Artigos

The Dynamics of Employer Enterprise Creation in Portugal Over the Last Two Decades: A Firm Size, Regional and Sectoral Perspective*

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abstract

The Portuguese economy underwent a process of growth and structural transformation during the twentieth century, while the last two decades conveyed a period of considerable creative destruction of firms. Indeed, following a period of rapid economic expansion in the second half of the 1990s, the deterioration of the economic situation felt since 2001 contributed to the deceleration of economic growth, which has also had an impact on firm turbulence. Using Quadros de Pessoal and the Eurostat and OECD methodology (Manual on Business Demography Statistics), this article describes employer enterprise dynamics in Portugal over 1985-2007, and discusses the main stylized facts related to firm creation, performance, and firm size distribution by region and sector.

resumo / résumé

A economia portuguesa viveu um processo de transformação estrutural no século XX, em particular nas suas duas últimas décadas, que se consubstanciaram numa considerável «destruição criativa» a nível empresarial. Após um período de rápida expansão económica na segunda metade dos anos 90, a deterioração sentida desde 2001 contribuiu para a desaceleração da actividade económica, patente igualmente no comportamento da demografia empresarial. Este artigo descreve a dinâmica empresarial de empresas empregadoras em Portugal, ao longo de duas décadas (1985-2007), com recurso a uma base de dados concebida a partir dos Quadros de Pessoal, que adopta a metodologia preconizada pela OCDE e Eurostat no «Manual on Business Demography Statistics». São também analisados os principais factos estilizados sobre a demografia, performance e distribuição de empresas de acordo com a sua caracterização dimensional, regional, e sectorial.

L'économie portugaise a connu un processus de croissance et de transformation structurelle au cours du XXe siècle. Les deux dernières décennies représentent une période où beaucoup d'entreprises ont été créés ou détruites. Après une période d'expansion économique dans la seconde moitié des années 90, la détérioration sentie depuis 2001 a contribué au ralentissement de l'activité économique, aussi bien qu'à la stabilisation de la turbulence des entreprises. Cet article aborde la dynamique des entreprises qui emploie plus d´un travailleur, au long de deux décennies (1985-2007), en utilisant un ensemble de données conçue à partir du Quadros de Pessoal, basé sur la méthodologie «Manual on Business Demography Statistics» de l'Eurostat et OCDE. Sont également abordés les principaux faits stylisés concernant la création, performance et distribution d'entreprises par taille, région, et principaux secteurs économiques.

JEL Classification: L26, L11.

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1. Introduction

Entrepreneurship policies became a central part of policy orientation in recent years in Portugal, as it is widely understood that enterprise dynamics allows tackling many problems related to competitiveness and innovation and the growing uncertainty faced in international markets. But most studies on enterprise dynamics in Portugal still lack a long run perspective, required to detect underlying structural changes in the entrepreneurial fabric.

This analysis provides a threefold perspective of the main stylized facts[1] of enterprise creation in Portugal, consolidated over a period of two decades. It focuses on employer enterprises (enterprises with more than one employee), which are an important source of job creation, thus playing a fundamental role in economic activity. The main data source in Portugal for this purpose is *Quadros de Pessoal*. This annual mandatory survey, conducted by the Portuguese Ministry of Labour and Social Security[2], provides a rich and comprehensive matched employer-employee-establishment dataset. According to the registers of the Portuguese Social Security, it is composed of all enterprises with at least one paid employee during the 1985-2007 period. Our database, extracted from *Quadros de Pessoal*, follows the Eurostat and OECD methodology «Manual on Business Demography Statistics» (Eurostat and OECD, 2007), and focuses on the analysis of entrepreneurial performance indicators of enterprise creation. Specifically, our derived dataset consists of an annual average of 215,903 employer enterprises, with an annual average of 36,803 births and 23,743 enterprise deaths.

According to the Eurostat and OECD methodology, the core measure of births reflects the concept of employer enterprise birth. A birth amounts to the «creation of a combination of production factors with the restriction that no other enterprises are involved in the event» (Eurostat and OECD, 2007: 34). Births do not include reactivations of units which are dormant within a period of two years. Thus, this population consists of enterprises that have at least one paid employee in its birth year and also of enterprises that, despite existing before the year in consideration, were below the one employee threshold. An employer enterprise birth is thus counted in the dataset as a birth after recruitment of the first employee. The employer enterprise birth rate is obtained dividing the number of births by the number of enterprises with one or more employees during the reference period.

The following sections describe the dynamics of employer enterprise creation over the last two decades (section 2) and analyse some stylized facts by looking at firm size categories and distribution (sections 3 and 4), regions (section 5) and sectors (section 6). Section 7 provides some concluding remarks.

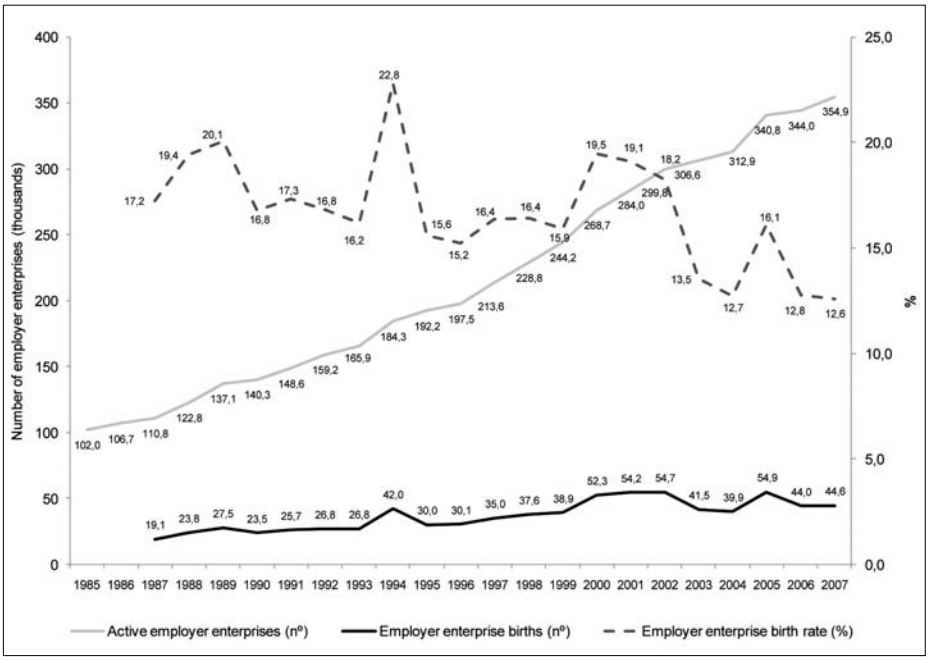
2. Performance Indicators for Employer Enterprises

The body of research published so far on entry has engendered a series of persistent and compelling stylized facts about firm dynamics, which are observed in a wide spectrum of countries (Carreira and Teixeira, 2011; Klapper et al., 2009; Plehn-Djowich, 2009; Cabral, 2007; Bartelsman et al., 2005; Geroski, 1995; Siegfried and Evans, 1994). One of the less controversial stylized facts is that net entry is far less important than the corresponding gross flows of entry and exit. In fact, a high number of firms enter and exit the market every year. Most new entrants are involved in the search process rather than competing against their rivals in the market (Bartelsman et al., 2004).

1. A stylized fact is a simplified presentation of an empirical finding, often used in social sciences and, in particular, in economics. It is conveyed as a broad generalization, often made across different countries, which summarizes more complex statistical analysis.
2. *Gabinete de Estratégia e Planeamento do Ministério do Trabalho e da Segurança Social.*

In Portugal, the population of employer enterprises has been growing steadily from 1985 to 2007, surpassing the 300,000 threshold after 2003 (Figure 1).

Figure 1 – Population of Employer Enterprises, Enterprises Births and Birth Rates, 1985-2007



Note: All figures and tables are based on our own calculations from *Quadros de Pessoal*.

The analysis of the growth rate of Portuguese employer enterprise creation (i.e. births, according to the Eurostat and OECD´s methodology) shows a considerable level of turbulence (defined as the amount of firms that either enter or exit the market in a given year) during the 1987-2007 period. Various studies have documented substantial rates of entry/exit in a number of countries (Klapper et al., 2008; Cabral, 2007; European Commission, 2003; Caves, 1998; Masso et al., 2004; Scarpetta et al., 2002; Ahn, 2001). Among European countries, Portugal records one of the highest rates of new firms relative to the stock of existing enterprises, irrespective of the selected methodology (OECD, 2009; Schrör, 2009; INE, 2009; Cabral, 2007; Bartelsman et al., 2004; Scarpetta et al., 2002). The Structural Business Statistics data by Eurostat (Schrör, 2009) shows that in 2005, Portugal had the second highest business entry rate among twenty countries. Approximately the same ranking is obtained if the entry rate based on *Quadros de Pessoal* or that from Statistics Portugal[3] (INE, 2009), were considered instead (Sarmento and Nunes, 2010b).

3. In 2006, within a panel of sixteen countries, Portugal is ranked the third highest, after Estonia and Romania (INE, 2009). Statistics Portugal (INE) also follows the Eurostat and OECD´s (2007) methodology, but considers a larger universe of «enterprises», where sole proprietors are also included.

In what concerns enterprise births, four main «peaks» are clearly shown in Figure 1, namely 1989, 1994 (with a 57% year on year growth rate and the highest birth rate throughout the period), 2000 and 2005.

Over the entire period, the annual average growth rate of employer enterprise births was 4.3%, but from 1996 to 2000, an economic recovery period[4], it becomes substantially higher (14.9%), decreasing subsequently to less than 1% (see Table 1). The average birth rate is in line with this change, in particular after 2000. From 1990 to 1995, it averages 18%, decreases during 1996 to 2000 and continues to fall in the following five-year period (approximately 16%). From 1987 to 2000, around 17 out of 100 enterprises were new. From 2000 to 2007, less than 16 were new enterprises.

Table 1 – Average Birth Rate and Annual Average Growth

Period	Average birth rate (%)	Annual average growth of births (%)
1987-2007	16.7	4.3
1987-2000	17.5	8.1
2000-2007	15.6	-2.3
1990-1995	17.6	4.9
1996-2000	16.7	14.9
2001-2005	15.9	0.3

Overall, the rhythm of growth of enterprise births has been decreasing since the 2000 «peak»[5]. Following a long period of rapid expansion in the second half of the 1990s, the economic deterioration felt since 2001 contributed to the slowdown in Portuguese domestic demand, leading to a sharp deceleration of activity. The readjustment process of balance sheets among households and firms, in order to correct economic imbalances was partly related to general cyclical developments in the European economy, but also to downward adjustment of expenditure patterns, bringing spending more in line with incomes and revenues. Although this coincided largely to what was happening in the European Union (EU) economy at large, the amplitude of the downsizing was more pronounced in Portugal (European Commission, 2004).

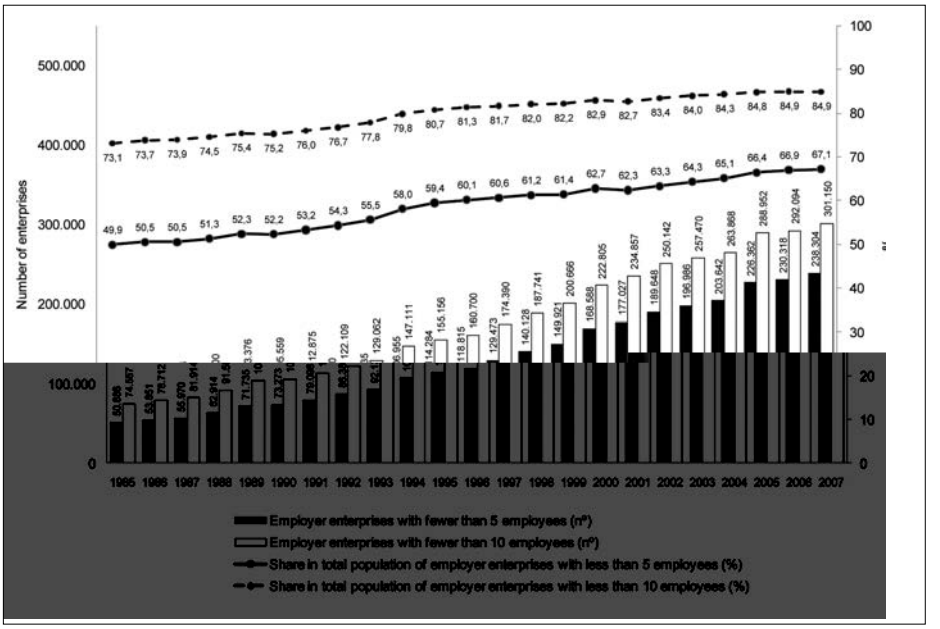
3. Employer Enterprises by Size Class

The majority of enterprises in OECD countries and in the EU are small and medium enterprises (SMEs) (Schrör, 2009; OECD, 2000; Storey, 1994). Overall, the weight of SMEs in the economy has been growing in recent years due to the increasing predominance of services, the outsourcing activities by large firms to smaller counterparts and the development in information technologies, which have lowered entry costs thus allowing smaller firms to enter into specific market niches. Small and micro units prevail therefore in the population of firms in most countries, with firms with less than ten employees representing approximately three quarters of the total (Schrör, 2009; Bartelsman et al., 2005; Bartelsman et al., 2004).

4. There is a close association between firm creation and the business cycle. Within the period 1996 to 2006, we observe positive correlations between the GDP and lagged GDP at current prices and firms´ birth rate (47.7% and 96.6%, respectively, the latter being statistically significant at 1%).
5. Except for 2005, which it is considered to be due to the start of the electronic delivery of *Quadros de Pessoal* (which increased the data coverage and reliability) and the slight recovery occurred in 2007.

As shown in Figure 2, in the 1996-2007 period, more than 60% of all employer enterprises are micro firms (i.e. firms with less than four employees[6], and more than 81% have fewer than ten employees (Sarmento and Nunes, 2010a). There is also a clear upward trend in the share of small firms with fewer than ten employees in the population: 74% in 1986, 82% in 1997 and 85% in 2007. In 2007, almost 98% of the Portuguese enterprises employed less than fifty workers, compared to 95% in 1985.

Figure 2 – Active Employer Enterprises



A second stylized fact in the literature is that firm entry is more likely to occur in smaller size classes (see, for instance, Segarra and Callejón, 2002). In general, due to the uncertainty regarding future profitability, most firms prefer to enter with a relatively small scale in order to have minimum costs in case of exit. Thus, births (and deaths) are traditionally more concentrated in smaller size classes, when compared to the overall firm population (OECD, 2009). On the other hand, firms with better information about their future success tend to enter with a bigger size[7] Another well-documented cause is that firms start small due to financing constraints (Silva and Carreira, 2011; Cabral and Mata, 2003; Brito and Mello, 1995).

6. Firms are divided into six different size classes: 1-4, 5-9, 10-19, 20-50, 50-250 and > 250 employees. This complies with the methodology applied to the dataset (Eurostat and OECD, 2007; Ahmad, 2006) which is due to grant greater international comparability. Different size thresholds in the sources of data on business demography are known to impact severely on data comparability. According to the OECD (2008: 10), «the size class breakdown used provides for the best comparability across countries given the varying data collection practices across countries».

7. Firms that start up bigger also have a higher probability of survival (Carreira and Teixeira, 2011; Nunes and Sarmento, 2012; Geroski et al., 2010). The role of size is even more substantial in the service sector as firm's current size dimension highly determines its survivability (Nunes and Sarmento, 2010).

In Portugal, small firms are created at a faster pace than larger firms, gaining share both in terms of both enterprise and employment coverage (Sarmento and Nunes, 2010a). In the period from 2000 to 2007, an average of 48,259 new enterprises debuted per year (Table 2). Among these, 40,297 were firms with less than five employees (84% of total enterprises) and 48,011 were below the fifty employees' range (99.5%).

Table 2 – Average Employer Enterprise Births by Period and Size Class

Period	Average entreprise births	Overall (score)					
		1-4	1-9	1-19	1-49	1-249	All
1987-2000	31,368	24,442	28,900	30,476	31,147	31,347	31,368
% of total	100	77.9	92.1	97.2	99.3	99.9	100.0
1987-2007	36,803	29,555	34,256	35,885	36,574	36,781	36,803
% of total	100	80.3	93.1	97.5	99.4	99.9	100.0
1992-1999	33,383	26,483	30,982	32,511	33,162	33,363	33,383
% of total	100	79.3	92.8	97.4	99.3	99.9	100.0
2000-2007	48,259	40,287	45,543	47,286	48,011	48,233	48,259
% of total	100	83.5	94.4	98.0	99.5	99.9	100.0

During 1993, a year characterized by a widespread international economic crisis and speculative currency attacks within the European Monetary System, Portugal's GDP growth was negative. Firms with over fifty employees were particularly hit. In 1994, the economy started to recover and the second Community Support Framework (QCA[8]II) began. In 1994, the rate of growth of births was the highest in all entire period (i.e. 57%), in particular in the over 250 employees class (i.e. 600%). The second highest growth rate occurred later in 2000 (35%), coinciding with the start of the third Community Support Framework (QCAIII), being particularly prominent for micro firms (with a growth rate of 38%).

As shown in Table 2, most enterprise births are in the smallest size class, in particular during the period 2000-2007 (84%), when compared to the previous period of 1992-1999 (79% of total). The annual average rate of growth of firms with fewer than five employees is one percentage point above the economy's average (4%) from 1986 to 2007. This growth is only surpassed by the largest firms with over two hundred and fifty employees, with a 6% growth rate. In 1995, firms with fewer than five employees represent more than 80% of the share of total businesses and have shown a steady increase since then, at the expense of all other size classes. The shift-share analysis provided by Sarmento and Nunes (2010a) shows that the greatest contribution to the rate of growth of births comes mainly from the smallest size class firms.

According to Schrör (2009), Portugal shows the highest share of enterprise births of firms with fewer than five employees (2005 and 2006 averages). The increasing number of start-ups in smaller size classes (Figure 2), combined with a smaller average entrant size and specialization effects towards industries with a smaller efficient scale, have led to a decline in average firm size in Portugal over time, from around five employees on average in 1987 to three in 2007.

8. QCA stands for *Quadro Comunitário de Apoio.*

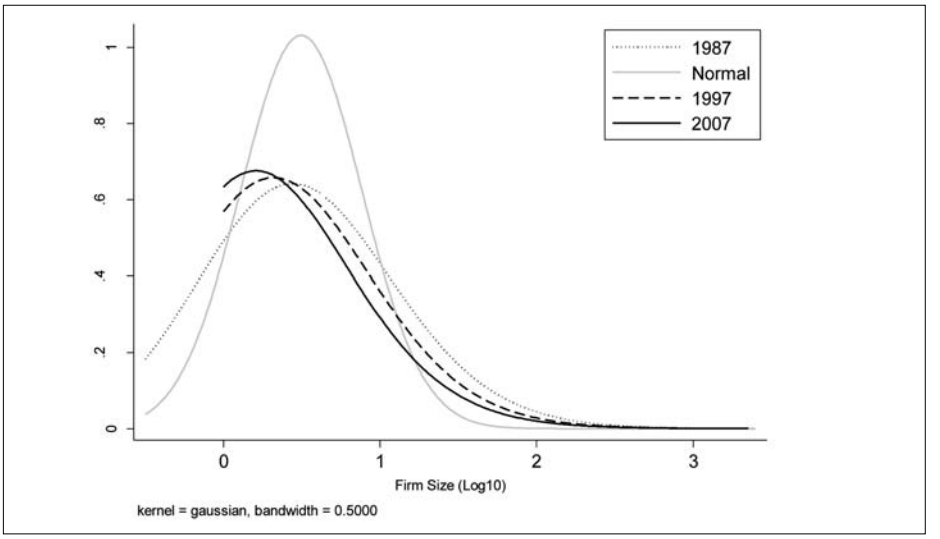
4. Firm Size Distribution

There is a considerably large amount of evidence in favour of the idea that the share of micro and small size firms relative to medium and large scale enterprises is increasing (Schaper et al., 2008; OECD, 2000; 2005; Storey, 1994; Loveman and Sengenberger, 1991), and also that the shift in firm size distribution towards smaller production units is an ongoing process since the 1970s (Ribeiro, 2007).

A third stylized fact points to the creation of new firms being in general of a smaller size than incumbents, thus making the firm distribution right skewed, with proportionally more small than large firms with respect to the lognormal distribution. In order to assess if the increasing presence of smaller firms is indeed affecting the composition of the population of firms, an analysis of the size distribution of employer enterprises was considered. The firm size distribution obtained for the subset of firms based on *Quadros de Pessoal* follows Cabral and Mata´s methodology (Cabral and Mata, 2003)[9]. A nonparametric estimation method (a gaussian kernel density smoother with a bandwidth of half per cent to the logartithm of firm size) was chosen to test if firm size (expressed as the log of the employment of the firm) distribution was stable and approximately lognormal for the population of enterprises.

As shown in Figure 3, the resulting firm size distribution of firm entrants is right skewed[10], with a distinct shape from the normal distribution, in line with Cabral and Mata's results. Secondly, the distribution is not stable over time. It has been shifting towards the smallest size classes, in line with the total economy, revealing the effect of the increasing prevalence of smaller firms in the population of employer enterprises. These results are also confirmed by looking at different firm cohorts, enterprises deaths and firm dynamics at the sectoral level (Sarmento and Nunes, 2010a).

Figure 3 – Firm Size Distribution by 1985, 1995, and 2005 Cohorts of Entrants



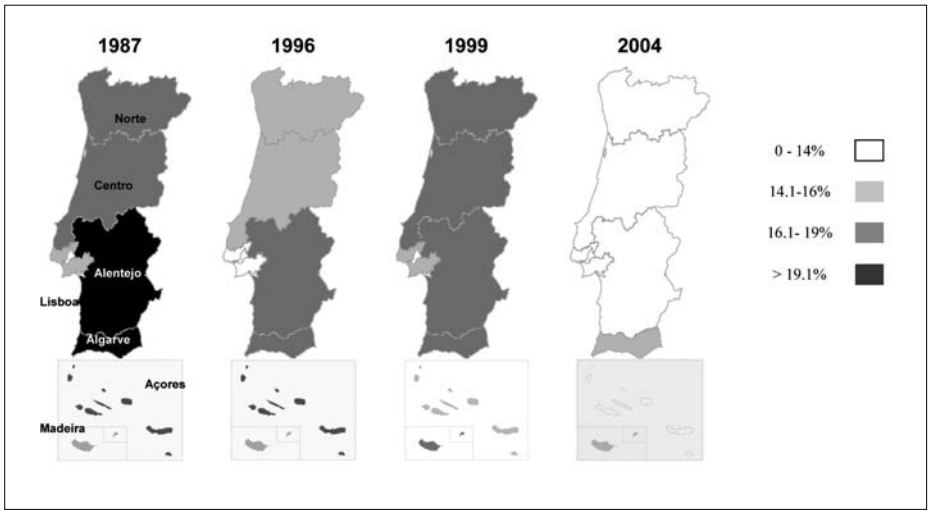
9. It is important to keep in mind that the type of distribution depends heavily on the data source considered (Cabral, 2007; Ribeiro, 2007; Cabral and Mata, 2003).
10. It has long been noted that the distribution of firms is skewed (Schaper et al., 2008; Cabral, 2007; Klette and Kortum, 2004; Ijiri and Simon, 1977). More recently, the availability of large micro data sets allowed uncovering

Barbosa and Eiriz´s (2011) work uncovers further evidence whereby for a majority of Portuguese districts, firm size is related to firm growth. It is also a widely accepted stylized fact that small firms grow faster than large firms[11] and that exit rates decline with size (Bartelsman et al., 2005; Fariñas and Moreno, 2000). Thus, firm size dynamics tend to be scale dependent, but on the other hand, this dependency from growth and exit rates is also systematically reflected in the size distribution of firms. Peretto (1999) tackled this issue theoretically and developed an endogenous growth model which included a market structure framework. His results indicate that the size distribution is not neutral with respect to growth. However, a contemporaneous empirical piece of research by Acs, Mork and Yeung (1999) reveals a positive association between size and growth for manufacturing in the United States. Furthermore, Pagano and Schivardi´s (2003) sectoral evidence drawn from eight European countries also gives support to the hypothesis that firm size distribution has a causal impact on growth at the industry level, the mechanism being innovation. Higher average size is associated with higher productivity growth, corroborating the existence of a relationship between firm size distribution and economic growth.

5. Employer Enterprises by Region

Enterprise creation is also a primary indicator of the level of entrepreneurship at the regional level. Among the seven Portuguese NUTII regions[12], Algarve displayed the highest annual average growth over the 2000-2007 period (at 9% compared to a national average of 6%) due to the dominance of services, especially those related to tourism activities (see Figure 4).

Figure 4 – Birth Rate by NUTII



that firm sizes are likely to be distributed as a Pareto distribution, instead of a log-normal (Gaffeo et al., 2003; Axtell, 2001).

[11] This has been widely demonstrated by many researchers since the work of Mansfield (1962). Consider for instance the surveys of Caves (1998), Sutton (1997) and Hall (1987), which document the robustness of these results over time, different industries and across countries.

[12] The Portuguese NUTII regions are Norte, Centro, Lisboa, Alentejo, Algarve, Açores and Madeira.

From 2000 to 2007, Norte and Madeira displayed the second greatest annual average growth (4.5%). However, Norte, the Portuguese region where the manufacturing sector is relatively more predominant, suffered from the highest regional volatility, particularly from 1993 to 1998. Despite Norte having the greatest share of enterprises and the greatest amount of small enterprises in the country, the weight of SMEs is the highest in Algarve (mainly due to services and construction from 2000) and Alentejo (mainly in services, agriculture and fishing sectors).

By combining the regional with the size class dimension, the predominance of small firms in most regions at the NUTII level can be observed (Table 3), in particular in the Algarve, Açores, and Alentejo. Small firms share of employment increased, particularly in Norte and Centro (Sarmento and Nunes, 2010c; 2010d), where manufacturing firms (of an average bigger size) are relatively more concentrated, thus revealing the effects of deindustrialization.

Table 3 – Employment Share of Employer Enterprises with Fewer than 20 Employees by NUTII (in percentage)

Regions	Enterprise share of enterprises with fewer than 20 employees												
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Norte	46.9	47.4	47.4	48.3	49.4	49.4	49.9	51.3	52.8	55.1	56.4	57.1	57.6
Algarve	52.8	53.4	53.9	54.7	58.4	58.4	60.6	62.0	63.8	65.7	67.0	67.0	67.7
Centro	49.3	50.4	50.5	51.2	52.4	52.2	53.7	54.9	56.2	59.1	60.6	61.4	61.8
Lisboa	51.0	51.2	51.3	51.6	52.3	52.1	53.1	53.8	54.8	57.7	59.1	59.9	60.2
Alentejo	52.9	54.8	54.7	57.1	58.6	58.5	59.7	60.2	61.9	63.6	65.3	65.1	66.7
Açores	66.6	66.2	66.4	66.4	65.2	64.5	64.9	64.8	66.8	65.1	67.6	68.4	68.2
Madeira	47.4	48.4	47.8	49.4	50.3	52.2	53.2	55.3	55.1	57.6	57.6	57.8	57.7
Portugal	**49.9**	**50.5**	**50.5**	**51.3**	**52.3**	**52.2**	**53.2**	**54.3**	**55.5**	**58.0**	**59.4**	**60.1**	**60.6**

Regions	Employment share of enterprises with fewer than 20 employees												
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Norte	34.7	35.2	36.2	37.5	38.6	40.4	41.0	43.2	43.3	43.0	43.5	42.8	42.4
Algarve	58.2	59.4	60.3	59.9	59.7	60.0	59.6	62.2	61.1	60.8	60.5	59.5	58.4
Centro	41.4	42.4	43.3	44.1	45.4	46.6	47.3	50.5	50.7	49.5	49.8	49.4	49.1
Lisboa	27.9	28.7	28.9	28.6	28.8	29.2	29.2	30.9	30.5	29.6	28.9	28.6	28.4
Alentejo	55.5	54.7	54.5	55.2	55.4	57.0	56.4	58.2	57.5	54.6	55.5	54.2	54.9
Açores	47.8	46.8	47.4	44.7	45.3	44.2	43.4	43.5	44.5	42.9	43.3	44.3	42.0
Madeira	39.2	37.7	38.4	39.5	41.0	42.9	42.5	42.0	42.1	42.0	42.5	43.2	43.2
Portugal	**35.1**	**35.9**	**36.6**	**37.1**	**37.9**	**39.0**	**39.3**	**41.6**	**41.5**	**40.7**	**40.8**	**40.2**	**39.9**

Average firm size of entrants has also been decreasing throughout the country's regions, except for size class of 20-49 employees, which has been able to show systematic recoveries and maintain its average range between 25-31 employees. The Açores had the smallest sized enterprises up to 2003, averaging less than five employees. From 2005, this region was overthrown by Norte. On the other hand, the biggest sized enterprises[13] are located in Lisboa,

[13] We refer to the biggest size class when firms are over two hundred and fifty employees.

although average firm size has been decreasing considerably in recent years (1,645 employees on average in 1989 to 624 in 2007). The tendency for firms to concentrate on core competences, deregulation and the successive privatization and downsizing waves that have swept Europe, have also taken a severe toll on larger Portuguese enterprises. In turn, the regional distribution of start-up rates is relatively uneven across the seven NUTII regions (see Table 4).

Table 4 – Employer Enterprise Birth Rates by NUTII (in percentage)

Regions	Employer enterprise birth rates															
	1987	1990	1994	1995	2000	2001	2002	2003	2004	2005	2006	2007	1987-1995	1990-1995	1996-2001	2002-2007
Norte	18.6	17.4	23.4	16.1	19.3	20.6	18.8	14.3	13.4	19.9	12.9	12.8	18.4	17.9	17.9	15.3
Algarve	25.7	22.8	28.9	17.7	22.3	23.4	20.9	14.7	14.1	16.9	14.9	15.3	23.7	22.1	19.8	16.0
Centro	16.9	16.9	23.2	16.0	20.8	18.1	18.1	12.3	11.6	14.4	11.3	10.8	18.5	18.4	17.4	13.0
Lisboa	14.4	14.8	20.8	14.0	18.4	17.5	17.4	13.2	12.7	13.0	13.6	13.5	16.1	16.0	15.8	13.9
Alentejo	20.4	18.5	22.8	16.7	19.7	17.9	17.2	13.5	12.0	14.5	12.1	11.8	19.9	18.6	18.0	13.5
Açores	18.9	15.1	20.3	15.3	15.2	16.8	17.4	13.7	13.4	12.4	12.5	11.4	16.8	16.2	14.8	13.4
Madeira	15.9	16.6	25.1	17.6	17.4	19.4	18.3	16.6	14.8	13.2	13.6	12.0	18.3	18.8	17.4	14.6
Portugal	**17.2**	**16.8**	**22.8**	**15.6**	**19.5**	**19.1**	**18.2**	**13.5**	**12.7**	**16.1**	**12.8**	**12.6**	**18.0**	**17.7**	**17.3**	**14.3**

Norte makes up for most of the enterprise births in the country, with an average share of 36% of total enterprises in the twenty year period under consideration, with a birth rate greater than the national average[14]. This region also presents the highest dispersion, followed by Centro and Lisboa. Lisboa and Açores have smaller birth rates than the country's average throughout most of the observed period, while the Algarve is systematically the region with the highest birth rates in Portugal. In higher firm birth rate years overall firm dimension increases, revealing some heterogeneity at the regional level, particularly from 2000 to 2002 (Sarmento and Nunes, 2010c; 2010d).

Colantone and Sleuwaegen (2008), when analysing entries and exits in eight European countries, point out that globalization is bringing an increasing level of risk, tougher competitive pressure and increasing barriers to entry the market for potential entrepreneurs, which have resulted in declining entry rates. Most Portuguese regions follow the country's general trend of decreasing birth rates, in particular after 2000, a phenomenon also depicted by decreasing annual average growth rates of enterprise births. The Algarve is the only region challenging this tendency and maintaining a positive annual growth rate of enterprise births (1%), during the period 2000 to 2007 (Sarmento and Nunes, 2010a).

6. Employer Enterprises by Sector

We have already accounted for the increasing presence of small firms in Portugal and its NUTII regions. Next, a sector dimension is added to the analysis, supporting small business dominance in all broad economic sectors[15], both concerning the number of enterprises and their number of employees (see Tables 5 and 6).

[14] With the exception of years 1991, 1992, and 2000.
[15] Broad economic sectors are Agriculture and Fishing, Construction, Manufacturing and Services. Only sections A to P of ISIC Revision 3 were considered for the total economy.

Table 5 – Share of Employer Enterprises with Fewer than 20 Employees, as a Percent of Sector's Total, by Broad Sectors

Sectors	Enterprises			Employment		
	1995-2007	1995-1999	2000-2007	1995-2007	1995-1999	2000-2007
Agriculture and Fishing	96.5	95.6	96.9	67.2	61.7	70.0
Manufacturing	81.5	79.6	82.6	25.1	22.5	26.8
Services	94.7	94.6	94.8	42.9	43.8	42.5
Construction	92.9	92.2	93.1	52.1	46.5	54.4
Total economy	92.4	91.5	92.8	38.9	36.6	40.2

Table 6 – Average Employer Enterprise Size by Broad Sectors

Period	Average number of employees				
	Agriculture and Fishing	Manufacturing	Services	Construction	Total economy
1995-2007	4.9	18.9	8.4	8.9	10.0
1995-1999	5.5	20.8	8.6	9.5	10.9
2000-2007	4.5	17.4	8.3	8.3	9.4

During the period 1995-2007[16], 93% of total enterprises in the economy employed fewer than twenty workers with all sectors, but manufacturing, having a share over 90%. From the 1995-1999 to 2000-2007 the number of small enterprises rose in all sectors. Manufacturing displays the highest increase, higher than the overall average, indicating a faster reduction in enterprise size over time. The inflow of smaller ventures has reduced not only the overall average size of the firm population, being most evident in the manufacturing sector. While the average size of manufacturing firms is still at least twice as large as in the service sector, it tends to decrease faster than that of the remaining sectors, from an average of twenty one employees, during 1995-2000, to seventeen, after 2000. New technologies have severely reduced the importance of scale economies and challenged mass production techniques in many sectors. In addition, the relative smaller average size of most services, enhanced by the effects of the information revolution, created more opportunities for business ownership. Furthermore, globalization and the increase of competition from lower cost Eastern countries have accelerated the deterioration of comparative advantages of many Portuguese traditional industries, particularly in the manufacturing sector.

In line with the literature, the employment share of small firms is lower than its share in the total number of firms (see Table 5). In parallel to enterprise behaviour, the share of employment in enterprises with fewer than twenty employees also rises (c.f. Table 3) in all sectors of activity, except in services. From 1995 to 2007, small firms with fewer than twenty workers employed 39% of the total workforce in the dataset. It is in the Agriculture and Fishing and in the Construction sector where small firms account for the largest share of employment. The construction sector, which lived through an expansion period, both in terms of share of

[16] In analyzing the sector dimension, we only take into account the period from 1995 to 2007. This has to do with the start of European System of Accounts (ESA) in 1995 and to compatibility issues introduced by the new Portuguese Classification of Economic Activities Revision 3, implemented in 2007.

enterprises and employment, between 1995 and 2000[17], shows a marked decline after 2003 in terms of enterprises, employment share and average size[18]. Over the 1990s, the development strategy followed in Portugal concentrated on the modernisation of its transport infrastructure (Pereira and Andraz, 2004), as it was long thought that one of the fundamentals holding back the rapid convergence towards the EU average was the lack of upgraded infrastructures. This was greatly assisted by a generous inflow of Community Structural Funds. In fact, survival rates for construction firms became the highest of all broad sectors during 1996-1998. From 1999 onwards, firm survival in the service sector overcame survival in the construction sector that kept on falling at a relatively higher rate than in other sectors (Nunes and Sarmento, 2010).

The revival of the small business sector has not only been influenced by the level of economic activity and the dynamics of entry and exit into the market, but also by its industry structure, where an economy with a growing service sector and a declining influence of the manufacturing sector, such as Portugal, is more likely to display a growing share of both SMEs and its weight in total employment.

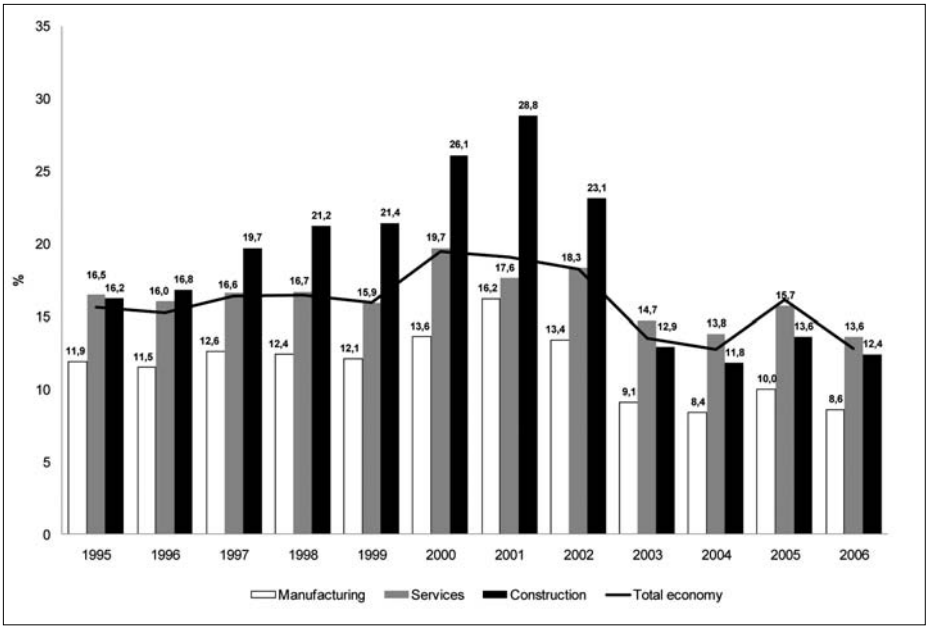
Over this period, the service sector reinforced its importance in the Portuguese economy, a phenomenon which is not unfamiliar to other countries (López-Garcia and Puente, 2006), given the increasing reliance on intangibles, information technologies and globalization (Colantone and Sleuwaegen, 2008), among other factors (Sarmento and Nunes, 2010a; Carree et al., 2002). According to *Quadros de Pessoal*, the service sector leads both in the number and in the share of employer enterprises, mainly after 2001 and in what concerns its weight in employment, but holds the lowest average firm size of the three main sectors (Table 6). In 2006, the service sector was responsible for 72% of all new ventures (3% more than in 1996). Moreover, 62% of total employment was generated by start-ups in services (6% more than in 1996), which is higher than service sector´s share in total employment (60% in 2006 compared to 50% in 1996) (OECD, 2005; Ahn, 2001).

Figure 5 shows the enterprise birth rates and that considerable discrepancies across Portuguese sectors still abound. Manufacturing birth rates have been decreasing since 2001, with a slight recovery in 2005, which was extended to all broad sectors. From 1998 to 2001, construction was the most dynamic sector. The birth rate was higher than 20% and was accompanied by an increasing weight in the share of total births. From 1996 to the early 2000s, the construction sector contributed the greatest to the overall growth of enterprise births (Sarmento and Nunes, 2010a). In 2001, 29 out of 100 were new construction enterprises. A similar trend can be found in other countries, particularly in Spain (European Commission, 2003; Fundación INCYDE, 2003).

A fifth stylized fact is that turbulence[19] is usually higher in services than in the manufacturing sector. For the period 2005 and 2006, the OECD (2009) observed that birth (and death) rates are significantly higher in the service sector for the vast majority of countries. According to *Quadros de Pessoal*, the service sector is ranked as having the second highest birth rate[20] from 1996, taking the lead from 2003 onwards (in 2005, 16 out of 100 were new service enterprises). High birth rates are also pointed out by the OECD. In 2006, Portugal had the highest birth rate in the service sector, above twenty other countries (OECD, 2009).

[17] The European Commission (2003) records the construction sector as having the highest number of enterprises and employees between 1998 and 2001 among ten member states.
[18] See also Sarmento and Nunes (2010a) and Sarmento (2010).
[19] Turbulence is given by the sum of birth and death rates. Sarmento and Nunes (2010a) also find significant high levels of correlation between average birth and death rates – a 10% significant positive Pearson correlation of 43.8%, from 1987 to 2005, and a 5% significant positive Pearson correlation of 92%, from 2000 to 2005.
[20] Industries characterized by high entry rates, at the moment of birth, find post-entry survival more difficult (Nunes and Sarmento, 2010).

Figure 5 – Birth Rate by Broad Sectors, 1995-2006



Moreover, births of small enterprises are also concentrated in the service sector in Portugal. More small ventures (with fewer than twenty employees) are born in the services sector relatively to the remaining sectors, with the exception of Agriculture and Fishing, where firms are created predominantly in this size class (Table 7).

Table 7 – Average Share of Employer Enterprise Births with Fewer than 20 Employees, by Broad Sectors

Period	Enterprise births with fewer than 20 employees					
	Agriculture and Fishing	Manufacturing	Services	Construction	Total births	Total enterprises
1995-2007	99.1	94.3	98.5	97.8	97.9	92.4
1995-1999	98.8	93.8	98.5	97.8	97.7	91.5
2000-2007	99.2	94.6	98.5	97.9	98.0	92.8

The proportion of firms born below the threshold of twenty employees is higher than the total weight of these enterprises in the population, revealing that newcomers have on average a smaller size than incumbents. This is also verified for all sectors and time periods (Sarmento and Nunes, 2010a). From the first sub-period to the second, proportionately more enterprises are

being born with fewer than twenty employees in all sectors, particularly in manufacturing, which reveals the greatest decrease in average size. Throughout the period, entrants (and exiting firms) are smaller than the average size of firms already in operation[21].

7. Main Conclusions

The Portuguese economy underwent a process of growth and structural transformation during the 20th century. In what concerns business demography, the last two decades were a period of considerable creative destruction of Portuguese firms, but the period following 2001 depicts a lower level of firm turnover, throughout all size classes, regions and broad sectors.

Some of the factors that contributed during the 1990s to the many imbalances felt in the Portuguese economy after 2000, are related to the cyclical position of the Portuguese economy relatively to other EU member states, the impact of the 1993 liberalization of capital movements, the financial deregulation on credit markets and the sharp decline in nominal and interest rates in the run-up to the Euro's accession. The upward revision in permanent income perceptions and the easing of liquidity constraints shifted the expenditures of households and firms to higher levels. Indebtedness of the household sector and the non-financial sector as a share of GDP more than doubled between 1995 and 2002. Following the period of rapid expansion in the second half of the 1990s, the economic deterioration felt since 2001 contributed to the deceleration in Portuguese economic activity, which is also conveyed by firm dynamics. Despite the deceleration in enterprise creation, Portugal still displays at the European and at the OECD level one of the highest rates of new firm creation relative to the stock of existing enterprises, even when other reference populations and methodologies are considered.

The number of employer enterprises has been growing steadily over more than twenty years, especially due to the contribution of a growing wave of smaller sized entrants. The increasing predominance of small firms is clearly observable in Portugal. Smaller enterprises are being created at a faster pace, in particular firms with fewer than five workers in most regions and in all Portuguese broad economic sectors. From 1987 to 2000, 78% of enterprises had fewer than four workers compared to 83.5% in the period of 2000 to 2007. In 2007, 98% of the enterprises employed less than fifty workers. This phenomenon is due to deindustrialization and increasing dominance of the service sector in the economy which leads enterprise creation since 2003 in terms of the number of enterprises and employees, but also to the gradual decrease of average firm size occurring in all broad sectors.

Consequently, we observe a gradual decrease of employer enterprises average size in Portugal over a period of more than twenty years, which is extended to all broad sectors, NUTII regions and entrants in the market. Average size of enterprise births has also decreased, from around five employees in 1987 to three in 2007. The revival of small enterprises has caused firm size distribution for the total and for entries into the population to shift over time to the smallest size classes, showing the entry of proportionally smaller than larger firms.

It is thus important to consider the long run effects of this 20-year trend towards smaller business and alternative public policy measures that should be envisaged therein, given that these smaller firms are in general more exposed to financial and administrative constraints and that recent research seems to point at the existence of a relationship between firm size and growth in Portugal.

[21] The small size of new entrants is a determinant factor, inhibiting enterprise survival (Nunes and Sarmento, 2010).

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Measuring Firms' Financial Constraints: A Rough Guide

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resumo

Os últimos anos têm sido prolíficos no desenvolvimento de novas medidas de restrições financeiras das empresas. Este artigo analisa as principais estratégias propostas. Discute-se, ainda, as principais vantagens e desvantagens de cada medida, bem como os dados estatísticos necessários para a sua implementação, fornecendo-se assim uma ferramenta útil para os investigadores que pretendem analisar o impacto das restrições financeiras sobre o comportamento das empresas.

abstract

The recent years have been prolific in terms of development of new measures of firms' financial constraints. This paper surveys the main strategies proposed. Additionally, we discuss the key advantages and disadvantages of each measure as well as the data requirements for implementation. Finally, it provides a useful tool for researchers that intend to analyse the impact of constraints on firm behaviour.

JEL Classification: D92; G32; L20.

1. Introduction

Firms' access to finance has been an increasingly relevant topic for researchers and policymakers (e.g. OECD, 2012). However, empirically addressing this issue can prove to be a difficult task. In this survey, we summarize the existing approaches and methodologies to measure financial constraints. It is organised in a way that facilitates the comparison of the different methodologies, taking into account the advantages and disadvantages of each approach. This allows the researcher to adequate the most appropriate technique for a research purpose and available data.

Financial constraints are empirically not observable. In fact, there is no item on the balance sheet that tells us if, and the extent to which, a firm is financially constrained. As a result, researchers have strived to develop methodologies that consistently allow identifying and measuring such constraints.

There are, however, a number of specificities associated with financial constraints that one should expect to be reflected in a good measure of financial constraints. Firstly, financial constraints are firm-specific. Even though interest lies in making inferences regarding a certain firm characteristic (e.g. firm size or age) or firm behaviour (e.g. innovation activity), one should expect highly heterogeneous levels of access to external finance. Additionally, constraints are time-varying, since a firm may move from constrained to unconstrained states (or across different degrees of constraint) as, for example, it establishes stronger investor-lender relationships and gains better visibility. The reverse may also be true if, for example, a firm's previously sound economic and financial conditions start to deteriorate (eventually defaulting on previous loans), investment opportunities change or idiosyncratic shocks occur. In this case, it might happen that this previously unconstrained firm will now find it difficult to obtain external finance. Therefore, one might expect different states of constraints along the timeline (e.g. Hubbard, 1998; Cleary, 1999). Finally, financial constraints is not a clear-cut phenomena where a firm is either financially constrained or not, but there are different degrees of constraint (Musso and Schiavo, 2008). As a result, each firm, for a given period of time, may move along a spectrum of constraints.

These characteristics imply that, beyond eventual theoretical issues, finding an appropriate measure of financial constraints may prove to be a rather difficult task. Optimally, the perfect measure of financial constraints should be objective, firm-specific, continuous, and time varying. Unfortunately, to our knowledge, there is no such measure. Nevertheless, we will present and discuss the main advantages and disadvantages of existing approaches to measure constraints. A summary of the different methodologies can be found in Appendix Table 1.

2. Indirect measures

2.1. Prologue: Primordial tests and the Q-theory of investment

Within the traditional Q model for investment (see Chirinko, 1993, for an overview), one should expect that Tobin's Q summarizes all future information that is relevant for a firm when deciding to invest.[1] Consequently, marginal Q should be the only predictor for investment (Chirinko, 1993). Therefore, we should not expect that additional variables (particularly financial ones) have a significant explanatory power in Q investment regressions. However, while financial variables, such as cash-flow, have been shown to be relevant in firms' investment decisions, the contribution of Q was found to be disappointingly low (e.g. Blundell et al., 1992). This type of result has driven researchers to argue that (after controlling for Q) investment may not be

[1] The theory was introduced by Brainard and Tobin (1968) and Tobin (1969).

independent from financial decisions due to the presence of financial markets imperfections. Specifically, the extent to which financial constraints increase the bias of average Q with respect to marginal Q has been given particular attention (see Hayashi, 1982; Gomes, 2001). If this is the case, then one should expect that financial variables, and specifically those that relate to firms' ability to generate funds, will turn out to be significant in an investment regression – see Hubbard (1998) for further discussion on Q-based models.

2.2. Cash-Flow Sensitivities

2.2.1. Investment

Theoretically, financial constraints have been incorporated in several models in the past. However, the empirical assessment of financial constraints can essentially be traced back to the seminal work of Fazzari Hubbard and Petersen (1988) – hereafter FHP – that introduced investment to cash-flow sensitivity (ICFS) as a measure of constraints.

The argument is the following. Financially constrained firms cannot obtain external finance – at least the full required amounts, or they do obtain them at significantly high costs. Therefore, these firms must rely on their internally generated funds once an investment opportunity arises. Meanwhile, financially unconstrained firms can easily resort to external funds to finance their investments. Accordingly, while constrained firms will exhibit a positive propensity to use cash-flows to finance investment (positive and significant ICFS), no systematic relationship should be found for unconstrained ones.

The approach used consisted in classifying firms *a priori* as constrained and unconstrained, based on their dividend policy. By assuming that constrained firms, in order to finance their investment, *«retain all of the low-cost internal funds they can generate»* and so pay lower dividends, FHP proceed to the estimation of ICFS for each class of firms. They regress investment on cash-flow, estimated Q (investment opportunities) and year and firm dummies, upon a sample consisting of 422 USA firms (1970-84).[2] Their findings, that low-dividend firms (constrained) exhibit higher ICFS than high-dividend ones (unconstrained), provided evidence that ICFS could be a useful measure of financial constraints.

Since the influential work of FHP, numerous studies focused on the use of ICFS to identify and measure firms' financial constraints – the contributions of Hadlock (1998) for the US, Chapman et al. (1996) for Australia; Guariglia (2008) for the UK; Audretsch, and Elston (2002) for Germany; Kadapakkam et al. (1998) and Bond et al. (2003) for different countries are just examples. Even though this approach is, by far, the most commonly used methodology to assess financial constraints (c.f. Carreira and Silva, 2010), it received severe criticism both at the theoretical and empirical levels. We summarize them into three main critiques that follow.

The first study that definitely challenged FHP's approach was Kaplan and Zingales (1997) – hereafter KZ. They pointed out that, not only certain assumptions made on the curvature of the cost function of external finance may not be verified (e.g. positive third derivatives), but also that the classification scheme used by FHP was flawed. In particular, due to precautionary savings and potentially risky adverse management, the dividend policy is an inaccurate sorting variable.

The second main critique, concerns problems associated with controlling for investment opportunities (FHP use Q). First, it is impossible to measure marginal Q and thus the empirical approximation, average Q (Hayashi, 1982), entails potential mismeasurements due to the violation of certain assumptions, such as imperfect competition and the relationship between

[2] As an alternative to the typical Q theory investment regression augmented with cash flow, some researchers also use an accelerator and\or error-correction specifications (e.g. Scellato, 2007; Guariglia, 2008).

firms' investment and financial decisions in these particular types of models (see Chirinko, 1993, and Hubbard, 1998, for a discussion). Second, Cash-Flow might itself contain information about investment opportunities, particularly for firms that face high uncertainty about their investment projects (usually young and growth firms). In this case, cash flow might indicate the direction to go, by revealing additional information on the projects' quality. As a result, one should expect that part of the ICFS is due to investment opportunities that were not captured by Q. In fact, Alti (2003), in a financially frictionless model, shows that even after Q correction firms still present significant ICFS.

Finally, several authors such as Povel and Raith (2002), Cleary et al. (2007) or Lyandres (2007) found the ICFS relationship to be non-monotonic. They argue that ICFS are U-shaped with respect to constraints due to the risk associated with firm default and the efforts of investors in trying to avoid corresponding liquidation losses – by providing larger amounts to mitigate the risk of default –, for sufficiently low levels of internal funds. In this case, a decrease in internal funds below a certain threshold would imply an increase in investment

Overall, these critiques cast serious doubts on the robustness of ICFS as a measure of financial constraints.

2.2.2. Growth

The approach described in the preceding section, has been extended to firm growth. As a result, a number of researchers have studied financial constraints by estimating the sensitivity of firm growth to cash flow (GCFS). We group these studies into three major categories, depending on the variable used to measure firm growth. Namely, we distinguish between employment growth (e.g. Oliveira and Fortunato, 2006), growth of total assets (e.g. Carpenter and Petersen, 2002) and sales growth (e.g. Fagiolo and Luzzi, 2006).

In this line of thought, we should note that some of these authors conclude that financial constraints (proxied by cash-flow) have a negative impact upon firm growth (e.g. Fagiolo and Luzzi, 2006; Oliveira and Fortunado, 2006). This type of conclusion may, however, be too sudden. Cash-flow *per se* is just a proxy (a better or worse one) for financial constraints (see Section 5.3). Therefore a positive and significant coefficient for cash-flow only tells us that firm growth responds positively to increases in cash-flow. Accordingly, unless we use a real measure of financial constraints as explanatory variable, or observe different sensitivities for different groups of firms (distinguishing their growth levels), there is not much one can say about the impact of constraints on firm growth. On the other hand, several papers (e.g. Serrasqueiro et al., 2010, Sarno, 2008) fail to control for investment opportunities. In this case, interpreting positive and significant sensitivities for a group of firms as evidence of financial constraints is flawed, due to investment opportunities hidden in cash-flows (see also Alti, 2003).

2.2.3. Cash

Recently, in a different perspective of demand for liquidity, Almeida et al. (2004) – hereafter ACW – suggest that financially constrained firms may alternatively be identified by looking at their cash policy. If a firm is constrained, it has to pass-up present investment opportunities and hoard cash, in order to be able to take advantage of profitable future investment opportunities and hedge against future shocks. The same is not true when it comes to unconstrained firms, since they are able to resort to external finance whenever investment opportunities arise (by definition of financial constraints). Therefore, one should expect a positive and significant association between cash stocks and cash-flow for constrained firms, while no such relationship should be found for unconstrained ones. Finally, the degree to which a certain group of firms is financially constrained should be reflected on the cash to cash-flow sensitivity estimate (CCFS), as in ICFS – the higher the CCFS, the more constrained is such group of firms. ACW test if financially constrained firms exhibit high cash-flow sensitivities, while unconstrained firms do not. Results

for four out of five classification schemes for constrained\unconstrained firms confirm their hypothesis. Only for the classification based on Kaplan and Zingales (1997), do the results differ.[3] Examples of this approach can also be found in Han and Qiu (2007) or Baum et al. (2011).

The financial nature of the cash stock variable is a shield against mismeasurements in Q and investment opportunities hidden in cash-flow. The reason being that it is not expected that firms will increase their cash stocks if cash-flow signals a new\better investment opportunity, unless they are financially constrained. However, constrained firms may use cash to reduce debt if hedging needs are low (Acharya et al, 2007). Accordingly, one should nevertheless control for debt issuances and investment opportunities. Additionally, as pointed by Almeida et al. (2011) in a subsequent paper, investment in relatively liquid assets, other than cash, may be used to transfer resources across time.[4] Therefore, any liquid types of investment should also be taken into consideration.

Finally, a few papers have empirically questioned the validity of this measure. They find that all firms, regardless of the *a-priori* classification as (un)constrained, exhibit positive and significant CCFS (e.g. Pal and Ferrando, 2009). Nevertheless, the sensitivity is found to be higher for firms that are expected to be constrained (Lin, 2007).

2.2.4. Common pitfalls

The above mentioned approaches share a number of drawbacks, mostly associated with the *ex ante* classification of firms, that are worthwhile mentioning. Sample partition into different groups of firms according to a certain segmenting variable that, *ex-ante*, is expected to provide information on the degree to which firms are financially constrained is, in fact, quite problematic.

First, it is questionable that the segmenting variable correctly distinguishes between constrained and unconstrained firms, since a superior proxy is yet to be found (Musso and Schiavo, 2008). Accordingly, some classification schemes may be flawed. The leading example is provided by Kaplan and Zingales's (2000) critique of FHP's use of dividend policy as a segmenting variable. They find that according to FHP (1988; 2000) Microsoft would be classified as financially constrained, even if it *«had net income of $3.5 billion, capital expenditures of $0.5 billion, no investment in inventories, no dividends, and no debt, yet held almost $9 billion of cash – or eighteen times capital expenditures»*.[5]

Second, it is also unclear that this proxy for constraints is not itself affected by financial constraints. In this situation, one will end up with an *a-priori* classification scheme based on an endogenous variable with respect to constraints – see for example Bond et al. (2003) for ICFS endogeneity problems and estimation biases.

Third, to categorize firms into different groups using continuous segmenting variables, one has to define cut-off points that are not arbitrary. The reason is that the relationship between the segmenting variable and financial constraints may be non-monotonic. As an example, even if it is generally agreed that larger and older firms are not as financially constrained as smaller and younger ones, some studies have shown that this relationship may in fact be U-shaped (e.g. Hadlock and Pierce, 2010).

Fourth, a firm may move across different states of the segmenting variable. Consequently, it might happen that a firm is also moving across different groups. As an example, if one uses firm

[3] The classification schemes are based on payout ratio, asset size, bond rating, commercial paper rating, and KZ index.
[4] In the original model they assumed that firms transfer resources only through cash.
[5] Firms in FHP (1988) and FHP (2000) were *a-priori* classified as financially constrained if they did not pay dividends and had high cash balances, respectively.

size as proxy, it might happen that a small, but fast growing firm, classified as constrained in the present, will be classified as unconstrained in the future just because it grew. This entails significant problems in the assignment of firms into such classes within a dynamic perspective.

Nevertheless, within cash-flow sensitivities (CFS), an alternative to perform a sample partition with respect to a given variable, is to test interaction terms of that variable with cash-flow. These interaction terms will then provide the sign (but not the magnitude) of the relationship between the variable and financial constraints. This slightly different approach also allows to test for non-monotonic relationships by introducing interactions of cash-flow with power values (e.g. the square) of the selected variable. Additionally, it also permits the treatment of such variable as endogenous in the regression. However, one still has to assume that CFS correctly identifies and measures financial constraints.

2.3. Euler Equation test

Based on Q-Theory and within the models for investment with adjustment costs, a strand of literature as attempted to identify financially constrained firms by estimating a reduced form Euler equation (see Whited, 1992).

The underlying Euler equation model describes an optimal path for investment given certain parametric adjustment costs. Accordingly, the marginal costs of investment in the present are set equal to the future's marginal costs of foregone investment. This approach prescribes that under perfect capital markets – i.e. under Modigliani-Miller theorem (1958) – a number of parameter restrictions must be verified (Table 1). Failure to verify such restrictions is interpreted as evidence of financial constraints. Note that these parameters are themselves functions of the model's structural parameters.

This test is then applied to a given subsample of firms. As with cash-flow sensitivity (CFS), researchers classify firms *ex-ante* as financially constrained based on a given variable (proxy) that is believed to clearly distinguish financially constrained from unconstrained firms. Accordingly, after deriving an empirical equation from the underlying Euler equation model, one should be able to reject the parameter restrictions for groups of firms that are financially constrained. Conversely, for groups of unconstrained firms, the parameter constraints should be met.[6] Applications of this methodology can be found, inter alia, in Bond and Meghir (1994) or Love (2003).

The main advantage of this approach over the traditional ICFS is that it avoids measuring Q, that may prove to be substantially difficult and confines the analysis to quoted firms. Additionally, the type of data required to the empirical test can be found in many datasets, as it is mostly based on information available in firms' balance sheets. However, the test is derived upon a large number of assumptions and on highly parametric models (see Coad, 2010 for a critique). Furthermore, the framework is based on parameter tests and does not directly produce a variable that can be used in subsequent estimations (see Section 3.2 for an index based on this approach). Finally, as in CFS approaches, *a-priory* classification schemes may be flawed due to non-monotonic relationships, endogeneity and aggregation issues regarding the proxy used.

2.4. Evolutionary test of selection forces

Recent trends, within Evolutionary theory, question the extent to which GCFS are indicative of the presence of financial constraints, rather than just a reflection of the selection process

[6] Within these parameters there is usually at least one that relates to the shadow cost of external finance (Whited, 1992).

mechanism. They challenge the core assumptions of rational optimization and optimal size, present in models of Neoclassical inspiration – such as Q theory and Euler equation approaches. The rationale is that a firm's growth will depend positively on its «fitness», which is reflected on their financial performance relative to others – explaining the positive GCFS found in the literature (see Carreira and Silva, 2010). Therefore, it is natural to expect that the «fittest» firms will grow faster (Coad, 2007).

Firms have «bounded rationality» (Simon, 1991), in the sense that they make decisions based on the information they presently have, rather than based on future states. Within this perspective, only highly productive firms are able to identify highly profitable investment opportunities due to an higher stock of knowledge, better routines and a set of capabilities (Coad, 2010) that lead to a persistence of profit levels (Geroski and Jacquemin, 1988; Dosi, 2007). As a result, it is reasonable to expect a high correlation between profitability and investment opportunities – this rationale is in line with the argument that cash-flows contain information on investment opportunities (Alti, 2003).

Another implication of bounded rationality is that it no longer makes sense thinking in terms of «optimal size» or «optimal path of growth». In fact, Coad (2010) argues that firms always want to grow, and so «*evolutionary firms are eternally financially constrained, irrespective of information asymmetries*». Accordingly, the extent to which one finds a positive impact of a profitability measure (e.g. operating margin) on firm growth (e.g. sales), is only indicative of the workings of the selection mechanism. In other words, there is a correct reallocation of market share to the most productive firms.[7] If, on the contrary, growth does not strongly respond to profitability (operating margin), then the selection mechanism is not selecting «the fittest» firms (Coad, 2007; Bottazzi et al., 2008).

However, we should note that the major force behind evolutionary dynamics is firms' ability to innovate (Schumpeter, 1939; Nelson and Winter, 1982; Nelson, 1995), of which one should stress radical innovation – where financial constraints are shown to be particularly severe (Czarnitzki and Hottenrott, 2011). In this perspective, selection forces «unfit» firms to exit, therefore having a «cleansing effect». As a result, if there are external factors that inhibit firms' innovation capacity, the selection process may drive out of the market firms that, even though having the right capabilities, did not have sufficient funds to overtake promising innovation projects. The extent to which financial constraints to innovation ultimately lead to the survival of inert big and established firms in detriment of vibrant new and small innovative firms (thus distorting the selection process), is certainly a question that deserves our attention in the future.[8]

2.5. Considerations on the data required

The type of data required to apply the methodologies described in this section is, essentially, information from firms' balance sheets. Despite the pitfalls of these approaches, it is certainly valuable that most National Statistical Offices are able to provide such information for very large (and representative) samples of firms operating in a certain region or country.[9]

However, for some of these approaches, one might also need information from financial markets (in order to compute average Q, for example). In the event that such information is strictly necessary, the corresponding sample will only contain publicly traded firms. This has serious

[7] Usually sales growth is preferred with respect to investment because it captures firms' intangible capital, knowledge, and processes.
[8] Note that several empirical studies find a negative impact of financial constraints on firm survival as well as on innovation (see Carreira and Silva, 2010).
[9] Even for cross-country comparisons, it is possible, although not easy, to obtain such data from International Organizations (e.g. OECD; World Bank), or to buy this information from specialized data collecting companies.

implications on the measurement of financial constraints. In fact, these firms are expected to be less financially constrained than untraded ones (see Carreira and Silva, 2010). First, traded firms can easily issue equity and debt. Second they have more visibility and are eventually more credible at the eyes of other types of investors\lenders. Third, information on these firms is widely available and circulates in a more efficient way (Fama, 1970). This reduces information asymmetries, therefore having a crucial impact upon firms' ability to obtain external funding. This distinction between traded and non-traded firms is particularly relevant for countries with less developed capital markets such as Portugal.

Overall, we should reinforce that indirect measures have two main problems. The first results from the fact that these measures rely on (sometimes strong) theoretical assumptions needed to construct the underlying models for empirical equations. The second is a practical problem associated with the type of measure that is obtained from the estimations. In fact, none of the measures produces a variable that is firm-specific and time-varying. Conversely they only provide a test, based on regression coefficients (or parameters), for the presence of financial constraints within a group\subsample of firms.

3. Direct measures

As an alternative to measuring financial constraints in an indirect way, when available, a direct measure of financial constraints can prove to be a useful tool that avoids the theoretical and measurement issues described in the preceding section. However, there are specificities associated with this type of measures that one must bear in mind. In this section we refer to two possible ways of directly measuring financial constraints and discuss the implications of using them.

3.1. Company reports

Major firms usually provide a report along with their end-of year financial statement – at least those firms that are traded in stock markets are required to do so in most countries. These reports contain rich qualitative information regarding firms' financial position and need for external finance. This information allows researchers to assign each firm a level of financial constraints (e.g. Kaplan and Zingales, 1997; Hadlock and Pierce, 2010).

Here follows an example given by Kaplan and Zingales (1997) of a report of a firm classified as «not financially constrained»: «*We ended the year in an exceptionally strong financial condition for a company of our size. During the year we paid off all long-term debt, and our cash and cash-equivalent assets have throughout the year exceeded all current liabilities.*»

In practice, researchers gather a sample of firms with available company reports. The first step is to search these statements for keywords and expressions that are symptomatic of the presence of financial constraints (Table 1). Secondly, each firm is assigned a level of financial constraints according to the information reported. Finally, if possible, this qualitative information should be complemented with quantitative information (e.g. financial variables) in order to build a final score of financial constraints – in line with Kaplan and Zingales (1997).

While the major advantage of using this type of approach is the richness of information available for the researcher to sort firms according to their levels of constraints, the major drawback is related to the sample size and representativeness of corresponding samples. If on the one hand company reports provide rich and relatively accurate information, on the other hand it is difficult to obtain such information for a large number of firms. Reports are only made available by a small number of firms. Therefore, inferences to the population regarding financial constraints can not be made due to representativeness problems. Among other reasons, these particular firms are usually publicly traded. Accordingly, such firms will, in principle, not be as financially constrained as the untraded ones (see Carreira and Silva, 2010).

Additionally, analysing company reports entails a significant amount of time and effort. In fact, even if reports were available for the whole population of firms, it would be extremely difficult (or virtually impossible) for the researcher to examine all of them with the necessary level of detail.

Finally, problems associated with managers misreporting may also be relevant in countries where managers may not be held liable for disclosure of false information, or whenever it is not possible to match the information from reports with quantitative data.

3.2. Self-evaluation: Survey data

The recent advances in data collection and availability have spawned a new wave of empirical literature that relies on business surveys to identify and measure firms' financial constraints – e.g. Savignac (2009); Beck et al. (2008).

The alternative to using firm reports as direct information on firms' ability to obtain external funds, is simply to ask firms whether or not they are financially constrained. This can be done either by a single question, directly asking firms about financial constraints (or access to external finance), or through a combination of a number of different questions. Such questions should regard, among others, the cost of external funds (excessive interest rates), credit denials and the availability of external financing sources. The latter approach requires the construction of a score based on the variables obtained from the different questions, following a given criteria.[10]

The main advantage of using this type of data is the fact that firms are the best informed agents with respect to the quality of their investment projects. Therefore one should expect that investment opportunities are already taken into account in firms' responses.[11] In addition to directly knowing firms' perception of constraints, unlike reports, one can measure constraints for small and young firms, provided that they are included in the survey's target population.

However, the subjective nature of the self-assessed variables means that potential biases, resulting from individuals' perception, may exist. As an example, we might have respondents that feel that their firm is highly financially constrained, when it actually is much less constrained than another firm reporting a low level of constraints.[12]

Furthermore, it is worthwhile noticing that, due to the non-linear nature of the resulting financial constraints variable, this measure can only be used as a dependent variable, with the appropriate non-linear regression technique. Nevertheless, the non-linear nature of an independent variable can be partially overcome if one previously estimates the corresponding non-linear regression and obtains fitted values of the underlying latent variable – provided that suitable instruments are available and the regression has a good fit. However, in this case we would be working with an index (Section 3.1).

With respect to data availability, although in the past this type of information was rather scarce and with an insufficient level of detail (Claessens and Tzioumis, 2006), we should note that the recent financial crisis has encouraged surveys directly aimed at firms' financial constraints. Examples for the European case are the EUROSTAT's *«Access to Finance»* and the ECB's *«Survey on the Access to Finance of SMEs in the Euro Area»*. We therefore expect availability of this type of data to be more frequent and detailed in the near future.

[10] As a mere example, if we have 3 different questions, each one with 3 distinct degrees of response (3 different ordinal variables with 3 levels), a plausible criteria is to build a score of constraints with 3 levels. Firms that answered the maximum (minimum) degrees in all questions are assigned the level 3(1). The remaining firms, that have mixed responses, are assigned the level 2.

[11] Note that deliberate missreporting should not be an issue since these types of surveys are usually anonymous.

[12] Some studies overcome this problem by using data on the credit requested and effectively granted (e.g. Russo and Rossi, 2001; Angelini and Generale, 2005).

A somewhat different approach (when analysing the bank lending channel) is to ask financial institutions (notoriously banks), rather than firms, the extent to which firm credit was denied and for which reasons – see for example Del Giovane et al., 2010. In this approach, one has the advantage of knowing the reasons for credit denial (controls for lenders perception of risk and project quality). However, there are a number of reasons for which this measure is seldom used. First, it is rather difficult to obtain such data from banks or even specialized institutions (a rare example is the ECB's *«Bank Lending Survey for the Euro Area»*).[13] Second, if one wants to analyse the relationship of financial constraints with other aspects of firm behaviour, one has to match bank with firm level information. This is virtually impossible due to data disclosure policies and confidentiality issues. Third, but related to the previous points, even if it is possible to obtain bank-firm level data, the extent to which the sample will be representative of the population is rather questionable.[14]

These direct measures of constraints all share the advantage of being firm-specific and eventually time-varying – if the reports\surveys are collected periodically. Additionally, in contrast with indirect approaches, it is possible to use this type of measure either as a dependent or explanatory variable. However, the subjective and qualitative nature of these measures often calls for the use of quantitative information. As a result, it is advisable to combine these direct measures with firms' financial data. The resulting measures are often referred to as indexes.

4. Indexes

In order to avoid some of the disadvantages of direct and indirect measures of financial constraints, the combination of different types of information and different variables into indexes provides a useful tool in the analysis of firms' constraints. The main motivations for the use of indexes is that they allow a firm-specific treatment of financial constraints, as well as they can be used either as dependent or explanatory variables, due to their continuous nature.[15]

4.1. With a qualitative dependent variable

The use of indexes of financial constraints is rather recent. This approach was, to our knowledge, first implemented by Lamont et al. (2001). Using KZ's ordered logit regression of financial constraints scores on relevant financial variables (see Section 3.1), they propose a firm-specific and time-varying index of constraints (known in the literature as the KZ index).[16]

The idea is that, given a qualitative variable of financial constraints, one can estimate the impact of a number of different determinants of financial constraints. These determinants are usually proxies that are expected to influence firms ability to obtain external finance (see Appendix Table 1). Using the appropriate non-linear regression technique, one can estimate coefficients for each of the determinants of constraints.[17] Having obtained these coefficients, it is then possible to construct an index that results from a linear combination of the determinants, weighted by the estimated coefficients (see Table 1).

[13] Note that this is a bank level survey that does not contain firm-specific information. Therefore, one can only observe the evolution of the credit policies, demand and supply of funds within banks' perspective.
[14] As an example, cooperation with the vast majority of banks with desired levels of regional and industry representativeness (branch representativeness) would be necessary.
[15] Note that the Class Ranking Index (Section 4.2.3) is an exception.
[16] The index is given by $KZ_{it} = -1.002 * CF_{it} + 3.139 * B_{it} - 39.368 * D_{it} - 1.315 * C_{it} + 0.283 * Q_{it}$, where CF is cash-flow over total assets, B is long-term debt over total assets, D is total dividends over total assets, C is liquid assets over total assets, and Q is Tobin's q.
[17] The estimation of the coefficient is based on a latent variable specification (since the dependent variable is binary\ordinal). See for example Greene and Hensher (2010) for details.

Even though the outcome is a continuous, firm-specific and time-varying measure of constraints, there are a number of problems associated with this approach. First, it relies on the availability of a qualitative dependent variable. Therefore, it also carries along all the sampling and subjectivity issues raised in Section 3.

Second, the index is constructed using a specific sample of firms. Accordingly, it is not reasonable to expect that the corresponding coefficients will remain unchanged if one intends to apply it to a different sample – see Silva and Carreira (2010a) for a discussion of the Size-Age index (Hadlock and Pierce, 2010). Consequently, the index can not be universally used as a measure of financial constraints.

Third, unless the non-linear regression has a very good fit, the corresponding index will only provide a noisy signal of financial constraints. This bias will be particularly severe if there are a number of unobservable and\or omitted variables in the regression that strongly determine financial constraints.

4.2. Without a qualitative dependent variable

In order to avoid the problems associated with the availability of qualitative data and sample specificity, a number of researchers have constructed indexes that do not rely on this type of data. We summarize these indexes into the three following categories.

4.2.1. Euler equation index

Building on the Euler equation approach (Section 2.3), Whited and Wu (2006) construct an index of constraints that does not require qualitative information. Instead, they use a structural parameter of the Whited (1992) model – the shadow cost of equity finance – that is set to be a function of observable firm characteristics.

In practice, the strategy boils down to estimate the Euler equation model's resulting empirical equation. In this framework, the shadow cost of finance is set, outside of the model, to be a function of observable «financial health» variables. As a result, they obtain a vector of coefficients, that is then used to build the index (known in the literature as the WW index).[18]

Although the data requirements for the construction of this index are not particularly difficult to meet – essentially balance sheet data and financial markets information –, the major concern when using this approach is the fact that the index results from a highly parameterized structural model (as in Section 2.3). Additionally, due to the number of parameters involved in the underlying model, this approach is of far more complex implementation than any other measure discussed here. Finally, as in the preceding Section, we should note that the estimated coefficients (hence the index) are sample-specific, which precludes any straightforward generalization.

4.2.2. MDA index

An alternative strategy that neither requires a qualitative dependent variable nor a structural underlying model was implemented by Cleary (1999). Using multiple discriminant analysis (MDA), one can examine which variables are likely to influence the characterization of a firm as either financially constrained or non-financially constrained – in line with Altman (1968) for the case of bankruptcy.

[18] The index is given by $WW_{it} = -0.091 * CF_{it} + 0.021 * B_{it} - 0.062 * D_{it} - 0.044 * A_{it} + 0.035 * Y_{it} + 0.102 * Y_{it}$, where CF is cash-flow over total assets, B is long-term debt over total assets, D is an indicator of whether or not a firm pays cash dividends, A is the logarithm of total assets, Y is sales growth and IY is the 3-digit industry sales growth.

The procedure requires two steps. First, one should use a segmenting variable that enables the distinction of firms into two (or more) mutually exclusive groups. Then, use MDA to assess the ability of each independent variable (determinants of financial constraints) to distinguish a firm between groups. As a result, one can build the index using the coefficients estimated through MDA. Within the same rationale, one can use the segmenting variable to distinguish two (or more) groups of firms (e.g. financially constrained and non-financially constrained) and then estimate a probit\logit on the determinants of financial constraints. The resulting coefficients will then be used to build the index.[19]

The major drawback of this approach is the need to have a superior segmenting variable that correctly discriminates between financially constrained and unconstrained firms. Cleary (1999) assumes that dividend policy serves as such variable because firms that reduce dividends are likely to be constrained, whereas a firm will only increase dividends if it knows it can maintain them (financially unconstrained).[20] However, if the segmenting variable does not consistently discriminate between constrained and unconstrained firms, the resulting index will biased. This problem is similar to the choice of a variable for an a-priory firm classification (see Section 2).

4.2.3. Class Ranking Index

An alternative to the traditional indexes, first introduced by Musso and Schiavo (2008), is to rank firms in a certain class (e.g. region or industry) that is believed to be reasonably homogeneous. These rankings are computed upon on a number of variables that are found to have a given relationship to financial constraints (proxies).[21] Therefore, one can build a score of constraints based on the relative rankings of a given number of variables for a certain firm, within a certain class. The motivation to disaggregate firms into homogeneous classes is to account for specificities that may affect the relationship between the proxies and the genuine level of constraints – for example, in some industries there might be a relationship between age and financial constraints.

The procedure requires two steps. Firstly, identify a number of variables that can serve as proxies of financial constraints – see Section 5.3. For each of these variables, compute the relative position of each firm to the corresponding class mean. Secondly, collapse the rankings from all the proxies into a single score of financial constraints. As an example, if a firm is very old and large, and has a higher dividend payout ratio, then it is considered not to be constrained. If the converse is true, then such firm is assigned as constrained. Intermediate levels may also be built based on the ranking – quantiles of these variables. Examples of this approach can also be found in Bellone et al. (2010) and Silva (2011).

A first problem arises if we wish to use the score of constraints as a continuous variable. In fact, the score variable is ordinal. One cannot be sure that the difference between a firm scoring 1 and 2 is the same as the difference between levels 2 and 3. As a result, the score must be taken as an ordinal variable, which has significant implications in the choice of the estimation procedure.

Secondly, if there are non-linearities in the relationship between the proxy and the effective level of constraints, the final score will misrepresent the level of constraints. As an example, while it is generally agreed that financial constraints are lower for larger and older firms, we point out that

[19] Note that multiple discriminant analysis is the predecessor of non-linear approaches such as the probit and logit. One can see the Z score as a latent variable of financial constraints, as in Section 4.1.
[20] This type of segmenting variable usually further requires information from financial markets, which may result in biased samples.
[21] Musso and Schiavo (2008) construct their index based on the following variables: size (total assets), profitability, liquidity (current asset over current liabilities), cash flow generating ability (the maximum amount of resources that a firm can devote to self-financing), solvency (own funds over total liabilities), trade credit over total assets, repaying ability (financial debt over cash flow).

such relationship might rather be non-monotonic (U-shaped). If this is the case, then we will have firms assigned the maximum score, while in fact they face a lower level of constraints.

Finally, we should point that the disaggregation in relatively homogeneous classes of firms might entail considerable difficulties when comparing firms across classes. As an example, if the index is built on relative rankings for each industry, and if the less constrained firms in industry A is more constrained than the most constrained firm in industry B, comparison of firms across the two groups will be misleading.[22]

5. Other approaches

5.1. Firm level cash-flow sensitivities

A recent strand of literature, based on the CFS rationale, tries to overcome the problems associated with aggregation, as well as *a priori* classification schemes that CFS approaches usually face. This approach consists in introducing firm-level heterogeneity in the measure of financial constraints, without requiring the use of qualitative data or heavily parameterized underlying models. Within this framework, two different methodologies should be mentioned: *i*) Hovakimien and Hovakimien (2009), hereafter HH, and *ii*) D'Espallier, Vandemaele and Peeters (2008), hereafter EVP.

The measure introduced by HH compares the time average of investment weighted by cash-flow, against the simple average investment. Accordingly, investment in years when cash-flow is higher receives a higher weight, which means that if a firm invests more (less) in years with higher cash flow, the HH index will turn our positive (negative). The converse is also true. As a result, this measure is expected to capture the sensitivity of investment with respect to variations in cash-flows. The approach can also be extended to other types of CFS (see Section 2.1).

However simple, this methodology fails to control for investment opportunities and other variables affecting investment. As an example, the ICFS test relies on the assumption that, holding investment opportunities constant, investment responds positively to cash-flow if a firm is financially constrained (no sensitivity should be found for unconstrained firms). Additionally this measure does not explore marginal effects (see D'Espallier et al., 2009 for a critique).

A different perspective, introduced by EVP, is to estimate heterogeneous cash-flow slopes of a CFS regression. Using the same rationale of a CFS regression, one obtains a coefficient vector instead of a scalar. As result, we will have a cash-flow sensitivity for each firm. Accordingly, in contrast with the HH index, this methodology controls for a number of other relevant variables affecting the dependent variable (e.g. investment opportunities). However, the estimation of firm-level slopes requires refined estimation techniques that may introduce some complexity in the implementation.[23]

Nevertheless, both these methodologies share two major shortcomings. Even though they are firm-specific, the extent to which firms move from financially unconstrained to constrained states and *vice-versa* is not captured by these time averages. Additionally, they require that the underlying CFS methodology consistently identifies and measures constraints.

[22] Note that firms operating in some industries are, on average, more constrained than firms in other industries (Silva and Carreira, 2010b).
[23] EVP use a Generalized Maximum Entropy estimator after Golan et al. (2006), while D'Espallier and Guariglia (2009) use Bayesian econometrics (c.f. Lancaster, 2004; Koop, 2003).

5.2. Credit ratings

Credit ratings are the evaluation given by certain agencies to firms. These ratings are the basis for establishing the cost of external funding of a given credit rated firm – either by private investors in capital markets or by financial institutions.

The main benefit from using credit ratings is related to the fact that they summarize a vast set of firms' characteristics, are firm-specific and vary over time, as well as they represent the opinion of the markets (e.g Bottazzi et al., 2008, for an application). Even though this measure partially captures the credibility of a given firm in the market for funds, it has three major pitfalls.

Firstly, it relies on the quality of the assessment of credit rating agencies. In other words, one must believe that these agencies correctly screen credible companies.[24] Secondly, these ratings are based on the credibility of a given firm at a certain point in time (mostly relying on past economic and financial information, as well as default events). This means that they may fail to capture the true quality of investment projects to be overtaken in the near future. Thirdly, there are sample representativeness problems. In general, firms that ask to be rated are usually large, mature and traded – we would expect them to be unconstrained, or at least, less constrained than the average firm (see Carreira and Silva, 2010). This problem can be partially addressed if, in the analysis of a larger sample that covers non-rated firms, one classifies firms as constrained or not, depending on being rated or not, rather than on the rating itself. Once again, we might incur in significant biases if there exist unconstrained firms that avoid being rated simply because they do not want to depend on such ratings for obtaining external finance. Furthermore, some firms may, at some point, become «too big» or «too important» to be downgraded, even though an objective analysis would suggest so.

We note that the type of rating abovementioned might be different from a closer credit risk assessment that, for example, banks usually do. Such analysis might prove to be more accurate than credit ratings (*strictu-sensu*). However, aside credibility issues, such information is rarely available to the researcher.

5.3. Proxies

The use of proxies is the simplest and most practical way to measure constraints. By definition, if a given variable is highly correlated with financial constraints, it may prove to be a good proxy. If a proxy is available, then it can easily be used as either a dependent or explanatory variable that is firm-specific and time-varying.

The large majority (if not all) of the empirical literature on financial constraints relies on a different variety of proxies either as explanatory or segmenting variables. Examples of commonly used proxies are the following: Cash-flow, Cash stocks, Size, Age, Export, R&D intensity, Leverage, Dividend payout ratio, Group membership and Ownership.

Even though there might be different variables that correlate with financial constraints, a good proxy for financial constraints is rather hard to find (Cleary et al., 2007). Additionally, the use of proxies relies on previous relationships between financial constraints and the selected variable. Finally, if these relationships are non-monotonic, then the corresponding variable will only work as a good proxy for a subset of its space (see Section 2.2.4).

[24] Note that the rating itself results from a multivariate score summarizing firms' characteristics or a collection of information from financial statements and reports.

6. Conclusion

The analysis of firms' access to finance has been sensitive to methodological challenges. This paper overviews the existing frameworks used to identify and measure financial constraints.

It is clear by now that the researcher can choose from wide range of different measures, with perhaps complementary advantages and disadvantages. Therefore it is hard to clearly point a superior approach. In fact, we would risk saying that there is no perfect measure of financial constraints. This scenario has serious implications on economic research and certainly on policymaking.

While future research should definitely make an effort to develop better methodologies to assess firms' financial constraints, empirical work on this field should be cautious when providing conclusions and suggesting policy actions.

Finally, policymakers should not take single studies as the sole basis for policy action and design of policy instruments, be it tax credits, subsidies, special lines of credit, credit guarantee schemes or equity instruments. In particular, if such policies require redirecting public funds from other public purposes, market distortions might be the result in the event that funds are not correctly allocated to constrained firms.

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Appendix Table 1 – Methodologies used to assess financial constraints

Measures	Data	Strategy	Typical regression\question used	Advantages	Disadvantages	Example
a) Indirect						
ICFS (Coefficient)	BS, preferably matched with FM.	Split-sample or interact CF with variable of interest. ICFS provide the magnitude of constraints.	$\left(\frac{I}{K}\right)_{it} = \propto Q_{it} + \beta\left(\frac{CF}{K}\right)_{it} + \varepsilon_{it}$ Alternative specifications, even though following the same ICFS principle, are also used. Examples are the accelerator and error correction models.	Easy to compute\estimate; Availability of data.	Consistency of theory behind empirical test; Is an average over time and firms (endogeneity and aggregation biases); Cannot use as dependent or explanatory variable; Not firm-specific; Not time-varying; Use of segmenting variable and endogeneity of *a priori* classification scheme.	FHP (1988) Scellato (2007) Guariglia (2008)
GCFS: Employment Sales Assets (Coefficient)	BS, preferably matched with FM.	Split-sample or interact CF with variable of interest. GCFS provide the magnitude of constraints.	$\left(\frac{\Delta G}{G}\right)_{it} = \propto Q_{it} + \beta\left(\frac{CF}{G}\right)_{it} + \varepsilon_{it}$, where *G* is the variable whose growth is analysed (e.g. total assets). Some authors drop *Q* (investment opportunities) and use *CF* as a proxy for financial constraints. Any sensitivity to *CF* is then interpreted as evidence of financial constraints. These are often referred to as reduced-form models.	Easy to compute\estimate; Availability of data.	Consistency of theory behind empirical test; Is an average over time and firms (endogeneity and aggregation biases); Cannot use as dependent or explanatory variable; Not firm-specific; Not time-varying; Use of segmenting variable and endogeneity of *a priori* classification scheme.	Carpenter and Petersen (2002) Oliveira and Fortunato (2006) Fagiolo and Luzzi (2006)

Appendix Table 1 – Methodologies used to assess financial constraints *(cont.)*

Measures	Data	Strategy	Typical regression\question used	Advantages	Disadvantages	Example
CCFS (Coefficient)	BS, preferably matched with FM.	Split-sample or interact CF with variable of interest. CCFS provide the magnitude of constraints.	$\left(\frac{\Delta CS}{A}\right)_{it} = \beta_1\left(\frac{CF}{A}\right)_{it} + \beta_2 Q_{it} + \beta_3\left(\frac{X}{A}\right)_{it} + \varepsilon_{it}$, where *X* contains controls for firm's size as well as sources, demands and substitutes of cash.	Easy to compute\estimate; Availability of data.	Consistency of theory behind empirical test; Is an average over time and firms (endogeneity and aggregation biases); Cannot use as dependent or explanatory variable; Not firm-specific; Use of segmenting variable and endogeneity of *a priori* classification scheme.	ACW (2004)
Euler equation test (Parameters)	BS, preferably matched with FM.	Using an Euler equation model: For a given sample\ sub-sample check if parameter restrictions hold.	$\left(\frac{I}{K}\right)_{i(t+1)} = \beta_1\left(\frac{I}{K}\right)_{it} + \beta_2\left(\frac{I}{K}\right)_{it}^2 + \beta_3\left(\frac{C}{K}\right)_{it} + \beta_4\left(\frac{Y}{K}\right)_{it} + \beta_5\left(\frac{P}{K}\right)_{it}^2 + \varepsilon_{it}$ Under the null hypothesis of absence of financial constraints, the following parameter restrictions should be met: $b_1>1$; $b_2<-1$; $b_3<0$; $b_4=0$ under perfect competition; >0 otherwise; $b_5=0$ under Mondigliani-Miller; <0 otherwise; These parameters are functions of the underlying model's structural parameters. We should note that the specification and corresponding parameter decision depend on the derivation of the specific Euler equation.	Availability of data; Avoids the necessity to estimate Q.	Consistency of theory behind empirical test; Cannot use as dependent or explanatory variable; Complexity; Not firm-specific; Not time-varying; Use of segmenting variable and endogeneity of *a priori* classification scheme.	Bond and Meghir (1994)
Evolutionary test of selection (Coefficient)	BS	If selection is present, growth should be associated with profitability ("growth of the fitter"). If not, the economy may not be reallocating market shares to the most productive firms.	$\left(\frac{\Delta Y}{Y}\right)_{it} = \beta\left(\frac{OM}{Y}\right)_{i(t-1)} + \varepsilon_{it}$	Availability of data.	Does not test financial constraints but rather the selection mechanism; Cannot be used as dependent or explanatory variable; Not firm-specific; Not time-varying;	Coad (2007)

Appendix Table 1 – Methodologies used to assess financial constraints *(cont.)*

Measures	Data	Strategy	Typical regression\question used	Advantages	Disadvantages	Example
b) Direct						
Company reports (Ordinal)	Reports	Build a score based on information from qualitative financial reports. Qualitative may be complemented with quantitative information as in KZ (1997).	Search reports for keywords such as: *"financing, finance, investing, invest, capital, liquid, liquidity, note, covenant, amend, waive, violate, and credit"* (Hadlock and Pierce, 2010) Assign firms a classification of constraints according to reports.	Richness of information; Can be used as dependent variable; Firm-specific, and time-varying;	Requires exhaustive analysis of reports; Small and biased samples; Managers may misreport; Qualitative nature of data.	KZ (1997)
Self-evaluation (Ordinal)	Survey	Directly use the variable from the survey question or build a score from different survey questions regarding financial constraints.	Survey questions such as: *Classify the degree to which the lack of external finance hampered your projects.* *Classify the degree to which high interest rates on external finance hampered your projects.* *At the current interest rate do you want additional credit?* *Are you willing to obtain additional credit at higher interest rates?* *Have you seen credit requests being denied?*	Can be used as dependent variable; Firm-specific and time-varying.	Subjective; Qualitative nature of data; Availability data.	Guiso (1998)
Indexes						
Qualitative index (Continuous)	BS matched with qualitative data (Reports or Survey)	Use qualitative information as dependent variable; Estimate parameters of the index using a non-linear regression of the qualitative variable on FC determinants.	Use a qualitative variable of financial constraints (normally a score\ordinal) and estimate a logit\probit. The underlying latent variable of financial constraints is given by: $FC_{it}^{*} = \beta_1 L_{it} + \beta_2 M_{it} + \varepsilon_{it}$ Therefore, financial constraints will depend on the variables L and M. The coefficients are then used to build the index of the form: $Index_{it} = \beta_1 L_{it} + \beta_2 M_{it}$.	Can be used as dependent or explanatory variable; Firm-specific and time-varying.	Availability data; Sample-specific; Non-linear regression must have a good fit.	Lamont et al. (2001)

Appendix Table 1 – Methodologies used to assess financial constraints *(cont.)*

Measures	Data	Strategy	Typical regression/question used	Advantages	Disadvantages	Example
Euler equation index (Continuous)	BS	Using an Euler equation approach: estimate the impact of observable financial variables on the model parameter of the unobserved shadow cost of finance (λ_{it}).	The unobserved shadow cost of finance (λ_{it}) of the Euler equation model is set to be a function of observable firm characteristics (used as instruments) such that: $\lambda_{it} = \beta_1 L_{it} + \beta_2 M_{it}$ Therefore, financial constraints will depend on the variables L and M. The index is built with the coefficients: $Index_{it} = \beta_1 L_{it} + \beta_2 M_{it}$.	Can be used as dependent or explanatory variable; Firm-specific and time-varying.	Sample-specific; Consistency of underlying structural model; Complexity.	Whited and Wu (2006)
MDA index (Continuous)	BS	Use a segmenting variable to perform MDA and assign firms into mutually exclusive groups; Estimate parameters of the index through the impact of variables that influence the assignment of firms into the different groups.	Determinants of financial constraints affect the score Z, that is used to discriminate groups: $Z_{it} = \beta_1 L_{it} + \beta_2 M_{it} + \varepsilon_{it}$. The variables L and M discriminate firms between mutually exclusive groups; The coefficients are used to build the index of the form: $Index_{it} = \beta_1 L_{it} + \beta_2 M_{it}$.	Can be used as dependent or explanatory variable; Firm-specific and time-varying.	Availability data; Use of segmenting variable.	Cleary (1999)
Class Ranking index (Ordinal)	BS	Build a score of a number of proxies, based on the relative position of a firm within a class (e.g. industry).	For each proxy L and M, the relative values to the class k average is L_{ick}/L_{ck}, M_{ick}/M_{ck} The quantiles of order p of the resulting distributions are respectively $\xi_{L,p}$, $\xi_{M,p}$ Build scores $S_{i,L}$ and $S_{i,M}$ with $1/p$ classes for each proxy and each firm. Combine the proxy scores to obtain a final score of financial constraints (different types combinations are possible). The simplest is just the sum of scores: $S_i = S_{i,L} + S_{i,M}$	Availability of data; Can be used as dependent or explanatory variable; Firm-specific and time-varying.	Comparability across classes; Non-monotonic relationships between proxies and financial constraints.	Musso and Schiavo (2008) Silva (2011)

Appendix Table 1 – Methodologies used to assess financial constraints *(cont.)*

Measures	Data	Strategy	Typical regression\question used	Advantages	Disadvantages	Example
c) Other						
	BS	Mimic CFS types of measures through: i) time averages weighted by CF; ii) estimating firm-specific slopes of a typical CFS regression.	$HH_i = \sum_{t=1}^{n}\left[\frac{\left(\frac{CF}{K}\right)_{it}}{\sum_{t=1}^{n}\left(\frac{CF}{K}\right)_{it}} * \left(\frac{I}{K}\right)_{it}\right] - \frac{1}{n}\sum_{t=1}^{n}\left(\frac{I}{K}\right)_{it}$ or $\left(\frac{I}{K}\right)_{it} = \propto_i Q_{it} + EVP_i\left(\frac{CF}{K}\right)_{it} + \varepsilon_{it}$ where β_i is the firm-specific index of financial constraints.	Easy to compute (HH); Availability of data; Can be used as dependent or explanatory variable; Firm-specific.	Not time-varying; Assumes CFS effectively measures constraints; Fails to control for investment opportunities and other relevant variables (HH); Requires different estimation techniques (EVP).	HH (2009) EVP (2008)
Credit Ratings (Ordinal)	Ratings	Match firm information with rating.	Use the credit rating available for each firm The rating represents the markets' perception of a firm's risk. Lower ratings signal higher financial constraints.	Availability data; Represents the market's perception; Can easily be used as dependent or explanatory variable; Firm-specific and time-varying.	Relies on credit agencies; Small and biased samples (only few firms are rated).	Bottazzi et al. (2008)
Proxies (Continuous)	BS	Use one of established proxies in the estimation.	Common proxies: CF; Cash stocks; Size; Age; Export; R&D intensity; Leverage; Dividend policy; Group membership, Ownership, among others (Chapter III).	Simplicity; Availability of data; Can easily be used as dependent or explanatory variable; Firm-specific and time-varying.	Weak correlation; Relies on previously devised relationships; Non-monotonic relationships between the proxy and financial constraints.	

Notes: BS stands for firms' balance sheet information, FM for financial markets information, MDA for multiple discriminant analysis and CFS for cash-flow sensitivity. CF is cash-flow, K is capital, I is investment, Q is Tobin's Q or an appropriate proxy (such as average Q), C is real cash-flow, B is debt, A is total assets, Y is sales, OM is operating margin, i and t under scripts stand for individual (firm) and time, ε is an error term.