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TOO MUCH OF A GOOD THING? THE MACRO IMPLICATIONS OF MASSIVE FIRM ENTRY

Sam Desiere
Tiziano Toniolo
Gert Bijnens

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GHENT UNIVERSITY

Department of Economics

Faculty of Economics and Business Administration
Campus Tweekerken, St.-Pietersplein 5, 9000 Ghent - BELGIUM

Too much of a good thing? The macro implications of massive firm entry*

Sam Desiere† Tiziano Toniolo‡ Gert Bijnens§

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Abstract

Policies supporting small businesses are popular among policymakers but often criticised by economists for their potential to distort the economy. This paper provides a comprehensive evaluation of a unique policy that subsidises the first employee. Empirically, we find that the policy led to a surge in the number of firms employing exactly one employee, without a noticeable effect on the number of firms with two or more employees. A simple frictionless general equilibrium model of occupational choices predicts the empirical facts remarkably well. Leveraging our model, we show that the general equilibrium effects on wages and aggregate output are likely to be small. However, the policy is expensive. Our findings support the traditional view that size-dependent subsidies distort the optimal allocation of resources.

Keywords: size-dependent policies; firm entry; small firms; wage subsidies; payroll taxes.
JEL Codes: D22, H25, J08, L25, L26.

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†Ghent University, Belgium. Contact: sam.desiere@ugent.be.
‡IRES/LIDAM, UCLouvain, Belgium. Contact: tiziano.toniolo@uclouvain.be.
§National Bank of Belgium. Contact: gert.bijnens@nbb.be.

1 Introduction

Policymakers across the political spectrum love small businesses. Barack Obama called small businesses *the backbone of our economy and the cornerstones of our communities* and supported them by lowering their taxes and providing subsidised loans. The Trump Administration also emphasised the critical role of small businesses and introduced the Paycheck Protection Program to protect small businesses during the COVID-19 pandemic. Support for small businesses is not restricted to the US. Policies favouring small over medium-sized businesses are prevalent across both developed (e.g., OECD, 2021) and developing countries (e.g., Martin et al., 2017; Bachas et al., 2023).

Economists are generally sceptical of size-dependent policies (Guner et al., 2008; Restuccia and Rogerson, 2008; Buera et al., 2013; Acs et al., 2016). A common assumption of economic models with heterogeneous firms is that larger firms are more productive than smaller ones. Given this assumption, policies favouring small firms over larger ones will reduce aggregate output, as labour will reallocate from large, high-productivity firms to small, low-productivity firms. Economists, therefore, argue that policies favouring small businesses can only be justified by market failures that impede the entry of new firms or hinder small firms from growing, such as liquidity and credit constraints (Evans and Jovanovic, 1989; Hurst and Lusardi, 2004; Cagetti and De Nardi, 2006; Moll, 2014; Siemer, 2019), the uninsurable risk of starting a business (Hombert et al., 2020; Ando, 2021), market power of incumbent firms (De Loecker et al., 2020), or missing markets for innovation (Acemoglu et al., 2018). Then, it becomes fundamental to understand whether market failures always play a central role in shaping the effects of size-dependent policies, or whether there are setups where a simple neoclassical model without market failures is sufficient to predict their first-order effects.

We focus on a unique and expensive size-dependent policy in Belgium.[1] Firms that hired their first employee after January 1, 2016 are permanently exempt from paying payroll taxes for a single employee, while paying the standard rate for subsequent employees. Eventually, all firms in Belgium will have a single employee exempt from payroll taxes, whose labour cost is about 20% lower than for the other employees. The policy favours small over larger firms, as the subsidy is, in relative terms, much more generous for the former group, making it a textbook example of a size-dependent policy.

To assess whether a frictionless model can predict the impact of this size-dependent policy, we proceed in four steps. First, we document the policy's impact on the number of firms, a key statistic our

[1]The Belgian policy is similar to the the long-standing *employment allowance* in the UK, which allows eligible employers to reduce their National Insurance Contributions (currently 13.8% of gross wages) by £5,000 a year (a recent government decision raised the tax rate to 15% and the allowance to £10,000). This allowance effectively exempts small firms from payroll taxes. To the best of our knowledge, the impact of this allowance has not yet been evaluated. Like Belgium, Finland experimented with offering a subsidy to entrepreneurs hiring their first employee. However, unlike the Belgian and UK policy, the Finnish subsidy was temporary rather than permanent, and the take-up was extremely low (2-12%) (Nivala, 2024).

model aims to predict. Second, we develop a frictionless model of occupational choice and calibrate it using only the pre-reform firm size distribution. Third, despite its simplicity, the model predicts the increase in the number of firms remarkably well, which we interpret as evidence in favour of the validity of our model. Finally, we leverage the model to explore the long-term impact of the policy on aggregate output, its budgetary cost and its distributional impact.

The first part of the paper presents empirical evidence on the evolution of the number of firms in the years following the reform. Using a difference-in-differences approach, we find that the number of firms with one employee increased by 7.2% three years after the reform, with little evidence of an increase in the number of firms with more than one employee. This finding, consistent with Cockx and Desiere (2024), illustrates that the policy led to a sudden and substantial rise in the number of firms with one employee. Additionally, the lack of an increase in the number of firms with two employees aligns with Deng et al. (2024), who show that new employers entering as a response to the subsidy are generally smaller and less productive than those who would have entered in the absence of the subsidy. Even three years after entry, most of the new employers who would not have hired without the subsidy appear to employ a single employee. These observations suggest that the policy did not spur new entrants to become highly successful firms.

The second part of the paper develops a simple general equilibrium model of occupational choice in the spirit of Lucas (1978), incorporating size-dependent payroll taxes following Braguinsky et al. (2011) and Garicano et al. (2016). Heterogeneous individuals have an individual-specific productivity level and choose between being a manager (and earning profits) or an employee (and earning the market wage). In equilibrium, the most productive individuals are managers, and the least productive ones are employees. The subsidy for the first employee makes it more attractive to become a manager, which induces some employees to become managers. However, these new managers are insufficiently productive to employ more than one employee. Consequently, the entry of new managers leads to an increase in the number of firms with at most one employee, without any effect on the number of firms with more than one employee, which is in line with the empirical findings. The subsequent decrease in labour supply (as some individuals switch from being an employee to being a manager) and increase in labour demand (by the new managers) increase equilibrium wages. The wage increase, in turn, reduces labour demand and leads to a reallocation of labour from firms with more than one employee to firms with at most one employee, resulting in a fall in aggregate output.

The third part of the paper shows that the calibrated model predicts a 10.2% increase in the number of firms with one employee, which is close to the 7.2% increase observed in the data. A straightforward extension of the baseline model, incorporating not only the exemption for the first hire but also a 3.3 percentage points reduction in the payroll tax rate for all other employees—a policy gradually

implemented between 2016 and 2019—predicts an 8.9% increase in the number of firms with one employee, aligning the simulated effect more closely with the DiD estimate. The close match between the empirical DID estimate and the simulated effect is noteworthy, especially given that the model contains only three fundamental parameters and is calibrated on the firm size distribution and average firm size in the pre-reform period. This finding suggests that simple frictionless models can provide useful insights into the first-order effects of size-dependent policies. This is a particularly relevant for government institutions responsible for making ex-ante forecasts of the likely long-term impact of size-dependent policies under consideration by policymakers.

In the final part of the paper, we leverage the model to quantify the general equilibrium effects of the policy on wages and output, and to reflect on its budgetary cost and distributional impact in the long run, i.e. when all firms employ a subsidised first employee. Although approximately 9% of the employees will eventually be subsidised, our model predicts a modest wage increase of 0.5%. Intuitively, this wage increase is limited because the subsidy provides a windfall profit for firms that would have employed more than one employee absent the subsidy, without affecting their optimal labour demand. Given the small wage increase, the impact on aggregate output is negligible, decreasing by less than 0.01% in equilibrium.

However, the policy is expensive for the government, amounting to 0.36% of output. The reduction in government revenues does not benefit all individuals equally. Individuals who are employees in both periods experience modest gains due to the 0.5% wage rise. The profits of individuals who become managers following the reforms are 0.5% to 6.5% higher than their pre-reform wages. The main winners are managers running firms with at most one employee in the pre-reform period, who experience a 6.5% increase in profits. The increase in profits gradually decreases with the managers' productivity and, thus, with firm size. Managers running firms with at most 25 employees experience profit gains, while firms with more than 25 employees experience a slight reduction in profits of less than 1% due to higher wages. In this sense, the policy achieves its objective of supporting small businesses, albeit at the cost of lower government revenues and, to a much smaller extent, lower profits for larger firms. To further illustrate the policy's substantial budgetary cost, we show that the payroll tax rate must increase by 1.2 percentage points, or 8% in relative terms, if the government aims at maintaining revenues constant.

Like much of the literature, our model abstracts from the solo self-employed and the unemployed.[2] Consequently, we assume that the sum of the number of employees and managers—called the 'labour force' in our model—is fixed. This setup implies that the number of managers increases after the reform at the expense of the number of employees. Admittedly, this is a strong assumption, as it

[2]Modelling the hiring decisions of the self-employed is challenging, as many self-employed individuals do not intend to hire (e.g., Hurst and Pugsley 2011, 2017).

rules out the possibility that the self-employed become employers after the reform. For this reason, we also consider the opposite assumption of a perfectly elastic labour force, where the new managers and their employees come from outside the labour force, which rules out a wage increases and job losses in larger firms. This scenario yields similar predictions regarding the evolution of the number of firms and budgetary costs but results in a 0.75% increase in the labour force and a 0.25% increase in output produced by employers.

The absence of market failures in our model implies that the policy cannot be rationalised on efficiency grounds because the allocation of resources is optimal without policy interventions. With a 'fixed' labour force, the policy always leads to the entry of low-productivity firms, results in job losses in larger, more productive firms, and, ultimately, reduces output. However, the policy could be justified for other reasons that are not explicitly modelled and may fall outside the realm of economics, such as a preference for small businesses. Our simulations of the cost of the policy in terms of reduced output or lower tax revenues can be used to support or dismiss the policy, depending on the value one attaches to small businesses.[3]

This paper contributes to the literature on size-dependent policies. The first strand of this literature, starting with the seminal work of Restuccia and Rogerson (2008) and Hsieh and Klenow (2009), finds that size-dependent policies can have significant negative effects on productivity and welfare. Our work is closely related to Guner et al. (2008) and Braguinsky et al. (2011). Guner et al. (2008) introduce size-dependent taxes or subsidies in a Lucas model calibrated to the US economy and simulate the impact of various potential policies. They consider both subsidizing capital and labour in small firms, and highlight that subsidising labour has a larger impact on the number of firms but leads to smaller welfare losses than subsidising capital. This prediction aligns with our findings, as we find a negligible impact on output (-0.01%), but a much larger impact on the total number of firms ($+2.8\%$), driven by the 10.2% increase in firms with one employee. Our findings are also consistent with Hopenhayn (2014) who argues that policies that distort the optimal firm size distribution but preserve the rank of the firms—such as the policy we study—have a limited impact on aggregate total factor productivity. Our modelling approach is similar to that of Braguinsky et al. (2011), who show that employment protection, modelled as a tax on labour in a Lucas model, reduces average firm size and leads to output losses.

The second strand of the literature evaluates country-specific size-dependent policies. Gourio and Roys (2014) and Garicano et al. (2016) evaluate the cost of labour market regulations in France that

[3] Dustmann et al. (2022) make a similar argument. They show that the introduction of a minimum wage in Germany led to a reallocation of labour from small (less productive) to large (more productive) firms, and argue that this reallocation does not necessarily increase welfare for all workers if small firms offer valuable job amenities. For instance, they demonstrate empirically that commuting time increased following the adoption of the minimum wage.

apply only to firms with at least 50 employees. Cahuc et al. (2023) evaluate a policy that prevents large firms from using temporary contracts in Portugal. Akcigit et al. (2023) study the implications of employment targets during the privatisation of firms in East Germany, and Rotemberg (2019) investigates the reallocation effects of relaxing eligibility criteria for small business subsidies in India. The key difference between our paper and the existing literature is that the Belgian policy explicitly aimed to stimulate firm entry and to increase the number of firms, unlike the existing studies that focus on policies with different objectives but unintentionally distort the firm size distribution.

The paper is organised as follows. The next section discusses the policy and the institutional setting. Section 3 presents the data. Section 4 evaluates the impact of the policy on the number of firms with one employee. Section 5 presents the model, which is calibrated in Section 6. Section 7 simulates and validates the model, and leverages it to reflect on the policy's macro implications and distributional impact. Section 8 concludes.

2 The policy and the institutional setting

In Belgium, employers pay payroll taxes, called Social Security Contributions (SSCs), on top of the wages they pay to the employees. These contributions are used to fund social security, including health care and retirement benefits. SSCs are an important determinant of labour costs, with the current nominal payroll tax rate amounting to 25% of gross wages.

On October 10, 2015, the Belgian government unexpectedly announced that new employers would receive a permanent exemption from payroll taxes for their first employee. The policy was justified by a widespread conviction that small businesses, and particularly new employers, deserve support. Additionally, the minister of Small and Medium-size Enterprises stated that the subsidy would encourage entrepreneurs to hire their first employee, fostering a virtuous cycle of firm growth.[4]

The new policy went into effect for private sector firms that hired their first employee after January 1, 2016. Private sector firms are eligible for the permanent exemption if they did not employ a worker subject to SSC in the previous four quarters. The law prohibits existing employers from splitting into smaller units or from establishing new firms in order to qualify for the subsidy. The National Social Security Office (NSSO) monitors and enforces these conditions (Court of Audit, 2021).

The tax exemption has some remarkable features. First, the exemption is not time-limited, making it a very generous subsidy. Second, firms retain the exemption even as they continue to expand. Third, the exemption is not tied to a specific individual. Firms retain the exemption even if the 'first' employee leaves and is replaced, and they can designate the employee for whom the exemption is

[4]Hiring rates among firms without employees are very low in Belgium (Cockx and Desiere, 2024), and elsewhere (see Fairlie and Miranda (2017) for the US).

claimed if they have several employees. To maximise the subsidy, employers will claim the exemption for the employee with the highest wage.

While the payroll tax exemption is not automatically awarded and must be claimed when filing quarterly payroll data to the NSSO, the take-up is high. Although not a legal requirement, most employers outsource payroll administration to specialised agencies, which are well-aware of the subsidy's existence. The Federal Planning Bureau estimates that the take-up of the tax exception in the first three quarters of 2016 was 82% (Boucq and López-Novella, 2018). Take-up likely increased further in the following years as more employers became aware of its existence.

The 2016 reform replaced previously existing less generous temporary hiring subsidies for the first employee that had been in effect with some modifications since 2004. When new employers hired their first employee in 2015, they could claim a €1,550 quarterly payroll tax reduction for the first five quarters, €1,050 for the next four quarters, and €450 for the last four quarters.

To illustrate the generosity of the temporary pre-reform and permanent post-reform subsidy, we compute the median payroll tax rate for the first employee paid by quarterly cohorts of new employers who hired their first employee in 2014 (pre-refom cohorts) and 2016 (post-reform cohorts) in function of the number of elapsed quarters since their first hire (Figure 1).[5] The black and orange lines show the average annual payroll tax rate of the 2014 and 2016 cohorts.

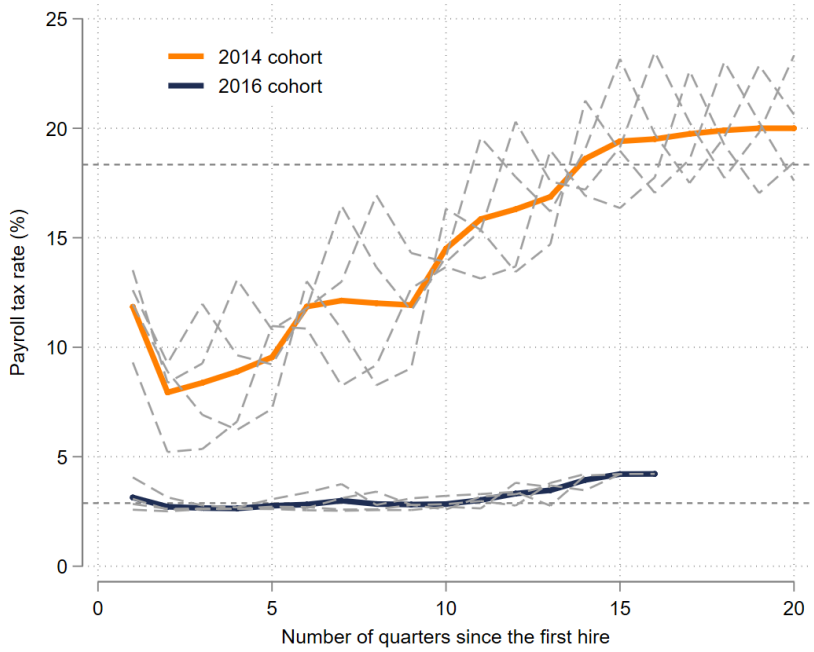
The 2016 cohort benefits from the permanent payroll tax exemption and faces a constant payroll tax rate of 2.9% for the first employee. This rate is not exactly equal to zero because employers are only exempt from the base contribution, but they still pay specific contributions, such as contributions for short-time work or sector-specific training. The 2014 cohort benefits from temporary tax reductions for the first employee that are gradually phased out over thirteen quarters. As a result, the payroll tax rate for the 2014 cohort gradually increases with the firm's age and reaches a stable level fourteen quarters after having hired their first employee.

Following Cockx and Desiere (2024), we compute the *expected* payroll tax rate for the first employee at the time of hiring in the pre-reform and post-reform period. The expected payroll tax rate is defined as the weighted average of the payroll tax rate for each quarter after hiring (shown in Figure 1), weighted by the firm's expected survival rate (i.e. the probability of still being an employer)[6] and

[5] We do not show the payroll tax rate of the 2015 cohort because this cohort was exempt from SSC for their first employee from 2016Q1 for at most thirteen quarters. When announcing the 2016 reform in October 2015, the government granted this temporary SSC exemption to the 2015 cohort of new employers to reduce the differential treatment of the 2015 and 2016 cohorts. Importantly, at the time of hiring, the 2015 cohort could not anticipate future government decisions and expected to be treated as the 2014 cohort.

[6] We compute the expected survival rate for the 2014 cohort of new employers for the first five years after hiring and assume that, after five years, 3% of the employers no longer employ workers in the following year, which corresponds to the Belgian average (Bijnens and Konings, 2020).

Figure 1: The payroll tax rate for the first employee over the firm's lifetime: 2014 vs. 2016 cohort of new employers



Notes: The figure shows the payroll tax rate for the first employee paid by new employers who hired their first employee in the first four quarters of 2014 and 2016 (grey dashed lines) and had not employed workers in the previous four quarters, in function of the number of elapsed quarters since their first hire. This population is eligible for temporary payroll tax reductions in the pre-reform period and the permanent payroll tax exemption in the post-reform period. The first quarter corresponds to the quarter in which the first employee is hired. To compute the payroll tax rate for the subsidised employee, the population of new employers is restricted to those that employ exactly one employee in a given quarter. The full black and orange lines show the payroll tax rate averaged over the four quarterly cohorts of new employers who hired their first employee in 2014 and 2016. The horizontal dashed lines indicate the expected payroll tax rate, defined in the text, in the pre-reform period (18.3%) and post-reform period (2.9%)

a quarterly discount rate set at 1.275% (e.g., Kaas and Kircher, 2015). These computations reveal that the expected payroll tax rate for the first employee of new employers is 18.3% in the pre-reform period and decreases to 2.9% in the post-reform period.

The generosity of the tax exemption depends on the expected payroll rate for the first employee and the rate paid by firms that do not benefit from this exemption. Table 1 shows the payroll tax rate paid by firms with 7-15 employees[7], along with the expected payroll tax rate for the first employee before and after the reform. This table contains four payroll tax rates, depending on the firm size and period. In our model, we refer to the rates for the first employee in the pre-reform ($b$efore) and post-reform ($a$fter) period as $\tau_{1,b}$ and $\tau_{1,a}$, respectively, while $\tau_{2,b}$ and $\tau_{2,a}$ denote the rate paid for subsequent employees in the pre-reform and post-reform period.

The table reveals two essential facts. First, in both periods, the (expected) payroll tax rate of firms with a single employee is lower than the rate paid by firms with 7-15 employees. This implies that

[7]We compute the median payroll tax rate for firms with 7-15 employees because (1) our data is restricted to firms with at most fifteen employees, and (2) only a tiny fraction of firms with at least seven employees receive payroll tax reductions.

Table 1: The (*expected*) payroll tax rate

	Pre-reform (b)	Post-reform (a)
1 employee (τ_1)	18.3%	2.9%
7-15 employees (τ_2)	26.9%	23.6%

Notes: The payroll tax rate for firms with 7-15 employees is computed as the SSCs divided by the wage bill. We first computed the rate for each firm in each quarter and then computed the median rate across all firms. We report the average annual rate taking the average over four quarters in the pre-reform (2014Q4-2015Q3) and post-reform period (2018Q4-2019Q3). The payroll tax rate for the first employee is the *expected* payroll tax rate at the time of hiring over the firm's lifetime.

payroll taxes are size-dependent in both periods, with smaller firms paying lower taxes. Second, the payroll tax rate paid by firms with 7-15 employees decreased by 3.3 percentage points (pp), from 26.9% in the pre-reform to 23.6% in the post-reform period. This decrease is due to the so-called tax shift, which gradually decreased the payroll tax rate between 2016 and 2019. Importantly, the difference between the payroll tax rates for the first and subsequent employees is larger in the post-reform period. The gap is 20.7 pp in the post-reform period, up from 8.6 pp in the pre-reform period. Hence, despite the tax shift, the payroll exemption for the first employee remains a very generous subsidy.

The subsidy for the first employee became slightly less generous in 2022 and 2024. While it remained permanent, the subsidy amount was capped at €4.000 per quarter in 2022 and to €3.100 per quarter in 2024, partly in response to a critical report by the Court of Audit (2021), which highlighted that subsidies for employees with high wages were excessively generous. While we do not model these caps, they are unlikely to have a major impact. In 2019, the subsidy exceeded €3.100 (€4.000) per quarter for only 6% (3%) of the subsidised employees.[8]

Besides the permanent subsidy for the first employee, firms can also claim temporary subsidies for the second to the sixth employee. The temporary subsidies for the second to the fifth employee were reinforced in 2016, along with the introduction of a subsidy for the sixth employee. We make abstractions from these subsidies for three reasons. First, the permanent payroll tax exemption for the first employee is far more generous than the temporary payroll tax reductions for the subsequent five employees, which last at most thirteen quarters. Second, the temporary subsidies already existed with some modifications since 2004 and became only slightly more generous in 2016, which makes it unlikely that these subsidies substantially altered the firm size distribution after 2016.[9] Finally, the introduction of the temporary subsidy for the sixth employee in 2016 is unlikely to affect the decision to hire the first employee.

[8]The new government, in place since January 2025, intends to cap the subsidy at €2.000 per quarter. The subsidy exceeded this cap for approximately one-quarter of subsidised employees in 2019.

[9]For instance, firms hiring their second employee could claim a payroll tax reduction over thirteen quarters of at most €8,850 before and €13,750 after the 2016 reform. The subsidy for subsequent hires are less generous than for the second hire.

3 Data

We rely on a firm-level panel dataset of the population of employers employing at most fifteen employees provided by the National Bank of Belgium (NBB) to evaluate the impact of the policy on the number of firms(Section 4) and to calibrate the firm model (Section 6).

The quarterly panel dataset covers the period from 2009Q1 to 2019Q4, encompassing both new entrants, i.e. firms that have hired a first employee since 2009Q1, and employers with a maximum of fifteen employees in at least one quarter during this period. Employers established before 2009Q1 and employing more than fifteen employees in all quarters between 2009Q1 and 2019Q4 are not included in the dataset. According to this dataset, Belgium counted 152,999 employers with at most fifteen employees in 2015Q3, of which 53,001 employed one employee.

The NBB compiles data from various administrative sources. In the context of this paper, the most relevant data stems from the National Social Security Office (NSSO), which administers Social Security Contributions (SSCs). The NSSO registers firm-level employment. For each employer, we observe the total number of full-time and part-time employees on the last day of the quarter. The exact number of days worked over a quarter is not observed.

The firm-level dataset includes information on the quarterly wage bill, SSCs, and total SSC reductions. Total SSC reductions include the temporary or permanent SSC reductions for the first employee but also include other SSC reductions such as the reductions for low-wage workers. These variables enable us to compute the payroll tax rate by quarter and employer size. The payroll tax rate paid by a firm is defined as the SSCs divided by the wage bill.

To calibrate the model, we need the average employer size and the proportion of employers with more than fifteen employees in 2015Q3. Since the NBB dataset is restricted to employers with fifteen employees, we obtained this information directly from the NSSO. In 2015Q3, the average employer has 10.84 employees and 11.8% of the employers have more than fifteen employees.

4 Evolution of employers

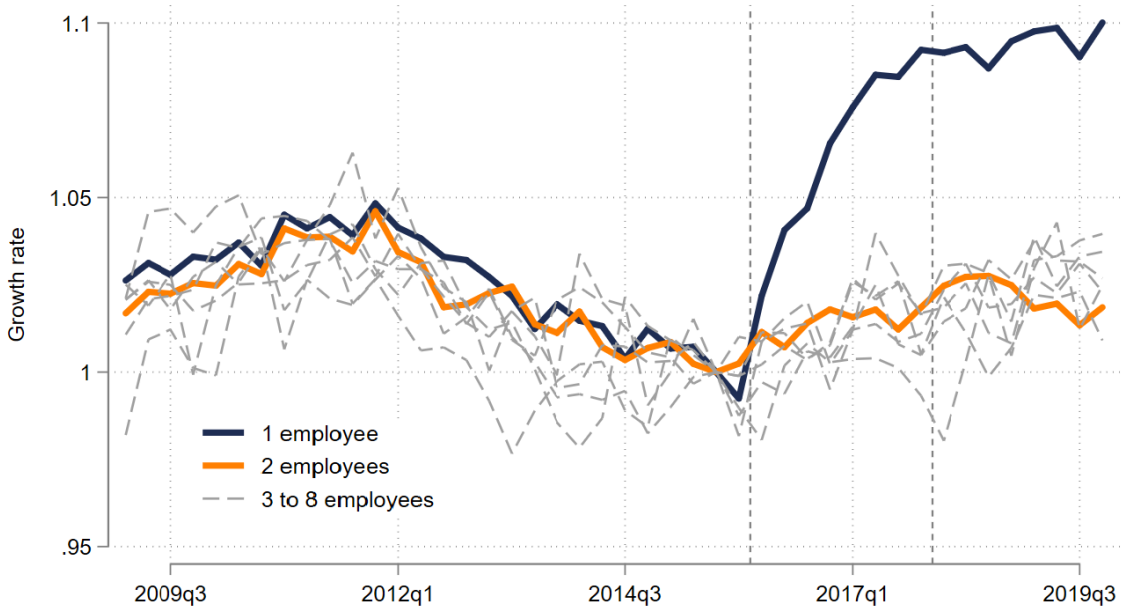
Using daily data on hiring decisions, Cockx and Desiere (2024) show that the labour cost reduction induced by the payroll tax exemption increases the monthly flow of new employers by 31% immediately after the implementation of the reform on January 1, 2016. Our quarterly data confirm the sharp jump in the quarterly flow of new employers.

In this section, we complement their study by examining the impact of the reform on the stock of firms, which is a key statistic our model aims to predict. More precisely, we examine whether the

reform increased the number of firms employing exactly one or two employees relative to a control group of bigger firms. We first present graphical evidence and then quantify this evidence using a Difference-in-Differences (DiD) framework. In these analyses, firm size is defined as the headcount of full-time and part-time employees at the end of the quarter.

Graphical evidence. Figure 2 shows the number of firms employing one to eight employees for the quarters 2009Q1-2019Q4 relative to 2015Q3, the quarter preceding the announcement of the policy.[10] The evolution of the number of firms with one and two employees is highlighted in black and orange. The grey dashed lines show the evolution of the number of firms with three to eight employees.

Figure 2: Growth in the number of firms



Notes: The figure shows the evolution of the number of firms by firm size relative to 2015Q3. The first dashed line indicates the start of the policy in 2016Q1. The second dashed line indicates 2018Q1, the point in time at which the number of firms with one employee stabilised. In 2015Q3, Belgium counted 53,001 firms with one employee, 28,672 firms with two employees, 18,163 firms with three employees, 12,381 employees with four employees, 9,037 firms with five employees, 6,823 firms with six employees, 5,251 firms with seven employees and 4,271 firms with eight employees.

The figure provides compelling evidence that (1) the number of firms by firm size evolved similarly in the pre-reform period; (2) the number of firms with one employee increased considerably after the implementation of the policy in 2016, continued to increase until the end of 2017, and stabilised thereafter; and (3) the number of firms with two employees evolved similarly as the number of firms with 3-8 employees in the post-reform period, suggesting that the reform did not affect the stock of firms with two employees.

DiD methodology. We use DiD regressions to quantify the graphical evidence. The DiD regressions

[10] After the 2012-13 recession, the Belgian economy quickly recovered and remained relatively stable between 2014Q1 and 2019Q4, with GDP growth hovering between 1% and 2%. The stable macroeconomic environment at the time of the policy's implementation alleviates concerns that differences in the evolution of the stock of firms with one vs. those with more employees were caused by the business cycle.

contrast the evolution of the stock of firms with one or two employees to the evolution of the stock of firms with several employees in the pre-reform vs. the post-reform period.

We estimate the following DiD regression using aggregate quarterly data:

$$\frac{y_{s,t}}{y_{s,2015Q3}} = S_s + \beta_t + \sum_{i=0}^{3} \gamma_i I_s * T_i + \epsilon_{s,t}$$

where the outcome, $\frac{y_{s,t}}{y_{s,2015Q3}}$, indicates growth in the number of firms employing s employees at quarter t ($y_{s,t}$) relative to the number of firms of size s in 2015Q3. S_s denotes group dummies and β_t are quarterly time dummies. The indicator I_s equals 1 for firms with one or two employees, and equals zero for larger firms.

The parameter of interests, γ_i, captures the difference between the growth rate of the number of firms with one (or two employees) and larger firms in four periods relative to 2015Q3. The indicators T_0, T_1, T_2 are T_3 are equal to 1 in respectively 2009Q1-2015Q2, 2015Q4, 2016Q1-2017Q4 and 2018Q1-2019Q4. Consequently, the parameter γ_0 captures the difference between in growth rate between both groups of firms in the pre-reform period (2009Q1-2015Q2) and 2015Q3, and allows us to test whether the outcome evolved similarly for both groups in the pre-reform period. This is essential, because if the number of small and slightly larger firms evolved similarly in the pre-refrom period, as Figure 2 suggests, it is reasonable to assume that this trends would have continued in the absence of the tax exemption. The parameter γ_1 captures anticipation effects in 2015Q4, during which the policy was already announced but not yet implemented; γ_2 captures the average impact of the reform from 2016Q1 to 2017Q4, that is the first two years after the reform, which is a transition period after which the number of firms with one employee stabilises, as evidenced by Figure 2; and γ_3 captures the average impact of the reform from 2018Q1 to 2019Q4.

We are only interested in γ_3 because our theoretical model captures the long-term impact on the number of firms but is silent about the dynamics leading to a new equilibrium. Hence, in Table 2, we only report γ_0, which allows to test the parallel trend in the pre-reform period, and γ_3, the parameter of interest.

We first contrast the evolution of the number of firms with one or two employees to the evolution of the number of firms with 7-8 employees. These latter firms are not directly affected by the subsidy for the first employee. According to the NSSO, in 2019Q, only 2% of the 30,000 full-time equivalent subsidised employees are employed by firms with 7-8 employees.[11] Next, we compare the number of firms with one or two employees to the number of firms with 3–8 employees. Firms with 3-8

[11] We do not include firms with more than eight employees because a visual inspection of the data reveals that the parallel trend does not hold for this group in the pre-reform period.

employees are more comparable to firms with one or two employees, which makes it more likely that the parallel trends assumption holds. Additionally, this specification has more observations, increasing the precision of our estimates. However, it is important to acknowledge that we cannot a priori rule out the possibility that the number of firms with 3-8 employees was affected by the policy, as some firms have received the subsidy and would potentially have had fewer employees in a counterfactual world without subsidies. To examine (and rule out) this possibility, we compare the growth in the number of firms with two employees—where spillover effects are expected to be strongest—with those employing 7–8 workers. The analysis reveals no evidence of such spillover effects, suggesting that comparing the number of firms with one or two employees to the number of firms with 3–8 employees is valid.

DiD results. Table 2 show that the number of firms with one employee was, on average, 7.2% higher in 2018Q1-2019Q4 than 2015Q3, relative to firms with 7-8 employees (column 1) or 3-8 employees (column 2). The effect is precisely estimated in the second specification, with a 95% CI ranging from 6.6% to 7.7%. In both specifications, the pre-reform estimate, γ_0, is close to 1% and statistically significant in the second specification where the coefficients are more precisely estimated. This indicates that the growth in the number of firms in both groups did not perfectly coincide in the pre-reform period, raising concerns about the validity of the parallel trend assumption. Nonetheless, the post-reform point estimate, γ_3, is eight times larger than the pre-reform estimate, indicating that the policy had a substantial effect on the number of firms with one employee, even if the parallel trend assumption does not hold perfectly.

Columns (3) and (4) examine the evolution of the number of firms with two employees relative to the number of firms with 7-8 and 3-8 employees. There are no pre-trends in the pre-reform period, and the post-reform point estimate is small and statistically insignificant, implying that the subsidy did not affect the stock of firms with two employees. Consistent with Deng et al. (2024), this finding indicates that the policy only affected the number of firms with one employee, without generating positive spillover effects on firms with more than one employee.

Finally, column (5) contrasts the evolution of the stock of firms with one vs. those with two employees. This comparison is warranted because we do not observe an effect on the number of firms with two employees and is relevant because firms with two employees are very similar to firms with one employee, alleviating concerns about the validity of the parallel trend assumption. Figure 2 demonstrates that the evolution of the stock of firms with one and two employees almost coincides in the pre-reform period, but diverges rapidly following the 2016 reform. This DiD regression indicates that the number of firms with one employee has increased by 7.2% in 2018Q1-2019Q4 relative to 2015Q3.

Table 2: DiD estimates of the growth in the number of firms

Treatment group Control groups	1 employee 7-8 employees	1 employee 3-8 employees	2 employees 7-8 employees	2 employees 3-8 employees	1 employee 2 employees
γ_0	0.0088	0.0095**	0.0039	0.0046	0.0049
	(0.015)	(0.0032)	(0.012)	(0.0032)	(0.014)
γ_3	0.0715***	0.0713***	−0.00079	−0.0011	0.072***
	(0.016)	(0.0028)	(0.013)	(0.0028)	(0.015)
N	132	308	308	132	88

Notes: The table shows the results of estimating DiD regressions, thereby quantifying the graphical evidence presented in Figure 2. γ_0 and γ_3 capture the differences in the evolution of the number of firms with one or two employees vs. firms with 7-8 or 3-8 employees in, respectively, 2009Q1-2015Q2 and 2018Q1-2019Q4 relative to 2015Q3. Standard errors are clustered by firm size in column (2) and (4). Conventional standard errors are reported in all other columns. *** and ** denote statistical significance at the 1% and 5% level, respectively.

One might be concerned that policy increases market-level wages, which could lead to job losses in firms with 3-8 employees. These general equilibrium effects would violate the Stable Unit Treatment Value Assumption (SUTVA). A (substantial) wage increase is unlikely in the three years following the reform because publicly available NSSO data shows that by the end of 2019 only about 1% of the employees in the private sector are subsidised. Moreover, the change in the number of firms with 1 employee materialises in the two years following the reform when the share of susbidised employees is even smaller, making general equilibrium effects even less likely in this period. Additionally, even when all employers have a subsidised employee, our calibrated general equilibrium model predicts a wage increase of 0.5%, which is sufficiently small to ignore general equilibrium effects. A related concern is whether the tax shift, which lowered the payroll tax rate for firms in the control group by 3.3 percentage points between 2015 and 2018 (see Table 1), violates SUTVA. This modest tax reduction is unlikely to have a substantial positive effect on the number of firms with 7-8 employees. Additionally, the tax shift may have increased wages, further damping its impact on the number of firms.

A natural question for economists is whether the policy led to strategic behaviour, prompting existing firms to close and reopen to take advantage of the subsidy. Cockx and Desiere (2024) find no evidence of higher exit rates immediately following the reform. While we do not study this type of behaviour, the marked increase in the stock of firms with one employee demonstrates that the policy had a real impact, and did not merely increase firm entry and exit without affecting the total number of firms.

Evolution during and after the COVID-19 pandemic. Our dataset ends in 2019Q4, just before the outbreak of the COVID-19 pandemic. However, to examine how the number of firms with one or more employees evolved during and after the pandemic, we obtained aggregate data directly from the NSSO on the number of firms by firm size for the period 2009Q1-2024Q2. Figure A.1 shows that the number of firms increased sharply following the onset of the pandemic, presumably because

government subsidies kept many firms artificially alive during this period, and then decreased sharply once the pandemic ended. By mid-2024, the number of firms with one employee was still 7% higher than in 2015Q3, while the number of firms with two and three employees had returned to its 2015Q3 level. We refrain from attributing a causal interpretation to these numbers, as the COVID-19 shock influenced entry decisions and may have differentially affected the exit of small versus slightly larger firms. However, the graphical evidence supports our view that, in the long run, the tax exemption increased the stock of firms with one employee by 7% without affecting the stock of firms with two or more employees.[12]

5 Theory

In this section, we adopt a frictionless static general equilibrium occupational choice model in the spirit of Lucas (1978). The model captures two key empirical findings: (1) the payroll tax exemption substantially increases the number of firms with one employee, and (2) low-productivity firms hire their first employee as a response to the policy, as shown by Deng et al. (2024).[13] At the same time, the model allows us to go beyond these reduced-form estimates. Comparing the model equilibria before and after the introduction of the exemption, we capture the general equilibrium effects on wages and the macroeconomic implications of labour misallocation caused by the tax exemption.

We first present the model with *size-independent* payroll taxes, where all employers pay the payroll tax rate, $\tau > 0$, on top of employees' wages. This model mimics the economy in the pre-reform period, and will be calibrated in the next section using pre-reform data. Importantly, in our model, a *size-independent* payroll tax does not distort the optimal labour allocation across firms.

We then introduce the payroll tax exemption by setting $\tau = 0$ for the first employee in each firm but keeping the payroll tax rate unaltered for subsequent employees. This makes the payroll tax rate *size-dependent*, as in Guner et al. (2008) and Braguinsky et al. (2011), and distorts the optimal labour allocation. We explore the general equilibrium effects of the policy on wages and derive the change in the number of firms, aggregate employment, and output from the pre-reform to the post-reform period. The model assumes that all firms employ a single employee exempt from payroll taxes, an outcome which only materialises in the long-run. Our static model is silent about the dynamics leading from the pre-reform to post-reform equilibrium.

[12] The figure also reveals an increase in the number of firms with more than four employees following the COVID-19 pandemic. This increase is unlikely to have been caused by the subsidy for the first employee, as most subsidised first employees are employed by firms with fewer than 4 employees.

[13] Deng et al. (2024) show that the average firm of the 2016 cohort of new entrants employs fewer workers and generates lower turnover and value-added compared to the average firm of the 2015 cohort, both at the time of hiring its first employee and in the subsequent three years. This indicates that firms hiring in response to the policy are less productive.

To clarify the model's intuition and simplify notation, our baseline model assumes a single payroll tax rate, τ, paid by all firms. This assumption implies that (1) the payroll tax rate does not vary by firm size in the pre-reform period, and (2) the reform only affected the payroll tax rate for the first employee while keeping the rate for subsequent employees unaltered. In Appendix D, we relax these assumptions by incorporating four payroll tax rates, differentiating between the rates paid firms with a single employee (τ_1) and those paid by larger firms (τ_2) in both periods, as reported in Table 1. This extension is insightful because the firm size distribution was already distorted in the pre-reform period—i.e. the tax rate was already 8.6pp lower for firms with a single employee than for larger firms before the reform. The extended model allows testing whether our calibrated parameters in the baseline model are sensitive to this distortion. Moreover, this extension clarifies how to define the payroll tax rate in the baseline model. Finally, it enables the simulation of the combined impact of the payroll tax exemption for the first employee and the payroll tax rate reduction for subsequent employees. The results of the simulation of the extend model are presented in Section 7.4.

5.1 A Lucas model with *size-independent* payroll taxes

Lucas (1978) introduces firm heterogeneity by assuming that individuals have a certain managerial ability, z, which follows a probability density function $\phi(z)$, with support in the range $[1, z_{max}]$. In equilibrium, individuals with managerial ability $z \geq z_{min}$ manage firms and employ workers, while individuals with $z < z_{min}$ are employees. The labour force is fixed, meaning that the sum of the number of managers and employees is constant. There is no unemployment.

To clearly distinguish between the pre and post-reform periods, we will respectively use the subscript b (before) and a (after).

Optimal labour demand of managers. The only input in production is labour provided by the employees, l. The labour input of the manager, while necessary to run the firm, does not contribute directly to production. Following Garicano et al. (2016), the production function of a manager with ability z is $y = zl^{\alpha}$. If an individual chooses to be a manager, she will choose l that maximises profits, $\pi(l, z) = zl^{\alpha} - w_b(1+\tau)l$, given the wage w_b and the payroll tax rate, $\tau > 0$.

The first-order condition determines optimal labour demand of managers with productivity z, $l_b^*(z)$:

$$l_b^*(z) = \left(\frac{\alpha z}{w_b(1+\tau)}\right)^{\frac{1}{1-\alpha}} \tag{1}$$

The profits of managers with optimal labour demand, $l_b^*(z)$, are equal to:

$$\pi_b^*(z) = (1-\alpha)\left(\frac{\alpha}{w_b(1+\tau)}\right)^{\frac{\alpha}{1-\alpha}} z^{\frac{1}{1-\alpha}} \tag{2}$$

Optimal employment and profits are strictly positive and increase in z for $\forall z \in [1, z_{max}]$, implying that more productive managers employ more workers and earn higher profits.

Occupational choice. Individuals choose between being a manager (and earning profits $\pi_b^*(z)$) or being an employee (and earning a gross wage, $w_b(1+\tau)$). Because profits increase with managerial ability while wages do not, there exists a minimum level of managerial ability, denoted by $z_{\min,b}$, at which the individual is indifferent between being a manager or an employee. Individuals with managerial ability greater than $z_{\min,b}$ are managers, whereas those with a lower ability are employees.

We assume that individuals care about gross wages, given by $w_b(1+\tau)$, rather than net wages, given by w_b. This assumption essentially rules out that some individuals prefer being managers to avoid payroll taxes. While some individuals may be managers for tax reasons (Parker, 2003; Zawisza et al., 2024)[14], this is not the phenomenon we want to study in this paper. This assumption can also be motivated by the fact that payroll taxes offer real benefits to employees, such as a pension. In contrast, managers must save some of their profits to obtain similar benefits.

This assumption leads to the indifference condition, $\pi_b^*(z) = w_b(1+\tau)$, which pins down the productivity level and labour demand of the marginal manager:

$$z_{min,b} = \left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha}(1+\tau)\frac{w_b}{\alpha} \tag{3}$$

$$l_{min,b} = \frac{\alpha}{1-\alpha} \tag{4}$$

Because about one-third of firms employ one employee (see Figure 2), $l_{min,b}$ should be smaller or equal to one. This requires $\alpha \leq 0.5$, implying strongly decreasing returns to scale.[15]

Labour market clearing. In equilibrium, labour demand equals labour supply:

$$\int_{z_{min,b}}^{z_{max}} l_b^*(z)\phi(z)dz = \int_1^{z_{min,b}} \phi(z)dz \tag{5}$$

The left-hand side of this condition expresses labour demand by the managers, i.e. individuals whose

[14] In Belgium, the High Council of Finance has warned that the differential tax treatment of labour and capital income provides an incentive to establish incorporated businesses, which may explain the continuous growth in incorporated businesses in Belgium (High Council of Finance, 2024).

[15] The literature on firm dynamics typically sets α in the range of 0.5 (Hsieh and Klenow, 2009) to 0.8 (Garicano et al., 2016) in order to match the firm size distribution and/or the labour share in the economy. By setting $\alpha = 0.8$, Garicano et al. (2016) implicitly assume that firms employ at least four employees (see their Appendix, equation (34)).

ability is greater than $z_{min,b}$. The right-hand side represents labour supplied by those individuals who are insufficiently productive to start their own firms. This condition determines the equilibrium wage, w_b.

Labour allocation across firms is independent of the payroll tax rate. Understanding the role of payroll taxes in this model is crucial. It turns out that the occupational choice and the allocation of labour across firms are independent of the payroll tax rate. As in the canonical tax incidence model with perfectly inelastic labour supply (Fullerton and Metcalf, 2002), an increase in the payroll tax rate is fully offset by a decrease in wages, leaving gross wages, occupational choice, employment and the allocation of labour across firms unchanged. In our model, this property follows directly from the indifference condition, which assumes that the marginal manager is indifferent between profits and gross wages.

The proof of this property is included in Appendix C, but the intuition is straightforward. Given a certain wage, a payroll tax increase reduces labour demand among existing firms. Additionally, a higher payroll tax diminishes the attractiveness of being a manager because the profits of the marginal manager must equal $w_b(1+\tau)$, prompting the least productive managers to become employees. The subsequent decline in labour demand (among existing firms) and increase in labour supply (as some managers become employees) decreases equilibrium wages. The wage decrease, in turn, boosts labour demand among existing firms and induces some employees to become managers. In equilibrium, the wage decrease perfectly offsets the higher payroll tax rate and gross wages remain constant. Consequently, the share of managers in the labour force and labour allocation across firms are unaffected by the payroll tax.

5.2 A Lucas model with *size-dependent* payroll taxes

We now introduce the payroll tax exemption for the first employee by setting τ equal to zero for the first employee while keeping τ unaltered for subsequent employees. The exemption affects the profit function and makes it more attractive to be a manager rather than an employee. This, in turn, affects optimal labour demand and the firm size distribution.

Our set-up assumes that firms do not share the subsidy with their subsidised worker but pay the same market wage to each employee. This is a plausible assumption for at least three reasons. First, wages in Belgium are set by collective bargaining agreements, and firm-specific wage top-ups are uncommon (Du Caju et al., 2012). Second, the subsidy is not tied to a specific employee, implying that the subsidised worker cannot threaten the employer to leave the firm. In addition, fairness considerations within firms make it unlikely that similar workers get a different wage (Benzarti, 2024). Finally, several recent papers find no pass-through to wages of hiring subsidies and payroll

tax cuts on the eligible population (e.g., Saez et al. 2019 in Sweden, Cahuc et al. 2019 in France), in particular when the payroll tax cut does not affect future benefits of the employees (Bozio et al., 2019), as in the case in our setting. Albanese et al. (2024) find no effect on wages of a generous hiring subsidy for lower-educated youth in Belgium.

Optimal labour demand of managers. The profit function of managers after the reform is:

$$\pi_a(z,l) = \begin{cases} zl^\alpha - w_a l & l \leq 1 \\ zl^\alpha - (\tau+1)w_a(l-1) - w_a & l > 1 \end{cases} \tag{6}$$

Then, the optimal labour demand of managers is given by the first order conditions:

$$l_a^*(z) = \begin{cases} \left(\frac{\alpha z}{w_a}\right)^{\frac{1}{1-\alpha}} & z < \underline{z}_{1,a} \\ 1 & z \in [\underline{z}_{1,a}; \overline{z}_{1,a}] \\ \left(\frac{\alpha z}{w_a(1+\tau)}\right)^{\frac{1}{1-\alpha}} & z > \overline{z}_{1,a} \end{cases} \tag{7}$$

Managers with productivity between $\underline{z}_{1,a} = w_a/\alpha$ and $\overline{z}_{1,a} = w_a(1+\tau)/\alpha$ employ exactly one employee. This means that labour demand bunches at one employee.

Optimal labour demand determines the profits, $\pi_a^*(z)$, that individuals with ability z will earn if they choose to be managers. Profits are strictly positive and are strictly increasing in z.

Occupational choice. As in the pre-reform period, individuals choose to be managers if profits exceed gross wages. The marginal manager is indifferent between being a manager or an employee if $\pi_a^*(z) = w_a(1+\tau)$. This condition pins down $z_{min,a}$ and $l_{min,a}$:

$$z_{min,a} = \left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} (1+\tau)^{1-\alpha} \left(\frac{w_a}{\alpha}\right) \tag{8}$$

$$l_{min,a} = \frac{(1+\tau)\alpha}{1-\alpha} \tag{9}$$

Individuals whose managerial ability exceeds $z_{min,a}$ are managers, while those with a lower ability level are employees.

Labour market clearing. In equilibrium, the following market clearing condition pins down the

equilibrium wage, w_a:

$$\int_{z_{min,a}}^{\underline{z}_{1,a}} l_a^*(z)\phi(z)dz + \int_{\underline{z}_{1,a}}^{\overline{z}_{1,a}} \phi(z)dz + \int_{\overline{z}_{1,a}}^{z_{max}} l_a^*(z)\phi(z)dz = \int_1^{z_{min,a}} \phi(z)dz. \tag{10}$$

The terms on the left-hand side denote labour demand by managers who have (1) fewer than one employee, (2) exactly one employee; and (3) more than one employee. The term on the right-hand side is labour supplied by individuals who are not sufficiently productive to be managers.

5.3 The pre-reform vs. post-reform period

The key element to understand the impact of the reform is the relation between the minimum level of productivity required to be a manager in the pre-reform ($z_{min,b}$) and post-reform period ($z_{min,a}$). Combining equation (3) and (8) implies:

$$\frac{z_{min,a}}{z_{min,b}} = \frac{1}{(1+\tau)^{\alpha}} \frac{w_a}{w_b}. \tag{11}$$

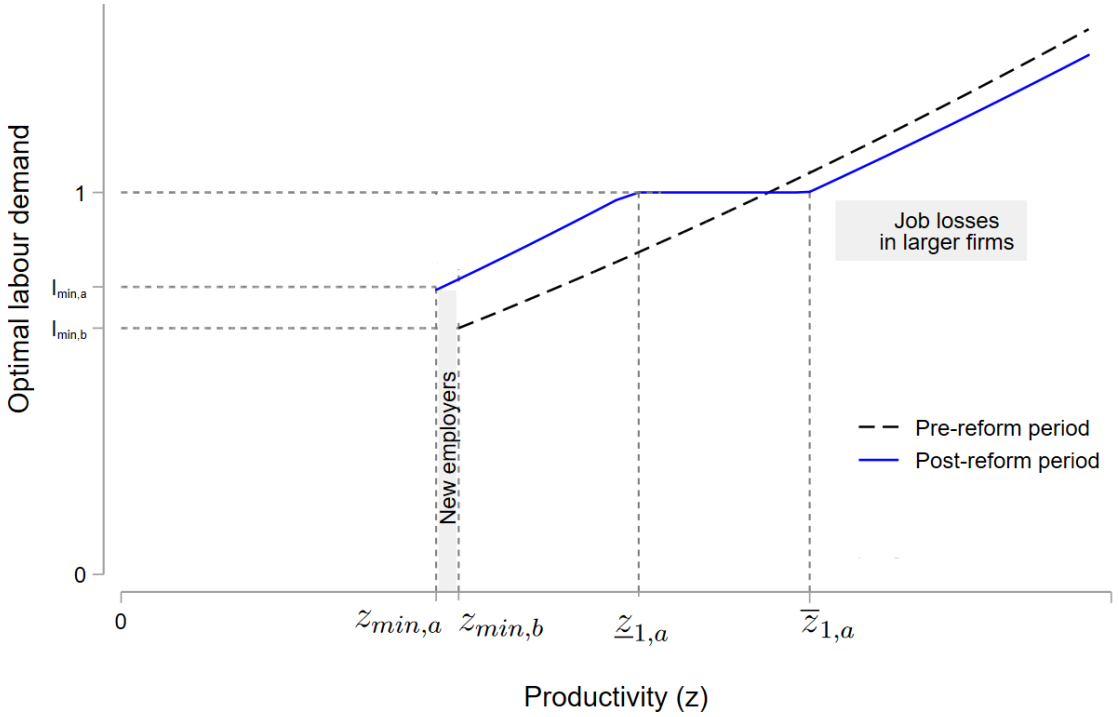
This equation shows that, if wages were to remain constant following the reform ($w_a = w_b$), the minimum productivity level required to be a manager would decrease. However, the entry of new firms increases labour demand and reduces labour supply, leading to a wage increase ($w_a > w_b$) to ensure that the labour market clears. The direct effect of τ on $z_{min,a}$ is stronger than the indirect effect through the wage increase, such that in equilibrium $z_{min,a} < z_{min,b}$.

Figure 3 helps to understand the key differences between the pre-reform and post-reform periods. It shows occupational choice and labour demand as a function of managerial ability in both periods, thereby illustrating that the precise response to the payroll tax exemption depends on someone's productivity level. While individuals with $z < z_{min,a}$ are employees in both periods, one can distinguish between three type of managers.

The first type are individuals who are just insufficiently productive to be managers in the pre-reform period, but become managers following the reform. This leads to an increase in the number of firms, as indicated by the grey bar in the figure. These managers recruit fewer than one full-time employee. The second type are managers who, pre-reform, employed fewer than one full-time employee. These managers adjust their labour demand following the reform, but remain insufficiently productive to employ more than one full-time employee after the reform. This explains why labour demand bunches at one full-time employee, a typical feature of models with kinked tax rates, as is the case in our setting (Saez, 2010). The third group are managers who, in the absence of the subsidy, would already have employed more than one full-time employee. For these managers, the payroll tax exemption

provides a windfall profit without directly affecting their optimal labour demand. However, due to general equilibrium effects driving up wages, there is a slight decrease in labour demand post-reform for this group, leading to job losses in these firms.

Figure 3: Occupational choice and optimal labour demand in the pre-reform and post-reform period



Effect on the number of firms. Using equation (11) allows us to compute the relative increase in the number of firms after the reform:

$$\frac{\text{New firms}}{\text{Number of firms pre-reform}} = \frac{\int_{z_{min,b}}^{z_{min,a}} \phi(z)dz}{\int_{z_{min,b}}^{z_{max}} \phi(z)dz} = C\left[\tau^{\alpha(\gamma-1)} \underbrace{\left(\frac{w_a}{w_b}\right)^{1-\gamma}}_{<1,\text{ general equilibrium effects}} - 1\right] \tag{12}$$

The second equality is derived assuming that managerial ability follows a bounded Pareto distribution, $\phi(z) = [\frac{\gamma-1}{1-z_{max}^{1-\gamma}}]z^{-\gamma} = \delta z^{-\gamma}$, where $\gamma > 1$ and $z \in [1, z_{max}]$. Section 6 motivates this choice. $C = 1/(1 - (\frac{z_{max}}{z_{min,b}})^{1-\gamma}) \approx 1$.[16]

Equation (12) demonstrates that the wage increase in general equilibrium ($w_a > w_b$) dampens the positive effect of the payroll tax exemption on the growth in the number of firms, compared to a scenario that assumes the absence of general equilibrium effects on wages.

Effect on employment and aggregate output. The effect on employment and aggregate output

[16]Equation (1) implies that $\frac{z_{max}}{z_{min,b}} = (\frac{l_{max,b}}{l_{min,b}})^{1-\alpha}$, where $l_{min,b}$ and $l_{max,b}$ are respectively the minimum and maximum firm size determined by the productivity of the marginal manager ($z_{min,b}$) and the productivity of the manager with the highest productivity level (z_{max}) in the pre-reform period. Hence, $(\frac{z_{max}}{z_{min,b}})^{1-\gamma} = (\frac{l_{max,b}}{l_{min,b}})^{1-K} \approx 0$, because $K = \gamma(1-\alpha) + \alpha > 1$ and $l_{max,b} >> l_{min,b}$.

is determined by two opposite forces. On the one hand, labour demand and output increase in firms with at most one employee before the reform. On the other hand, higher wages reduce labour demand and output in larger, more productive firms (see Figure 3). Eventually, the reallocation of labour from high-productivity to low-productivity firms reduces aggregate output and employment.

More formally, let $z_{1,b}$ denote the productivity level of managers with exactly one employee and $L_{b,\text{large firms}}$ total employment in firms with more than one employee in the pre-reform period. Then, the difference in aggregate labour demand in the post-reform vs. the pre-reform period is:

$$L_a - L_b = \underbrace{\int_{z_{min,a}}^{z_{min,b}} l_a^*(z)\phi(z)dz}_{\text{Job creation in new firms}} + \underbrace{\int_{z_{min,b}}^{z_{1,b}} [l_a^*(z) - l_b^*(z)]\phi(z)dz}_{\substack{\text{Job creation in existing firms} \\ \text{employing less than one employee pre-reform}}} + \underbrace{\int_{z_{1,b}}^{z_{max}} [l_a^*(z) - l_b^*(z)]\phi(z)dz}_{\text{Job losses in larger firms}}$$

$$\approx \underbrace{\int_{z_{min,a}}^{z_{min,b}} l_a^*(z)\phi(z)dz + \int_{z_{min,b}}^{z_{1,b}} (l_a^*(z) - l_b^*(z))\phi(z)dz}_{\text{Job creation in firms with at most one employee}} - \underbrace{[1 - (\frac{w_b}{w_a})^{\frac{1}{1-\alpha}}]L_{b,\text{large firms}}}_{\text{Job losses in larger firms}} < 0 \quad (13)$$

The first two terms capture the increased labour demand by new firms and by firms that would have employed less than one full-time employee in the pre-reform period but expand in the post-reform period. The third term captures the job losses in firms with more than one employee caused by the wage increase.[17] This term illustrates that a small wage increase can cause a decline in overall employment because firms with more than one employee account for the lion's share of total employment. Job losses in large firms exceeded job creation in new and small firms for the simple reason that the tax exemption induces some employees to become managers. Given that the labour force is fixed, the share of employees in the labour force must, therefore, decrease.

Similarly, the effect of the tax exemption on aggregate output in general equilibrium can also be decomposed into a positive effect on firms with one employee and a negative effect on larger firms:

$$Y_a - Y_b \approx \underbrace{\int_{z_{min,a}}^{z_{min,b}} l_a^{*\alpha} z\phi(z)dz + \int_{z_{min,b}}^{z_{1,b}} (l_a^*(z)^\alpha - l_b^*(z)^\alpha)z\phi(z)dz}_{\text{Additional output in firms with one employee}} - \underbrace{[1 - (\frac{w_b}{w_a})^{\frac{\alpha}{1-\alpha}}]Y_{b,\text{large firms}}}_{\text{Output loss in larger firms}} < 0 \quad (14)$$

Because of decreasing return to scale, the reduction in output in larger firms is smaller than the reduction in employment. Again, there is no output loss in large firms if wages do not adjust.

[17] $\int_{z_{1,b}}^{z_{max}} (l_a^*(z) - l_b^*(z))\phi(z)dz \approx -[1 - (\frac{w_b}{w_a})^{\frac{1}{1-\alpha}}]L_{b,\text{large firms}}$ is derived assuming that managerial ability follows a bounded Pareto distribution. Because we neglect job losses in firms with productivity between $z_{1,b}$ and $\overline{z}_{1,a}$, i.e. firms whose labour demand is exactly equal to one in the post-reform period but slightly higher than one in the pre-reform period.

6 Calibration

Following the literature, we assume that managerial ability follows a bounded Pareto distribution, $\phi(z) = [\frac{\gamma-1}{1-z_{max}^{1-\gamma}}]z^{-\gamma} = \delta z^{-\gamma}$, where $\gamma > 1$ and $z \in [1, z_{max}]$. This functional form allows us deriving the pre-reform firm size distribution, which is the key moment targeted in the calibration (see Appendix E). The pre-reform firm size distribution is a bounded Pareto distribution with parameter $K = \gamma(1-\alpha)+\alpha$ and support $[l_{min,b}, l_{max,b}]$, where $l_{min,b}$ and $l_{max,b}$ are respectively the minimum and maximum firm size determined by the productivity of the marginal manager ($z_{min,b}$) and the productivity of the manager with the highest productivity level (z_{max}).

Therefore, the model contains four fundamental parameters: α, γ, z_{max} and τ. We set $\tau = \frac{1+\tau_{1,b}}{1+\tau_{1,a}} - 1 = 0.15$[18] to match the ratio of the expected payroll tax for the first employee in the pre-reform and the post-reform period. Recall that, in the baseline model, the level of τ does not affect the optimal value of α, γ and z_{max} because the firm size distribution is independent of τ.

We obtain α, γ, and z_{max} by matching the average firm size while minimizing the distance between the observed and simulated firm size distribution in 2015Q3.[19,20] More specifically, we minimize the following chi-square statistic:

$$\min_{\alpha,\gamma}\Big[\sum_{i=1}^{15}\frac{(observed_i - simulated_i)^2}{simulated_i} + \frac{(observed_{>15} - simulated_{>15})^2}{simulated_{>15}}\Big]$$

where $observed_i$ and $simulated_i$ denote the observed and simulated share of firms employing exactly i employees; and $observed_{>15}$ and $simulated_{>15}$ denote the observed and simulated share of firms with more than 15 employees.

Table 3 shows the optimal values of α, γ and z_{max} along with the minimum level of productivity required to start a firm and the minimum and maximum firm size, while Figure 4 compares the observed versus the simulated firm size distribution. Our parsimonious model matches the firm size distribution in the pre-reform period relatively well. The share of firms employing one employee (30.5%) is almost perfectly matched by the model (29.8%). The model overstates the share of firms employing exactly two employees (16.5% in reality vs. 20.3% in the model) and the share of firms

[18] This choice is motivated by equation (D.5) of the extended model, and corresponds to assuming that the payroll tax rate only changed for the first employee in the post-reform period, but remained unaltered for subsequent employees.

[19] 2015Q3 is the quarter preceding the announcement of the policy. This choice is innocuous because the firm size distribution is remarkable stable from 2009Q1 to 2015Q3, with the share of firms with one (two) employee(s) out of firms with at most fifteen employees ranging from 34.6% (18.7%) to 35.1% (18.9%). The average firm size in the private sector in 2015Q3 was 10.84.

[20] The calibration follows a simple iterative procedure. In the first step, we choose starting values for γ and α, which pins down $l_{min,b}$. In the second step, we determine the equilibrium wage, w_b, so that labour demand equals labour supply, and determine z_{max} so that the simulated average firm size equals the observed average firm size. This step determines $l_{max,b}$. In the third step, we compute the firm size distribution, and compare the simulated and observed firm size distribution. We obtain the optimal values of α and γ by repeating steps 2 and 3 until the chi-square statistic reaches a minimum.

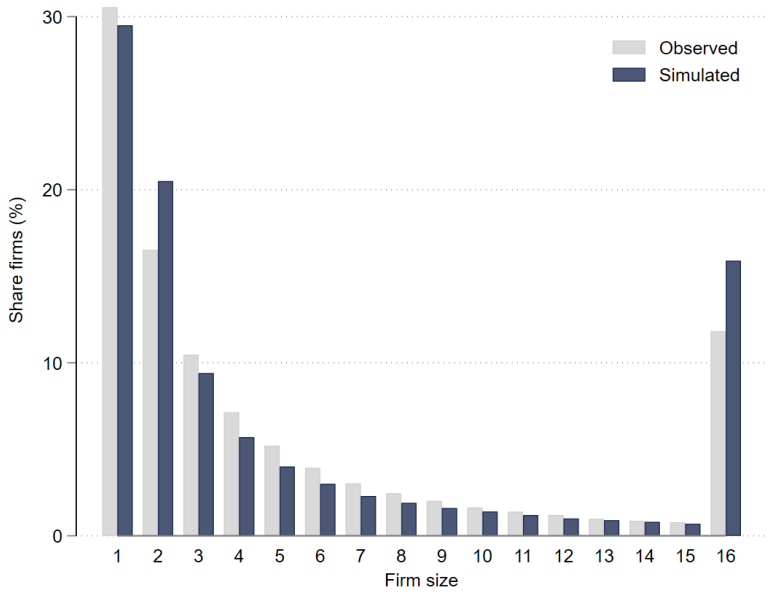
employing more than 15 employees (11.8% vs. 16.0%).

Table 3: Optimal parameter values

Fundamental parameters	
α	0.32
γ	1.63
z_{max}	2,417
Derived parameters	
$z_{min,b}$	44.2
$l_{min,b}$	0.47
$l_{max,b}$	172

Our calibrated parameters come with two caveats. First, the choice of a bounded Pareto distribution implies that one can either accurately match the distribution of small or large firms, but rarely both (Dewitte et al., 2022). We choose to match the distribution of firms with 15 employees because small firms are directly affected by the payroll tax exemption. In our setting, it is crucial to accurately match the share of firms with one employee, as these firms benefit most from the subsidy. The implication of this choice is that the employment distribution in large firms is poorly matched by the model. For instance, our model predicts that firms with more than 100 employees employ 28.1% of the employees, while these firms actually employ 52.7% of the employees. The mismatch occurs because our model imposes a maximum firm size of 172, which rules out the existence of very large firms that account for a disproportionate share of employment.

Figure 4: Simulated versus observed firm size distribution in the pre-reform period



Second, while we do not explicitly impose the condition that $\alpha < 0.5$ when calibrating the model, this condition is naturally met. Firms with one employee only exist if $\alpha < 0.5$ (see eq. (4)), and

since almost one-third of firms have one employee, the optimal value of α must be smaller than 0.5.

The low value of α implies that the labour share of output is not matched. Given the Cobb-Douglas production function, the share of output spent on labour equals α, while the share spent on the other input (here: the managers) equals $1-\alpha$. In our specific setting, the labour share is split between the employees, who get α/τ, and the government, which gets $\alpha(\tau-1)/\tau$. With the optimal value of α being 0.32, the labour share of output is 32%, split between employees (28%) and the government (4%). This is low compared to what is typically reported in the national accounts.[21]

The main explanation for the discrepancy between the simulated labour share and the one reported in the national accounts, is that, empirically, the labour share is lower in small firms than at the aggregate level. To illustrate this, we compute the labour share by firm size using our firm-level data on turnover, the wage bill (including payroll taxes), and intermediate inputs. We define the labour share at the firm-level as the 'wage bill' divided by 'turnover minus intermediate inputs' (Appendix B). In our model, the labour share is always equal to α, but in the data, the labour share increases with firm size . The median labour share in firms with one employee is 21%, rising to 60% for firms with 10-15 employees. Since we match the size distribution of firms with fewer than 15 employees, it is expected that our estimate of α lies in-between the labour share for firms with one employee and those with 10-15 employees.

Appendix F investigates the sensitivity of our results to (1) the poor match of employment in large firms, and (2) the low value of α. Following Guner et al. (2008), we assume that a small fraction of firms have a high productivity level, whereas the productivity level of the other (small) firms continues to follow a Pareto distribution. This additional assumption helps in matching the employment distribution and allows setting the value of α to 0.8 for large firms. Our main results remain unaffected.

7 Simulation

We first test whether the predictions from the calibrated baseline model align with the empirical findings. To this end, we compare the simulated to the observed impact of the payroll tax exemption on the total number of firms. Additionally, we verify that the simulated performance of new employers that enter in response to the exemption is consistent with the empirical findings of Deng et al. (2024).

After scrutinizing the validity of our model, we leverage it to quantify the macroeconomic implications of the payroll tax exemption. Specifically, we examine its impact on wages, employment and aggregate output. Finally, we discuss its budgetary cost, and distributional implications.

[21] The labour share increases to 35% if the compensation managers receive for running the firm, about 3% of output (i.e., $w(1+\tau)$ per manager), is added to the labour share, as is common in national accounts.

The baseline model—to which we refer as the flexible-wage scenario—assumes that wages are flexible and fully adjust to ensure equilibrium in the labour market. We also consider an alternative polar scenario, termed the fixed-wage scenario, in which wages remain constant at their pre-reform level. In this scenario, the labour force—defined as the sum of managers and employees—is perfectly elastic with respect to the equilibrium wage rather than perfectly inelastic, as in the flexible-wage scenario. This assumption holds if the increased labour demand can be entirely met by attracting individuals who were previously outside the labour force (e.g., the unemployed or the inactive). Wages remain constant in the fixed-wage scenario because there is no competition among firms to attract employees.

Our baseline scenario is the flexible-wage scenario, which represents the lower-bound scenario in terms of the policy's impact on aggregate output. Indeed, since labour supply is perfectly inelastic, it leads to a reallocation of labour from the largest, most productive firms to smaller, less productive ones, resulting in a decrease in aggregate output. In contrast, the flexible-wage scenario does not involve any reallocation of labour and leads to an expansion of aggregate output. Empirically, we cannot distinguish between the flexible and fixed-wage scenarios. However, the current labour market shortages in Belgium and the relatively low labour supply elasticities reported in the literature justify our assumption that labour supply is perfectly inelastic and, consequently, our focus on the flexible-wage scenario.

7.1 Model validation

Impact on the number of firms. To empirically support our model, we compare the DiD estimate of the impact of the exemption on the number of firms with one employee to the model's prediction. We expect the DiD estimate and model prediction to be comparable for three reasons.

First, our static model simulates the new equilibrium but remains silent about the dynamics leading from the pre-reform to post-reform equilibrium. The DiD estimate captures the impact on the number of firms after three years. Therefore, the DiD estimate is comparable to the model only if the number of firms with one employee has already reached the new equilibrium within this time frame. This is plausible because new managers (i.e. those with $z < z_{min,b}$) tend to hire their first employee almost immediately after the reform (Cockx and Desiere, 2024), a finding consistent with the existing literature on labour demand adjustment to large shocks in labour costs (Hamermesh, 1989). Equally important, Figure 2 shows that the number of firms with one employee increased rapidly until the end of 2017, but remained stable between 2018Q1 and 2019Q4, suggesting that the number of firms reached a new equilibrium two years after the reform. The statement that the DiD estimate captures the long-term equilibrium is further reinforced by the observation that the number of firms with one employee in 2024, two years after the Covid-19 shock, is still approximately 7%

above its 2015Q3 level (Figure A.1).

Second, the wage increase predicted by our model affects the control group, leading to a violation of the SUTVA assumption in the DiD regressions. However, even if wages immediately increase by 0.5% following the reform rather than adjusting slowly to the new equilibrium, the impact on the control group will be limited. In the flexible-wage scenario, the number of firms with 1 employee increases by +10.18%, whereas the number of firms with 2, 3-8, and 7-8 employees decreases by −0.33% due to the rise in the equilibrium wage.

Third, our model assumes that all firms have a subsidised first employee, which is not the case three years after the reform, as it takes time for existing firms to be replaced by subsidised ones. However, this does not cause our model to under or overstate the effect of the policy on the number of firms or wages. Our simulation reveals that the increase in labour demand among firms with at most one employee that would also have existed without the exemption only marginally contributes to the total change in employment and output post-reform. In other words, the wage increase is primarily caused by the entry of new employers rather than by increased labour demand among existing firms.[22]

Given that these three conditions are met, it is reassuring to observe that the DiD estimate (+7.2%) is remarkably close to the model prediction, as reported in Table 4. The model predicts that the number of firms with one employee increases by 10.5% (fixed-wages) or 10.2% (flexible-wages). This demonstrates that our simple, frictionless model, which consists of only four fundamental parameters and is calibrated using pre-reform data only, matches a key empirical fact in the post-reform period surprisingly well. As we will discuss in Section 7.4, the simulated impact gets even closer to the DiD estimate when taking into account that the tax shift decreased the payroll tax rate for all employees.

Productivity of new employers. Our model is static and abstracts from firm growth, thereby assuming that firms immediately reach their optimal size. For this reason, our predictions relate to the stock of firms. This makes it challenging to compare empirical findings related to the flow of entrants to the model predictions. However, the predictions and the empirical findings of Deng et al. (2024), who study firm performance of cohorts of new entrants in the pre-reform and post-reform periods, are at least qualitatively similar. They show that the number of new entrants was 24% higher in 2016 than 2015, and report that the 2016 cohort of new entrants recruits fewer employees at entry and employs fewer employees in subsequent years than the previous cohort.

A key feature of our model is that the increase in the total number of firms is entirely driven by the entry of low-productivity firms with at most one employee, without any increase in the number of

[22] Assuming that only firms that would not have existed absent the subsidy (i.e. those with $z < z_{\min,b}$) hire after the reform and ignoring labour adjustments among firms that already employed one or fewer employees before the reform limits the increase in the equilibrium wage to 0.34% instead of 0.52%. This shows that the wage increase is primarily caused by the new employers.

firms with more than one employee. In our model, a 24% increase in the number of entrants would reduce the share of entrants with at least two (three) employees at entry by 4.0 (2.5) percentage points.[23] This reduction is greater than but qualitatively comparable to the empirical estimates of Deng et al. (2024) who find a decline of 2.40 (1.10) percentage points in the share of entrants with at least two (three) employees at entry.

7.2 Macroeconomic implications

In this section, we leverage our model to reflect on the macroeconomic effects of the tax exemption when all firms employ a subsidised first employee. Specifically, Table 4 examines the impact of the tax exemption in the fixed-wage (column 1) and flexible-wage (column 2) scenarios on the following three macroeconomic outcomes: (1) number of employees, (2) average firm size, and (3) aggregate output. We report the relative change between the post-reform and pre-reform period.

In the fixed-wage scenario, the labour force (defined as the sum of managers and employees) expands by 0.75%. This small expansion of the labour force is sufficient to ensure that the increase in managers and the additional labour demand by these new managers can be met. In the flexible-wage scenario, wages increase by 0.52%. This modest wage increase is sufficient to ensure that the additional labour demand from new managers is compensated by job losses in larger firms.

Table 4: Impact on the number of firms, the macro economy, and the government budget

	Fixed wages	Flexible wages
Defining characteristics of each scenario (%Δ)		
Minimum productivity level	−4.04%	−3.91%
Wage rate	0.00%	+0.52%
Labour force	+0.75%	0.00%
Evolution of the number of firms (%Δ)**:**		
Number of firms with one employee	+10.54%	+10.18%
Number of firms	+3.13%	+2.77%
Evolution of macro economic indicators (%Δ)**:**		
Number of employees	+0.53%	−0.26%
Average firm size	−2.53%	−2.95%
Output	+0.25%	−0.01%
Budgetary cost (% output$_b$)	0.36%	0.36%

The implications of the policy are different depending on whether the labour force or wages adjust. In the fixed-wage scenario, the expansion of the labour force leads to a 0.53% increase in the number of employees, which in turn increases aggregate output by 0.25%. Because wages are assumed to remain constant, the policy has no negative spillover effect on firms with more than one employee and

[23] In the pre-reform period, 25.9% (13.0%) of the new entrants hired at least two (three) employees. A 24% increase of new entrants with at most one employee decreases the share of new entrants with least two or three employees to 20.9% (=29.9%/124%) and 10.5% (=13.0%/124%), respectively.

does not lead to labour reallocation between firms. This explains why the key economic indicators evolve favourably in this scenario.

By contrast, the wage increase in the flexible-wage scenario causes job losses in firms with more than one employee and leads to a small reduction in aggregate output. In this scenario, the 2.77% increase in the number of managers is compensated by a 0.26% decrease in the number of employees to ensure that the labour force remains constant. As a result, in the post-reform period, 91.3% of the labour force are employees and 8.7% are managers, compared to, respectively, 91.6% and 8.4% in the pre-reform period. At the same time, we observe a shift from employment in firms with more than one employee to employment in firms with at most one employee. The share of employees in firms with one employee increases from 1.9% in the pre-reform period to 2.4% in the post-reform period, offset by a corresponding decrease in employment in firms with more than one employee. The reallocation of labour from high-productivity to low-productivity firms results in a negligible loss in output (−0.01%).

7.3 The budgetary cost and the distributional impact

Budgetary cost. From a policy perspective, the main implication of the payroll tax exemption is the reduction in government revenues. Once all firms benefit from the tax exemption, both scenarios predict its budgetary cost at 0.36% of output. The budgetary cost is computed as the difference in the share of government revenues in the post-reform and pre-reform period, relative to pre-reform output. A back-on-the-envelope computation suggests that this is a realistic long-term prediction.[24]

Budget constraint. To further illustrate the substantial loss in government revenues, we introduce a budget constraint in the flexible-wage scenario. More specifically, we assume that the government increases the payroll tax rate for all employees except the first one to balance the books. This approach allows us to examine the extent to which the payroll tax rate has to increase in order to exempt the first employee in each firm from payroll taxes. The simulation shows that the payroll tax rate must increase by a sizeable 1.2 percentage points, from 15% to 16.2%, to balance the budget (Table 5, column 2).

The tax increase makes the exemption for the first employee more valuable, leading to a further increase in the number of firms with at most one employee and reinforcing the reallocation of labour from large to small firms. The rise in the payroll tax rate reduces wages. Without a budget constraint, wages increase by 0.52%. With a budget constraint, wages decrease by 1.11%. Balancing the budget

[24] According to the NSSO, the private sector in Belgium counted 216,450 firms in 2015Q3 and employed 2.22 million full-time equivalent employees. When all firms receive the subsidy, 9.8% of the employees will be exempt from payroll taxes, which is consistent with the model predictions of 8.9%. The average annual cost per subsidised employee in 2018-19 is €7,769, so the total cost is in the order of 1.69 billion euros, or 0.35% of GDP.

Table 5: Effect of the policy without and with a budget constraint (flexible wages)

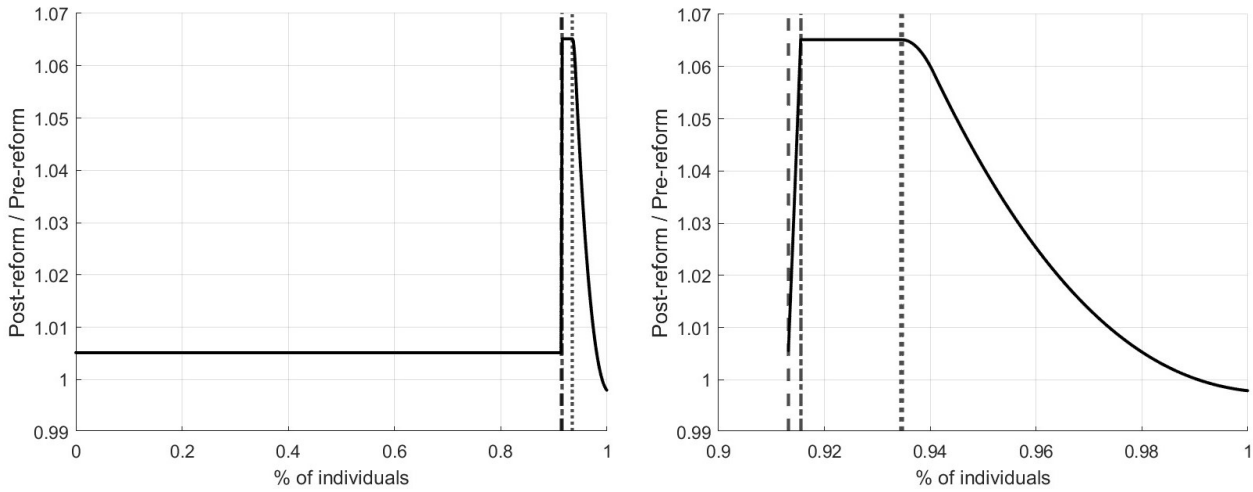
	No budget constraint	Budget constraint
Number of firms with one employee	+10.18%	+11.31%
Wages	+0.52%	−1.11%
Output	−0.010%	−0.012%
Budgetary cost (% output)	0.36%	0.00%
Payroll tax rate	15%	16.2%

occurs at the expense of employees' wages.

Distributional impact in the flexible-wage scenario. The distributional impact depends on someone's managerial ability. The left panel of Figure 5 shows the ratio of someone's income (either wages or profits) in the post-reform to the pre-reform period, ranking individuals by managerial productivity. The gains are modest for the large majority (90%) of individuals who are employees in both periods. This group experiences a 0.52% wage increase. By contrast, managers experience more substantial gains, although the 1% most productive managers lose out from the policy.

Figure 5: Income ratio in the post-reform vs pre-reform period

(a) All individuals (b) Managers



Notes: The dashed line identifies $z_{min,a}$, the dash-dotted line identifies $z_{min,b}$, while the dotted line identifies $\underline{z}_{1,a}$.

The right panel of Figure 5 zooms in on the managers, showing the gains or losses for those individuals who manage firms in the post-reform period. The figure illustrates that individuals with managerial ability between $z_{min,b}$ and $\underline{z}_{1,a}$, meaning those who were just sufficiently productive to be managers in the pre-reform period, benefit most from the policy. Following the reform, their profits increase by 6.5%. Profits increase less for larger firms, and even slightly decline for firms with more than 25 employees. For these larger firms, the reduction of profits due to the wage increase is not compensated by the tax exemption for the first employee.

Individuals who become managers following the reform, i.e. those with productivity between $z_{min,a}$ and $z_{min,b}$, are also better off in the post-reform period, with post-reform profits being 0.5% to 6.5% higher than their pre-reform wages. The benefits for the post-reform marginal managers are exactly equal to those for individuals who are employees in both periods.

7.4 The extended model - impact of the tax shift

The extended model, discussed in Appendix D, allows for size-dependent payroll taxes in the pre-reform and post-reform periods. One advantage is that we can account for the fact that firms with only one employee were paying a lower payroll tax rate than larger firms even before the reform (18.3% vs 26.9%). We find that the calibrated values of α and γ (see Table D.1) are largely identical in this model compared to the baseline model, indicating that not accounting for this wedge in the payroll tax rate before the reform does not significantly bias the value of the calibrated parameters. Then, we introduce the exemption while we assume that payroll taxes for firms with more than one employee did not change from the pre-reform to the post-reform period (Table 6, column 2). This choice implies that $\tau_{2,b} = \tau_{2,a} = 27\%$, while the payroll tax rate for the first employee changes from $\tau_{1,b} = 18\%$ in the pre-reform to $\tau_{1,a} = 3\%$ in the post-reform period. The extended model leads to similar conclusions as our baseline model (Table 6, column 1), illustrating that our results are robust to having size-dependent payroll taxes also in the pre-reform period.

Table 6: Impact of the SSC exemption and the tax shift in the extended model

	Baseline model	Extended model	
	(flexible wages)	Tax exemption	Tax exemption & tax shift
Evolution of:			
Wages	+0.52%	+0.52%	+3.10%
Number of firms with one employee	+10.18%	+10.93%	+8.85%
Output	−0.01%	−0.02%	−0.02%

Notes: The baseline model sets the payroll tax rate at 15%. The extended model contains four tax rates. In column (2), we set the payroll tax rate for the first employee at 18.3% and 2.9% in the pre-reform and post-reform period, respectively, and assume that the tax rate for subsequent employees is 26.9% in both periods. In column (3), we model the impact of the tax shift by changing the payroll tax rate in the post-reform for firms with more than one employee to 23.6%.

Additionally, the extended model enables us to simulate the impact of the payroll tax exemption in combination with the tax shift, which reduced the payroll tax rate for firms with more than one employee by 3.3 percentage points, from 26.9% in 2015 to 23.6% in 2019 (see Table 1). The model reveals that the combination of both policies leads to a smaller increase in the number of firms with one employee (+8.9%) than the tax exemption alone (+10.9%) (Table 6, column 2). This brings our empirical DiD estimate of the evolution of the number of firms with one employee between 2015 and 2019 even closer to the model prediction. Intuitively, the tax shift reduces the relative value of the tax exemption, which makes it less attractive to hire a first employee, and dampens the increase in the number of firms. The main effect of the tax shift is to increase wages by 3.1%. This effect is

expected because, even in a model with size-dependent taxes, general payroll tax reductions primarily increase wages, with limited effects on the allocation of labour across firms.

8 Conclusion

This paper evaluates a unique size-dependent policy in Belgium that subsidises the first employee of new employers. We found empirically that the policy increased the number of firms with one employee by 7.2% three years after its implementation, without much evidence of an increase in the number of firms with more than one employee.

We then developed a frictionless occupational choice model, calibrated using pre-refom data. The key take-away from our paper is that this simple model accurately predicts the actual increase in the number of firms with one employee. This indicates that, at least in our setting, modelling market failures is not necessary to evaluate the effect of this size-dependent policies on the number of firms.

Our results raise an intriguing question: why does a frictionless model accurately predict the impact of this size-dependent policy? A tempting conclusion is that market failures are either insignificant or do not impede entrepreneurs from hiring their first employee. However, this seems unlikely, as a voluminous literature documents that young firms face market failures, particularly credit constraints. Perhaps the specific policy we evaluate is not well-suited to support highly productive entrepreneurs that refrain from hiring. As Acemoglu et al. (2018) and De Haas et al. (2022) point out, effective subsidies for start-ups must be targeted at high-potential start-ups while disencouraging low-productivity entrants. However, the exemption does the opposite, disproportionately benefiting firms with a single employee over those intending to grow quickly. Furthermore, it might be that access to and the cost of capital, rather than the cost of the first employee, is the main bottleneck for firms aiming to scale up.

The model enables us to consider the macro implications of the policy in the long-run when all firms employ a subsidised employee. In our preferred scenario—where labour supply is perfectly inelastic and wages fully flexible—labour demand from new firms is entirely offset by job losses in larger firms. The increased labour demand from the additional firms with a single employee results in a slight wage increase (+0.5%), causing a reallocation of labour from large, high-productivity firms to low-productivity firms with a single employee. This shift leads to a negligible reduction in output (−0.01%). In contrast, the polar scenario—where labour supply is perfectly elastic and wages remain fixed—leads to an expansion of the labour force (+0.75%) and a modest increase in output (+0.25%). Regardless of the scenario, the main winners of the policy are managers of firms with a single employee, who experience an income gain of up to 6.5%. The main loser is the government,

as the long-term budgetary cost, estimated at 0.36% of output, is sizeable.

Our evaluation does not provide economic arguments to justify this policy. However, it could still be supported for other reasons, such as a preference for small businesses. In this sense, the limited negative impact on output may be reassuring. Nevertheless, the budgetary cost remains a concern, raising difficult questions about who will ultimately bear the budgetary cost of the subsidy for the first employee.

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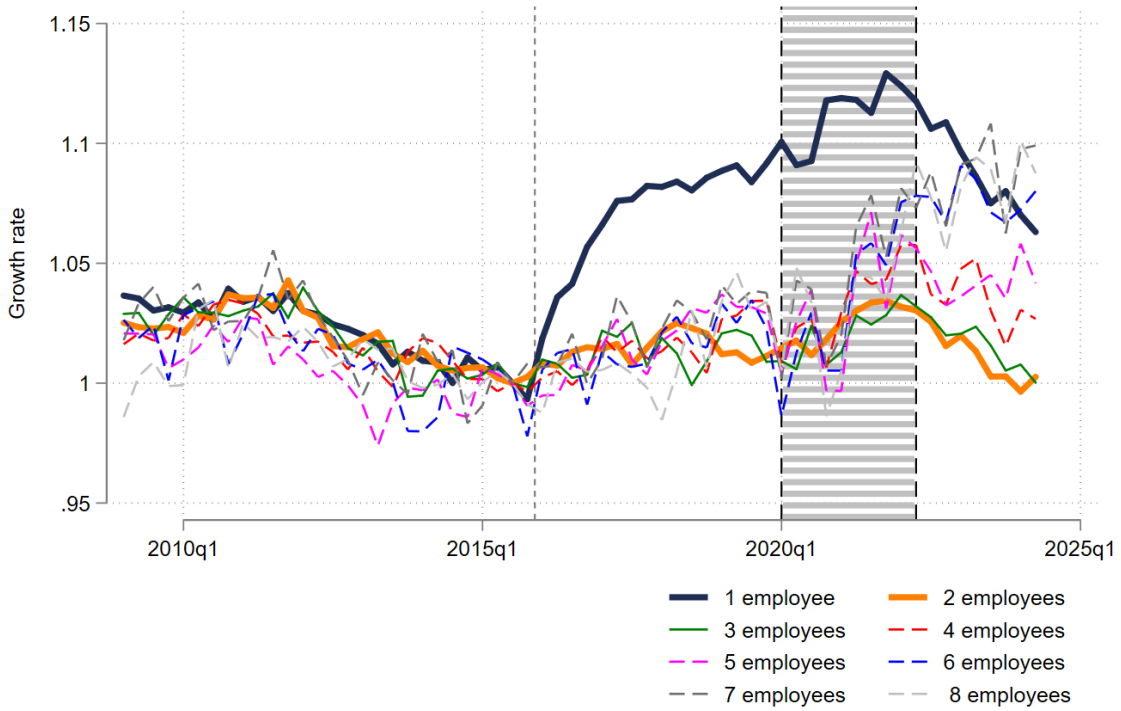
A Additional results

Figure A.1: Growth in the number of firms before and after the COVID-19 pandemic - NSSO data



Notes: The figure shows the evolution of the number of firms by firm size relative to 2015Q3 based on aggregated NSSO data on the number of firms by firm size. The first dashed line indicates the start of the policy in 2016Q1. The shaded area indicates the COVID-19 period. The number of firms is systematically higher in the NSSO data (used here) than the NBB data (used in the main text). According to the NSSO data, in 2015Q3, Belgium counted 69,257 firms with one employee, 34,910 firms with two employees, 21,459 firms with three employees, 14,405 employees with four employees, 10,365 firms with five employees, 7,804 firms with six employees, 6,023 firms with seven employees, and 4,888 firms with eight employees.

B Labour share in firm-level data

Using the NBB firm-level data, Table B.1 reports annual turnover, the wage bill (including payroll taxes), and inputs by firm size for the period 2014Q4-2015Q3. We first computed the median outcome by quarter, and then summed the medians over the four quarters.

Table B.1: Annual turnover, wage bill, inputs and labour share (2014Q4-2015Q3), by firm size

Firm size	Turnover	Wage bill	Inputs	Labour share
1	194,817	22,521	109,574	21%
2	310,609	50,468	180,530	34%
3	427,513	81,695	249,964	41%
4	554,598	115,450	316,838	45%
5	684,585	152,650	393,689	48%
6	824,945	190,928	470,151	51%
7	978,367	228,923	572,118	53%
8	1,156,398	271,276	674,677	54%
9	1,307,846	313,843	777,627	55%
10	1,441,123	353,528	866,435	56%
11	1,657,691	396,784	982,107	58%
12	1,781,542	443,269	1,093,195	59%
13	1,969,981	478,187	1,232,854	60%
14	2,102,829	520,201	1,311,362	61%
15	2,413,063	563,978	1,500,153	60%

The 'labour share', reported in the last column, is defined as the ratio of the wage bill to value added, defined as turnover minus inputs. We computed the labour share of the median firm by quarter, and report the average over these four quarters. The labour share increases gradually with firm size, from 21% for firms with one employee to 60% for firms with 15 employees.

C The equilibrium is independent of the payroll tax rate

It is straightforward to prove that the payroll tax rate does not affect labour allocation across firms in the model with size-independent payroll taxes. Using the indifference condition of the marginal manager (eq. (3)), we can write optimal labour demand in function of $z_{min,b}$ and α:

$$l_b^*(z) = \frac{\alpha}{1-\alpha}\left(\frac{z}{z_{min,b}}\right)^{\frac{1}{1-\alpha}}, z > z_{min,b} \tag{C.1}$$

Substituting this expression in the equilibrium condition (eq. (5)) gives:

$$\int_{z_{min,b}}^{z_{max}} \frac{\alpha}{1-\alpha}\left(\frac{z}{z_{min,b}}\right)^{\frac{1}{1-\alpha}} \phi(z)dz = \int_{1}^{z_{min,b}} \phi(z)dz \tag{C.2}$$

This equation explicitly determines $z_{min,b}$ as a function of the parameter of the production function, α, and the parameters of the probability density function, $\phi(z)$. This proves that, in equilibrium, $z_{min,b}$ does not depend on τ.

Combining this finding with the definition of $z_{min,b}$ (eq. (3)), implies that:

$$\frac{dz_{min,b}}{d(1+\tau)} = \frac{d}{d(1+\tau)}\left[\left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} w(1+\tau)\right] = 0 \Rightarrow \frac{d[w(1+\tau)]}{d(1+\tau)} = 0 \Rightarrow \epsilon^{w}_{1+\tau} = \frac{d[log(w)]}{d[log(1+\tau)]} = -1 \tag{C.3}$$

This last expression shows that the elasticity of the wage with respect to the change in the payroll tax is equal to -1. In other words, a change in the payroll tax rate is fully absorbed by the wage.

D Model extension: size-dependent payroll taxes in both periods

The baseline model assumes that (1) the payroll tax rate in the pre-reform period does not depend on the firm size; (2) the payroll tax rate is the same in the pre-reform and post-reform period, except for the first employee; and (3) the payroll tax rate for the first employee is exactly equal to zero in the post-reform period.

As documented in Table 1, these simplifying assumptions do not hold perfectly because firms hiring their first employee received temporary payroll tax reductions in the pre-reform period, the tax shift reduced the payroll tax rate for all firms in the post-reform period, and the payroll tax rate for the first employee in the post-reform period is not exactly equal to zero.

It is straightforward to relax these assumptions. To this end, we distinguish between the payroll tax rate for the first employee, τ_1, and the rate for subsequent employees, τ_2, in the pre-reform and post-reform periods (with $\tau_2 > \tau_1$ in both periods). Consequently, the extended model contains four payroll tax rates, depending on the firm size and the period. The introduction of two payroll tax rates leads to the following profit function:

$$\pi(z,l) = \begin{cases} zl^{\alpha} - (1+\tau_1)wl & l \leq 1 \\ zl^{\alpha} - (1+\tau_2)w(l-1) - (1+\tau_1)w & l > 1 \end{cases} \tag{D.1}$$

The first-order conditions determine optimal labour demand:

$$l^*(z) = \begin{cases} 0 & z < z_{min} \\ \left(\frac{\alpha z}{(1+\tau_1)w}\right)^{\frac{1}{1-\alpha}} & z \in [z_{min}; z_{1,\tau_1}[\\ 1 & z \in [z_{1,\tau_1}; z_{1,\tau_2}] \\ \left(\frac{\alpha z}{w(1+\tau_2)}\right)^{\frac{1}{1-\alpha}} & z \geq z_{1,\tau_2} \end{cases} \tag{D.2}$$

Labour demand bunches at one full-time employee because firms with a productivity between $z_{1,\tau_1} = w(1+\tau_1)/\alpha$ and $z_{1,\tau_2} = w(1+\tau_2)/\alpha$ are sufficiently productive to employ a single employee, but are not sufficiently productive to pay the higher payroll tax rate for the second employee.

The assumption that the marginal manager is indifferent between earning the gross wage, $w(1+\tau_2)$, or profits, $\pi(z_{min})$, pins down z_{min} and l_{min}:

$$z_{min} = \left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} \left(\frac{w(1+\tau_2)}{\alpha}\right) \left(\frac{1+\tau_1}{1+\tau_2}\right)^{\alpha} \tag{D.3}$$

$$l_{min} = \frac{\alpha}{1-\alpha} \frac{1+\tau_2}{1+\tau_1} \tag{D.4}$$

These equations encompass equation (3) of the baseline model, which determined $z_{min,b}$ in the pre-reform period assuming that $\tau_1 = \tau_2 = \tau$, and equation (8) of the baseline model, which determined $z_{min,a}$ in the post-reform period assuming that $\tau_1 = 0$ and $\tau_2 = \tau$.

As in the baseline model, the condition that labour supply equals labour demand closes the model.

The extended model contains three new insights. First, the relation between the minimum level of productivity required to be a manager in the pre-reform and post-reform period—which plays a key role in understanding general equilibrium effects—is determined by the four payroll tax rates, and the wage response:

$$\frac{z_{min,a}}{z_{min,b}} = \frac{w_a}{w_b} \left(\frac{1+\tau_{1,a}}{1+\tau_{1,b}}\right)^{\alpha} \left(\frac{1+\tau_{2,a}}{1+\tau_{2,b}}\right)^{1-\alpha} \tag{D.5}$$

This equation simplifies to equation (11) if the three aforementioned assumptions hold, i.e. $\tau = \tau_{2,b} = \tau_{2,a} = \tau_{1,b}$ and $\tau_{1,a} = 0$.

The second insight from the extended model is that the firm size distribution (derived in Appendix E) is already distorted in the pre-reform period. Even in the pre-reform period, some firms will bunch at one employee because the payroll tax rate kinks at one employee. The payroll tax exemption in the post-reform period reinforces bunching at one employee, as the payroll tax rate for the first employee

further decreases. One concern is that the distortion in the pre-reform period biases the calibration of α, γ, and z_{max} in the undistorted baseline model. To verify this, we also calibrated the extended model (Table D.1). The values of α and γ in the baseline and extended models are similar, and the simulated firm size distribution is identical, indicating that failing to account for the empirical fact that payroll taxes are size-dependent in the pre-reform period only leads to a small bias in α and γ.

Table D.1: Optimal parameter values - baseline vs. extended model

	Baseline model	Extended model
Fundamental parameters		
α	0.32	0.33
γ	1.63	1.65
z_{max}	2,417	2,027
Derived parameters		
$z_{min,b}$	44.2	40.14
$l_{min,b}$	0.47	0.54
$l_{max,b}$	172	173

Notes: The baseline models sets $\tau = 15\%$. The extended model sets $\tau_{1,b} = 2.9\%$ and $\tau_{2,b} = 18.3\%$.

The third insight is that equation (D.5) justifies the choice for setting the single payroll tax, $1 + \tau$, in the baseline model, equal to $\frac{1+\tau_{1,b}}{1+\tau_{1,a}}$. To see this, note that the baseline model assumes that the payroll tax rate only changed for the first employee, but remained constant for subsequent employees ($\tau_{2,a} = \tau_{2,b}$). This assumption simplifies equation (D.5) to $\frac{z_{min,a}}{z_{min,b}} = \frac{w_a}{w_b}\left(\frac{1+\tau_{1,a}}{1+\tau_{1,b}}\right)^{\alpha}$. Comparing this expression to equation (11) reveals that $1 + \tau$ in the baseline model corresponds to $\frac{1+\tau_{1,b}}{1+\tau_{1,a}}$ in the extended model.

E The firm size distribution

In this section, we derive the firm size distribution for the extended model. The extended model encompasses all other models discussed in the main text. The baseline model with size-independent payroll taxes corresponds to $\tau_1 = \tau_2 = \tau$, while the baseline model with size-dependent payroll taxes corresponds to $\tau_1 = 0; \tau_2 = \tau$. Hence, the firm size distribution of the extended model also pins down the firm size distribution of the other models.

The derivation of the firm size distribution follows Garicano et al. (2016). Given optimal labour demand in function of managerial productivity z, the firm size distribution $g(l)$ can be derived as:

$$g(l) = \frac{\phi(z(l))}{p}\frac{dz(l)}{dl} \tag{E.1}$$

where p is the share of individuals who are managers.

Using this change-of-variable formula in combination with optimal labour demand given by equation (D.2) gives:

$$g(l) = \begin{cases} \frac{\delta(1-\alpha)}{p} \left(\frac{w(1+\tau_1)}{\alpha}\right)^{1-\gamma} l^{-K} & l < 1 \\ \frac{1}{p} \int_{z_{1,\tau_1}}^{z_{1,\tau_2}} \phi(z) dz & l = 1 \\ \frac{\delta(1-\alpha)}{p} \left(\frac{w(1+\tau_2)}{\alpha}\right)^{1-\gamma} l^{-K} & l > 1 \end{cases} \tag{E.2}$$

where p denotes the share of individuals who are managers, and $K = \gamma(1-\alpha) + \alpha > 1$.

This expression can be simplified. We first compute the share of firms employing exactly one employee:

$$\begin{aligned} \frac{1}{p} \int_{z_{1,\tau_1}}^{z_{1,\tau_2}} \delta z^{-\gamma} dz &= \frac{1}{p} \int_{(1+\tau_1)w/\alpha}^{(1+\tau_2)w/\alpha} \delta z^{-\gamma} dz \\ &= \frac{\delta}{p(1-\gamma)} \left(\frac{w}{\alpha}\right)^{1-\gamma} [(1+\tau_2)^{1-\gamma} - (1+\tau_1)^{1-\gamma}] \\ &= \underbrace{\frac{\delta}{p(1-K)} \left(\frac{w}{\alpha}\right)^{1-\gamma} (1-\alpha)}_{C} [(1+\tau_2)^{1-\gamma} - (1+\tau_1)^{1-\gamma}] \\ &= C[(1+\tau_2)^{1-\gamma} - (1+\tau_1)^{1-\gamma}] \end{aligned}$$

In the last step, we use the fact that $1 - K = (1-\gamma)(1-\alpha)$.

We then exploit that $\int_{l_{min}}^{l_{max}} g(l) dl = 1$:

$$\begin{aligned} \int_{l_{min}}^{1} g(l) dl + \frac{1}{p} \int_{z_{1,\tau_1}}^{z_{1,\tau_2}} \phi(z) dz + \int_{1}^{l_{max}} g(l) dl = 1 \\ \Rightarrow C(1 - l_{min}^{1-K})(1+\tau_1)^{1-\gamma} + C[(1+\tau_2)^{1-\gamma} - (1+\tau_1)^{1-\gamma}] + C(1+\tau_2)^{1-\gamma}(l_{max}^{-K+1} - 1) = 1 \\ \Rightarrow C = -\frac{l_{min}^{K-1}(1+\tau_1)^{\gamma-1}}{1 - (\frac{1+\tau_2}{1+\tau_1})^{1-\gamma} (\frac{l_{max}}{l_{min}})^{1-K}} < 0 \end{aligned}$$

Using the previous expressions, we obtain the following probability density function of the firm size distribution in the extended model:

$$g(l) = \begin{cases} (1+\tau_1)^{1-\gamma} C(1-K) l^{-K} & l < 1 \\ C[(1+\tau_2)^{1-\gamma} - (1+\tau_1)^{1-\gamma}] & l = 1 \\ (1+\tau_2)^{1-\gamma} C(1-K) l^{-K} & l > 1 \end{cases} \tag{E.3}$$

Without size-dependent payroll taxes ($\tau = \tau_1 = \tau_2$), the firm size distribution simplifies to:

$$g(l) = \frac{(K-1)l_{min}^{K-1}}{1-(\frac{l_{min}}{l_{max}})^{K-1}} l^{-K} \tag{E.4}$$

The calibration of the baseline model exploits this equation to estimate α, γ and z_{max}.

F Matching the employment distribution

One might be concerned that the poor approximation of the employment distribution in large firms could bias our results. To address this, we follow Guner et al. (2008) and assume that productivity in firms below a certain size—specifically, those with fewer than 100 employees—follows a Pareto distribution. Meanwhile, a small proportion of firms——approximately 2%—is assumed to have a high productivity. This approach allows us to match the number of small firms relatively well, while also replicating the employment distribution in larger firms more precisely. Moreover, it enables us to test the sensitivity of our results to the low value of α in the baseline model, as we can use a different value of α for the small proportion of firms with the high productivity level. Indeed, descriptive evidence reported in Appendix B demonstrates that small firms have a lower labour share than larger ones.

We first assume a common output elasticity of labour, α, for firms with productivity following the Pareto distribution and those with the high productivity level. Next, we exogenously set α to 0.8 for the small fraction of highly productive firms, a value commonly used in the literature (e.g., Guner et al. (2008); Bilal et al. (2022); Schaal (2017)). Both specifications yield results consistent with our baseline model, indicating that the baseline results are not driven by the poor approximation of the employment distribution of relatively large firms or by imposing a low α for large firms.

Our NBB data includes the number of employees in firms with up to 15 employees. To derive the firm size and employment distribution for the whole economy, we supplement these statistics with publicly available data from the National Social Security Office (NSSO) for 2015Q3 (NSSO, 2015). The NSSO provides data on the number of firms with fewer than 5 employees, 5–9, 10–19, 20–49, 50–99, 100–199, 200–499, 500–999, and over 1,000 employees, along with the total number of employees in each group. Thus, by merging the NBB and NSSO data, we can compute the moments we aim to match (Table F.1). To calibrate the model, we also assume that each highly productive firm employs exactly 524 employees, which is the average number of employees in firms with more than 100 employees. Therefore, the employment share in firms with more than 100 employees is only implicitly targeted in our estimation.

Formally, we assume that z follows a bounded Pareto distribution with support $[0, z_{max}]$, but differently from our baseline model, we set z_{max} such that $l_b^*(z_{max}) = 99$. Moreover, we assume that

Table F.1: Targeted moments

N of firms by size over the total N of firms	
1	0.295
2	0.160
3	0.101
4	0.069
5	0.050
6	0.038
7	0.029
8	0.024
9	0.019
[10, 19] employees	0.104
[20, 49] employees	0.070
[50, 99] employees	0.021
more than 100	0.020

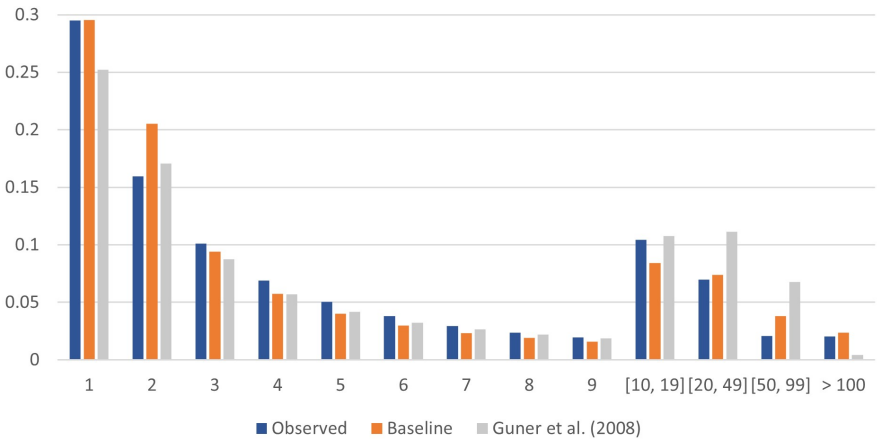
N of employees by size over the total N of employees	
[10, 19] employees	0.078
[20, 49] employees	0.120
[50, 99] employees	0.080

there is a mass of firms, called Ω that takes productivity z_Ω, where z_Ω is such that $l_b^*(z_\Omega) = 524$. We search for the value of α, γ and Ω that minimize the distance between the moments presented in table F.1, identified with the letter i, and the corresponding ones computed in the model:

$$\min_{\alpha,\gamma,\Omega} \Big[\sum_{i=1}^{16} \frac{(observed_i - simulated_i)^2}{simulated_i} \Big] \tag{F.1}$$

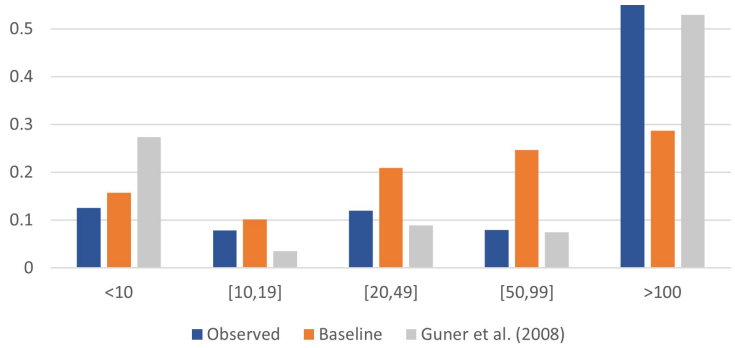
The model matches the distribution of small firms well. This is illustrated in Figure F.1, where we plot the simulated distributions against the observed firm size distribution in the pre-reform period. However, the advantage of Guner et al. (2008)'s approach lies in its ability to match the employment distribution in relatively larger firms, as shown in Figure F.2.

Figure F.1: Simulated versus observed firm size distribution in the pre-reform period



The estimated value of α remains largely unchanged compared to the baseline model, at 0.30 (vs 0.32). However, γ decreases to 1.34 (from 1.63), leading to a distribution of firms that is less left-

Figure F.2: Simulated versus observed employment distribution in the pre-reform period



skewed than in our baseline estimation. Note that setting α to 0.8 for firms with more than 100 employees reduces the productivity level needed for large firms to employ 524 workers, but does not affect the estimated values of the estimated parameters, nor the simulated firm size and employment distribution.

Table F.2: Impact on the number of firms, the macro economy, and the distributional impact - Guner et al. (2008)'s approach vs. baseline

	Flexible-wage (baseline)	Guner et al.	Guner et al. with $\alpha = 0.8$
Defining characteristics of each scenario (%Δ)			
Minimum productivity level	−3.91%	−3.72%	−3.88%
Wage rate	+0.52%	+0.30%	+0.21%
Labour force	0.00%	+0.00%	+0.00%
Evolution of the number of firms (%Δ):			
Number of firms with one employee	+10.18%	+7.54%	+7.57%
Number of firms	+2.77%	+1.79%	+1.83%
Evolution of macro economic indicators (%Δ):			
Number of employees	−0.26%	−0.13%	−0.13%
Output	−0.01%	−0.01%	−0.01%
Budgettary cost (% output$_b$)	−0.36%	−0.26%	−0.30%

Table F.2 compares the policy's macroeconomic implications in the flexible-wage scenario for the baseline model (column 1) vs. the alternative models (columns 2 and 3). The main message of the baseline model is retained. Indeed, all statistics change by a similar magnitude in the three simulations. Interestingly, the simulated impact on the number of firms in the alternative models (+7.5%) is closer to the DiD estimate (+7.2%) than in the baseline model. The wage increase is lower than in the baseline model, presumably because more individuals work in large firms so that a small wage increase leads to sufficient job losses in these larger firms to offset increased labour demand in new firms.

Imposing $\alpha = 0.8$ for large firms (column 3) only marginal changes the results, indicating that imposing a low value for α for large firms in our baseline estimation is unlikely to drive the results in the baseline model.