Journal of Industrial and Business Economics (2023) 50:283–320
https://doi.org/10.1007/s40812-023-00266-0

Red tape and industry dynamics: a cross-country analysis

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Received: 8 October 2022 / Revised: 24 March 2023 / Accepted: 27 March 2023 /
Published online: 17 April 2023

Abstract

In this paper, we analyze the relationship between the stringency of red tape and the entry and exit rates of firms. To do so, we use a panel dataset on firm entry and exit rates, obtained from Eurostat Business Demography, covering 22 European countries and 14 manufacturing sectors observed over the period 2013–2019. We complement the information on firm dynamics with country-level data on red tape from the World Bank's Doing Business database. Five dimensions of red tape are considered: regulations for starting a business, construction permits, procedures for getting electricity, registering property, and contract enforcement. In addition, both the cost and the time taken to complete the administrative procedures are used as metrics of red tape. Using a difference-in-difference approach *à la* Rajan and Zingales (1998), we find a negative effect of administrative burdens on the entry and exit rates of firms across European countries. Moreover, we find that the negative effect is more pronounced for smaller firms. Finally, the time taken to comply with bureaucratic procedures is a greater impediment to smooth entry and exit than the monetary costs associated with these administrative barriers.

Keywords Entry rate · Exit rate · Regulation · Red tape · Difference-in-difference

JEL Classification L51 · L53 · L60 · M13

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1 Introduction

The creation of new businesses and the exit of the least productive firms matter for productivity and economic growth (Schumpeter, 1947; Foster et al., 2001; Bartelsman et al., 2009; Brandt et al., 2012; Garcia-Macia et al., 2018; Asturias et al., 2023). Business dynamism is key to the efficiency-enhancing reallocation of resources, by allowing successful firms to enter and grow and less productive ones to shrink and exit. Moreover, the entry of new firms pushes down prices, thereby reducing profit margins, which in turn induces incumbents to become more efficient by reducing costs. Finally, business dynamism can encourage the introduction of radical innovations and the diffusion of technology and knowledge, which are fundamental drivers of productivity growth.

Given the role of firm dynamics in aggregate productivity and economic growth, the economic literature has extensively studied its determinants. A considerable number of both theoretical and empirical studies have recognized the existence of industry-, country- and firm-specific factors that play an important role in the entry-exit process (Kessides, 1990a; Buch & Smiley, 1992; Hopenhayn & Rogerson, 1993; Micco & Pagés-Serra, 2008).[1] One factor that has received increasing attention in recent decades is product market regulation (PMR), which refers to the rules related to barriers to entrepreneurship, price controls and public ownership, as well as barriers to trade and foreign investment (Scarpetta et al., 2002; Cincera & Galgau, 2005; Nicodème & Sauner-Leroy, 2007; Bjørnskov & Foss, 2008; Anderton et al., 2020). Overall, cumbersome regulations and administrative procedures for running a business, from inception to maturity, have a direct impact on the costs of both entry and exit, thereby negatively affecting business dynamism. Conversely, pro-competitive reforms (i.e. the reduction of entry barriers, the privatization of state-owned enterprises, the introduction of a more efficient bankruptcy framework) that reduce the administrative burden on firms can stimulate business dynamism by reducing adjustment costs and uncertainty, by providing the stability necessary for investment in productive activities, and by ensuring a more efficient use of capital and labor (Djankov et al., 2006; Calvino et al., 2020).

In this paper, we contribute to this strand of the literature, by providing some new empirical evidence on the relationship between the stringency of red tape and firm entry and exit rates. Red tape refer to those rules that may discourage firm entry, by increasing the costs associated with setting up a firm as a legal entity, or by complicating the procedures for obtaining permits to start a business activity. Similarly, they may hamper the exit of inefficient firms by reducing competitive pressure and keeping "zombie" firms alive (Andrews & Petroulakis, 2019).

We take the opportunity to examine the relationship between red tape barriers and business dynamics using several data sources. First, we rely on the Business Demography database provided by Eurostat for the information on the entry and exit of firms in the manufacturing sector (NACE Rev.2 10-33), for 22 European

[1] Section 2 provides a compact review of the determinants of firm entry and exit.

countries observed over the period 2013–2019. The data on firm entry and exit rates are further disaggregated into four classes of firm size, which allows us to identify some heterogeneous patterns. The information on business dynamics is enriched with country-level data on red tape, both in terms of the time (number of days) required for a firm to operate legally in the market, and the costs borne by the firm to complete all the required administrative procedures. This data comes from the World Bank's Doing Business project. More specifically, Doing Business covers several dimensions of red tape: regulations for starting a business, dealing with construction permits, getting electricity, registering property, and enforcing contracts. While these dimensions capture different features of the business environment in a detailed way, the amount of information they contain could hardly be managed within the same empirical model. For this reason, we apply a principal component analysis (PCA) to the variables related to the costs incurred by firms in complying with bureaucratic obligations and the time taken to complete all procedures, and obtain two synthesized indicators (principal components) of red tape.

From an empirical point of view, to reduce the endogeneity problems associated with omitted variable bias, we run a specification where we include a large number of fixed effects to account for different sources of unobserved time-invariant heterogeneity. To further mitigate this problem, we introduce into the empirical model a vector of time-varying country and country-sector characteristics that are relevant determinants of firm entry and exit rates. Nevertheless, there may still be a concern that business dynamics and red tape are jointly determined, creating a problem of reverse causality that potentially invalidates our empirical strategy. To address this concern, we enrich the econometric analysis by using a difference-in-difference (DiD) approach *à la* Rajan and Zingales (1998). This framework has been used in several policy-oriented papers, such as Klapper et al. (2006), Ciccone and Papaioannou (2007), Barone and Cingano (2011), Bassanini and Cingano (2014) and Andrews and Cingano (2014). The main idea behind this approach is that some industries are "naturally" more exposed to a given policy. These can be considered as a kind of treated group and should be disproportionately more affected by the policy than the control group, which consists of the less exposed industries. We exploit this idea to assess whether countries with higher levels of red tape have relatively lower rates of firm entry and exit in sectors that are more exposed to these policies. We hypothesize a higher exposure to administrative burdens for those manufacturing sectors that are more dependent on those services related to the fulfillment of red tapes, i.e. legal, accounting, technical services, and public sector bureaucracy. We measure the dependence of each manufacturing sector on these services, by using the input–output (I–O) tables for the US, which is taken as the benchmark country.[2] We calculate the share of intermediate costs corresponding to services' inputs for each manufacturing sector. In the DiD specification, this industry characteristic is interacted with the measure of red tape at the country-level. By focusing on the interaction term, we can also include country-size-time and sector-size-time

[2] We recognize that this approach has been recently examined by Ciccone and Papaioannou (2022). We cross-refer the reader to Sect. 4, where we discuss this framework at greater length.

fixed effects that allow us to control for country-wide shocks (i.e., macroeconomic and institutional changes, as suggested by Bassanini and Cingano 2014), as well as industry-specific supply or demand shocks.

In line with the extant empirical literature, our regression framework confirms the working hypothesis that both entry and exit rates are negatively and significantly correlated with red tape (Ciccone & Papaioannou, 2007; Klapper et al., 2006, 2011; Kaplan et al., 2011; Ciriaci, 2014).[3]

We enrich previous analyses along two dimensions. First, we use two metrics of red tape that take into account both the cost and the time required to comply with bureaucratic barriers. Our results show that the two metrics indeed capture different dimensions of red tape and can be included together in the empirical analysis. In particular, we find that a reduction in red tape from the most to the least affected countries increases the entry rate by about 6.4% in the case of a reduction in the time required to comply with administrative burdens, and by only 0.87% in the case of lower costs borne by firms. This differential effect is also confirmed for exit rates, with an increase of 5.4% in the case of a shorter time and of 3.5% in the case of lower costs. This result suggests that the time needed to comply with red tape may be a more relevant brake on firm entry and exit than the monetary costs, and that economies characterized by a long time to comply with bureaucratic obligations may be particularly harmed in terms of lower business dynamism. Second, we test the heterogeneous effect of red tape across firm size classes. We show that the negative effects are more pronounced for smaller firms, for which the administrative burdens depress business churning through both the entry and exit channels. Thus, red tape is particularly burdensome for small and young firms. These firms, and in particular the few high-growth firms among them, have recently attracted the interest of policymakers (Vértesy et al., 2017), academics (Henrekson & Johansson, 2010), and the popular press because they are crucial for the introduction of new products and processes and are responsible for the creation of most new jobs across countries and industries (Schreyer, 2000; Nesta, 2009; Audretsch, 2012; Haltiwanger et al., 2017). In this sense, cumbersome bureaucratic barriers can act as a brake on a country's ability to grow in the long-run.

The study that comes closest to our paper, both in terms of research questions and data, is that of Ciriaci (2014), which provides evidence on the impact of changes in the cost and the time required to start a new business. As in our work, Ciriaci (2014) has used the information on red tape from the Doing Business database, while the information on entry rates comes from Eurostat and covers 17 European countries over the period 2004–2011. The author confirms that the higher the level of red tape, the lower the entry rate. Our work extends and deepens Ciriaci (2014)'s work, because we consider both entry and exit rates. Entry and exit of firms are related phenomena whose joint analysis is necessary if one wants to assess the role of market selection and competition in a more comprehensive way. Furthermore, we assess

[3] A complementary line of research assesses the role of specific pro-competitive reforms that take place within countries, by using time- and region-/industry-changes in entry costs (Bertrand & Kramarz, 2002; Kaplan et al., 2011; Branstetter et al., 2013; Amici et al., 2016).

a heterogeneous effect of red tape across firm size classes by showing that they are particularly harmful to smaller firms. Finally, we improve the identification strategy by controlling for several important sources of unobserved heterogeneity and by implementing an econometric technique that mitigates some endogeneity concerns.

The rest of the paper is organized as it follows. Section 2 provides a summary of the main determinants of firms' entry and exit decisions. Section 3 describes the data and variables used. Section 4 explains the identification strategy and the econometric results of the paper. Section 5 provides some final remarks.

2 Barriers to entry (and exit) and industry dynamics: the role of red tape

According to Geroski (1995), the decision to enter an industry at a given time is a function of expected profits net of entry costs. A simple version of this model is

$$E = \beta\{\pi^e - F\} + \mu, \tag{1}$$

where E is entry, π^e is expected post-entry profits, F refers to entry costs, β is an unknown parameter that approximates the speed of entry in response to profitable opportunities and μ captures transitory variations in the unobserved factors.

In general, entry and exit[4] decisions may well be related, because of the (1) displacement and (2) 'vacuum' effects (Siegfried & Evans, 1994). The displacement effect refers to the fact that new entrants drive some inefficient incumbents out of the market: the entry of new firms leads to an increase in the level of competition and, because of the market selection process, makes it easier to exit the market. The second effect relates to the opportunities created for potential entrants by firms that exit the market, leaving part of consumer demand unfulfilled. Both (1) and (2) imply a positive correlation between entry and exit rates across industries, in such a way that high entry barriers also reduce exit rates by reducing competitive pressure.

High entry barriers correspond to high entry costs (F), which must be sunk in order to be taken into account in firms' entry decisions. F may be high, especially in some industries and countries, due to various factors (Siegfried & Evans, 1994).

First, some structural determinants at the industry-level are relevant. High entry costs may depend on high factor prices and the technological intensity of the industry in which a firm operates. For factors of production, the existence of a minimum capital requirement can be seen as a barrier to entry for new firms if the cost of capital rises with its required level, or if it is a sunk cost (Kessides, 1990b, 1991; Sutton, 1991). Research and Development (R &D) intensity is also a source of higher sunk costs (Sing et al., 1998; Chang & Tang, 2001) and when this is relevant, potential entrants may not be able to afford the high initial capitalization required. We should bear in mind that sunk costs in durable tangible (physical capital) and intangible (advertising and R &D) specific assets appear to discourage exit (Caves & Porter,

[4] The reader is referred to Cefis et al. (2022), for a systematic literature review on firm exit.

1976; Dunne & Roberts, 1991). Market size may be (inversely) related to the degree of concentration of an industry and hence to the intensity of competition. In smaller industries the degree of concentration may be higher and therefore incumbents may more easily collude to deter entry. If the displacement effect of efficient entrants on incumbents is lower, exit rates may also be lower.

Second, cyclical factors may also affect the dynamism of firms. In particular, the phase of the business cycle (Davis & Haltiwanger, 1999; Hahn, 2000; Foster et al., 2001; Disney et al., 2003) helps to explain the variation in entry and exit rates of firms over time. In addition, other macroeconomic features, such as labor costs in the form of wages and salaries and the tax rate that a firm has to pay once it enters an industry, may all discourage entry (and, through a lower displacement effect, exit). Indeed, if labor costs, taxes and contributions represent a relatively higher share of profits, they reduce π^e, *ceteris paribus*.

Third, national regulations in the input markets may well affect the process of entry and exit. In particular, the rigidity of the employment protection legislation (EPL) plays an important role. As Bottasso et al. (2017) explain, a stricter EPL can have a negative impact on the entry and exit rates of firms. An increase in the labor adjustment costs (Hopenhayn & Rogerson, 1993) borne by firms leads to an allocative inefficiency that reduces the value of entry (Micco & Pagés-Serra, 2008; Gnocato et al., 2020). EPL may also affect exit as a tax on it if exiting firms bear firing costs in the same way as continuing firms do (Samaniego, 2006; Poschke, 2009). In addition, higher firing costs may reduce incentives to experiment with new ideas and firms may use more established technologies, thereby reducing failure rates.

In addition to all these structural, cyclical and institutional factors, the role of specific product market regulations has received increasing attention from both academics and policy makers in recent decades. These regulations cover a wide range of regulatory aspects (Scarpetta et al., 2002), ranging from the state control of economic activities (state ownership, command and control regulations) to barriers to entrepreneurial activity (restrictions on market entry), and to barriers to international trade and investments (tariffs, regulatory barriers).

In this paper, we focus our attention on the administrative constraints that limit the market access for new firms, also known as red tape. These rules govern the entry into a particular industry and the process of starting a new businesses (entrepreneurship) through registration and start-up costs, both monetary and non-monetary. The role of anti-competitive administrative barriers in firms' dynamics is due to two main mechanisms. First, if entry costs are high, relatively fewer new firms will enter the market. This comes at the cost of less experimentation of new ideas, products and process in the market (Franco et al., 2016). Second, as explained at the beginning of this section, less entry implies less exit through weaker displacement and 'vacuum' effects: incumbents would be less affected by competition and would remain in the industry, leading to a lower exit rate.

Thus, the first expected effect of higher anti-competitive bureaucratic barriers on firm dynamics is a decrease in both firm entry and exit rates. Moreover, we expect a stronger negative effect of red tape on smaller firms than on their larger counterparts (Scarpetta et al., 2002; Anderton et al., 2020). This is because most new firms are small at entry, and they tend to be understaffed to deal with high anti-competitive administrative burdens. Conversely, firms that are already large when they enter the market may be better able to cope with the (monetary and non-monetary) costs associated with administrative barriers and, at the same time, may have chosen a mode of entry that is less subject to this type of administrative burden, i.e. mergers and acquisitions.

3 Data and descriptive analysis

3.1 Data sources and definitions of variables

The information on enterprise births and deaths is taken from Eurostat's Business Demography statistics, which include variables on the characteristics and demography of the population of enterprises. For entry, the firm birth rate is defined as the ratio between the number of enterprise births in the reference period *t*, and the number of enterprises active in *t*. For exit, the firm death rate is calculated as the ratio between the number of enterprise deaths in *t* and the number of active enterprises in *t*. Both birth and death rates are available for each country-year pair and by economic activity (NACE Rev.2 10-33) and by firm size class (zero, from 1 to 4, from 5 to 9 and more than 10 employees).[5]

Our main empirical interest lies in the effect of administrative barriers on both entry and exit dynamics. To measure this administrative burden on firms, we use some indicators included in the World Bank's Doing Business project, for the period 2013–2019.[6] These indicators capture different aspects of the business regulatory environment that firms have to deal with during their operations. We focus on those dimensions that are mainly related to red tape. Specifically, we consider five topics: regulations for starting a business, dealing with construction permits, getting electricity, registering property, and enforcing contracts.[7] For each of these topics, the Doing Business database provides information on the number of procedures, time, and cost required for a firm to comply with the administrative obligation.[8] However, while the data on time and cost are available for the whole period (2013–2019) and

[5] Data are taken from business registers, although some countries improve the availability of data on business turnover by integrating them with other sources of information.

[6] Due to some data irregularities in the 2018 and 2020 waves, the World Bank has decided to suspend the Doing Business project in 2021. Full historical data up to 2020, revised to correct for these data irregularities, are now available on the World Bank website.

[7] The Doing Business initiative collects data on other topics including the time and cost of getting credit, protecting minority investors, trading across borders, and paying taxes. Doing Business also collects and publishes data on the regulation of employment, in the areas of hiring, working hours, and redundancies. Because these measures are less related to red tape, which is the focus of our paper, we do not include them in our analysis.

[8] As reported on the World Bank website "To make the data comparable across 190 economies, Doing Business used a standardized business that is 100% domestically owned, has a start-up capital equivalent to 10 times the income per capita, engages in general industrial or commercial activities and employs between 10 and 50 people 1 month after the commencement of operations, all of whom are domestic nationals".

for all countries, information on the number of procedures is missing for the most recent years. Therefore, our analysis focuses on only two metrics: (1) the cost and (2) the time required for a firm to comply with administrative obligations. In total, we obtain ten indicators: five are proxies for the costs (in value) borne by firms to comply with administrative barriers, and five are proxies for the time (in number of days) needed to comply with these rules.

Specifically, from the topic "starting a business" we get two variables: (1) Start Cost_{ct}, measured as a percentage of the economy's per capita income, net of all the official charges and fees for legal or professional services; (2) Start Time_{ct}, recorded in calendar days, indicating the median time that incorporation lawyers or notaries say it takes to obtain the final incorporation document or to officially start business operations. The second topic, "dealing with construction permits", provides information on: (1) the cost (Permits Cost_{ct}) to legally build a warehouse, expressed as a percentage of the value of the warehouse (assumed to be 50 times the economy's income per capita), net of all the fees associated with completing the procedures including those associated with obtaining land use permits, inspections, obtaining utility connections, and registering the warehouse at the property registry; (2) the time (Permits Time_{ct}) required to build a warehouse, which includes obtaining the necessary licenses and permits, filing the notifications, receiving the inspections and obtaining utility connections. A third dimension we consider is "getting electricity", which collects: (1) Electricity Cost_{ct}, measured as a percentage of the economy's per capita income, associated with completing the procedures to connect a warehouse to electricity; (2) the time (Electricity Time_{ct}) required for a business to obtain a permanent electricity connection, including applications and contracts with electricity utilities, all necessary inspections and approvals from the distribution utility, and the final connection between the building and the electricity grid. The topic "registering property" provides information on: (1) the cost (Property Cost_{ct}) expressed as a percentage of the value of property (assumed to be 50 times the economy's income per capita), required for a company to buy a property or expand its business, net of all the fees, taxes, stamp duties and any other payment to the property registry, notaries, public agencies or lawyers; (2) the time (Property Time_{ct}), which measures the median duration that property lawyers, notaries or registry officials declare is necessary to complete a procedure. The dimension—"enforcing contracts"—measures (1) the cost (Dispute Cost_{ct}) and (2) time (Dispute Time_{ct}) for the resolution of a commercial dispute by a local court of first instance. The time is measured in calendar days, from the date the seller decides to file a lawsuit to the date of payment. The cost is expressed as a percentage of the value of the claim, which is assumed to be 200% of the income per capita.

We complement the information on business dynamics and red tape with several important control variables that have been suggested in the theoretical literature as barriers to entry and exit the market. In particular, we collect information from the World Bank's Doing Business dataset on the amount that entrepreneurs must deposit in a bank or with a third party (such as a notary) before registering a business or up to 3 months after incorporation (Deposit_{ct}), as a percentage of the economy's per capita income. We also collect data on the total tax and contribution rate (Total Taxes_{ct}), which measures the amount of taxes and compulsory contributions borne by firms in the second year of operation, expressed as a percentage of profits. As discussed in Sect. 2, while Deposit$_{ct}$ may well be a proxy for capital requirements, higher Total Taxes$_{ct}$ may discourage entry (and exit) by reducing the expected post-entry profits. From the Eurostat database, we obtain additional controls at the country-sector-time level: the investment rate in tangible goods (Investment Ratio$_{cst}$), as a proxy for the sunk costs, and calculated as the gross investment in tangible capital goods over the valued added;[9] the share of personnel costs in production (ShareLaborCost$_{cst}$), where the personnel costs are defined as the total compensation including wages and salaries and employers' social security contributions, while output is based on sales and changes in stocks;[10] the annual growth rate of country-sector valued added per employee (LP growth$_{cst}$) to control for macroeconomic dynamics. Table 1 shows, for each variable included in the analysis, the name, the possible country-, industry-, size class- and time-dimension, and the respective source.

While the information is in principle available for 34 European countries, due to some missing values we limit our analysis to the 22 European countries for which we have most of the relevant information for the period 2013–2019. Moreover, we focus on manufacturing (NACE Rev.2 10-33).[11] Indeed, while entry and exit of enterprises play a relevant role in some services sectors (e.g. the retail trade sector, as shown by Foster et al. 2006), manufacturing sectors are, on average, more exposed to market competition (Inklaar et al., 2008). Moreover, manufacturing firms are highly intensive when it comes to R &D, are the most innovative, and where productivity gains most often occur (Pilat et al., 2006; Castaldi, 2009). Thus, faster and smoother entry and exit dynamics in these sectors can strongly contribute to productivity gains and economic growth.

After dropping the country-industry-size class-year cells with missing information on the two proxies for firm dynamics, the final sample includes data on entry and exit rates in 22 countries (Table 2), 14 industries (left panel of Fig. 3 and Table 16) and four size classes observed over a 7-year period (2013–2019), amounting to 8468 observations in the case of entry rates and 8435 observations in the case of exit rates.[12] In the specification that includes the full vector of controls, the sample size shrinks further, but still retains 90% of the observations.

An important feature of the bureaucratic barriers variables is that they capture different dimensions of the environment with which a firm must contend. While there is some degree of correlation between different topics, as shown by the matrices of pairwise correlation coefficients in Tables 12 and 13 in the Appendix, economies

[9] Alternatively, we use the investment per person employed or the (log) gross investments in tangible goods. The results, which are available from the authors upon request, do not change.

[10] Alternatively, we use the average personnel costs (personnel costs per employee) or the (log) of wages and salaries. The results, which are available from authors upon request, do not change if we use these alternative proxies for labor costs.

[11] We exclude the peculiar industry of Coke and refined petroleum (NACE 19) due to the high level of concentration and the low turnover rate that characterize this sector.

[12] The full list of countries, together with the average value of firm birth and death rates, is provided in Table 11 in the Appendix.

Table 1 Variables' names and definitions

	Variable	Description	Data source
Industrial dynamics	Birth rate$_{csdt}$	# of enterprise births / # of enterprises active	Eurostat business demography
	Death rate$_{csdt}$	# of enterprise death / # of enterprises active	Eurostat Business Demography
Red tape-cost (%)	Start Cost$_{ct}$	Cost to start a business	Doing Business WB
	Permits cost$_{ct}$	Cost to build a warehouse	Doing business WB
	Electricity cost$_{ct}$	Cost to obtain the electricity connection	Doing business WB
	Property cost$_{ct}$	Cost to purchase a property	Doing business WB
	Dispute cost$_{ct}$	Cost to resolve a commercial dispute through the court	Doing business WB
Red tape-time (# Days)	Start Time$_{ct}$	Time necessary to start a business	Doing business WB
	Permits time$_{ct}$	Time necessary to build a warehouse	Doing Business WB
	Electricity time$_{ct}$	Time necessary to obtain the electricity connection	Doing business WB
	Property time$_{ct}$	Time necessary to purchase a property	Doing business WB
	Dispute time$_{ct}$	Time necessary to resolve a commercial dispute through the court	Doing business WB
Control variables	Total taxes$_{ct}$	Total tax and contribution rate	Doing business WB
	Deposit$_{ct}$	Minimum capital to deposit when registering a company	Doing business WB
	ShareLaborCost$_{cst}$	Share of personnel cost in production	Eurostat
	Investment ratio$_{cst}$	Investment in tangible products/valued added	Eurostat
	LP growth$_{cst}$	Valued added per employees growth rate	Eurostat

The subscripts c, s, d, and t (if applicable) denote country, sector, size classes and time, respectively

Table 2 The five indicators related to the cost, by country; average values, 2013–2019

Variable	Start cost$_c$	Permits cost$_c$	Electricity cost$_c$	Property cost$_c$	Dispute cost$_c$
Austria	5.1	1.3	97.6	4.6	20.5
Belgium	5.3	1.0	97.1	12.7	17.9
Czech Republic	5.2	0.3	29.1	3.9	33.8
Denmark	0.2	1.7	112.1	0.6	23.3
Estonia	1.3	0.3	173.1	0.5	19.8
Finland	0.9	0.9	28.7	4.0	16.2
France	0.8	4.9	6.3	6.6	17.4
Germany	6.5	1.2	43.0	6.4	14.4
Hungary	7.3	0.8	101.4	5.0	15.0
Iceland	2.3	0.5	11.9	3.3	9.0
Italy	14.7	3.8	174.4	4.4	26.3
Latvia	2.2	0.6	306.7	2.0	23.1
Lithuania	0.6	0.3	46.5	0.8	23.6
The Netherlands	4.7	3.7	31.5	6.1	23.9
Norway	1.1	0.5	11.7	2.5	9.9
Poland	12.5	0.4	45.1	0.3	19.3
Portugal	2.2	1.3	59.8	7.3	17.0
Slovak Republic	1.4	0.2	263.8	0.0	27.7
Slovenia	0.0	3.0	112.7	2.2	12.7
Spain	4.5	4.8	171.5	6.4	17.9
Sweden	0.5	2.2	33.8	4.3	30.7
United Kingdom	0.2	1.2	51.6	4.7	44.0
Total	3.6	1.6	91.3	4.0	21.1

The table shows the average value over the years (2013–2019) by country of the 5 indicators related to the cost, expressed as percentages

rarely score well or poorly on all the topics we consider. In fact, the score of a country economy can vary both between topics and within the same topic across the two metrics (cost vs time). This could reflect differences in the priority that governments give to certain areas of bureaucratic regulation.

As an example of the first type of heterogeneity, we observe in Table 2 that the Slovak Republic performs rather poorly (relative to the sample averages) in terms of the cost of getting connected to the electricity grid, but it is well below the average value for three out of four of the other topics.[13] This confirms that a country's relatively good performance in one area of regulation can well coexist with a low score in another topic. A similar degree of heterogeneity is observed when we look at the indicators relating to the time needed to complete individual procedures (Table 3). In Austria, the number of days needed for an entrepreneur

[13] The higher the score, the worse the performance of a country in that particular dimension of bureaucratic barriers.

Table 3 The five indicators related to the time, by country; average values, 2013–2019

Variable	Start $time_c$	Permits $time_c$	Electricity $time_c$	Property $time_c$	Disputes $time_c$
Austria	22	222	23	20	397
Belgium	4	212	197	59	505
Czech Republic	28	246	71	28	678
Denmark	5	64	38	5	479
Estonia	4	103	95	18	451
Finland	17	65	42	48	469
France	5	187	68	64	447
Germany	11	126	28	52	460
Hungary	7	203	254	17	605
Iceland	10	84	22	4	417
Italy	12	211	110	17	1148
Latvia	9	191	107	17	469
Lithuania	8	101	111	4	370
The Netherlands	4	161	105	3	514
Norway	5	110	66	3	400
Poland	37	138	139	42	685
Portugal	6	161	72	2	804
Slovak Republic	28	300	89	16	719
Slovenia	6	252	38	63	1210
Spain	17	154	115	13	510
Sweden	11	117	52	15	482
United Kingdom	7	86	78	22	437
Total	12	159	87	24	575

to set up and formally operate an industrial or commercial enterprise and the time required to set up a warehouse are quite high compared to other countries, while for the other three topics the value is rather low compared to other economies. In general, the data suggest that Northern European countries perform better on average in terms of bureaucratic barriers, with some degree of variability across the five topics. A second relevant type of heterogeneity is within each topic and between the two metrics. Indeed, we can compare the same bureaucratic barrier when measured either in terms of cost or in terms of the number of days it takes a firm to comply with administrative obligations. Take the case of Italy. While it is in line with the average value of all economies in the sample in terms of the number of days required to start a business, it is the highest value in terms of the cost associated with this obligation.

Due to the high level of information contained in the ten red tape indicators, we use a principal component analysis (PCA) to simplify the interpretation and reduce the number of variables. The PCA is a dimensionality-reduction technique that transforms a large set of (likely correlated) variables, into a smaller set of new covariates that are linear combinations of the original variables. These new predictors, called principal components (PCs), are uncorrelated and orthogonal to each other. This results in a smaller number of covariates that still contain most of the information. Reducing the number of variables naturally comes at the expense of accuracy, but the dimensionality reduction allows one to avoid a saturated regression model in which there are too many estimated parameters compared to the data points.

The goal of the PCA is to find components $z = [z_1, z_2, \dots z_p]$, which are a linear combination (or mixture) $u = [u_1, u_2 \dots u_p]'$ of the original variables $x = [x_1, x_2, \dots x_p]$ that achieve maximum variance. The first component z_1 is given by the linear combination of the original variables x and accounts for the maximum possible variance. The second component captures most of the information not captured by the first component and is also uncorrelated with the first component. PCA therefore maximizes the variance of the elements of $z = xu$, such that $u'u = 1$. The PCA procedure consists of two steps. First, the covariance matrix is computed with all possible pairwise correlations of the original variables. The second step is to compute the eigenvectors and eigenvalues of the covariance matrix to identify the PCs in the data. Since the PCA is a data reduction method, it is necessary to find an appropriate number of factors based on the trade-off between "simplicity" (keeping as few factors as possible) and "completeness" (explaining most of the variation in the data). To select the number of components we apply the Kaiser's rule, which recommends retaining factors whose eigenvalues are greater than one.[14] Discarding components with low information allows us to reduce dimensionality.

We apply the PCA to both the five cost-related indicators and the five time-related indicators.[15]

In Table 14 of the Appendix, we show the results of the PCA for the selected years (2013, 2014, 2018 and 2019) but similar findings are obtained for the other years. First, we observe that the number of components is equal to the number of variables but only the first component, for both cost and time, has an eigenvalue substantially greater than 1, meaning that the component explains at least as much of the variation as the original variables. In addition, the Kaiser–Meyer–Olkin measure of sampling adequacy reports a value above 0.5 which is considered satisfactory for the application of this methodology. The PCA yields two components, one for the cost and the other for the time, which we named, respectively, "Red Tape Cost$_{ct}$" and "Red Tape Time$_{ct}$". Descriptive statistics on these two new variables are presented and discussed in the next section, together with a preliminary analysis of birth and death rates.

[14] Intuitively, this rule means that any retained factor should account for at least as much variation as any of the original variables.

[15] We apply the PCA on a year-by-year basis. We recognize that this can only be a legitimate choice if the loadings, the coefficients and the eigenvalues are consistent from year to year. This is exactly the case, as shown in Table 14, where the eigenvalues, for both cost and time, are stable across selected years. In addition, as a robustness check, we have recalculated the PCs by pooling the seven cross-sections (2013–2019) and used the results of this PCA in the regressions. The main results shown in Table 7 that include the PCs calculated on a year-by-year basis, are virtually equivalent to those shown in Table 15, which include the PCs calculated on the pooled cross-section.

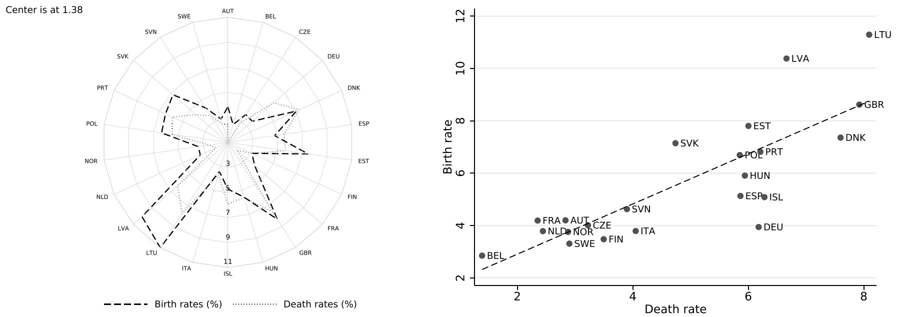

Fig. 1 Birth and death rates across countries; average values, 2013–2019

3.2 Descriptive analysis on industry dynamics and red tape barriers

This section provides some preliminary evidence on the main variables used in the empirical analysis. We begin by presenting some descriptive statistics on the two dependent variables, "Birth Rates$_{csdt}$" and "Death Rates$_{csdt}$", and then move to the analysis of the two main covariates, "Red Tape Cost$_{ct}$" and "Red Tape Times$_{ct}$".

At first sight, there is a high degree of variability in birth and death rates, especially across countries and size-classes. The variability between countries can be observed through the radar chart in the left panel of Fig. 1, which shows the average value of birth and death rates for the period 2013–2019. Birth (death) rates are particularly high for the Baltic countries—Latvia, Lithuania and Estonia—but business churn is above 8% also for United Kingdom and Denmark. The lowest values, close to 3%, are observed in Belgium for both the birth and death rates. The variability across countries for both birth and death rates is also shown in the box-plot in Fig. 2, which shows the distribution of birth (upper left) and death (upper right) rates for each year in each country. Looking at the figures, we see that the support of the distribution is quite broad, suggesting the existence of a widespread heterogeneity across economies. In the bottom panel of Fig. 2 we see that, with the exception of a few countries, business rates vary less over time within each economy. This can also be seen by comparing the between and within variances.[16] For both the birth and death rates, the between-panel standard deviation, which is 2.3 and 1.9, respectively, is much higher than the within-panel standard deviation, which is 0.6 and 0.7, suggesting that much of the variability in the variables is across countries rather than over time.

Studies of business dynamics have consistently shown that entry and exit rates are highly positively correlated, even within narrowly-defined industries of the economy (Dunne et al., 1988; Geroski, 1995). This regularity is confirmed in our sample: entry and exit rates are positively correlated across countries, as shown in the right panel of Fig. 1. The pairwise correlation coefficient is around 0.8. This stylized fact

[16] We use the xtsum command in Stata, which reports the within-panel standard deviation and the between-panel standard deviation.

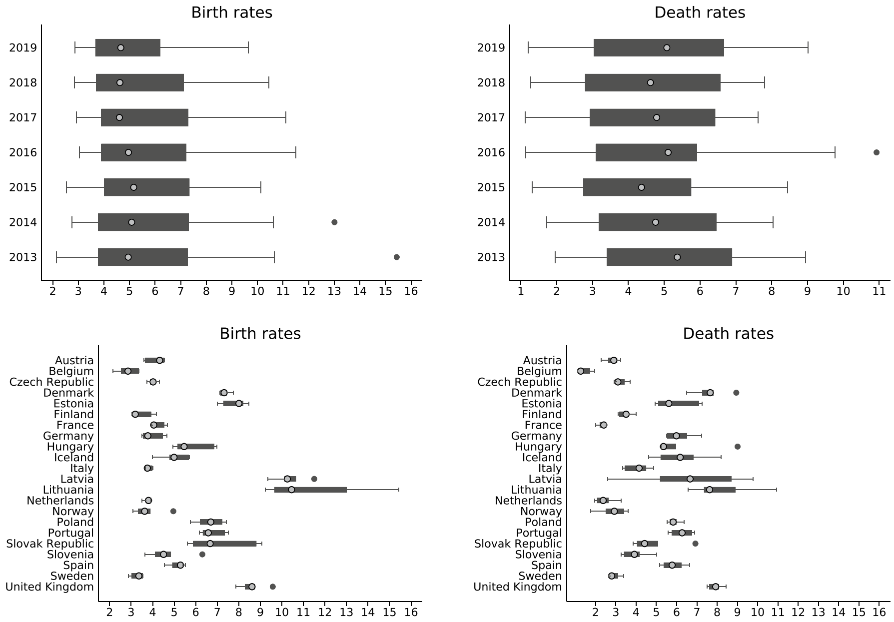

Fig. 2 Distribution of birth rates (left) and death rates (right) across countries and over time (2013–2019)

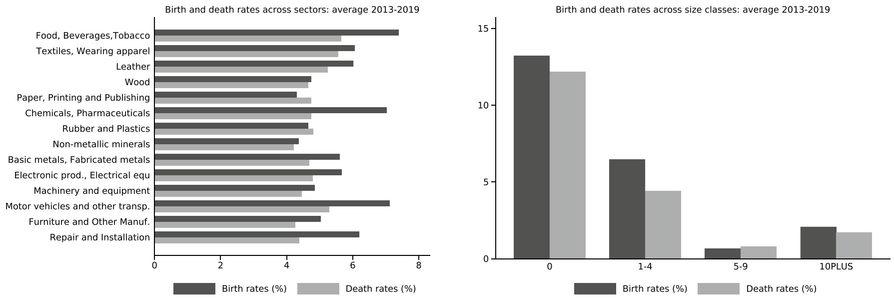

Fig. 3 Heterogeneity of birth and death rates across sectors (left panel) and size classes (right panel); average values 2013–2019

could be explained by cyclical factors as well as by the displacement and 'vacuum' effects (Sect. 2). The entry and exit of firms are elements of a search and experimentation process, in which new firms replace outpaced incumbents without significantly affecting the total number of enterprises in the market. Indeed, the entrance of new firms leads to an increase in the level of competition and, because of the market selection process, facilitates a higher number of exits from the market.

There is some heterogeneity in entry and exit rates across sectors and size classes. Differences in firm dynamics across industries (left panel of Fig. 3) may well reflect differences in sunk costs (related to specialized capital, advertising

Table 4 Red tape indicators; average values 2013–2019

Country	Red tape barriers			
	Red tape cost	Ranking	Red tape time	Ranking
Austria	0.124	14	0.241	14
Belgium	1.883	21	1.060	17
Czech Republic	− 0.557	7	1.630	19
Denmark	− 1.087	5	− 1.892	1
Estonia	− 1.732	3	− 1.178	6
Finland	0.015	10	− 0.768	8
France	2.019	22	0.245	15
Germany	1.032	18	− 0.406	10
Hungary	0.305	15	0.840	16
Iceland	0.090	13	− 1.708	2
Italy	1.029	17	1.852	20
Latvia	− 1.900	2	− 0.134	12
Lithuania	− 1.203	4	− 1.457	4
The Netherlands	1.454	19	− 0.688	9
Norway	− 0.155	9	− 1.568	3
Poland	− 0.390	8	1.509	18
Portugal	0.827	16	− 0.034	13
Slovak Republic	− 2.546	1	2.150	21
Slovenia	0.027	11	2.684	22
Spain	1.468	20	− 0.143	11
Sweden	0.027	12	− 0.949	7
United Kingdom	− 0.828	6	− 1.269	5

and R &D investments) and adjustment costs. With regard to heterogeneity across size-classes, it is possible to deepen the analysis by looking at the right panel of Fig. 3, which shows the average entry and exit rates for the four employment categories. As expected, the data show that the highest values are observed for sole proprietorship, followed by the other size-classes in decreasing order. This evidence is consistent with a theoretical framework in which firm entry is a process of search and experimentation, in which businesses confronted with uncertainty enter small, and expand later if they prove to be profitable (Caves, 1998).

As described in Sect. 3.1, from the PCA we obtain the two components, “Red Tape Cost$_{ct}$” and “Red Tape Time$_{ct}$”. In Table 4 we show, for each country, the average value of the two components, together with the ranking of the countries, based on their scores. Although Denmark, Estonia, Norway, Lithuania and the United Kingdom perform well on both cost and time, the scores of individual economies can vary considerably on both measures. For example, the Slovak Republic ranks first in terms of the cost of red tape for businesses, but 21st for the time it takes to complete the administrative tasks. Iceland ranks second in terms of the time but occupies the 13th position for the cost of red tape. The low

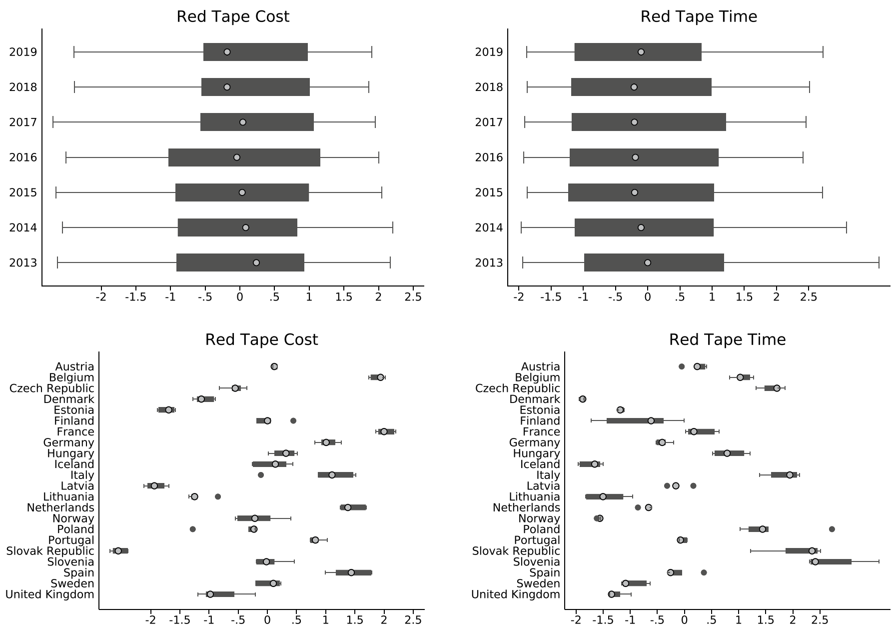

Fig. 4 Distribution of red tape cost (left) and red tape time (right) across countries and over time

correlation between the two components is shown in Fig. 5 in the Appendix. The upper panels in Fig. 4 show the cross-country variability within each year of the two principal components of red tape barriers. The support of the distribution is quite broad, suggesting that there is widespread heterogeneity across countries. Conversely, as shown in the lower panels of Fig. 4, the principal components of bureaucratic barriers do not vary much within each country over time. In particular, the between-panel standard deviation, is 1.2 for the cost and 1.3 for the time, while the within-panel standard deviation is 0.2 and 0.3, respectively.

4 Empirical analysis

4.1 Identification strategy

To study the effect of red tape on firm dynamics, we estimate two types of models. We start with a specification in which the birth or death rates are regressed on the proxies for bureaucratic barriers and a vector of controls. Formally, this can be written as

$$Y_{cst} = \beta_0 + \beta_1 \text{Red Tape}_{ct} + \beta_2 X_{ct} + \beta_3 Z_{cst} + \delta_{st} + u_{cst}, \tag{2}$$

where Y_{cst} is either the birth or the death rates at the country (c), sector (s), and time (t) level and Red Tape_{ct} is our variable of interest. $\text{Red Tape}_{ct} = \{\text{Red Tape Cost}_{ct}, \text{Red Tape Time}_{ct}\}$, denotes the bureaucratic burden expressed either in terms of cost or time. As the two variables we obtained from the PCA capture different features of the red tape, in some specifications we insert both of them. In order to identify the coefficient of interest (β_1), we include a set of fixed effects δ_{st} to control for any unobserved sector-time confounding factor.

In the case of Eq. (2), therefore, the main source of identification of β_1, which captures the effect of the Red Tape_{ct} on birth or death rates, is the variation of the red tape across countries. Based on Sect. 2, we expect that lower red tape will be reflected in higher firm entry and exit rates ($\beta_1 < 0$).

Despite the introduction of this set of fixed effects, uncontrolled confounders at the country-level could still bias the estimates of our parameter of interest, β_1. To reduce the likelihood of endogeneity due to omitted variable, we introduce a vector of time-varying country (X_{ct}) and country-sector characteristics (Z_{cst}) (Table 1), which, as discussed in Sect. 2, are relevant determinants of firm entry and exit. We consider the total tax and contribution rate (Total Taxes_{ct}), the paid-in minimum capital requirement (Deposit_{ct}), the share of personnel cost in production ($\text{ShareLaborCost}_{cst}$), the investment rate in tangible goods ($\text{Investment Ratio}_{cst}$), and the annual growth rate of labor productivity (LP Growth_{cst}).

Based on the evidence provided in the right panel of Fig. 3, and in order to explore the possible heterogeneous effects that red tape may have on the dynamics of firms in different size classes, we enrich the analysis by measuring birth and death rates at the country-sector-size class-time level. In this case, the estimated equation becomes

$$\text{Y}_{csdt} = \beta_0 + \beta_1 \text{Red Tape}_{ct} + \gamma_1 \text{Red Tape}_{ct} \times \text{Size}_d + \beta_2 X_{ct} + \beta_3 Z_{cst} + \theta_{sdt} + u_{cst}, \tag{3}$$

where the dependent variable is either the birth or the death rate at the level of country (c), sector (s), size class (d) and time (t). The dummy variable Size_d equals 1 if the firm belongs to one of the two smallest size classes (those with less than 5 employees), and equal to 0 otherwise. We control for sector-size class-time unobserved heterogeneity by including a set of fixed effects, θ_{sdt}. The coefficient γ_1 gives us the difference in the impact of red tape on the birth and death rates for the smallest firms relative to the baseline. Based on Sect. 2, we expect red tape to be particularly burdensome for small firms relative to their larger counterparts ($\gamma_1 < 0$). In estimating both Eqs. (2) and (3), we include cluster-robust standard errors at the country-year level.[17]

Although in the empirical framework we control for a number of time-variant and time-invariant characteristics that could lead to omitted variable bias, it is difficult

[17] While it would be desirable to include cluster-robust standard errors at the level of the 'treatment', as suggested by Abadie et al. (2017), the relatively small number of clusters (countries) would lead to too narrow confidence intervals, and an over-rejection of the test statistics based on the cluster-robust standard errors (Cameron & Miller, 2015).

to control for an exhaustive list of confounding factors that could potentially invalidate our empirical strategy. First, the results could be driven by unobservables at the country-level, typically omitted institutions, that are correlated with both the business dynamics and red tape (Bassanini & Garnero, 2013). Second, red tape and firm dynamics may be jointly determined. For example, the same exogenous adverse shocks that cause entrepreneurs to reduce investments, exacerbate financial constraints, and force less efficient firms to exit the market, may also increase political pressure from incumbent firms to change the administrative burdens towards higher entry costs. To identify the true effect of administrative barriers, it is necessary to sort out these sources of endogeneity.

Omitted variable and reverse causality problems can be mitigated by using a DiD approach *à la* Rajan and Zingales (1998). This approach exploits the idea that some industries are more exposed to bureaucratic barriers than others, because of their technological characteristics. By exploiting the industry heterogeneity in the exposure to administrative burdens, this DiD approach tests for possible differences in the way industries are naturally affected by higher levels of red tape. Since red tape mainly affects activities such as dealing with permits or enforcing contracts that rely on legal, accounting and technical services, we expect that the manufacturing sectors that are more dependent on these service inputs will be disproportionately affected by red tape (Barone & Cingano, 2011; Franco et al., 2016). We measure the dependence of each manufacturing sector on services using the input–output (I–O) tables for the United States, which is taken as the benchmark country.[18] The share of service input is calculated in 2012, the year before to the period analyzed.[19] In the spirit of Rajan and Zingales (1998) we assume that the dependence on service inputs allows us to capture the underlying technological differences between sectors that do not vary across country.[20] The DiD equation reads as follow

$$Y_{csdt} = \alpha + \beta_1 RedTape_{ct} \times ShareService_s^{US} + \beta_3 Z_{cst} + \phi_{cdt} + \omega_{sdt} + u_{cst}, \quad (4)$$

[18] The group of services we consider comprises the following (NACE rev 2) 2-digit industries: 69 (Legal and accounting activities), 70 (Activities of head offices; management consultancy activities), 71 (Architectural and engineering activities; technical testing and analysis), 72 (Scientific research and development), 73 (Advertising and market research), 74 (Other professional, scientific and technical activities), 75 (Veterinary activities), and 84 (Public administration and defence; compulsory social security). As a robustness check, we exclude industry 84 (Public administration and defence; compulsory social security) from the services considered and re-run the analysis, whose main results—available upon request—do not change significantly.

[19] Table 16 provides the shares of service inputs across the US manufacturing sectors in 2012. These values are used in the DiD analysis. As robustness checks, we compute the shares from the US I–O table by using the average value between 2010 and 2012, the average value across the entire period 2013–2019, or a time-variant value. Results, which do not change significantly, are available upon request.

[20] We acknowledge that this approach has recently been discussed in detail by Ciccone and Papaioannou (2022). A basic assumption is that the relevant industry characteristic must be independent of country characteristics. If this is the case, the use of US data might entail measurement error in its classical form, resulting in an *attenuation bias*. Conversely, if this assumption does not hold, the use of an industry characteristic of the benchmark-country (in our case, the US) may lead to biased results in the form of amplified estimates (*amplification bias*). A full examination of this issue goes beyond the scope of this paper, and our main results hold in the absence of cross-country heterogeneity in industry technology.

where Y_{cst} is either the birth rate or the death rate at the country-sector-size class-time level. Our main explanatory variable is obtained as the interaction of the country characteristic, $RedTape_{ct}$, with the industry characteristic, $ShareService_{s}^{US}$.

We expect the coefficient of the interaction term to be negative ($\beta_1 < 0$): in countries with higher administrative barriers, entry and exit rates should be lower in industries that are more exposed (i.e. the treatment group) than in industries that are less exposed to these administrative burdens (i.e. the control group). We should bear in mind that β_1 captures the relative effect of red tape on "naturally" exposed industries with respect to the control group, still providing an indication of the direction of the average effect (Bottasso et al., 2017). Moreover, by focusing on the interaction term, we can include country-size-time (ϕ_{cdt}) and sector-size-time (ω_{sdt}) fixed effects, which allow us to control for country-wide shocks (including macroeconomic and institutional changes), as well as industry specific supply or demand shocks that may affect firm dynamics. The inclusion of these fixed effects significantly reduces the risk of biased results due to omitted variables. Equation (4) also includes a vector of country-sector-time characteristics, Z_{cst}, which can be still identified. As before, we include cluster-robust standard errors at the country-year level.

Finally, we capture the heterogeneous effects of red tape on firm entry and exit across size classes by including in Eq. (4) an additional interaction with the dummy for size class.

4.2 Econometric results

The results of the model specified in Eq. (2) are shown in Tables 5 and 6. As for the birth rate, Y_{cst}, the first column in Table 5 shows that when we use the variable Red Tape $Cost_{ct}$ there is a clear negative relationship between the birth rate of firms and red tape. This result is confirmed when the vectors of controls, X_{ct} and Z_{cst}, are included, as shown in column (2). The results in columns (3) and (4) do not change when the proxy for the time to complete bureaucratic procedures is included in the analysis. Moreover, the coefficients are quite stable in terms of both magnitude and statistical significance when the two PCs for the cost and time required to comply with red tape are included together (columns 5 and 6). This evidence supports the hypothesis that administrative burdens are a brake on the dynamism of manufacturing firms, both in terms of the costs borne by firms and the time taken to comply with these rules. As shown in Table 6, the death rate is also negatively related to red tape, regardless of whether controls are included or not. Moreover, the results do not change when the PC related to the cost (columns 1, 2) or the one related to the time (columns 3, 4) of complying with red tape is used in the analysis, or even when they are introduced together in the model (columns 5 and 6). Overall, the results in Table 5 are in line with Ciriaci (2014) and confirm that the higher the level of bureaucracy (both in terms of cost and time to comply), the lower the rate of entry. Moreover, in Table 6 we provide evidence that red tape are also detrimental to exit rates, thus supporting

Table 5 Red tape and birth rates: no size classes

	Birth rate$_{cst}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Red tape cost$_{ct}$	− 1.229*** (0.118)	− 1.078*** (0.122)			− 1.202*** (0.108)	− 1.068*** (0.111)
Red tape time$_{ct}$			− 0.364*** (0.129)	− 0.419*** (0.164)	− 0.266*** (0.100)	− 0.394*** (0.133)
Total taxes$_{ct}$		− 0.035*** (0.012)		− 0.075*** (0.014)		− 0.020* (0.012)
Deposit$_{ct}$		− 0.016* (0.009)		− 0.004 (0.012)		− 0.006 (0.010)
ShareLaborCost $_{cst}$		− 0.039** (0.020)		− 0.102*** (0.028)		− 0.078** (0.024)
Investment ratio$_{cst}$		0.011*** (0.003)		0.021** (0.008)		0.013** (0.005)
LP growth$_{cst}$		0.015** (0.006)		0.024*** (0.007)		0.015** (0.006)
δ_{st}	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	ct	ct	ct	ct	ct	ct
Adj. R^2	0.330	0.365	0.104	0.228	0.344	0.387
No. of Obs	2135	1999	2135	1999	2135	1999

Table reports the regression for the determinants of firms' birth rate. Clustered standard errors at country-time level are reported in parenthesis. Asterisks denote significance levels: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$

Table 6 Red tape and death rates: no size classes

	Death rate$_{cst}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Red tape cost$_{ct}$	−0.765*** (0.129)	− 0.528*** (0.129)			− 0.720*** (0.109)	−0.517*** (0.116)
Red Tape Time$_{ct}$			− 0.513*** (0.104)	− 0.499*** (0.118)	− 0.454*** (0.094)	− 0.487*** (0.106)
Total Taxes$_{ct}$		− 0.064*** (0.014)		− 0.071*** (0.014)		− 0.045*** (0.013)
Deposit$_{ct}$		0.010 (0.012)		− 0.024** (0.012)		− 0.023** (0.012)
ShareLaborCost $_{cst}$		− 0.011 (0.020)		− 0.070*** (0.021)		− 0.059*** (0.019)
Investment Ratio$_{cst}$		0.002 (0.002)		0.008* (0.004)		0.004 (0.003)
LP Growth$_{cst}$		0.004 (0.006)		0.009 (0.006)		0.004 (0.006)
δ_{st}	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	ct	ct	ct	ct	ct	ct
Adj. R^2	0.132	0.202	0.074	0.167	0.187	0.243
No. of Obs	2136	2000	2136	2000	2136	2000

Table reports the regression for the determinants of firms' death rate. Clustered standard errors at country-time level are reported in parenthesis. Asterisks denote significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

a link between entry and exit dynamics through competitive mechanisms, such as crowding-out and "vacuum" effects.

Although a detailed analysis of the full set of control variables is beyond the scope of this paper, it is worth noting that the coefficient of $TotalTaxes_{ct}$ is negative and statistically significant, implying that firms are less likely to enter (Table 5) or exit (Table 6) if taxes represent a significant portion of their profits. The coefficient related to the paid-in minimum capital requirement ($Deposit_{ct}$) shows a negative relationship with birth and death rates, although is less precisely estimated in some estimations. This implies that a higher minimum capital requirement is a relevant barrier to entry and exit an industry (Kessides, 1990b, 1991; Sutton, 1991). The coefficient of $ShareLaborCost_{cst}$ is negative and statistically significant in explaining both birth and death rates, meaning that firm entry and exit rates are lower when labor costs are higher. Unexpectedly (Caves & Porter, 1976; Dunne & Roberts, 1991), the coefficient on the investment rate is positive and statistically significant. The $LPgrowth_{ct}$ is positively correlated with the birth rate suggesting that during expansionary phases of the business cycle (Foster et al., 2001; Disney et al., 2003), entry rates are higher. When the exit rate is considered, the coefficient is positive but not statistically significant.

The main results of the previous analysis are confirmed in Table 7, where we measure birth and death rates at the country-sector-size class-time level. The main differences with respect to Tables 5 and 6 are an increase in the number of observations and the inclusion of a vector of sector-size class-time fixed effects. An advantage of measuring birth and death rates at the country-sector-size class-time level is that we are now able to control for the possible heterogeneous effects of red tape on firm entry and exit across size classes, by estimating Eq. (3). The results are shown in Table 8. We observe that when either the cost (columns 1 and 4) or the time (columns 2 and 5) required to comply with the red tape is considered, the negative effect of an increase in the bureaucratic procedures on entry and exit rates is larger in magnitude for smaller firms, while it is smaller (in the case of cost) or even not significant (in the case of time) for their larger counterparts. The results are confirmed when the proxies for the two measures of red tape are included together in the regression (columns 3 and 6). All the estimates of the coefficients on the controls are consistent with those reported in Tables 5 and 6.

Overall, these results confirm the two main expectations we put forward in Sect. 2. First, more burdensome administrative obligations reduce the incentives for new firms to enter the market. In addition, inefficient incumbents would be less affected by competition and they would remain in the industry, resulting in a lower exit rate. Second, we find a stronger negative impact of red tape on smaller firms than on their larger counterparts (Scarpetta et al., 2002; Anderton et al., 2020). Small firms are most affected by the increase in anti-competitive administrative burdens. This is consistent with the fact that most new firms enter the market with a small size and understaffed to deal with heavy administrative burdens. Moreover, larger firms may have chosen an entry mode that is less subject to this type of regulation, i.e. mergers and acquisitions. We confirm the evidence provided by previous studies that used databases with a smaller number of countries and industries

Table 7 Red tape and industrial dynamics: size classes

	Birth rate$_{csdt}$			Death rate$_{csdt}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Red tape cost$_{ct}$	− 1.115*** (0.120)		− 1.104*** (0.110)	− 0.603*** (0.123)		− 0.589*** (0.110)
Red tape time$_{ct}$		− 0.410** (0.167)	− 0.379*** (0.133)		− 0.442*** (0.118)	− 0.424*** (0.102)
Total taxes$_{ct}$	− 0.035*** (0.012)	− 0.077*** (0.014)	− 0.021* (0.012)	− 0.065*** (0.014)	− 0.078*** (0.013)	− 0.049*** (0.013)
Deposit$_{ct}$	− 0.017* (0.010)	− 0.006 (0.013)	− 0.007 (0.011)	0.000 (0.011)	0.013 (0.011)	0.012 (0.011)
ShareLaborCost $_{cst}$	− 0.041** (0.020)	− 0.103*** (0.028)	− 0.079*** (0.024)	− 0.026 (0.019)	− 0.080*** (0.021)	− 0.068*** (0.019)
Investment ratio$_{cst}$	0.011*** (0.004)	0.022** (0.009)	0.013** (0.005)	0.002 (0.002)	0.009* (0.005)	0.004 (0.003)
LP growth$_{cst}$	0.016*** (0.006)	0.025*** (0.007)	0.016*** (0.006)	0.003 (0.006)	0.008 (0.006)	0.003 (0.006)
θ_{sdt}	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	ct	ct	ct	ct	ct	ct
Adj. R^2	0.606	0.575	0.610	0.608	0.602	0.615
No. of Obs	7927	7927	7927	7894	7894	7894

Table reports the regression for the determinants of firms' birth and death rates. Clustered standard errors at country-time level are reported in parenthesis. Asterisks denote significance levels: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Table 8 Red tape and industrial dynamics: heterogeneity across size classes

	Birth rate$_{csdt}$			Death rate$_{csdt}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Red Tape Cost$_{ct}$	− 0.114* (0.058)		− 0.138** (0.057)	0.015 (0.088)		− 0.010 (0.077)
× Size$_d$	− 1.988*** (0.194)		− 1.919*** (0.162)	− 1.228*** (0.211)		− 1.152*** (0.172)
Red Tape Time$_{ct}$		0.011 (0.103)	− 0.051 (0.077)		− 0.024 (0.112)	− 0.063 (0.088)
× Size$_d$		− 0.840*** (0.217)	− 0.660*** (0.166)		− 0.835*** (0.200)	− 0.725*** (0.184)
Total Taxes$_{ct}$	− 0.035*** (0.012)	− 0.077*** (0.014)	− 0.021* (0.012)	− 0.065*** (0.014)	− 0.079*** (0.013)	− 0.049*** (0.013)
Deposit$_{ct}$	− 0.017* (0.010)	− 0.006 (0.013)	− 0.007 (0.011)	0.001 (0.011)	0.013 (0.011)	0.012 (0.011)
ShareLaborCost $_{cst}$	− 0.041** (0.020)	− 0.103*** (0.028)	− 0.079*** (0.024)	− 0.026 (0.019)	− 0.081*** (0.021)	− 0.068*** (0.019)
Investment ratio$_{cst}$	0.011*** (0.004)	0.022** (0.009)	0.013** (0.005)	0.002 (0.002)	0.009* (0.005)	0.004 (0.003)
LP growth$_{cst}$	0.016*** (0.006)	0.025*** (0.007)	0.016*** (0.006)	0.003 (0.006)	0.008 (0.006)	0.003 (0.006)
θ_{sdt}	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	ct	ct	ct	ct	ct	ct
Adj. R^2	0.641	0.582	0.650	0.626	0.611	0.639
No. of Obs	7927	7927	7927	7894	7894	7894

Table reports the regression for the determinants of firms' birth and death rates. Clustered standard errors at country-time level are reported in parenthesis. Asterisks denote significance levels: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

(Scarpetta et al., 2002) or that used a more general measures of anti-competitive regulations in the product market (Anderton et al., 2020).

The results of the DiD exercise *à la* Rajan and Zingales (1998) are presented in Tables 9 and 10. Due to the inclusion of country-size class-time fixed effects, the coefficients of the country time-variant characteristics cannot be identified. As expected, the coefficient on the interaction term, β_1, is negative in all six columns of Table 9, suggesting that the marginal impact of an increase in Red Tape$_{ct}$ on birth and death rates is higher in sectors that are "naturally" more exposed to these administrative burdens. Indeed, industries that are more dependent on service inputs show lower entry and exit rates in countries where red tape are more burdensome.

When the time required to comply with administrative procedures is considered either alone (columns 2 and 5) or together with the costs borne by firms due to red tape (columns 3 and 6), this shows a stronger effect in terms of statistical significance with respect to the coefficient of the PC related to costs. Excessive time spent complying with burdensome bureaucratic procedures is an obstacle for firms to enter and exit the market smoothly. Moreover, the effect of the costs borne by the firm also has the expected (negative) sign, but is less precisely estimated. There are several reasons for this asymmetry in the results. First, $RedTapeTime_{ct}$ may be a more comprehensive proxy for the total amount of resources that firms use to comply with red tape. Indeed, this proxy should take into account the opportunity-cost of the time spent on these activities, whereas $RedTapeCost_{ct}$ may only capture the monetary costs. Second, although we found a low correlation between the two variables in Fig. 5, we cannot exclude that a residual correlation may still lead to an inferior precision in the estimation of $RedTapeCost_{ct}$, when it is included together with $RedTapeTime_{ct}$.

Considering column 3 of Table 9, which includes both the cost and the time to comply with administrative procedures, the interpretation of the coefficient of the interaction term is as follows. The coefficient of Red Tape Cost$_{ct}$ is equal to − 0.002, indicating that the difference in the entry rate between a manufacturing sector at the 90th percentile of the distribution in the use of service inputs (Chemicals and Pharmaceuticals with a value of 11.2) and a sector at the 10th percentile (Rubber and plastics with a value of 3.6) is reduced by about 0.049 percentage points in a country at the 90th percentile of the Red Tape Cost$_{ct}$ distribution (Spain with a value of 1.468) compared to a country at the 10th percentile (Estonia with a value of − 1.732). However, this difference is not statistically significant. Conversely, the coefficient of Red Tape Time$_{ct}$ is equal to − 0.014. This suggests that the difference in entry rate between a manufacturing sector that is highly intensive in the use of service inputs and a sector that is much less dependent on service inputs is reduced by about 0.364 percentage point in a country at the 90th percentile of the Red Tape Time$_{ct}$ (Italy, with a value of 1.852) with respect to a country at the 10th percentile of the distribution (Norway, with a value of − 1.568).[21] In terms of

[21] Following Bottasso et al. (2017), the percentage differential is calculated as: $D = \beta_1 * (ShareService^{US}_{90} - ShareService^{US}_{10}) * (RedTapeCost/Time_{90} - RedTapeCost/Time_{10})$, where β_1 is the coefficient of the interaction.

Table 9 Red tape and industrial dynamics: difference in difference

	Birth rate$_{csdt}$			Death rate$_{csdt}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Red tape cost$_{ct}$ × ShareService$_s^{US}$	– 0.004* (0.002)		– 0.002 (0.002)	– 0.006* (0.003)		– 0.007** (0.003)
Red tape time$_{ct}$ ×ShareService$_s^{US}$		– 0.015*** (0.004)	– 0.014*** (0.004)		– 0.010*** (0.003)	– 0.010*** (0.003)
ShareLaborCost$_{cst}$	– 0.016 (0.012)	– 0.018 (0.012)	– 0.017 (0.012)	– 0.021 (0.013)	– 0.018 (0.013)	– 0.021 (0.013)
Investment ratio$_{cst}$	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	– 0.001 (0.001)	– 0.001 (0.001)	– 0.001 (0.001)
LP growth$_{cst}$	0.003 (0.004)	0.002 (0.004)	0.002 (0.004)	– 0.002 (0.004)	– 0.003 (0.003)	– 0.003 (0.004)
ϕ_{cdt}	Yes	Yes	Yes	Yes	Yes	Yes
ω_{sdt}	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	ct	ct	ct	ct	ct	ct
Adj. R^2	0.832	0.832	0.832	0.878	0.878	0.878
No. of Obs	7927	7927	7927	7894	7894	7894

Table reports the regression for the determinants of firms' birth and death rates. Clustered standard errors at country-time level are reported in parenthesis. Asterisks denote significance levels: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$

Table 10 Red tape and industrial dynamics: difference in difference

	Birth rate$_{csdt}$			Death rate$_{csdt}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Red tape cost$_{ct}$ × ShareService$_s^{US}$	0.000 (0.002)		0.001 (0.002)	– 0.008*** (0.003)		– 0.008*** (0.002)
× Size$_d$	– 0.008** (0.003)		– 0.008* (0.004)	– 0.006* (0.003)		– 0.003 (0.005)
Red tape time$_{ct}$ ×ShareService$_s^{US}$		– 0.004* (0.002)	– 0.004* (0.002)		0.001 (0.002)	– 0.000 (0.002)
× Size$_d$		– 0.021** (0.009)	– 0.020** (0.008)		– 0.021*** (0.007)	– 0.021*** (0.007)
ShareLaborCost$_{cst}$	– 0.016 (0.012)	– 0.018 (0.012)	– 0.017 (0.012)	– 0.021 (0.013)	– 0.018 (0.013)	– 0.021 (0.013)
Investment ratio$_{cst}$	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	– 0.001 (0.001)	– 0.001 (0.001)	– 0.001 (0.001)
LP growth$_{cst}$	0.003 (0.004)	0.002 (0.004)	0.002 (0.004)	– 0.002 (0.004)	– 0.003 (0.003)	– 0.003 (0.004)
ϕ_{cdt}	Yes	Yes	Yes	Yes	Yes	Yes
ω_{sdt}	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	ct	ct	ct	ct	ct	ct
Adj. R^2	0.832	0.832	0.832	0.878	0.878	0.878
No. of Obs	7927	7927	7927	7894	7894	7894

Table reports the regression for the determinants of firms' birth and death rates. Clustered standard errors at country-time level are reported in parenthesis. Asterisks denote significance levels: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$

economic significance, since the average entry rate in the sample (Table 11) is equal to 5.64%, a reduction in the costs borne by firms increases the entry rate by 0.869% (0.049/5.64). In terms of the time needed to comply with red tape, the effect is much higher, about 6.4% (0.36/5.64). Similar reductions in terms of both the cost and the time of dealing with anti-competitive administrative obligations would lead to an increase in the exit rate of 3.5% and 5.4%, respectively. These results are in line with previous studies on the effect of changes towards pro-competitive regulations in the product market. For example, Franco et al. (2016) found that a unit decrease in regulation is associated with 2.2 % increase in R &D efficiency and, through this channel, in patenting. Alesina et al. (2005) and Fiori et al. (2012) find an effect of product and labor market reforms of about 1 % on investments, and of 0.3–0.4 % on the employment rate, respectively. The results in Table 9 provide support for the conclusion that improvements in business dynamism are higher in industries that are more exposed to bureaucratic barriers when moving from a country with high entry barriers to a country with low entry barriers (Klapper et al., 2011).

The results in Table 10 show that red tape has heterogeneous effects on small and large firms. The time spent complying with bureaucratic procedures negatively affects small firms more than their larger counterparts, both when considering firm entry and exit rates (columns 2 and 5; columns 3 and 6). The negative effect of the costs borne by firms also hurts smaller firms more than larger ones, although the double interaction is not precisely estimated in all specifications (columns 1 and 4; columns 3 and 6). This is consistent with the results shown in Table 9 and the fact that $RedTapeTime_{ct}$ may be a more comprehensive proxy for the total amount of resources firms spend to comply with red tape. Non-monetary costs may be particularly relevant for smaller firms with fewer resources and personnel. These findings confirm and extend the results of the DiD model. Smaller firms in highly exposed sectors are the most affected by an increase in administrative burdens, especially in the form of a longer time period to comply with them.

5 Concluding remarks

Business dynamics play an important role in productivity and economic growth. Firm entry and exit rates are parts of the key process of search and experimentation that leads to new firms replacing outdated incumbents through an increased level of competition, more efficient production processes and new products. Bureaucratic barriers could prevent new, and potentially innovative, firms from entering the market, thereby weakening the creative destruction process (Schumpeter, 1947). It is therefore crucial for economic policy to understand the factors that may affect the process of entry and exit of firms and, possibly, remove or limit their effects through appropriate reforms. This is all the more true for policy makers in those countries that are characterized by a relatively higher share of small and old firms. In these countries, new and high-potential business ideas may find it difficult to enter in the competitive arena, with adverse effects on employment and productivity growth. In addition to structural and cyclical factors, which have been shown in the existing literature to facilitate or hinder firms' entry and exit decisions, regulations in the product market play a relevant role.

Based on these motivations, in this paper we analyse the relationship between the stringency of red tape, and firms' entry and exit rates in a large group of European countries. For this purpose, we make use of a panel database on firms' entry and exit rates, obtained from Eurostat, covering 22 European countries and 14 manufacturing sectors observed over the period 2013–2019. The information on firm dynamics is complemented by country-level data proxying indicators of red tape, obtained from the World Bank's Doing Business project. We consider five topics: regulations for starting a business, dealing with construction permits, getting electricity, registering property, and enforcing contracts. We consider both the cost and the time required to comply with these administrative procedures.

Using a difference-in-difference approach *à la* Rajan and Zingales (1998), we find a negative impact of anti-competitive bureaucratic barriers on firm entry and exit rates across European countries. In particular, the marginal impact of an increase in red tape regulation on the birth and death rates is higher in sectors that are naturally more exposed to it, both in terms of cost and time to complete the administrative procedures. Moreover, the time taken to comply with burdensome red tape procedures is a stronger brake on smooth entry and exit with respect to the monetary cost that firms bear. Thus, economies that are characterized by long times to comply with red tape obligations may be particularly affected in terms of lower business dynamism. Another interesting result of our analysis is that the negative effect of red tape barriers on firm dynamics is particularly strong for smaller firms. For these firms, bureaucratic barriers depress business turnover through the entry and exit channels. Small firms are the most affected by the increase in red tape. This seems reasonable given that most new firms are small and tend to be understaffed to deal with more burdensome bureaucracy.

Policymakers should streamline anti-competitive red tape. According to our analysis, this policy would have a significant positive impact on firms' entry and exit decisions which, in turn can have a positive impact on economic growth. Small firms, which make up the vast majority of companies in all European countries, may benefit particularly from a reduction in red tape. Reforms that promote the ease of doing business, faster reallocation of factors of production from (inefficient) exiters to high-potential entrants, and an effective bankruptcy legislation may certainly help towards this goal.

Appendix

See Fig. 5 and Tables 11, 12, 13, 14, 15 and 16.

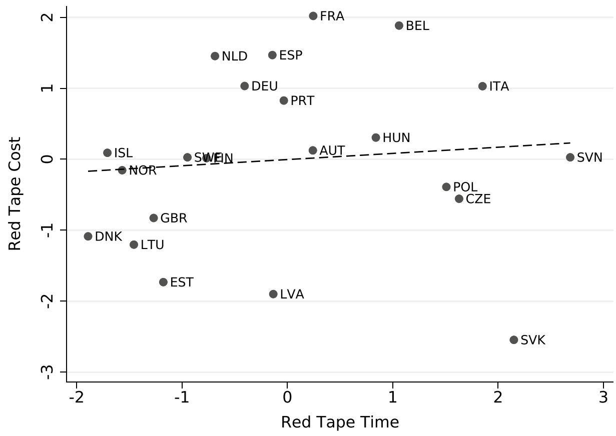

Fig. 5 Correlation between Red Tape Cost and Red Tape Time: average value 2013–2017

Table 11 List of countries, number of observations and average birth and death rates

Country	Birth rates		Death rates	
	N.Obs	Mean	N.Obs	Mean
Austria	392	4.20	392	2.83
Belgium	392	2.85	392	1.39
Czech Republic	392	4.01	392	3.22
Denmark	392	7.36	392	7.60
Estonia	392	7.81	392	6.00
Finland	392	3.48	392	3.50
France	392	4.19	392	2.35
Germany	356	3.95	302	6.18
Hungary	392	5.91	392	5.94
Iceland	389	5.09	389	6.28
Italy	392	3.79	392	4.05
Latvia	392	10.38	392	6.66
Lithuania	392	11.29	392	8.09
The Netherlands	392	3.79	392	2.44
Norway	392	3.76	392	2.88
Poland	392	6.69	392	5.85
Portugal	392	6.82	392	6.21
Slovak Republic	392	7.14	392	4.74
Slovenia	392	4.63	392	3.90
Spain	331	5.13	352	5.86
Sweden	392	3.31	392	2.90
United Kingdom	336	8.62	336	7.92
Total	8468	5.64	8435	4.82

Observations are at the country level (average across years-sectors-size classes)

Table 12 Pairwise correlation across five cost dimensions in 2019

Variables	Start cost$_c$	Permits cost$_c$	Electricity cost$_c$	Property cost$_c$	Dispute cost$_c$
Start cost$_c$	1.0000				
Permits cost$_c$	0.1912	1.0000			
Electricity cost$_c$	0.0716	− 0.0852	1.0000		
Property cost$_c$	0.1669	0.3741	− 0.2908	1.0000	
Dispute cost$_c$	0.0439	0.0174	0.0111	− 0.0300	1.0000

This table provides correlation coefficients across pairs of variables measuring red tape barriers

Table 13 Pairwise correlation across five time dimensions in 2019

Variable	Start time$_c$	Permits time$_c$	Electricity time$_c$	Property time$_c$	Dispute time$_c$
Start time$_c$	1.0000				
Permits time$_c$	0.3240	1.0000			
Electricity time$_c$	0.0309	0.2365	1.0000		
Property time$_c$	0.4426	0.1664	0.0718	1.0000	
Dispute time$_c$	0.2449	0.5252	0.0366	0.2227	1.0000

This table provides correlation coefficients across pairs of variables measuring red tape barriers

Table 14 Principal component analysis

Component	Eigenvalue	Proportion	KMO	Component	Eigenvalue	Proportion	KMO
Red tape-cost 2013				*Red tape-time 2013*			
Component 1	1.6	0.5	0.51	Component 1	1.9	0.5	0.51
Component 2	1.0	0.25	0.53	Component 2	0.9	0.2	0.55
Component 3	0.9	0.14	0.51	Component 3	0.8	0.2	0.62
Component 4	0.8	0.07	0.51	Component 4	0.6	0.07	0.7
Component 5	0.5	0.04	0.64	Component 5	0.3	0.03	0.58
Overall			0.53	Overall			0.59
Red tape-cost 2014				*Red tape-time 2014*			
Component 1	1.6	0.5	0.50	Component 1	1.8	0.45	0.58
Component 2	1.1	0.2	0.53	Component 2	1.0	0.2	0.59
Component 3	0.8	0.1	0.51	Component 3	0.8	0.2	0.45
Component 4	0.7	0.1	0.51	Component 4	0.7	0.10	0.53
Component 5	0.5	0.0	0.67	Component 5	0.3	0.05	0.55
Overall			0.51	Overall			0.53
Red tape-cost 2018				*Red tape-time 2018*			
Component 1	1.6	0.6	0.57	Component 1	1.86	0.5	0.61
Component 2	1.0	0.2	0.57	Component 2	0.9	0.2	0.51
Component 3	0.9	0.1	0.51	Component 3	0.9	0.1	0.47
Component 4	0.7	0.06	0.53	Component 4	0.7	0.1	0.78
Component 5	0.5	0.04	0.49	Component 5	0.3	0.07	0.53
Overall			0.54	Overall			0.51
Red tape-cost 2019				*Red tape-time 2019*			
Component 1	1.6	0.5	0.56	Component 1	1.99	0.5	0.58
Component 2	1.0	0.2	0.57	Component 2	1.0	0.2	0.54
Component 3	0.9	0.2	0.48	Component 3	0.9	0.1	0.45
Component 4	0.8	0.07	0.53	Component 4	0.5	0.1	0.56
Component 5	0.5	0.03	0.59	Component 5	0.3	0.1	0.58
Overall			0.54	Overall			0.55

This table provides the results of the PC analysis for years 2013, 2014, 2018, 2019

Table 15 Red tape and industrial dynamics: size classes

	Birth rate$_{csdt}$			Death rate$_{csdt}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Red tape cost$_{ct}$	− 1.142*** (0.127)		− 1.126*** (0.116)	− 0.589*** (0.126)		− 0.569*** (0.114)
Red tape time$_{ct}$		− 0.415** (0.165)	− 0.367*** (0.126)		− 0.437*** (0.118)	− 0.410*** (0.104)
Total taxes$_{ct}$	− 0.030** (0.011)	− 0.076*** (0.014)	− 0.016 (0.012)	− 0.064*** (0.014)	− 0.078*** (0.013)	− 0.048*** (0.013)
Deposit$_{ct}$	− 0.016 (0.010)	− 0.005 (0.013)	− 0.006 (0.011)	0.001 (0.011)	0.013 (0.011)	0.012 (0.011)
ShareLaborCost $_{cst}$	− 0.041** (0.020)	− 0.105*** (0.028)	− 0.079*** (0.023)	− 0.026 (0.019)	− 0.081*** (0.020)	− 0.068*** (0.018)
Investment ratio$_{cst}$	0.011*** (0.004)	0.022** (0.009)	0.013** (0.005)	0.002 (0.002)	0.009* (0.005)	0.004 (0.003)
LP growth$_{cst}$	0.017*** (0.006)	0.025*** (0.007)	0.017*** (0.006)	0.004 (0.006)	0.008 (0.006)	0.004 (0.006)
θ_{sdt}	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	ct	ct	ct	ct	ct	ct
Adj. R^2	0.607	0.575	0.611	0.607	0.601	0.613
No. of Obs	7927	7927	7927	7894	7894	7894

Principal components calculated by pooling all years. Table reports the regression for the determinants of firms' birth and death rates. Clustered standard errors at country-time level are reported in parenthesis. Asterisks denote significance levels: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$

Table 16 Share of service input in the US manufacturing industries: 2012

Industry	NACE rev.2 codes	Share
Food, beverage and tobacco	10–12	3.9
Textiles, wearing apparel	13–14	5.2
Leather	15	5.2
Wood	16	3.1
Paper, printing and publishing	17–18	5.2
Chemicals and pharmaceuticals	20–21	11.2
Rubber and plastics	22	3.6
Non-metallic minerals	23	5.2
Basic metals, fabricated metals	24–25	3.1
Electronic prod., electrical equip	26–27	6.9
Machinery and equipment	28	4.5
Motor vehicles and other transp	29–30	13.1
Furniture and other man	31–32	4.2
Repair and installation	33	4.3

This table provides the values of share of service input across US manufacturing industries in 2012

Acknowledgements We are grateful to the Associate Editor (Luca Grilli), and two anonymous reviewers for helpful comments and suggestions. The usual disclaimer applies.

Funding Open access funding provided by Università degli Studi di Trento within the CRUI-CARE Agreement.

Declarations

Conflict of interest On behalf of all authors, Fabio Pieri states that there is no conflict of interest.

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