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

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Abstract
Whether subsidies targeted at small firms have the potential to increase aggregate output by helping to overcome frictions or, on the contrary, distort the optimal firm size and reduce aggregate output remains an open question. This paper offers a comprehensive evaluation of a unique policy that subsidises the first employee. Empirically, we observe 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 well. Leveraging our model, we show that general equilibrium effects on wages and aggregate output are likely to be small. The policy is, however, expensive, and most of the subsidies are captured by employers. Our findings support the traditional view that size-dependent subsidies distort the optimal allocation of resources.

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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 pandemic. The love of and 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 sceptical of size-dependent policies (Acs et al., 2016; Restuccia and Rogerson, 2008; Guner et al., 2008; Buera et al., 2013). 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 over larger firms will reduce aggregate output for two reasons. First, these policies lead to the excessive entry of small, low-productivity firms. Second, the reallocation of labour from large, high-productivity firms to small, low-productivity firms reduces aggregate output. Economists, therefore, argue that policies favouring small businesses can only be justified by market failures or frictions that impede the entry of new firms or hinder small firms to grow, such as credit constraints (Siemer, 2019; Banerjee and Duflo, 2014), the (uninsurable) risk of starting a business (Ando, 2021; Hombert et al., 2020), market power of incumbent firms (De Loecker et al., 2020), or missing markets for innovation (Acemoglu et al., 2018). A fundamental question is whether a frictionless model is adequate to predict the first-order effects of size-dependent policies or whether one needs richer models that allow for the possibility that size-dependent policies reduce frictions.

To address this question, we focus on a unique size-dependent policy in Belgium that subsidises the first employee. Since 2016, new employers have enjoyed a permanent exemption from payroll taxes for their first employee. This subsidy reduces the expected labour cost for the first employee by 15%. Perhaps unsurprisingly, as soon as the policy was implemented, the number of employers who hired their first employee in a given month jumped by 31% (Cockx and Desiere, 2023).[1]

This paper contrasts empirical evidence on the impact of the 2016 reform with predictions from a frictionless general equilibrium model of occupational choice, and then uses this (validated) model to examine general equilibrium effects on wages. The model enables us to quantify the impact of the policy on outcomes that cannot be observed in the data, such as aggregate output and the distribution of the surplus generated by the subsidy among employees and employers.

The first part of the paper provides 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 increases by 7.1% three years after the

[1] Cockx and Desiere (2023) provide evidence that the increase is 'real' rather than driven by strategic behaviour, such as employers closing down existing firms and setting up new ones to benefit from the subsidy.

reform, without much evidence of an increase in the number of firms with more than one employee. Consistent with Cockx and Desiere (2023), this finding illustrates that the policy led to a sudden and substantial rise in the number of firms with one employee and decreased the average firm size.

The second part of the paper builds a frictionless general equilibrium model of occupational choice in the spirit of Lucas (1978). As Garicano et al. (2016), we add size-dependent payroll taxes to a standard Lucas (1978) model. 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, but these new managers are insufficiently productive to employ more than one employee. Consequently, the entry of new firms 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. 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 key assumption of frictionless complete-market models is that only low-productivity firms enter the market as a response to the subsidy. Since there are neither frictions nor market failures, all individuals who are sufficiently productive are already managers in the pre-refom period and only individuals for whom starting a firm is not profitable without the subsidy enter once the subsidy is in place. This key assumption is supported empirically by Deng et al. (2023), who evaluate the impact of the subsidy for the first employee on the economic performance of new employers. They compare the performance of non-subsidised employers that hired their first employee in 2015 to the performance of subsidised employers that hired their first employee in 2016. On average, subsidised employers hire fewer employees at the time of entry and are less likely to employ more than one employee one year after entry compared to non-subsidised employers. Moreover, the average subsidised employer appears less profitable in the sense that the ratio of turnover or profits to the wage bill is lower for subsidised employers compared to non-subsidised ones. We review the methodology and findings of Deng et al. (2023) in Appendix A.

The third part of the paper calibrates the three fundamental model parameters using the firm size distribution and average firm size in the pre-refom period, and uses the calibrated model to predict the change in the number of firms once the first employee is exempt from the payroll tax. The model predicts a 10.1% increase in the number of firms with one employee in equilibrium. This prediction is remarkably close to the reduced-form estimates, which indicate that the number of firms with one employee increases by 7.1% three years after the reform. The model prediction is even closer (+8.9%) to our empirical estimate when we extend the base model to take into account the impact of another policy, which was implemented simultaneously with the payroll tax exemption and reduced the payroll tax rate for all firms in the post-reform period. The remarkably closeness between the prediction and the empirical estimate suggests that the exemption does not play a major role in alleviating frictions and market failures, and suggests that simple frictionless models might be adequate to capture the first-order effects of size-dependent policies.

In the final part of the paper, we leverage the model to quantify the general equilibrium effects of the policy on wages, to investigate the impact of the policy on aggregate output and on the distribution of the surplus generated by the subsidy between employees and employers, and to reflect on its budgetary cost. Although 9% of the employees will eventually be subsidised, our model predicts a modest wage increase of 0.5%. Given the small wage increase, the impact on aggregate output is limited, decreasing by less than 0.01% in equilibrium. By contrast, the policy is expensive from the government's point of view. The model predicts that the budgetary cost amounts to 0.35% of output. We show that keeping government revenues constant at the pre-reform level requires increasing the payroll tax rate by 1.6 percentage points, or by a sizeable 10% in relative terms. We estimate the budgetary cost per new firm at 280,00 to 310,000 euros. In addition, we find that 80% of the surplus generated by the subsidy is captured by the managers in terms of higher profits. This result is in stark contrast to the effect of general size-independent payroll tax rate reductions which in our model—as in the conventional tax incidence model—are completely offset by an increase in wages.

The absence of frictions in our model implies that the policy cannot be rationalised on efficiency grounds because the allocation of resources is already optimal without policy interventions. In general equilibrium, 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, such as a love 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.[2]

This paper contributes to the literature on size-dependent policies. Within this literature, one can identify two strands. The first strand, starting with the seminal work of Restuccia and Rogerson (2008) and Hsieh and Klenow (2009), relates size-dependent policies to productivity differences across countries. Our paper is closely related to the paper of Guner et al. (2008) who introduce size-dependent taxes or subsidies in a Lucas model calibrated to the US economy. One policy considered in their paper is subsidising the cost of capital for small firms so that the average firm size decreases by 10%. This policy, which is similar in spirit to the one we study, increases the number of firms by 10% and has non-trivial negative welfare effects of 0.63%. They also note that policies that subsidise labour in small firms will have a larger impact on the number of (small) firms but will lead to smaller welfare losses.[3] This is exactly what we observe. In general equilibrium,

[2]Dustmann et al. (2022) make a related 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.

[3]Hopenhayn (2014) argues that policies that distort the optimal firm size distribution but preserve the rank of the firms (i.e., a productive firm never employs fewer employees than a less productive one) will have a limited impact on aggregate total factor productivity. This is consistent with our findings. The payroll tax exemption preserves the rank of the firm, and we indeed find small negative effects on

the policy we consider increases the number of firms by 2.8% and reduces the average firm size by 3% and output by 0.01%. A key difference with our paper is that we model the impact of an existing policy rather than simulating the impact of potential policies and are able to compare the model predictions to the actual impact of the policy, which helps us validate the model.

The second, smaller strand of the literature on size-dependent policies assesses the aggregate welfare losses of specific policies. Gourio and Roys (2014) and Garicano et al. (2016) evaluate the cost of labour market regulation in France that only binds for firms with more than 50 employees; Cahuc et al. (2023) evaluate a policy that prevents large firms from using temporary contracts in Portugal; and Akcigit et al. (2023) study the implications of employment targets during the privatisation of firms in East Germany. We contribute to this strand of literature by evaluating a specific size-dependent policy that subsidises the first employee in all firms. An important difference with our paper is that in the aforementioned papers the entry of new employers is an *indirect* consequence of policies that reduce equilibrium wages, whereas in our paper entry of new employers is a *direct* consequence of the policy. Put differently, we observe empirircally that new employers indeed enter when labour costs decrease, whereas previous research assumes that they do. Conclusions in these models can hinge on the response of new employers to the equilibrium wage. For instance, Gourio and Roys (2014) show that the aggregate welfare costs of labour regulation in France crucially depend on the extent to which new employers enter the market as labour costs decrease. Welfare costs are non-existent when new employers are very sensitive to labour costs, but they are substantial if the number of firms is fixed.

The paper is organised as follows. The next section discusses the policy and the institutional setting. Section 3 presents the data. Using Difference-in-Differences regressions, Section 4 evaluates the impact of the policy on the number of firms with one employee. Section 5 presents the frictionless general equilibrium model, which is calibrated in Section 6. The predictions of the model for observable and unobservable outcomes are discussed in Section 7, while Section 8 quantifies the budgetary cost. Section 9 concludes.

2 The policy and the institutional setting

2.1 The SSC reduction and exemption for the first employee

In Belgium, employers pay payroll taxes, called Social Security Contributions (SSC), on top of the wages they pay to the employees, which are used to fund social security, including health care and retirement benefits. SSC are an important determinant of labour costs, amounting to 25% of wages in 2019.

On October 10, 2015, the Belgian government unexpectedly announced that new employers would be permanently exempt from SSC for the first employee. The new policy went into effect for private sector firms that hired their first employee after January 1, 2016.

output.

Private sector firms are eligible for the SSC 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 SSC 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 claimed if they have several employees. To maximise the subsidy, employers will claim the SSC exemption for the employee with the highest wage.

The 2016 reform replaced previously existing 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 SSC reduction for the first five quarters, €1,050 for the next four quarters, and €450 for the last four quarters.

We use firm-level data to 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).[4] The black and red lines show the payroll tax rate of the 2014 and 2016 cohorts, averaged over the four quarterly cohorts of new employers who hired in 2014 and 2016.

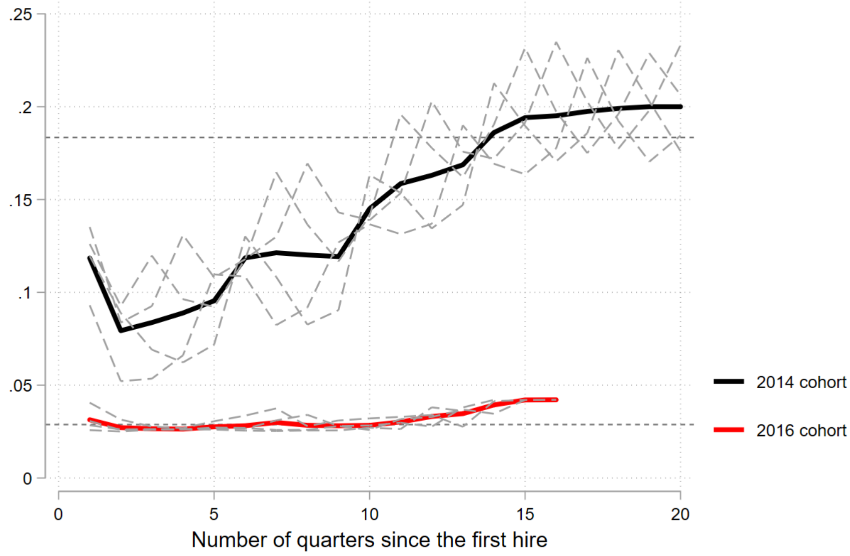
The 2016 cohort benefits from the permanent SSC exemption and faces a constant payroll tax rate of 2.9% for the first employee. This rate is not exactly equal to zero because employers are only exempt from the base contribution, but they still have to pay specific contributions, such as contributions for short-time work or sector-specific training. The 2014 cohort benefits from temporary SSC 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.

In order to compare the value of the temporary SSC reductions in the pre-reform period vs. the permanent SSC exemption in the post-reform, we compute the *expected* payroll tax rate for the first employee at the time of hiring the first employee over the firm's expected lifetime. The ratio of the expected payroll tax rate across both periods is a fundamental parameter in our model.

In the post-reform period, the payroll tax rate is constant over the firm's lifetime. This

[4] 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.

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



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 SSC reductions in the pre-reform period and the permanent SSC exemption in the post-reform period. The first quarter corresponds to the quarter in which the first employee is hired. In order to compute the payroll tax rate for the first employee, the population of new employers is restricted to those that employ exactly one employee in a given quarter. The full black and red 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%)

implies that the expected payroll tax rate in the post-reform period is 2.9%. By contrast, the payroll tax rate in the pre-reform period increases over the firm's lifetime. This implies that the expected payroll tax rate at the time of hiring the first employees is a weighted average of the payroll tax rate for each quarter, the expected survival rate in that quarter (i.e. the probability of still being an employer), and the annual discount rate.

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). Following the search and matching literature (e.g., Kaas and Kircher (2015)), we use an annual discount rate of 5%. These computations reveal that the expected payroll tax rate for the first employee of new employers is 18.3% in the pre-reform period. Hence, the 2016 reform reduced the expected payroll tax rate for the first employee by 15 percentage points, from 18.3% to 2.9%. Details are provided in Appendix B.

The SSC exemption for the first employee proved popular. Until 2016, the number of subsidised first employees with a temporary SSC reduction fluctuated around 22,000 full-time equivalents. Since 2016, the number of subsidised employees has gradually increased, surpassing 30,000 full-time equivalents by 2019 (approximately 1% of the employees in Belgium). According to data from the National Social Security Office, one out of three firms with a single employee and one out of four firms with two employees benefited from the subsidy in 2019.

In 2019, the last year for which we have access to firm-level data, the cost of the subsidy amounted to 277 million euros (approximately 0.06% of GDP). Despite the COVID-19 pandemic, which dramatically slowed down the establishment of new employers, and capping the subsidy at €4,000 per quarter in 2022, the cost of the policy reached 427 million euros in 2022 and continues to increase.

2.2 The tax shift

The SSC exemption was part of a broader reform, the so-called tax shift, which aimed at decreasing the payroll tax rate.

Within this framework, two other tax policies were implemented from 2016 on. The first policy reinforced temporary SSC reductions for firms that hired for the first time a second to fifth employee and introduced a temporary SSC reduction for the sixth employee. This paper makes abstraction of these subsidies for two reasons. First, the permanent SSC exemption for the first employee is far more generous than the temporary SSC reductions for the subsequent five employees, which last at most thirteen quarters; Second, the generosity of the SSC reductions for the second to the fifth employee increased modestly in 2016, which makes it unlikely that these subsidies substantially altered the firm size distribution after 2016.[5]

The second policy gradually reduced SSC for all private sector firms.[6] Using firm-level data, Table 1 shows the average annual payroll tax rate in the pre-reform (2014Q4-2015Q3) and post-reform period (2018Q4-2019Q3) paid by firms that employ 7-15 employees[7], as well as the *expected* payroll tax rate for the first employee discussed earlier.

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 for larger firms. This implies that payroll taxes are size-dependent in both periods, with smaller firms paying lower

[5]For instance, firms hiring their second employee could claim a SSC reduction over thirteen quarters of at most €8,850 before and €13,750 after the 2016 reform.

[6]The tax shift reduced the nominal payroll tax rate from 32.4% in 2015 to 25% in 2019, and reformed the SSC reductions for low-wage and high-wage workers. These reductions make the effective payroll tax rate, which we compute in 1, much lower for most firms.

[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) a tiny fraction of firms with at least seven employees receive SSC reductions for their first six employees. We focus on the period 2014Q4-2015Q3 because this is the last full year before the announcement of the policy in October 2015, and on the period 2018Q4-2019Q3 because the tax shift was gradually phased in from 2016Q1 on and was fully implemented by 2019Q1.

taxes. Second, the tax shift reduced the payroll tax rate paid by large firms by 3.3 percentage points (pp) between the pre-reform and post-reform period, from 26.9% to 23.6%. Importantly, the difference between the payroll tax rates for the first and subsequent employees is larger in the post-reform period. The gap is 8.6 pp in the pre-reform period, increasing to 20.7 pp in the post-reform period. This finding illustrates that, despite the tax shift, the SSC exemption for the first employee remains a very generous subsidy.

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

	Pre-reform	Post-reform
1 employee	18.3%	2.9%
7-15 employees	26.9%	23.6%

Notes: The payroll tax rate for firms with 7-15 employees is computed as the SSC 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, as discussed in the previous section.

Our baseline model focuses on the SSC exemption for the first employee, thereby ignoring the fact that the tax shift simultaneously reduced the payroll tax rate for all employees. We will then extend the baseline model to account for the tax shift. This extended model will allow us to isolate the effects of the SSC exemption from those of the tax shift.

3 Data

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

The quarterly panel dataset covers the period from 2009Q1 to 2019Q4, encompassing employers with a maximum of fifteen employees in at least one quarter during this period. This comprises both new employers who hired their first employee after 2009Q1, as well as employers that hired their first employee before 2009Q1. 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 (SSC). The NSSO registers firm-level employment. For each firm, 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. Firm size, a key concept in the model and the empirical analyses, is defined as the sum of the number of full-time and part-time employees at the end of the quarter.

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The firm-level dataset includes information on the wage bill, SSC, 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 firm size.

To calibrate the model, we need the average firm size and the proportion of employers with more than fifteen employees in 2015Q3. Since the NBB data is limited to firms with fifteen employees, we obtained this information directly from the NSSO. In 2015Q3, the average employer employed 10.84 employees and 11.8% of the employers employ more than fifteen employees.

4 Evolution of employers

Introduction. Using daily data on hiring decisions, Cockx and Desiere (2023) show that the labour cost reduction induced by the SSC 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.

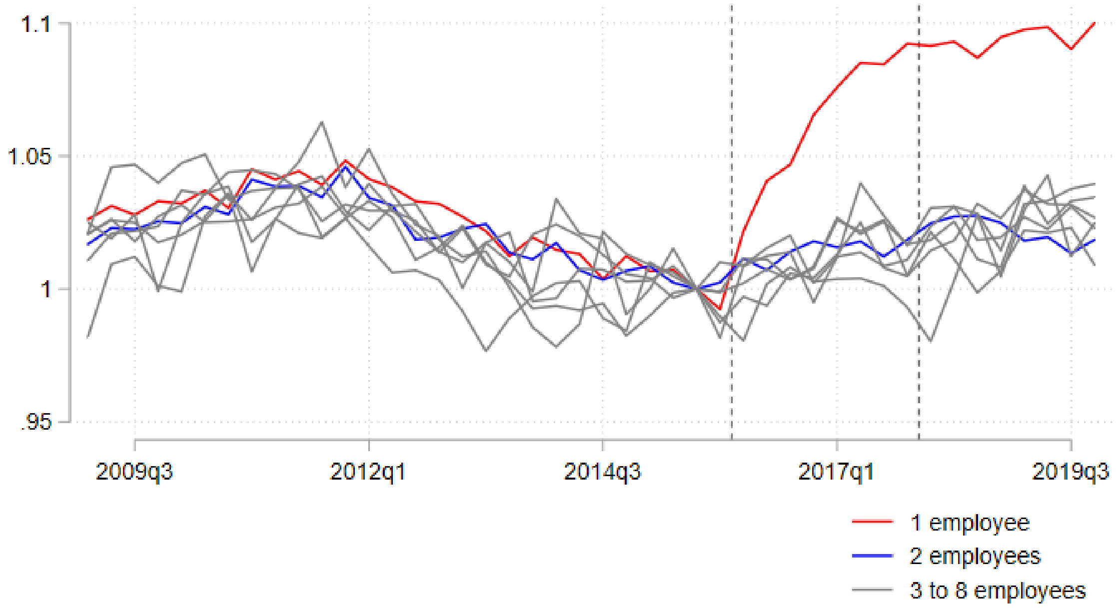
In this section, we complement their study by examining the impact of the reform on the stock of firms. More precisely, we examine whether the reform increased the number of firms employing exactly one or two employees relative to a control group of bigger firms. We first present graphical evidence and then quantify this evidence using a Difference-in-Differences (DiD) framework.

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. The evolution of the number of firms with one and two employees is highlighted in red and blue. The grey lines show the evolution of the number of firms with three to 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 7-8 employees in the post-reform period, suggesting that the reform did not affect the stock of firms with two employees.

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

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 employing at most 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.

regressions contrast the evolution of the stock of firms with one or two employees (treatment group) to the evolution of the stock of firms with several employees (control group) in the pre-reform vs. the post-reform period.

We consider two control groups. We first use firms with 7-8 employees as the control group. These firms are not directly affected by the subsidy for the first employee. By 2019Q2, only 2% of the 30,000 fte subsidsed employees are employed by firms with 7-8 employees.[8] We then use firms with 3-8 employees as the control group. While this control group might be affected by the policy, it has the advantage that firms in the treatment and control group are relatively similar, making it more likely that the parallel trend assumption holds. Additionally, we have more observations in this specification, which increases the precision of the estimates.

We estimate the following DiD regression using aggregate quarterly data:

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

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

where the outcome, $\frac{y_{s,t}}{y_{s,2015Q3}}$, indicates growth in the number of firms employing s employees in time period 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 in the treatment group, and zero otherwise. 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.

We compare the difference in the growth rate of the number of firms between the control and treatment groups relative to 2015Q3. We consider four time periods. The parameter γ_0 captures the difference between the treatment and control groups in the pre-reform period (2009Q1-2015Q2) and 2015Q3. This parameter allows us to test whether the outcome evolved similarly in the treatment and control group. The parameter γ_1 captures anticipation effects in 2015Q4, during which the policy was already announced but not yet implemented; γ_2 captures the 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 impact of the reform from 2018Q1 to 2019Q4. We only report γ_0 and γ_3 in Table 2.

Regardless of the choice of the control group, the first two columns of Table 2 show that the SSC exemption increased the number of firms with one employee by 7.1% by 2018Q1-2019Q4. We interpret the 7.1% increase as the net impact of the SSC exemption on the number of firms with one employee. As Cockx and Desiere (2023) show, the SSC exemption led to an inflow of new employers, thereby increasing the number of firms with one employee. At the same time, the 2016 reform might have increased the exit rate of existing firms with a single employee that did not benefit from the subsidy. Our estimate identifies the net effect in the sense that it captures both the positive entry effects and the potentially negative effects on existing employers. Firms with one employee account for 31% of all firms in the private sector. Hence, an increase in the number of firms with one employee by 7.1% implies that the total number of firms increased by 2.3%.

Columns (3) and (4) examine the evolution of the number of firms with two employees versus the evolution for firms with 7-8 and 3-8 employees. In both specifications, the point estimate in the post-reform period is small and not statistically significant, suggesting that the subsidy did not affect the stock of firms with two employees.

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 firms with two employees and is relevant because firms with two employees are very similar to firms with one employee. As Figure 2 shows, 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 again indicates that the number of firms with one employee increased by 7.2%.

One might be concerned that policy increases wages, which could lead to job losses in firms in the control group. These general equilibrium effects would violate the Stable

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 a DiD regression, 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 in the treatment group vs. the control group in in, respectively, 2009Q1-2015Q2 and 2018Q1-2019Q4. Standard errors are clustered by firm size in column (2) and (4). Conventional standard errors are reported in all other columns. ***,**,** denote statistical significance at the 1%, 5% and 10%, respectively. Figure C.1 presents a DiD event study plot contrasting quarterly growth in the number of firms with one vs 3-8 employees and confirms the absence of pre-reform trends.

Unit Treatment Value Assumption (SUTVA). A (substantial) wage increase is unlikely in the three years following the reform because by 2019 only about 1% of the employees in the private sector are subsidised. Furthermore, the calibration of our general equilibrium model predicts a wage increase of 0.5%, which is sufficiently small to ignore general equilibrium effects.

In the baseline specification, firm size is defined as the number of full-time and part-time employees at the end of the quarter. This definition gives the same weight to full-time and part-time employees. In Appendix D, we show that our findings remain robust to using an alternative definition of firm size, which assigns a weight of 0.5 to a part-time and 1 to a full-time employee. According to this full-time equivalent definition of firm size, the smallest firms employ 0.5 employees and firms of size one employ either one full-time or two part-time employees. We find that the number of firms of size one grows 8.27% more than the number of firms employing 2-5 fte-employees between 2015Q3 and 2018Q1-2019Q4.[9] We also observe that the number of firms with 0.5, 2, 3 and 4 fte-employees evolves similarly in the pre-reform and the post-reform period, suggesting that the policy only affected the number of firms employing exactly one fte-employee.

5 Theory

In this section, we develop a frictionless general equilibrium occupational choice model in the spirit of Lucas (1978) that captures the two empirical findings reported earlier: (1) the SSC exemption substantially increased the number of firms with one employee, and (2) low-productivity firms hired their first employee as a response to the policy. At the same time, this model allows us to go beyond these reduced-form estimates. It captures the general equilibrium effects on wages and enables us to study labour misallocation caused

[9]Firms with more than 5 fte-employees are not included in the control group because the parallel trend does not hold in the pre-reform period.

by the preferential tax treatment.

The two empirical findings lead us to adopt a frictionless occupational choice model in the spirit of Lucas (1978). The starting point of a Lucas model is that individuals are heterogenous in terms of managerial ability and choose between being an employee or a manager, who always employs employees. In equilibrium, only the most productive individuals will be managers.

We first present the model with *size-independent* payroll taxes. This model mimics the undistorted 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 SSC exemption for the first employee to model the distorted economy in the post-reform period. This policy makes the payroll tax rate *size-dependent*, as in Guner et al. (2008) and Braguinsky et al. (2011). Firms employing at most one employee no longer pay payroll taxes after the reform, while the payroll tax rate does not change for larger firms. In line with our empirical findings, the model predicts that the SSC exemption induces new low-productivity managers—who would have been employees in the absence of the subsidy—to hire their first employee, but has no direct effect on more productive managers who would have employed more than one employee in the absence of the policy.

Next, we consider the general equilibrium effects of the policy on wages and derive the evolution of the number of firms (with one employee) and aggregate output in the pre-reform vs. post-reform period. The SSC exemption increases labour demand because new managers start a firm, which results in a wage increase in equilibrium. The wage increase leads to job losses in larger, more productive firms and a fall in aggregate output due to labour reallocation from large, productive firms to smaller, less productive firms.

For simplicity, the baseline model assumes that the payroll tax rate is size-independent in the pre-reform period and does not change between the two periods except for the first employee. These assumptions imply that the model includes a single payroll tax rate, $\tau > 1$. However, as documented in Table 1, these assumptions do not hold perfectly. For this reason, we construct an extended model that includes four payroll tax rates (firms with a single employee vs. larger firms, with different rates in both periods). This extension does not alter the intuition of the baseline model but enables us to better match the empirical facts.

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

If agents decide to hire employees, they obtain profits given by $\pi_b(z) = zl^\alpha - w\tau l$. Otherwise, they may either become employees or solo entrepreneurs. We do not endogenously model the individual's choice between these two options, but we exogenously fix the proportion of solo entrepreneurs relative to the total number of agents. This proportion is set to the observed ratio of solo entrepreneurs to the total number of agents in the data - i.e. N solo entrepreneurs / (N solo entrepreneurs + N employers + N employees).

Additionally, we assume that both employees and solo entrepreneurs get $w\tau$.

Labour market clearing "before".

In equilibrium, the proportion of agents that are hired by employers must be equal to the proportion of agents that decide not to become employers minus the exogenous set proportion of solo entrepreneurs, denoted with Ω_b.

$$\int_{z_{min,b}}^{z_{max}} l_b^*(z)\phi(z)dz = \int_{1}^{z_{min,b}} \phi(z)dz - \Omega_b. \quad (1)$$

Labour market clearing "after".

We assume that any increase in the number of employers resulting from the reform is compensated by the same reduction in the number of solo entrepreneurs. Wages still adjust to equate labor demand and labor supply. Therefore:

$$\Omega_b - \Omega_a = \int_{z_{min,a}}^{z_{max}} \phi(z)dz - \int_{z_{min,b}}^{z_{max}} \phi(z)dz, \quad (2)$$

and,

$$\int_{z_{min,a}}^{z_{max}} l_a^*(z)\phi(z)dz = \int_{1}^{z_{min,a}} \phi(z)dz - \Omega_a. \quad (3)$$

Notice we could also assume, for example, that only half of the change in the number of employers is obtained by transitions from "solo entrepreneurs", while the other half is from "employees". Equation 2 would become

$$\Omega_b - \Omega_a = \frac{1}{2}\left(\int_{z_{min,a}}^{z_{max}} \phi(z)dz - \int_{z_{min,b}}^{z_{max}} \phi(z)dz\right) \quad (4)$$

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. In other words, the most talented individuals employ the less talented individuals. The labour force is fixed, meaning that the sum of the number of managers and employees is constant. There is no unemployment.

As is standard in these models, all firms are employers. Firms without employees or solo-self employed individuals do not exist. The manager does not contribute directly to production. The effort of the manager—who is indispensable and needs to be rewarded for taking up this role—captures a similar idea as a fixed production cost in dynamic firm models in the spirit of Hopenhayn (1992) and Melitz (2003).

The model with size-independent payroll taxes mimics the economy in the pre-reform period. To clearly distinguish the pre-reform and post-reform periods, we will use the subscript b (before) and a (after) to denote respectively the pre-reform and post-reform period.

Optimal labour demand. The only input in production is labour, l. Following Garicano et al. (2016), the production function of an individual with ability z is $y = zl^\alpha$. If an individual chooses to be a manager, she will maximise profits, $\pi_b(z) = zl^\alpha - w\tau l$, given the wage w and the payroll tax, $\tau > 1$.

The first-order condition determines optimal labour demand in the pre-reform period, $l_b^*(z)$.

$$l_b^*(z) = \begin{cases} 0 & z < z_{min,b} \\ \left(\frac{\alpha z}{w\tau}\right)^{\frac{1}{1-\alpha}} & z \geq z_{min,b} \end{cases} \tag{5}$$

Occupational choice. Individuals with managerial ability greater than $z_{min,b}$ start a firm, employ workers and earn profits. Individuals with a lower ability earn the market wage, which does not depend on their ability.

We assume that an individual with managerial ability, $z_{min,b}$, is indifferent between being an employee and earning a gross wage, $w\tau$, or owning a firm and earning profits, $\pi(z_{min,b})$. Put differently, we assume that individuals care about gross rather than net wages. This assumption essentially rules out that some individuals prefer being managers to avoid payroll taxes. While some individuals may be self-employed for tax reasons (Parker, 2003), 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. Furthermore, the model abstracts from taxes on profits. Our assumption is equivalent to assuming that profits and wages are taxed at the same rate.

As we will prove, this assumption ensures that an increase in payroll taxes is fully incident on the worker, without any effect on employment or on the allocation of labour across firms. This is an attractive model property for two reasons. First, it aligns our model with the standard tax incidence model, which predicts that an increase in payroll taxes is fully passed on to the employee without any effect on employment (Fullerton and Metcalf, 2002).[10] Second, it ensures that only size-dependent payroll taxes affect the equilibrium.

The assumption that $\pi(z_{min,b}) = w_b\tau$ pins down the productivity level of the marginal manager, $z_{min,b}$, and her labour demand, $l_{min,b}$:

$$z_{min,b} =(\frac{\alpha}{1-\alpha})^{1-\alpha}(\frac{\tau w_b}{\alpha}) \tag{6}$$

$$l_{min,b} =\frac{\alpha}{1-\alpha} \tag{7}$$

Because 31% of firms employ at most one employee, $l_{min,b}$ should be smaller than one. This requires $\alpha < 0.5$, implying strongly decreasing returns to scale.[11]

[10]This prediction holds if labour supply is perfectly inelastic.

[11]The literature on firm dynamics typically sets α in the range of 0.5 (Hsieh and Klenow, 2009) to

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

$$\int_{z_{min,b}}^{z_{max}} l_b^*(z)\phi(z)dz = \int_1^{z_{min,b}} \phi(z)dz \quad (8)$$

The left-hand side of this condition expresses labour demand by the managers, i.e. individuals whose 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. It is crucial to understand the role of payroll taxes in this model. It turns out that the occupational choice and the allocation of labour across firms are independent of the payroll tax. As in the canonical tax incidence model (Fullerton and Metcalf, 2002), an increase in the payroll tax is fully offset by a decrease in wages, without any effect on labour costs, occupational choice, employment or the allocation of labour across firms.

The proof of this property is included in Appendix E, but the intuition is straightforward. Given a certain wage, a payroll tax increase reduces labour demand among existing firms. Furthermore, a higher payroll tax makes it less attractive to be a manager because the profits of the marginal manager must be equal to $w\tau$ and induces some 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, increases labour demand among existing firms and induces some employees to become managers. In equilibrium, the wage decrease perfectly offsets the higher payroll tax and labour costs remain constant. As a result, the share of managers in the population and labour allocation across firms is unaffected by the payroll tax.

Firm size distribution. We will calibrate the model using the firm size distribution in the pre-reform period. To derive the firm size distribution, following the literature (Lucas, 1978; Garicano et al., 2016), we have assumed that the managerial ability follows a bounded Pareto distribution:[12]

$$\begin{aligned}\phi(z) &= [\frac{\gamma - 1}{1 - z_{max}^{1-\gamma}}]z^{-\gamma} \\ &= \delta z^{-\gamma}, \qquad \text{where } \gamma > 1 \text{ and } z \in [1, z_{max}]\end{aligned}$$

We prove in Appendix G that the probability density function of the firm size distribution, $g_b(l)$, is a bounded Pareto distribution with support in the range $[l_{min,b}, l_{max,b}]$, where $l_{min,b}$ and $l_{max,b}$ is respectively the minimum and maximum firm size firm determined by the productivity of the marginal manager ($z_{min,b}$) and the productivity of the manager with

0.8 (Garicano et al., 2016) in order to match the firm size distribution and/or the labour share in the economy. By setting $\alpha = 0.8$ in their Lucas model, Garicano et al. (2016) implicitly assume that firms employ at least four employees (see their Appendix, equation (34)).

[12]See Dewitte et al. (2022) for an overview of alternative choices.

the highest productivity level (z_{max}) :

$$g_b(l) = \frac{(K-1)l_{min,b}^{K-1}}{1-(\frac{l_{min,b}}{l_{max,b}})^{K-1}} l^{-K}, \text{ where } K = \gamma(1-\alpha)+\alpha \tag{9}$$

The firm size distribution is unaffected by the payroll tax, which confirms that labour allocation across firms is independent of the payroll tax.

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

We now introduce the SSC exemption for the first employee. This 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. We use the subscript a (after) to denote the post-reform period.

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

$$\pi_a(z) = \begin{cases} zl^\alpha - w_a l & l \leq 1 \\ zl^\alpha - \tau w_a(l-1) - w_a & l > 1 \end{cases} \tag{10}$$

Exploiting the first-order conditions, optimal labour demand is given by:

$$l_a^*(z) = \begin{cases} 0 & z < z_{min,a} \\ \left(\frac{\alpha z}{w_a}\right)^{\frac{1}{1-\alpha}} & z \in [z_{min,a};\ z_{1,min}[\\ 1 & z \in [z_{1,min};\ z_{1,max}] \\ \left(\frac{\alpha z}{w_a \tau}\right)^{\frac{1}{1-\alpha}} & z > z_{1,max} \end{cases} \tag{11}$$

where $z_{min,a}$ is the productivity level of the marginal manager after the reform who is indifferent between being an employee or a manager. Managers with productivity between $z_{1,min} = w_a/\alpha$ and $z_{1,max} = w_a\tau/\alpha$ employ exactly one full-time employee.

Occupational choice. As in the pre-reform period, the marginal manager is indifferent between being an employee or owning a firm: $\pi_a(z_{min,a}) = w_a\tau$. This condition pins down $z_{min,a}$ and $l_{min,a}$:

$$z_{min,a} = (\frac{\alpha}{1-\alpha})^{1-\alpha}\tau^{1-\alpha}(\frac{w_a}{\alpha}) \tag{12}$$

$$l_{min,a} = \frac{\tau\alpha}{1-\alpha} \tag{13}$$

This expression shows that, if wages do not adjust in the post-reform period $(w_a = w_b)$, $z_{min,a} = \tau^{-\alpha} z_{min,b}$, which shows that the minimum productivity level required to be a manager decreases in the post-reform period. As a result, average firm productivity will be lower in the post-reform period. The decrease in firm productivity will be less pronounced if wages increase after the reform ($w_a > w_b$).

Optimal labour demand and occupational choice in the pre-reform vs. post-reform period. It is insightful to compare optimal labour demand and occupational choice in the pre-reform and post-reform period for two scenarios. The first scenario, called the fixed-wage scenario, assumes that wages in the pre-refom and post-reform period remain the same ($w_a = w_b$). The second scenario is the general equilibrium scenario, which takes into account that wage increases after the reform ($w_a > w_b$) to clear the labour market. Figure 3 shows pre-reform and post-reform labour demand in function of managerial productivity for both scenarios.

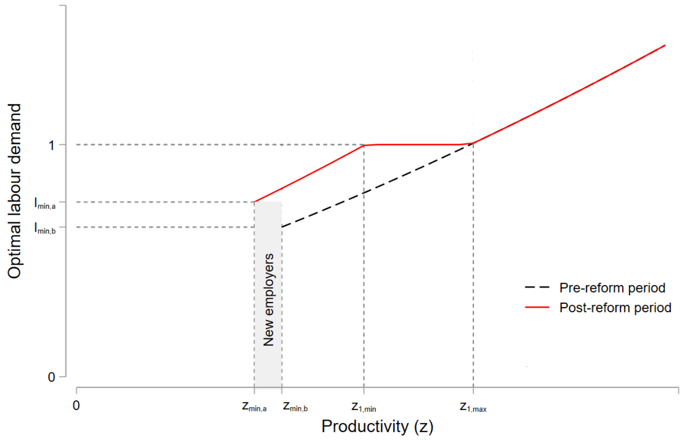
In the fixed-wage scenario, labour demand in the pre-reform and post reform coincides for firms whose productivity exceeds $z_{1,max}$. In other words, firms that are sufficiently productive to employ at least one employee in the pre-reform period continue to do so in the post-reform period. For these firms, the SSC exemption provides a windfall profit. By contrast, labour demand in the fixed-wage scenario increases among individuals whose productivity level is lower than $z_{1,max}$. The precise response to the reform of these individuals depends on their productivity level. Three groups can be distinguished. The first group consists of firms with productivity between $z_{1,min}$ and $z_{1,max}$. These firms are sufficiently productive to hire a single, subsidised full-time employee in the post-reform period, but are not sufficiently productive to hire a second employee. Consequently, labour demand bunches at one employee in the post-reform period. The second group comprises firms with productivity between $z_{min,b}$ and $z_{1,min}$. These firms exist in both periods and hire more workers as a response to the policy, but they are insufficiently productive to hire a full-time subsidised employee. Finally, the third and most interesting group comprises individuals whose managerial ability is below $z_{min,b}$. These individuals are employees in the pre-reform period, but become managers once the subsidy is in place. This third group illustrates a key prediction of the model: the policy induces low-productivity individuals to enter the market and hire their first employee, which leads to an increase in the number of firms after the reform.

There are two key differences between the fixed-wage and general equilibrium scenario. First, the wage increase in general equilibrium needed to clear the labour market makes it less attractive to become a manager, leading to a rise in the minimum productivity level required to be a manager and dampening the entry of new employers in the market. Second, the wage increase reduces optimal labour demand and leads to job losses in firms that employ more than one employee in the pre-reform period.

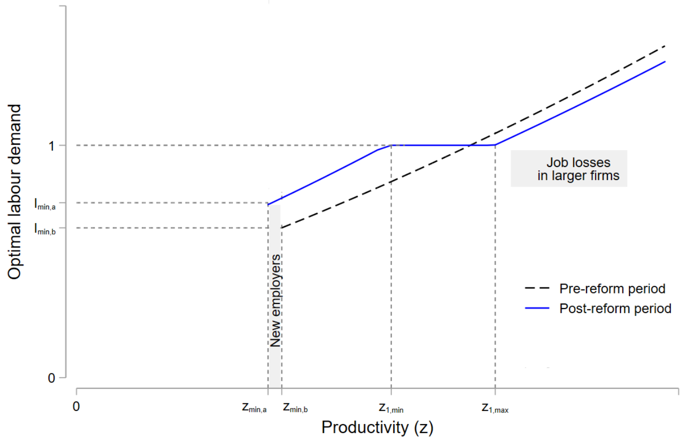
Labour market clearing. In equilibrium, wages in the post-reform period must be higher than in the pre-reform period ($w_a > w_b$). The entry of new employers increases labour demand and reduces the number of employees as some individuals become managers. Because the total number of agents is fixed, increased labour demand pushes up wages until labour demand by managers is equal to the share of individuals who prefer being employees.

Figure 3: Labour demand in the pre-reform and post-reform period

(a) Fixed wages



(b) General equilibrium



In equilibrium, the following market clearing condition holds:

$$\int_{z_{min,a}}^{z_{1,min}} l_a^*(z)\phi(z)dz + \int_{z_{1,min}}^{z_{1,max}} \phi(z)dz + \int_{z_{1,max}}^{z_{max}} l_a^*(z)\phi(z)dz = \int_{1}^{z_{min,a}} \phi(z)dz. \tag{14}$$

This condition pins down the market wage, w_a.[13]

[13]For completeness, the firm size distribution in the post-reform period is derived in Appendix G. In contrast to the distribution in the pre-reform period, the distribution in the post-reform period depends on the payroll tax and bunches at one employee. While the distribution in the pre-reform is used to calibrate the model, the distribution in the post-reform period does not play any role in the calibration.

5.3 Equilibrium in the pre-reform vs. post-reform period

The key element to understand the impact of the reform on aggregate employment and output 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 (6) and (12) implies:

$$\frac{z_{min,a}}{z_{min,b}} = \tau^{-\alpha}[\frac{w_a}{w_b}] \tag{15}$$

This expression illustrates that the value of the SSC exemption, captured by the parameter τ, and the general equilibrium effects on wages determines the change in the minimum productivity level after the reform and, thus, the number of new, low-productivity employers who enter after the reform.

Effect on employers. Using equation (15) allows us to compute the increase in the number of employers after the reform:

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

where C denotes a positive constant equal to $1/(1-(\frac{z_{max}}{z_{min,b}})^{1-\gamma})$.[14]

The equation demonstrates that the wage increase in general equilibrium ($w_a > w_b$) dampens the positive effect of the SSC exemption on the growth of the number of employers. Furthermore, as in Hombert et al. (2020), the parameter γ plays an important role. The larger γ, the larger the reform's effect on the number of employers. Intuitively, the SSC exemption will have larger effects if the subsidy tilts the balance towards hiring for many individuals. This is the case if many individuals have a low level of productivity, i.e. when γ is large. By contrast, if γ is small, most individuals have relatively high levels of productivity and these individuals will always hire, even in the absence of the subsidy.

Effect on employment and aggregate output. The effect on employment and aggregate output in general equilibrium is determined by two opposite forces. On the one hand, labour demand and output increase in firms employing at most one employee. On the other hand, higher wages reduce labour demand and output in larger, more productive firms (see Figure 3b). The latter force dominates, leading to an overall decline in labour demand and aggregate output. Eventually, the reallocation of labour from high-productivity to low-productivity firms reduces aggregate output.

More formally, the difference in labour demand in the post-reform vs. the pre-reform period is:

[14] This constant is close to 1. Equation (11) implies that $\frac{z_{max}}{z_{min,b}} = (\frac{l_{max}}{l_{min,b}})^{1-\alpha}$. Hence, $(\frac{z_{max}}{z_{min,b}})^{1-\gamma} = (\frac{l_{max}}{l_{min,b}})^{1-K} \approx 0$, because $K > 1$ and $l_{max} >> l_{min}$.

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

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

where $z_{1,b}$ denotes the productivity level of managers who employed exactly one employee in the pre-reform period. $L_{b,\text{large firms}}$ denotes employment in the pre-reform period in firms employing more than one employee.[15]

The first two terms capture the increase in employment due to increased labour demand by new firms and increased labour demand by firms that would have employed less than one 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. This term drops out if wages do not adjust, but it also illustrates that a small wage increase can cause a large decline in overall employment because 98% of the employees are employed by firms employing more than one employee.

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

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

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.

5.4 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 the first employee is exactly equal to zero in the post-reform period.

[15] $\int_{z_{1,b}}^{z_{max}} (l_a(z) - l_b(z))\phi(z)dz \approx [1 - (\frac{w_b}{w_a})^{\frac{1}{1-\alpha}}]L_{b,\text{large firms}}$ because we slightly overestimate job losses in firms with productivity between $z_{1,b}$ and $z_{1,max}$, i.e. firms whose labour demand is exactly equal to one in the post-reform period and slightly higher than one in the pre-reform period.

As documented in Table 1, these simplifying assumptions do not hold perfectly because firms hiring their first employee received temporary SSC 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 is 2.9% in the post-reform period.

It is straightforward to relax these assumptions. To this end, we distinguish between the payroll tax for the first employee, τ_1, and the payroll tax for subsequent employees, τ_2, in the pre-reform and post-reform periods. Consequently, the extended model contains four payroll tax rates, depending on the firm size and the period. This approach allows us to match the calibrated model to the size-dependent payroll tax rates in place in both periods and to simulate the combined effect of the tax exemption for the first employee and the tax shift. The derivation of the extended model is included in Appendix F.

The extended model contains two 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:

$$\frac{z_{min,a}}{z_{min,b}} = \frac{w_a}{w_b}\left(\frac{\tau_{1,b}}{\tau_{1,a}}\right)^{-\alpha}\left(\frac{\tau_{2,a}}{\tau_{2,b}}\right)^{1-\alpha} \tag{16}$$

This equation simplifies to equation (15) if the three aforementioned assumptions hold, i.e. $\tau = \tau_{2,b} = \tau_{2,a} = \tau_{1,b}$ and $\tau_{1,a} = 1$.

This expression shows that the tax shift, which reduces payroll taxes for all firms ($\tau_{2,b} < \tau_{2,a}$), dampens the change in the minimum level of productivity relative to the baseline model because a lower payroll tax rate makes the SSC exemption for the first employee relatively less valuable.

The second insight from the extended model is that the firm size distribution (derived in Appendix G) 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 kinks at one employee. The SSC exemption in the post-reform period reinforces bunching at one employee, as the payroll tax for the first employee further decreases.

As a robustness check, we will calibrate the extended model. This calibration accounts for the fact that the firm size distribution is already distorted in the pre-reform period.

6 Calibration

The baseline model contains four fundamental parameters: α, γ, z_{max} and τ. We set τ equal to 1.15. to match the ratio of the expected payroll tax for the first employee in the pre-reform (1.183) and the post-reform period (1.029).[16] Recall that, in the baseline

[16] This decision is motivated by eq. (16) of the extended model and corresponds to assuming that the payroll tax only changed for the first employee in the post-reform period, but remained constant for subsequent employees ($\tau_{2,b} = \tau_{2,a}$). These assumptions simplify equation (16) to $\frac{z_{min,a}}{z_{min,b}} = \frac{w_a}{w_b}\left(\frac{\tau_{1,b}}{\tau_{1,a}}\right)^{-\alpha}$.

model, the level of τ does not affect the optimal α, γ and z_{max} because the firm size distribution is independent of τ.

The three remaining parameters are calibrated by targeting the firm size distribution and the average firm size in 2015Q3. The firm size distribution is stable in the pre-reform period (2009Q1-2015Q3).[17] We chose 2015Q3 because this is the last quarter before the announcement of the policy. The average firm size in the private sector was 10.84 in 2015Q3. Note that the latter statistic determines the share of managers. Each manager employs, on average, 10.84 employees, implying that one out of 11.84 individuals (8.4%) are managers.

The calibration of α, γ, and z_{max} 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 plug the values of α, γ, $l_{min,b}$ and $l_{max,b}$ into equation (9) to compute the firm size distribution. We then 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 difference between observed and simulated firm size distribution reaches a minimum. More specifically, we minimize the minimum chi-square statistic[18]:

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

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 employing more than 15 employees.

Table 3 shows the values of α, γ and z_{max} that best match the firm size distribution in 2015Q3. We also report the minimum level of productivity required to start a firm and the minimum and maximum firm size. The first column calibrates the baseline model, in which the fundamental parameters are independent of τ. The second column calibrates the extended model that allows for a different payroll tax for the first vs. subsequent employees. In this model, the fundamental parameters depend on the choice of the payroll tax rates. The values of α and γ in both 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. We will, therefore, focus on the baseline model in the following sections. We briefly discuss the extended model in Section 7.3.

Comparing this equation to the fact $\frac{z_{min,a}}{z_{min,b}} = \frac{w_a}{w_b}\tau^{-\alpha}$ in the baseline model reveals that τ in the baseline model corresponds to $\frac{\tau_{1,b}}{\tau_{1,a}}$ in the extended model.

[17] For instance, from 2009Q1-2015Q3, the share of firms with one employee out of firms with at most fifteen employees ranges from 34.6% to 35.1%, while the share of firms with two employees ranges from 18.7% to 18.9%.

[18] The parameter values remain similar when minimizing $\big[\sum_{i=1}^{15}(\frac{observed_i - simulated_i}{observed_i})^2 + (\frac{observed_{>15} - simulated_{>15}}{observed_{>15}})^2\big]$, as in Bilal et al. (2022).

Firm productivity ranges from 44 to 2,417, implying that the most productive firm is 55 times more productive than the least productive firm. Differences in productivity levels translate into differences in optimal labour demand and, thus, firm size. The minimum and maximum firm size is 0.47 and 172. The maximum firm size appears reasonable given that only 0.77% of the firms in the private sector employed more than 200 workers in 2015Q3.

Table 3: Optimal parameter values

	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

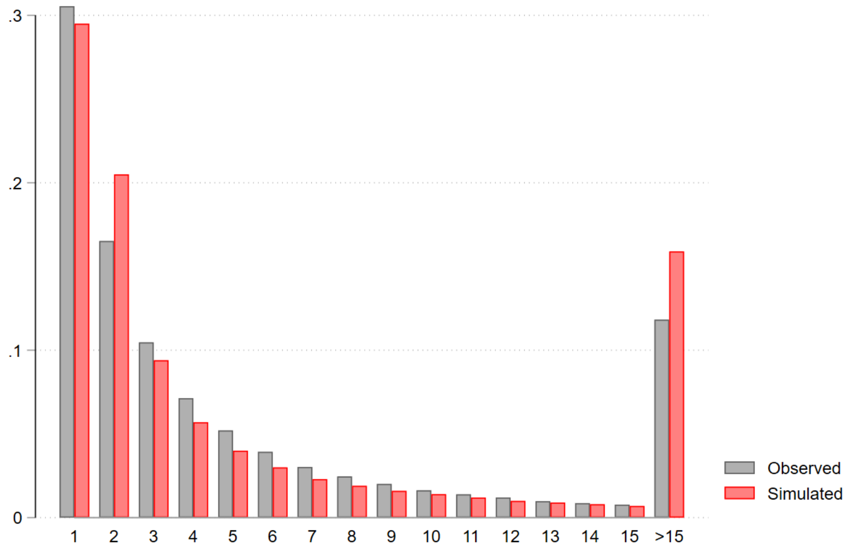
Notes: The baseline models sets $\tau = 1.15$. The extended model sets the payroll tax for the first employee equal to 1.183 and for subsequent employees to 1.269 (see Table 1).

Figure 4 compares the observed versus the simulated firm size distribution. By construction, the average firm size is perfectly matched, but our parsimonious model also matches the firm size distribution relatively well. For instance, 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 employing more than 15 employees (11.8% in reality vs. 16.0% in the model).

The model matches the distribution of employment among firms with up to fifteen employees. For instance, the model predicts that firms with more than fifteen employees employ 77.9% of the employees, which is close to the empirical counterpart (78.9%). By contrast, employment 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 larger firms that account for a disproportionate share of employment.

It is well-known that the choice of a (bounded) Pareto distribution implies that one can either accurately match the distribution of small firms or large firms, but never both (ref). We choose to match the distribution of small firms because these firms are directly affected by the SSC exemption, and we want to capture the impact of the SSC exemption on the number of firms with at most one employee. In Appendix X, we follow Guner et al. (2008) to tests whether our findings are sensitive to the exclusion of large firms. Guner

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



et al. (2008) assume that a small fraction of firms have a high level of productivity while the productivity of all other firms follows a pre-defined distribution. This assumption allows matching employment in large firms, but it does not alter our main findings.

Finally, it is important to emphasize that α determines the share of output allocated to the managers vs. the share allocated to the employees and the government. As is well known, the Cobb-Douglas production function implies that the share of income 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 $\alpha(\tau - 1)/\tau$. Given the optimal value of α, this implies that the employees' share of output is 28.0% and the government's share is 4.2%, whereas about two-thirds of the output goes to the managers in the form of profits.

7 Simulation

We use our calibrated baseline model to simulate the impact of the SSC exemption on several outcomes in general equilibrium, that is after wage have fully adjusted. We first focus on observable outcomes such as the total number of firms and the number of firms employing exactly one employee, which we observe empirically. In Section 4, we used microeconometric methods to evaluate the impact of the SSC exemption on these outcomes three years after the reform. We will show that our empirical estimates are close to the predictions generated by the model, which validates our model.

We then focus on unobservable outcomes that cannot be examined without a macroeconomic model. Specifically, we examine the impact on wages, employment, aggregate output, government revenue and the distribution of the surplus generated by the subsidy between employees and managers.

To gain additional insights into the general equilibrium effects, we consider two additional scenarios. We first consider the fixed-wage scenario, in which wages do not adjust as a response to the policy. This scenario allows us to isolate the second-order feedback effects caused by the upward wage pressure from the first-order effects of the entry of low-productivity employers. Furthermore, this scenario is interesting in itself because it could be argued that wages are fixed and will not increase after the reform. One justification for this assumption is that individuals out of the labour force might be willing to join the labour force when wages increase, thereby reducing the upward wage pressure. While this possibility is not explicitly modelled, the baseline model could easily be extended so that the labour force—which is assumed to be fixed in the baseline model—depends on the wage rate. When discussing this scenario, we will report the increase in the labour force required to ensure that wages remain unchanged while labour demand by the new employers is still met, under the assumption that new agents who join the labour force can only become employees. This statistic allows us to verify whether the assumption that wages remain constant is a realistic one.

Both the general equilibrium and the fixed-wage scenario assume that all firms employ a subsidised first employee. In reality, this will only occur after a very long time because new employers who benefit from the subsidy will only slowly replace the existing employers who do not benefit from the subsidy. In this sense, both scenarios should be considered the 'long-run' outcome. Our model is inherently static and does not model the dynamic processes of firm entry, growth, and exit. However, to gain some insights into the short-run effects, we consider a third scenario that mimics the short-run impact of the policy. In this scenario only new employers, defined as individuals whose productivity is between $z_{min,a}$ and $z_{min,b}$, receive the subsidy and wages are assumed to remain constant. This scenario implies that new employers immediately enter the market following the reform, while the existing firms are not immediately affected, which is consistent with the findings of Cockx and Desiere (2023).

7.1 Impact on observable outcomes

Simulation. Table 4 shows the impact of the SSC exemption on key (observable) outcomes for the three scenarios. The main takeaway is that the impact on the minimum productivity level required to start a firm and on the number of firms is remarkably similar in the three scenarios. The minimum productivity level decreases by about 4%. As a result, some individuals who preferred being employees in the absence of the subsidy become managers and hire employees. Consequently, the number of firms increases by 3%, entirely driven by a 10% increase in the number of firms with at most one employee.

While in long-term scenarios (columns 2 and 3), all firms benefit from the subsidy, in the short-term scenario (column 1), only the new, low-productivity firms receive the subsidy. We find that, in the latter, only 3% of the firms and 0.16% of the employees receive the subsidy. This is lower than what we observe in the data. For instance, By the end of

2016Q4, 0.70%[19] of full-time equivalent employees were subsidized employees. The reason is that the short-run simulations do not consider the exemption granted to new employers that would also have entered the market in the absence of the reform. In this sense, the short-run scenario presents the most optimistic evaluation because it assumes that only firms that use the subsidy to hire their first employee receive the subsidy and does not consider deadweight losses caused by subsidising firms that would also have hired in the absence of the subsidy.

Table 4: Simulated impact on observable outcomes

	Short-run	Long-run	
		Fixed wages	General equilibrium
Evolution of:			
Minimum productivity level	−4.04%	−4.04%	−3.91%
Wages	0.00%	0.00%	+0.52%
Number of employers	+3.13%	+3.13%	+2.77%
Number of firms with one employee	+10.54%	+10.54%	+10.18%
Number of employees	+0.16%	+0.53%	−0.26%
Labour force	+0.41%	+0.75%	0.00%
Share subsidised employers	3.04%	100%	100%
Share subsidised employees	0.16%	8.86%	8.89%

The growth in the number of employers is exactly the same in the short-run and the long-run fixed-wage scenario. This occurs because both scenarios assume that wages do not adjust after the reform. To keep wages constant, these scenarios assume that the labour force expands so that new employees enter the labour force, taking up the jobs created by the new employers. In both scenarios, the growth in the labour force (defined as the sum of the number of employees and managers) is fairly limited, despite the strong growth in the number of firms. Even in the long run, the labour force increases by less than 1%. This finding can be explained by noting that only a minority of individuals are managers so a strong increase in the number of managers has a modest impact on the total labour force. Moreover, labour demand by the new, low-productivity firms, each employing between 0.55 ($l_{min,a}$) and 0.58 employees[20], is limited.

Column 3 of Table 4 presents the general equilibrium in which wages adjust. A 0.5% wage increase is sufficient to ensure that labour demand equals labour supply. This wage increase causes a 0.8% reduction in employment in firms that employ more than one employee, implying a labour demand elasticity of −1.51. The wage increase explains why the minimum productivity level decreases less in general equilibrium (−3.91%) than in the two other scenarios (−4.04%). Consequently, the increase in the number of employers is also lower in general equilibrium than in the other scenarios (+2.77% vs. +3.13%).

The second-order feedback effects caused by the wage increase are modest. The slight

[19] $= 12,953/2,220,000$

[20] This corresponds to optimal labour demand of firms with productivity $z_{min,b}$ when exempt from payroll taxes, see Figure 3.

wage increase already destroys enough jobs (in large firms) to compensate for the fact that some previously employed individuals become managers and the increase in labour demand in employers with one or fewer employees. This is illustrated in Table 5, which shows the fraction of employees and managers in the labour force in both periods. The table also shows the job creation in firms employing at most one employee and the job losses in firms employing more than one employee.

As we noted earlier, the reform increased the number of managers (and, therefore, firms) by 2.8% and reduced the number of employees by −0.26%. Before the reform, 1.9% of the employees were employed by firms with at most one employee. After the reform, these firms employ 2.4% of the employees, which amounts to a 28% increase in employment in firms with one employee. At the same time, the share of employees employed in larger firms decreases by 0.5%. Because large firms employ nearly all employees, a small reduction (in relative terms) in employment in these firms is sufficient to counterbalance the strong increase in employment in firms with one employee.

Table 5: Employees and managers in the pre-reform vs post-reform period

	Pre-reform	Post-reform	Evolution
Employees (% of labour force)	91.6%	91.3%	−0.26%
In firms with one employee	1.9%	2.4%	+27.50%
In firms with more than one employee	98.1%	97.6%	−0.53%
Managers (% of labour force)	8.4%	8.7%	+2.80%

How well do the observed and simulated outcomes align? The empirical evaluation in Section 4 establishes the impact of the reform on the number of firms employing one employee, while Deng et al. (2023) shows that subsidised employers hire fewer employees than non-subsidised ones. In this section, we compare these empirical findings with the model predictions.

Impact on employers. The DiD regressions showed that the number of employers employing at most one employee is 7.1% to 8.2% higher in 2018Q1-2019Q4 than in 2015Q3. This estimate is remarkably close to the model's prediction of 10.2% in general equilibrium. This finding 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 remarkably well.

It is worth noting that the model allows us to quantify the bias of our DiD due to the violation of the SUTVA assumption. Our model shows that, even if wages increase immediately following the reform, the wage increase will be small and will have a negligible impact on the number of firms in the control group. The simulations indicate that the number of firms with two employees and the number of firms with 3-8 employees decreases by less than 0.5% after the reform, implying that the wage increase induces inconsequential bias in the DiD estimates.

Our model quantifies the new equilibrium after the market has fully adjusted to the SSC exemption, while the empirical estimate captures the impact of the reform after three years. The finding that the empirical estimate is close to the model's prediction indicates that the market quickly adjusted to the new equilibrium. Consistent with Cockx and Desiere (2023), it suggests that new low-productivity firms quickly entered the market so that the stock of firms rapidly reaches the new equilibrium. Put differently, prospective employers for whom the SSC exemption made it profitable to hire their first employee responded immediately to the policy and hired their first employee soon after its implementation.

Productivity of new employers. Deng et al. (2023) shows that new employers who hired their first employee after the 2016 reform hired on average fewer employees than new employers who hired before 2016. The share of firms employing at least two employees at the end of the first quarter during which they entered the market decreased by 3.2 percentage points. At the same time, they also observed that the share of firms employing exactly one employee one year after the reform increased. We interpreted these findings as evidence that the SSC exemption induced low-productivity employers to enter the market. The methodology and findings of Deng et al. (2023) are reviewed in Appendix A.

Our model is static and abstracts from firm entry and growth. This makes it difficult to compare these empirical findings to the model predictions. However, the predictions and the empirical findings are at least qualitatively similar. Between 2015 and 2016, the quarterly flow of new employers increased by about 25% (Deng et al., 2023). If we assume, in line with the model, that firms that enter as a response to the subsidy are low-productivity firms employing at most one employee, the share of new employers who employ at least two (three) employees would mechanically decline by 6.0 (3.3) percentage points.[21] This is greater than but qualitatively comparable to the empirical estimates that showed a 3.20 (2.13) percentage points decline in the share of new employers who hired at least two (three) employees at entry (Figure A.1).

7.2 Impact on unobservable outcomes

In this section, we focus on the long-run fixed-wage and general equilibrium scenarios of the SSC exemption on the following six outcomes: (1) average firm size, (2) average firm productivity, (3) aggregate output, (4) profits, (5) the total wage bill (defined as total wages paid to employees), and (6) the incidence of the subsidy, defined as the share of the surplus, generated by the subsidy, that goes to employers. We also compute the budgetary cost of the policy.

Table 6 shows the impact of the SSC exemption on these outcomes in the fixed-wage scenario (column 1) and in general equilibrium (column 2). The welfare implications of the policy are fundamentally different depending on whether wages remain constant or adjust. As we showed in the previous section, wages can only remain constant if the labour force expands. Consequently, with fixed-wage, the SSC exemption generates additional employment (see Table 4), which increases aggregate output by 0.25%, profits by 0.67%

[21] In the pre-reform period, 29.9% (16.6%) of the new employers employed at least two (three) employees. A 25% increase of new employers who employ at most one employee decreases the share of new employers who employ at least two or three employees to 23.9% (=29.9%/125%) and 13.3% (=16.6%/125%), respectively.

and the total wage bill by 0.53%.

By contrast, the labour force is fixed in general equilibrium and the SSC exemption induces employees to become managers. This process leads to a misallocation of labour from high-productivity to low-productivity firms, which reduces aggregate output by 0.01%. Profits and the total wage bill still increase at the expense of lower government revenues.

Table 6: Simulated impact on unobservable outcomes

	Fixed wages	General equilibrium
Evolution of:		
Average firm size	−2.53%	−2.95%
Average firm productivity	−2.57%	−2.28%
Output	+0.25%	−0.01%
Profits	+0.67%	+0.41%
Wage bill	+0.53%	+0.26%
Cost policy (% of output)	0.35%	0.36%
Share surplus for employers	75.66%	79.09%

Both scenarios estimate the budgetary cost of the policy at 0.35% of output. The budgetary costs 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.[22] The reduction in government revenues generates a surplus that is shared between the employees and managers. We compute the surplus as the sum of the increase in profits and the increase in the total wage bill. The managers capture 75% to 80% of the surplus (Table 6).

The observation that the managers are the main beneficiaries of the subsidy is intuitive when wages remain constant. In this scenario, the subsidy provides a windfall profit for firms with more than one employee. These firms capture most of the subsidy. Firms that would have employed fewer than one employee prior to the reform or firms that would not exist without the subsidy hire more employees, thereby sharing the subsidy with new employees.

The intuition is less straightforward in general equilibrium. In this scenario, wages increase for all employees by 0.5%—which increases the wage bill—but the wage increase entails job losses in large firms—which lowers the wage bill. Both forces oppose each other, but the wage increase is insufficient to ensure that employees obtain a larger share of the surplus.

The finding that the SCC exemption mainly benefits the managers contrasts sharply with the fact that a size-independent payroll tax reduction is fully compensated by a

[22] 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 employers receive the subsidy, 9.8% of the employees will be exempt from SSC, which is consistent with the model predictions of 8.86%. The average annual cost per subsidised employee in 2018-19 is €7,769, so the total cost should be in the order of 1.69 billion euros, or 0.35% of output, which is identical to the simulated cost in the long-run scenarios.

higher wage, as we proved in Section 5.1. In other words, a size-independent payroll tax reduction does not benefit the managers but only affects the employees (higher wage) and the government (lower revenues). By contrast, the size-dependent SSC exemption mainly benefits managers (more profits), has modest benefits for employees (higher wages) and reduces government revenues.

7.3 The extended model - impact of the tax shift

The extended model allows for size-dependent payroll taxes in the pre-reform and post-reform period. The main advantage of the extended model is that we can either simulate the impact of the SSC exemption for the first employee in isolation, or we can examine the combined impact of the SSC exemption and 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).

We first simulate the impact of the SSC exemption by assuming that payroll taxes for firms with more than one employee did not change from the pre-reform to the post-reform period (column 2, Table 7). This choice implies that we set $\tau_{2,b} = \tau_{2,a} = 1.27$, while the payroll tax for the first employee changes from $\tau_{1,b} = 1.18$ in the pre-reform to $\tau_{1,a} = 1.03$ in the post-reform period. We then simulate the combined impact of the SSC and the tax shift by reducing the payroll tax for firms with more than one employee in the post-reform period to 1.24. By comparing both scenarios, we can isolate the effect of the SSC exemption from the effect of the tax shift.

In both simulations, we focus on the general equilibrium because the tax shift immediately lowered the tax rate for all firms, making it unlikely that the market wage did not increase. To facilitate comparing predictions from the baseline and the extended model, we show the predictions from the baseline model in column 1.

The baseline model (column 1) and the extended model without the tax shift (column 2) lead to very similar results. The extended model that simultaneously considers the SSC exemption and the tax shift (column 3) reveals that the combination of both policies has a smaller impact on the number of employers (+2.4%) than the SSC exemption alone (+2.8%). Consequently, the number of firms with a single employee increases less (+8.9%). Accounting for the tax shift brings our empirical estimate of the evolution of the number of firms with one employee between 2015 and 2019 even closer to the model prediction.

The intuition for this finding is straightforward. The tax shift reduces the relative value of the SSC exemption for the first employee. This makes it less attractive for prospective employers to hire their first employee and reduces the impact of the SSC exemption on the number of firms. Also note that the tax shift increases wages (+3.10%), consistent with the property of the model with size-independent payroll taxes that payroll tax reductions increase wages, without any effect on the equilibrium.

Table 7: Impact of the SSC exemption and the tax shift in the extended model

	Baseline model	Extended model	
		SSC exemption	SSC exemption & tax shift
Evolution of:			
Minimum productivity level	−3.91%	−4.04%	−3.29%
Wages	+0.52%	+0.52%	+3.10%
Employers	+2.77%	+2.95%	+2.38%
Firms with one employee	+10.18%	+10.93%	+8.85%
Employees	−0.26%	−0.27%	−0.22%
Output	−0.01%	−0.02%	−0.02%
Cost policy (% of output)	0.36%	0.36%	1.0%

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%.

8 The cost of the policy

The policy reduces government revenues from SSC. The loss of revenues gradually increases over time as more firms employ a subsidised employee and will, according to our simulations, amount to 0.36% of output once all firms in the private sector benefit from the subsidy.

We use two complementary approaches to evaluate whether this cost is sizeable. First, we introduce a budget constraint in the baseline model and assume that the government balances the books by increasing the payroll tax. This approach allows examining the extent to which the payroll tax has to increase in order to subsidise the first employee. Second, we directly compute the budgetary cost of the policy per new firm and per new job.

8.1 A budget constraint

We assume that the government balances the books by raising the payroll tax for firms with more than one employee until revenues from SSC in the pre-reform period equal revenues from SSC in the post-reform period. In the baseline model, the payroll tax rate has to increase by a sizeable 1.7 percentage points, from 15% to 16.7%, to balance the budget (Table 8, column 2).[23] The payroll 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. Most interestingly, the rise in the payroll tax reduces wages. Without a budget constraint,

[23]We also experimented with a budget constraint in the extended model. The results are comparable. In the extended model, the budget constraint increases the payroll tax rate for firms with more than one employee from 26.9% to 28.9%, while wages decrease by −0.96%.

wages increase by 0.52%. With a budget constraint, wages decrease by 0.86%. Balancing the budget occurs at the expense of employees' wages.

Table 8: Effect of the policy without and with a budget constraint (general equilibrium)

	No budget constraint	Budget constraint
Employers	+2.77%	+3.06%
Wages	+0.52%	−0.86%
output	−0.010%	−0.013%
Cost policy (% output)	0.36%	0.00%
Payroll tax rate	15.0%	16.7%

8.2 The budgetary cost per new firm and new job

Table 9 provides insights into the budgetary cost of the policy in the short and long run using our DiD estimates and the simulations. Although tentative, these findings offer some insights into the magnitude of the cost of the policy. Furthermore, the possibility of comparing the cost of this particular policy to the cost of other (potential) policies makes our assessment policy-relevant. The policy aimed at supporting entrepreneurs to become employers as well as creating new jobs. For this reason, we compute the cost per new firm, the cost per new employee and the cost per new job. This latter outcome takes into account that the policy also created jobs for the managers of new firms.

Column (1) of Table 9 relies on the DiD estimates to quantify the budgetary cost of the policy in the short run. The DiD regression reported earlier indicates that the policy increased the number of new firms employing one employee by 7.1% from 2015Q3 to 2018Q1-2019Q4 (see Table 2). This corresponds to 3,763 new employers. A similar DiD regression estimates that the policy created jobs in firms with one employee for 4,066 full-time equivalent (fte) employees. Our model assumes that each firm employs exactly one manager, so the estimates suggest that the policy created 7,829 fte-jobs. According to official government statistics, the average annual budgetary cost of the policy in 2018-19 is 244 million euros.[24] Taken together, these estimates imply a cost of about €65,000 per new firm, €60,000 per employee and €31,000 per new job.

In column (2) of Table 9, we simulate the change in new firms, employees and fte-jobs in the short run, and we assume that the budgetary cost amounts to 244 million euros, as observed in the data.[25] We find that the simulated cost of the policy mimics what we see in the data, and we interpret this as additional evidence that our model predicts credible changes in the number of firms and employees.

[24]The cost is 210 and 277 million euros in 2018 and 2019, respectively.

[25]As mentioned earlier, the simulated short-term cost of the policy is lower, because the simulation assumes that only new low-productivity employers are subsidised. In reality, even in the short run, some employers who would anyway have entered the market obtain the subsidy. For this reason, the short-term simulation underestimates the budgetary cost of the policy.

Table 9: The budgetary cost of the policy

	Short-run		Long-run (simulations)	
	DiD estimates (2018Q1-2019Q4)	Simulation	Fixed wages	General equilibrium
New firms	3,763	5,430	5,430	4,805
New employees	4,066	3,553	11,766	−4,805
New fte-jobs (employees & managers)	7,829	8,982	17,196	0
Cost (million €)	244	244	1,528	1,533
Cost per firm (€)	64,708	44,847	281,423	319,075
Cost per employee (€)	59,887	68,553	129,886	∞
Cost per fte-job (€)	31,102	27,111	88,860	∞

Columns (3) to (4) of Table 9 rely on the simulations to quantify the costs. The cost of the policy in the long-run is about 1.5 billion euros (0.3% of output), which is much higher than in the short run, as all firms employ a subsidised first employee in the long run while only a tiny fraction employ a subsidised employee in the short run.[26]

The cost per new firm is similar in both long term scenarios ranging from €281,000 to €319,000. By contrast, the cost per employee and per job is fundamentally different in the fixed-wage vs. general equilibrium scenario. In the general equilibrium scenario, the labour force is fixed, so policies cannot create jobs but only change the composition of the labour force, as some employees prefer to be managers in the post-reform period. In the fixed-wage scenario, the labour force expands and new jobs for both employees and managers are created, which makes the evaluation less gloomy. The budgetary cost per employee and per job in the fixed-wage scenario is about €130,000 and €89,000, i.e. about two to three times higher than the simulated short-term cost.

9 Conclusion

This paper exploits a unique policy in Belgium that exempts new employers from payroll taxes for their first employee to examine the macro-implications of excessive firm entry. We showed empirically that the policy increased the number of firms with at least one employee by 7.1% three years after the implementation of the policy inducing low-productivity firms to hire their first employee, without much evidence of an increase in the number of firms with more than one employee.

These empirical findings led us to develop and calibrate a frictionless occupational choice

[26] Two complementary approaches can be used to compute this cost. We focus here on the fixed-wage scenario, but the computations for the general equilibrium follow the same steps. The first approach directly uses the simulated impact of the policy on government revenues. The simulation estimates the cost of the policy at 0.35% of output, which corresponds to 1.68 billion euros in 2019. The second approach uses the simulated share of subsidised employees (8.38%) as the starting point, and combines this statistic with information on the number of fte-employees in Belgium (2.22 million) and the average annual subsidy per subsidised employee in 2019 (€7,769). This second method, which we report in Table 9, estimates the cost at 1.53 billion euro (0.31% of GDP). These computations ignore the fact that the government may partly recoup this cost through higher tax incomes as profits and wages increase.

model in order to quantify the general equilibrium impact of the payroll tax exemption on wages, employment, and output and to examine the reallocation of labour from large high-productivity to small low-productivity firms. The main lesson from this model, which predicts the observed facts well, is that the general equilibrium impact on wages and output is limited. Wages are predicted to increase by 0.5% while the negative impact on output is negligible (−0.01%). By contrast, the budgetary cost of the subsidy is substantial, amounting to 0.36% of output, leading to an estimated cost per new firm in the order of 300,000 euros. Interestingly, the lion's share of the surplus generated by the subsidy goes to employers in terms of higher profits.

Our findings question the rationale of exempting the first employee from payroll taxes on efficiency grounds and align with the traditional view that size-dependent policies distort the optimal allocation of resources. Frictions in the product, labour, or credit market, which could in principle justify supporting new employers, either do not prevent prospective employers from hiring their first employee, or the subsidy for the first employee is not the right policy instrument to overcome these frictions. This finding is consistent with the De Mel et al. (2019) who conducted an RCT in Sri Lanka to evaluate the potential of temporary hiring subsidies for self-employed entrepreneurs. However, one could still support the policy for other reasons, such as a love for small businesses (Schumacher, 1973). In that sense, the observation that the negative impact of the policy on output is limited is reassuring, although the budgetary cost remains a concern, raising thorny questions about who will eventually pay for the subsidy for the first employee.

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A Productivity of new, subsidised employers

Introduction. The assumption that only low-productivity firms will enter as a result of the policy, hiring at most one employee, is central to our model. If we assume that only low-productivity firms enter as a response to the policy, the cohort of new employers in the post-reform period (which comprises both firms that, without the reform, would not have entered, and firms that would still have entered) will hire fewer employees at entry, will employ fewer employees after one year and will have a lower turnovers and profits than the cohorts of new employers in the pre-refrom period.

Deng et al. (2023) test these predictions by contrasting firm-level outcomes of cohorts of new employers who hired their first employee before and after 2016. They provide evidence that the 2016 cohort of new employers is indeed less productive than the previous cohort(s). In this section, we replicate their analyses but only for the outcomes employment at entry and after one year, as this is the key outcome in our model.

Methodology. Following Deng et al. (2023), cohorts of firms that hired their first employee before the 2016 reform (control group) are compared to those that hired after the 2016 reform (treatment group). Only firms in the treatment group are eligible for the permanent SSC exemption.

The identification strategy consists in estimating the following regression:

$$y_{it} = \mu_{2015} + \sum_{\substack{t=2009 \\ t\neq 2015}}^{2019} \beta_t year_t + \epsilon_{it}$$

where y_{it} denotes the outcome of firm i that hired their first employee in year t. The coefficients of interest are β_t, which identify the difference between the outcome for firms that hired their first employee in year t relative to firms that hired their first employee in 2015.

The policy was announced in 2015Q4 and some prospective employers postponed hiring from 2015Q4 to 2016Q1 (Cockx and Desiere, 2023). We exclude both quarters in the regression to rule out bias due to anticipation effects in 2015Q4 and catch-up effects in 2016Q1[27]. We compare outcomes by year, rather than by quarter, to address seasonality in the quarterly time series.

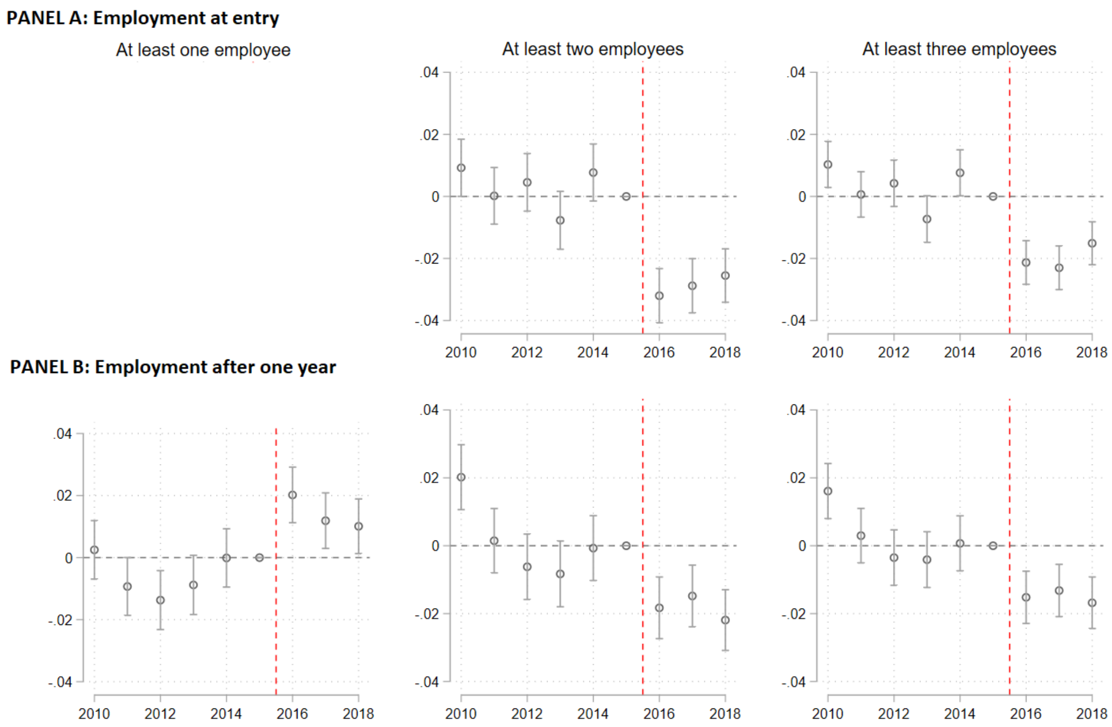
The impact of the policy on new employers is then captured by β_{2016}, which estimates the difference between the outcome for firms that hired their first employee with a subsidy in the period 2016Q2-2017Q1 to firms that hired their first employee without a subsidy in the period 2014Q3-2015Q3. This estimate is only credible if the coefficients β_t in the years preceding the reform are not statistically different from zero, which indicates that

[27]For this reason, the precise definition of a year differs in the pre-reform and post-reform periods. In the pre-reform period, year t includes the period from the fourth quarter of year $t-1$ up to (and including) the third quarter of year t. In the post-reform period, a year includes the period from the second quarter of year t to the first quarter of year $t+1$.

the outcome remained stable in the pre-reform period.

Employment at entry and after one year by cohort of new employers. Figure A.1 compares employment at the time of hiring the first employee (Panel A) and one year after hiring the first employee (Panel B) between employers who hired their first employee in 2015 and employers who hired their first employee in previous or subsequent years. The outcome is defined as employing at least one (figures on the left), at least two (figures in the middle) or at least three employees (figures on the right). Importantly, most outcomes are remarkably stable in the pre-reform period, which strongly suggests that the decrease observed in 2016 can be attributed to the SSC exemption[28].

Figure A.1: Employment of new employers at the time of entry (Panel A) and after one year (Panel B)



Notes: The figures show the probability of employing at least one, two or three employees at the time of entry (Panel A) and after one year (Panel B) for new employers relative to the cohort of new employers who hired their first employee in 2014Q4-2015Q3. 29.9% and 16.6% of the new employers hiring their first employee in 2014Q4-2015Q3 employ at least two and three employees at the end of the quarter in which they hired their first employee. After one year, 69.8%, 34.8% and 21.0% of these new employers employ at least one, two and three employees.

[28]We do not define the outcome as the total number of employees because this outcome is sensitive to outliers. It is well-documented that a few existing firms obtain new firm identifiers in each period (for instance, after a merger) and appear as new employers in the dataset, but are in reality existing employers obtaining a new firm identifier (Geurts and Van Biesebroeck, 2016).

Figure A.1 confirms the key assumption of the Lucas model: new employers who hired with a subsidy employ on average fewer employees at entry than new employers who hired without the subsidy. Panel A shows that new employers hiring their first employee with a subsidy in 2016 are 3.20 (2.13) percentage points (pp) less likely to employ at least two (three) employee(s) at the time of entry. In relative terms, the SSC exemption reduces the probability of employing at least one (two) employees by 10.7% (12.8%).

These negative effects persist (Panel B). Although new employers who hired for the first time in 2016 are 2 pp more likely to employ an employee after one year than employers who hired their first employee just before the reform, they are 1.8 pp (1.5 pp) less likely to employ at least two (three) employees after one year.

Deng et al. (2023) conduct similar analyses for firm-level outcomes such as turnover and profits. Overall, their finding shows that cohorts of subsidised employers obtain lower turnover and profits, suggesting that the SSC exemption induced low-productivity firms to hire their first employee. At the same time, they find little evidence that the SSC exemption created a few highly successful firms.

B Expected payroll tax rate for the first employee

Figure 1 in the main text shows the payroll tax rate for the first employee paid by the 2014Q1, 2014Q2, 2014Q3 and 2014Q4 cohorts of new employers[29] and the rate averaged over these four cohorts. As highlighted in the main text, this figure demonstrates that, in the pre-reform period, the payroll tax rate increases gradually as the firm ages.

In this section, we compute the expected payroll tax rate for the first employee defined as the payroll tax rate an employer is expected to pay over the firm's lifetime. The expected payroll tax rate depends on (1) the payroll tax rate in a given quarter after hiring the first employee; (2) the survival rate (i.e. the probability of remaining an employer); and (3) the annual discount rate.

More specifically, we compute the expected payroll tax rate as a weighted average of the payroll tax rate in a given quarter, where the weights depend on the survival and discount rate:

$$\text{expected payroll tax rate} = \frac{\sum_{i=1}^{\infty} \frac{S_i}{(1+r)^i} T_i}{\sum_{i=1}^{\infty} \frac{S_i}{(1+r)^i}}$$

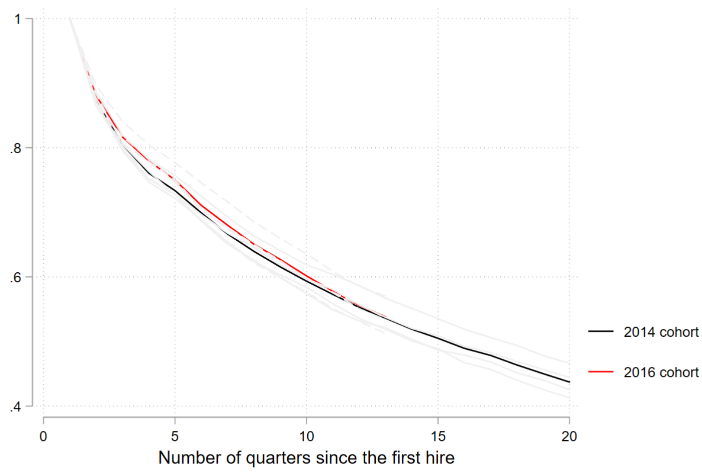
where S_i denotes the survival rate, i.e. the probability of still employing employees after i quarters; r represents the quarterly discount rate; and T_i is the payroll tax rate in quarter i.

Figure B.1 shows the survival rate of the 2014 (and 2016) cohort of new employers in the first five years after hiring. We assume that the annual exit rate is equal to 3% after five

[29]For each cohort, the population is restricted to employers who employ exactly a single employee, so that the payroll tax rate for the first employee can be computed

years, which corresponds to the average exit rate in Belgium (Bijnens and Konings, 2020). We use the payroll tax rate shown in Figure 1 for the first five years and assume that the payroll tax rate is constant thereafter. In line with the search and matching literature, we use an annual discount rate of 5%. Using the formula, the expected payroll tax rate in the pre-reform period is equal to 18.3%.

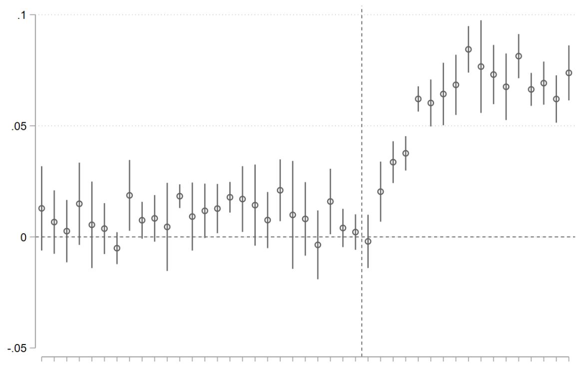
Figure B.1: Survival rate: 2014 vs. 2016 cohort



The grey (dashed) line show the survival rate of four quarterly 2014 (2016) cohorts of new employers in funtion of the number of elapsed quarters since the first hire. The black and red lines show the survival rate of the 2014 and 2016 cohorts averaged over the four quarters. The survival rate is defined as the share of firms that still employ employees in a given quarter.

C DiD event study plot

Figure C.1: DiD event study: firms with one employee vs firms with 3-8 employees



Notes: The figure presents a DiD event plot contrasting growth in the number of employers with one employee versus firms with 3-8 employees. The reference period is 2015Q3. The standard errors are clustered by firm size.

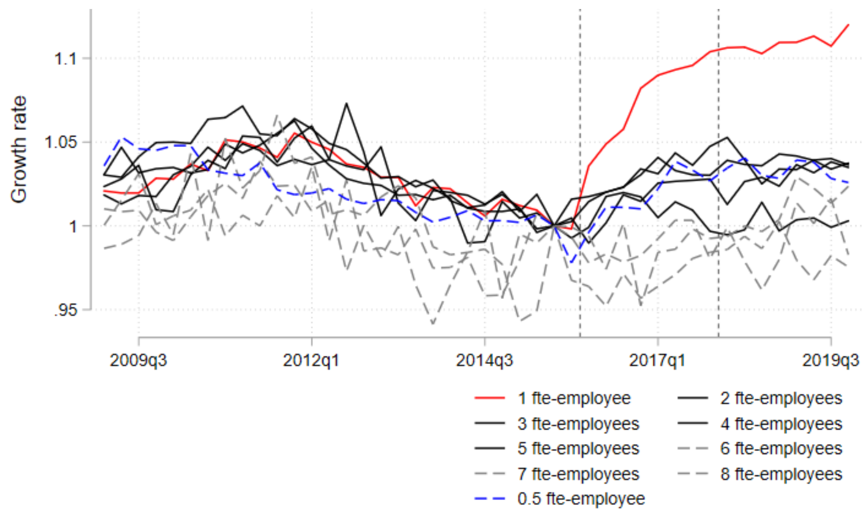
D Evolution of employers - fte-definition of firm size

In the empirical analyses, we defined firm size as the sum of the number of full-time and part-time employees employed by a firm at the end of a quarter. In this section, we show that our findings hold when firm size is defined as the number of full-time equivalent (fte) employees employed at the end of the quarter. This definition no longer gives equal weight to full-time and part-time employees, but assigns a weight of one to full-time and of 0.5 to part-time employees.

The fte-definition implies that the firm size increases in steps of 0.5 fte-employees. The smallest firms employ 0.5 fte-employees. Firms with one fte-employee employ either one full-time employee or two part-time employees.

Figure D.1 shows the evolution of firms employing exactly 0.5 fte-employees, and 1 to 8 fte-employees, thereby excluding firms employing 1.5, 2.5, etc. fte-employees. Figure D.2 groups firms with at most one fte-employees, 1.5-2 fte-employees, 2.5-3 fte-employees, etc.

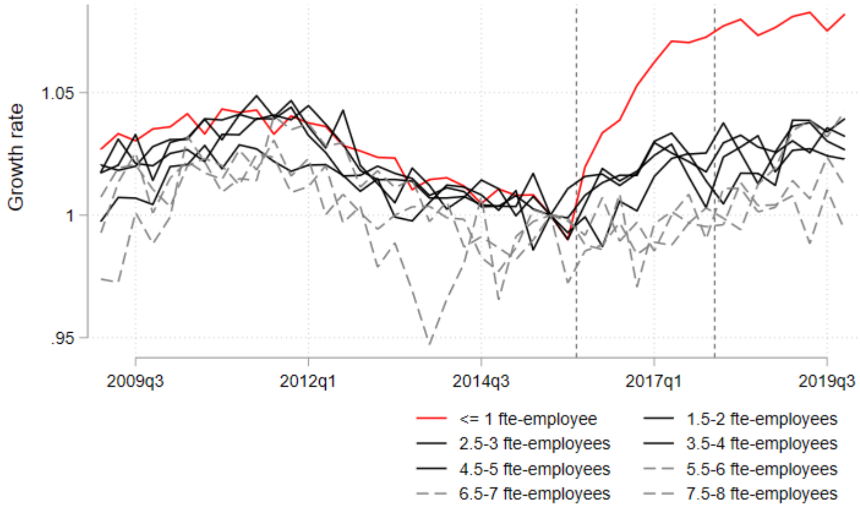
Figure D.1: Evolution of the number of firms, by fte-definition of firm size



The figure shows the growth in the number of firms by firm size, defined as the number of fte-employees employed at the end of the quarter, relative to 2015Q3. In 2015Q3, Belgium counted 24,805 firms with 0.5 fte-employees, 36,323 firms with 1 fte-employee, 17,333 firms with 2 fte-employees, 10,060 firms with 3 fte-employees, 6,622 firms with 4 fte-employees, 4,680 firms with 5 fte-employees and 3,545 firms with 6 fte-employees.

Both figures confirm the sharp increase in the number of firms employing exactly one (Figure D.1) or at most one fte-employee (Figure D.2). The figures also show that growth in the number of firms employing 2-5 fte-employees evolved similarly to the growth in the number of firms with one fte-employee in the pre-reform period. We will use these firms as the control group in the DiD analyses. By contrast, the number of firms employing 6-8 fte-employees evolved differently in the pre-reform period, suggesting that these firms do not provide a valid control group.

Figure D.2: Evolution of the number of firms, by fte-definition of firm size (grouped)



The figure shows the growth in the number of firms by firm size, defined as the number of fte-employees employed at the end of the quarter, relative to 2015Q3. Firms are grouped as follows: firms with <=1 fte-employee, firms with 1.5-2 fte-employees, firms with 2.5-3 fte-employees, etc.

Table D.1 shows the DiD estimates using different treatment and control groups. Our preferred specification, which compares firms with exactly one fte-employee to firms with 2-5 employees (column 5), shows that the SSC exemption increased the number of firms employing exactly one fte-employee by 8.27%. The effect on the number of firms employing at most one fte-employee (column 6) is smaller (+5.11%), mainly because the number of firms employing one part-time employee (i.e. the smallest firms) did not increase much in the post-reform period, as evidenced in Figure D.1.

Table D.1: DiD estimates of the growth in the number of firms (fte-definition of firm size)

Treatment group	1	1	1	1	1	≤ 1
Control groups	2	3	4	5	2-5	[2-5]
γ_0	3.23e-05	-0.00911	0.00285	0.00175	-0.00112	0.00687*
	(0.0212)	(0.0230)	(0.0212)	(0.0240)	(0.00271)	(0.00269)
γ_3	0.0711***	0.0719***	0.0803***	0.108***	0.0827***	0.0511***
	(0.0221)	(0.0239)	(0.0221)	(0.0250)	(0.00854)	(0.00134)
N						

The table shows the results of estimating equation (4). Regression (1)-(5) quantify the graphical evidence presented in Figure D.1; regression (6) quantifies the graphical evidence presented in Figure D.2. The standard errors are clustered by firm size in regression (5) and (6). Conventional standard errors are reported in all other regressions. ***,**,** denote statistical significance at the 1%, 5% and 10%, respectively.

An important question is whether the subsidy for the first employees supported firms to grow, and increased the number of firms employing more than one fte-employee. If the policy provides a stepping stone to expand employment, one would expect a larger increase in the number of firms with two employees than in the number of firms with three or four employees. In the short run, the impact on the number of firms with three or four fte-employees should be limited, because only a small share of firms with three or four employees employs a subsidised employee.

The observation that the growth in the number of firms with two fte-employees coincided with the growth in the number of firms with 0.5, 3 and 4 fte-employees (see Figure D.1 and Figure D.2) suggests that the 2016 policy only increased the number of firms with exactly one fte-employee, without affecting the number of firms employing exactly two fte-employees. DiD analyses, not reported here, confirm that growth in the number of firms with exactly 2 fte-employees coincided with the growth in the number of firms with 0.5, 3 and 4 fte-employees. This finding aligns with the result, reported in the main text, that new employers who hired their first employee after the 2016-reform hired fewer fte-employees than new employers who hired their first employee in the pre-reform period.

We do observe, however, that the number of firms with 0.5, 1, 2, 3 and 4 fte-employee increased about 3% more in the post-reform period than the number of firms employing 5 fte-employees. Firms with 5 fte-employees are, in principle, a valid control group, because the parallel trend holds in the pre-reform period. We do not believe, however, that the policy increased the number of firms with 0.5, 2, 3 and 4 employees by 3% for two reasons, First, the DiD estimates (not reported) are not significant at conventional levels. Second, and more importantly, if the policy has a positive impact on the number of firms with more than one fte-employee, it should have a larger effect on firms with 2 fte-employees than on firms with 3 or 4 fte-employees. This is not what we observe in the data.

E The equilibrium is independent of the payroll tax rate

It is straightforward to prove that the payroll tax rate does not labour allocation across firms in the model with size-independent payroll taxes. Using the indifference condition of the marginal manager (eq. (6)), we can write optimal labour demand in function of $z_{min,b}$ and α:

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

Substituting this expression in the equilibrium condition (eq. (8)) gives:

$$\int_{z_{min,b}}^{z_{max}} \frac{\alpha}{1-\alpha}(\frac{z}{z_{min,b}})^{\frac{1}{1-\alpha}}\phi(z)dz = \int_{1}^{z_{min,b}} \phi(z)dz$$

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. (6)), implies that:

$$\frac{dz_{min,b}}{d\tau} = \frac{d}{d\tau}[(\frac{\alpha}{1-\alpha})^{1-\alpha}w(\tau)\tau] = 0 \Rightarrow \frac{d[w(\tau)\tau]}{d\tau} = 0 \Rightarrow \epsilon_\tau^w = \frac{d[log(w)]}{d[log(\tau)]} = -1$$

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

F The extended model

The baseline model assumes a single payroll tax rate τ that either applies to all firms (the pre-reform period) or corresponds to the marginal payroll tax rate paid by firms with more than one employee (post-reform period). By contrast, the extended model introduces a payroll tax rate τ_1 for the first employee and a payroll tax rate τ_2 for subsequent employees.

The profit function equals:

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

The first-order conditions determine optimal labour demand:

$$l^*(z) = \begin{cases} 0 & z < z_{min} \\ \left(\frac{\alpha z}{\tau_1 w}\right)^{\frac{1}{1-\alpha}} & z \in [z_{min}; z_{1,\tau_1}[\\ 1 & z \in [z_{1,\tau_1}; z_{1,\tau_2}] \\ \left(\frac{\alpha z}{w\tau_2}\right)^{\frac{1}{1-\alpha}} & z \geq z_{1,\tau_2} \end{cases} \quad (17)$$

Labour demand bunches at one employee because firms with a productivity between $z_{1,\tau_1} = w\tau_1/\alpha$ and $z_{1,\tau_2} = w\tau_2/\alpha$ are sufficiently productive to hire 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, $w\tau_2$ or profit $\pi(z_{min})$ pins down z_{min} and l_{min}:

$$z_{min} = \left(\frac{\alpha}{1-\alpha}\right)^{\frac{1}{1-\alpha}}\left(\frac{w\tau_2}{\alpha}\right)\left(\frac{\tau_1}{\tau_2}\right)^{\alpha} \quad (18)$$

$$l_{min} = \frac{\alpha}{1-\alpha}\frac{\tau_2}{\tau_1} \quad (19)$$

These equations encompass equation (6) of the baseline model, which determined $z_{min,b}$ in the pre-reform period assuming that $\tau_1 = \tau_2 = \tau$, and equation (12) of the baseline model, which determined $z_{min,a}$ in the post-reform period assuming that $\tau_1 = 1$ and $\tau_2 = \tau$.

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

G 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 $\tau_1 = 1; \tau_2 = \tau$. 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:

$$g(l) = \frac{\phi(z(l))}{p}\frac{dz(l)}{dl} \quad (20)$$

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 (17) gives:

$$g(l) = \begin{cases} \frac{\delta(1-\alpha)}{p}\left(\frac{w\tau_1}{\alpha}\right)^{1-\gamma} l^{-K} & l < 1 \\ \frac{1}{p}\int_{z_{1,\tau_1}}^{z_{1,\tau_2}} \phi(z)dz & l = 1 \\ \frac{\delta(1-\alpha)}{p}\left(\frac{w\tau_2}{\alpha}\right)^{1-\gamma} l^{-K} & l > 1 \end{cases} \quad (21)$$

where p denotes the share of individuals who are managers.

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

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

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

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

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

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

$$g(l) = \begin{cases} C(1-K)l^{-K} & l < 1 \\ C(\tau_2^{1-\gamma} - \tau_1^{1-\gamma}) & l = 1 \\ C(1-K)(\frac{\tau_2}{\tau_1})^{1-\gamma} l^{-K} & l > 1 \end{cases}$$

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

$$g(l) = \frac{(K-1)l_{min,b}^{K-1}}{1 - (\frac{l_{min,b}}{l_{max,b}})^{K-1}} l^{-K} \tag{22}$$

which corresponds to the firms size distribution in the pre-reform period reported in the main text (eq. (9)). The calibration exploits this equation to estimate α, γ and l_{max}.