yes	Yes	Yes
Observation		77,594	102,966	77,594	102,966

Table 5.
Firm productivity and fixed-term contracts with control variables

Note(s): Estimations of the basic model and the skill model. Robust standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$
Source(s): Authors' own work

information is often stable over time, we use it to classify sectors into high and low rates of probationary contracts for our observed period between 2011 and 2017. We obtain results that are comparable with those found in the main analysis (see Table 6).

Finally, to remove potential biases caused by the endogeneity of the firm conversion rate, we repeat our analyses on a sample of firms that are relatively comparable across various characteristics but differ in their conversion rates. Specifically, we match firms in the high-conversion-rate group with firms in the low-conversion-rate group using a matching algorithm that combines propensity-score matching and nearest-neighbour matching methods. In the matching algorithm, we consider important firm characteristics such as value-added, capital, revenue, firm's revenue share within its sector, firm size, firm age, firm's share of high-skill workers and firm's average wage. This results in a matched sample with 19,891 firms that are comparable in terms of financial performance and workforce composition. The analysis in the matched sample gives similar findings to those obtained from the whole sample, that is, fixed-term workers contribute more to productivity in firms with high conversion rates, compared with firms that are "similar" but with low conversion rates. These findings also hold when considering worker skills, i.e. the contribution of high-skilled fixed-term workers is larger in high-conversion-rate firms, compared with that in "similar" low-conversion-rate firms (see Table 7).

		Basic model		Skill model	
		Sectoral probationary rate		Sectoral probationary rate	
		High	Low	High	Low
(1)	β_K	0.217***	0.202***	0.223***	0.204***
		(0.007)	(0.005)	(0.007)	(0.005)
(2)	β_L	0.566***	0.559***	0.511***	0.488***
		(0.026)	(0.018)	(0.024)	(0.019)
(3)	s	0.391***	0.395***		
		(0.021)	(0.015)		
(4)	$s^{P,LS}$			0.291***	0.216***
				(0.014)	(0.009)
(5)	$s^{F,HS}$			0.273***	0.239***
				(0.029)	(0.015)
(6)	$s^{F,LS}$			0.144***	0.114***
				(0.011)	(0.007)
(7)	γ	0.026***	0.015**		
		(0.008)	(0.007)		
(8)	$\gamma^{P,HS}$			0.052***	0.021***
				(0.008)	(0.007)
(9)	$\gamma^{P,LS}$			−0.019**	−0.005
				(0.009)	(0.007)
Control variables					
(10)	Firm size	−0.000***	−0.000	−0.000***	−0.000
		(0.000)	(0.000)	(0.000)	(0.000)
(11)	Firm age	−0.012	−0.016***	−0.013*	−0.013**
		(0.007)	(0.006)	(0.007)	(0.006)
(12)	Share of high-skilled workers	0.056***	0.022**	0.079***	−0.022**
		(0.011)	(0.009)	(0.012)	(0.009)
(13)	Sector dummies	Yes	Yes	Yes	Yes
Observation		67,091	113,469	67,091	113,469

Note(s): Estimations of the basic model and the skill model. Robust standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Source(s): Authors' own work

Table 6. Firm productivity and fixed-term contracts with sectoral rate of probationary contracts

		Basic model Conversion rate		Skill model Conversion rate	
		High	Low	High	Low
(1)	β_K	0.192***	0.203***	0.202***	0.211***
		(0.014)	(0.031)	(0.014)	(0.031)
(2)	β_L	0.587***	0.414***	0.589***	0.385***
		(0.032)	(0.146)	(0.031)	(0.123)
(3)	s	0.412***	0.182		
		(0.035)	(0.140)		
(4)	$s^{P,LS}$			0.694***	0.855***
				(0.028)	(0.186)
(5)	$s^{F,HS}$			0.543***	0.079
				(0.060)	(0.137)
(6)	$s^{F,LS}$			0.180***	0.103
				(0.020)	(0.070)
(7)	γ	0.043**	0.052		
		(0.020)	(0.039)		
(8)	$\gamma^{P,HS}$			0.015	−0.027
				(0.022)	(0.058)
(9)	$\gamma^{P,LS}$			0.056***	0.037
				(0.018)	(0.066)
	Observations	17,129	2,762	17,129	2,762

Table 7.
Firm productivity and fixed-term contracts in the matched sample

Note(s): Estimations of the basic model and the skill model. Robust standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$
Source(s): Authors' own work

6. Conclusion and discussion

Despite the growing research on the impact of fixed-term employment on firm performance, the existing evidence remains inconclusive. We contribute to the empirical literature on the relationship between fixed-term employment and firm productivity by investigating how firm conversion rates from fixed-term to permanent contracts and workers' skills matter for this relationship. We argue that the contribution of fixed-term workers, especially those who are highly skilled, will be greater in firms with high conversion rates, used as a measure for screening strategies. The reason is that the work of high-skilled workers is harder to monitor and it demands more firm-specific investment compared with low-skilled ones (Becker, 1975; Parker *et al.*, 2017). Screening not only improves the firm-worker match for future permanent positions (Faccini, 2014), but also incentivises high-skilled fixed-term workers to exert more effort at work (Engellandt and Riphahn, 2005).

The first finding in our research is that fixed-term contracts contribute to firm productivity less than permanent ones, aligned with Addessi (2014), Aguirregabiria and Alonso-Borrego (2014), and Castellani *et al.* (2020). Second, we find that the impact of fixed-term contracts on firm productivity is stronger when firms have high conversion rates, implying the positive impact of screening strategies on the productivity contribution of fixed-term workers. This finding aligns with Dolado *et al.* (2016) who suggest that the transition from fixed-term to permanent status enhances fixed-term workers' effort which subsequently increases productivity. Third, when distinguishing the productivity contribution by worker skills, we find that the contribution of fixed-term workers is more substantial when they are highly skilled. This distinction suggests the importance of understanding how different worker skill levels affect firm productivity. Finally, we discover that the conversion from fixed-term to permanent employment has a more substantial effect on high-skilled fixed-term workers compared to low-skilled ones. This indicates that firms

may increase their productivity by using fixed-term contracts to screen high-skilled workers for permanent employment. Our findings are consistently supported by supplementary analyses.

We acknowledge some limitations of our research. First, because we do not have data for the use of temporary agency workers and other external work arrangements in firms, we did not include them in the analyses while these workers might also play a role in the labour contribution to firm productivity. Future research should address whether the relation we found between the employment of fixed-term workers and firm productivity, also holds for other types of flexible work. Second, we have no perfect measure for individual skills due to data constraints. Therefore, we use individual wages as a proxy for workers' skills as the literature suggests a close relationship between education and wages (e.g. Mincer (1958)). Future research should delve more into which types of skills benefit most from using fixed-term contracts to screen workers for permanent positions, in terms of productivity gains. Third, we argue that the firm-level conversion rate from fixed-term to permanent contracts is a measure, albeit incomplete, for using fixed-term contracts as a screening device since prior research has documented a strong link between the transition from fixed-term to permanent employment and employers using fixed-term contracts for their screening strategies (Masui, 2020; Mattijssen *et al.*, 2022). However, factors other than screening might impact firm-level conversion rates. Therefore, future research should consider a broader set of indicators for measuring screening strategies, accommodate various strategies for different types of work and account for the impact of economic conditions on actual conversion rates.

Regardless of these limitations, our research complements previous studies with a more detailed investigation of the role of firm conversion rates, used as a proxy for screening strategies, and workers' skills in the nexus between firm productivity and fixed-term employment.

Notes

1. Depending on the institutional context, there may be a third motive, namely cost reduction. In some countries, some types of temporary contracts are cheaper for other reasons than the associated hiring and firing costs. Firms may then choose to employ workers on temporary contracts even though they have no need for numerical flexibility nor for screening.
2. Following prior research (e.g. Addessi (2014), Aguirregabiria and Alonso-Borrego (2014), Caggese and Cuñat (2008), and Castellani *et al.* (2020)), permanent workers' productivity is normalised to one to assume that permanent and fixed-term workers are substitutes, hence s represents the relative productivity differential between fixed-term and permanent workers.
3. Alternatively, while Levinsohn and Petrin (2003) use intermediate inputs, Olley and Pakes (1996) use investments to control the correlations between input levels and the unobserved productivity shocks and estimate the production function with the presence of simultaneity problems.
4. To identify sectors, we use 2 digits of the Dutch Standard Business Classification which is similar to the International Standard Industrial Classification of All Economic Activities (ISIC) revision 4.
5. These are sectors with 2-digit Dutch Standard Business Classification codes from 10 to 82.
6. A general concern regarding fixed-term workers is that they might get paid less for the same work than permanent workers doing the same job which might result in a downward bias of the wage-based skill level classification of fixed-term jobs (see Brown and Sessions (2003)). However, for the Netherlands, it is found that after controlling for individual and occupational characteristics, the remaining wage gap between fixed-term and permanent workers is very small, namely 7% (see Smits and Vries (2019)). Moreover, the remaining wage difference is not necessarily due to the contract *per se* but might also be related to unobservable worker characteristics. For this reason, we expect the potential downward bias of skill-level classification of fixed-term workers to be negligible.

7. The median number of total workers in our sample is 23.
8. Following Addessi (2014) and Castellani *et al.* (2020), we guessed the initial values for the parameters to start the estimation procedure. Under the assumption of constant return to scale, we started with 0.35 for β_K and 0.65 for β_L. We started with 1 for s, which means different contract types have the same labour-augmenting productivity, and with 0 for γ, which means the lagged labour composition has no impact on productivity dynamics.
9. The sectoral rates of temporary contracts with the prospect of permanent employment are available at the sectoral level but not at the firm level.

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