The Impact of the Data Protection Regulation in the E.U.

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Executive Summary

We evaluate the impact of the proposed EU Data Protection Regulation on small and medium sized enterprises ("SMEs"), with a specific focus on job growth and business creation. We find that information-intensive SMEs are likely to incur significant costs in complying with the EU Data Protection Regulation and that these costs are likely to have economy-wide impacts.

As has been noted by others, compliance with these new rules will impose a number of costs on SMEs including the need to hire additional personnel, purchase new IT software, and consult with data protection authorities in advance of certain new projects. Furthermore, rules limiting the use of personal information, particularly in advertising, will impact all businesses engaged in targeted consumer marketing. Given that SMEs increasingly rely on online advertising to drive revenue growth, the economic impact is likely to be substantial and widespread.

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To determine the impact of the EU Data Protection Regulation, we first estimated the direct costs likely to be incurred by SMEs. Each article within the regulation was reviewed and only articles deemed to have significant costs or benefits were selected. Where possible, we used the EC Impact Assessment on the reform of the data protection regulatory framework report as a starting point for our calculations. Baseline costs and benefits were reviewed and modified based on third party research to estimate the cost of each article group to an SME. Using this methodology, we estimate that the average SME in the EU can expect its annual costs to increase by between approximately €3,000 and €7,200, depending on the industry in which that SME is located; this represents between 16 and 40 percent of current annual SME IT budgets.

Based on these estimates, we then simulated the impact of the EU Data Protection Regulation on business and job creation. Our simulation shows a substantial negative impact of the introduction of the EU Data Protection Regulation on business creation and employment. The reduction in employment and the number of operating firms is most severe in those sectors where compliance with the EU Data Protection Regulation will imply higher operating fixed costs for firms. For example, the effect is stronger in sectors where a large fraction of firms will be subject to the designation of a DPO. Among the industrial sectors that we consider, the one most severely affected by the regulation is the Real Estate and Business Activities sector, which experiences a decline in employment of between 0.2 and 0.6 percent a reduction in the number of market competitors of between 3 and 5 percent.

1 Introduction

Policymaking and regulation at the centralized level of a union of countries such as the European Union requires a correct balance between the benefits of the harmonization of policies and the internalization of cross-country spillovers and the costs related to heterogenous preferences of the countries that take a decision in common. This trade-off is at the basis of any cost-benefit analysis concerning decisions centralized at a union level (Alesina *et al.*, 2005). An interesting example is emerging in the debate on the new European regulation on data protection, which lays down rules relating to the protection of individuals with regard to the processing of personal data and represents an attempt to harmonize different national regulations introducing a number of new requirements to business and a new complex regulatory framework.

This paper contributes to the debate by evaluating the impact of the proposed EU Data Protection Regulation[2] on small and medium sized enterprises (SMEs) with a specific focus on the compliance costs associated to the direct application of the new regulation and to the indirect effects on job growth and business creation. Compliance with the proposed regulation poses a number of challenges for firms. The first challenge concerns the design of systems and procedures for data protection. In particular, under the proposed regulation, firms must develop data management systems that allow for greater flexibility such as the right to data portability (i.e. the right to transfer data from one electronic processing system to another), as well as the right of data subjects (identified natural persons) to obtain personal data in a structured, commonly used electronic format. In addition, data protection impact assessments must be incorporated into IT project management so that firms can identify and mitigate specific risks associated with data the processing of personal data. Another major challenge is the designation of a data protection officer (DPO). This obligation will apply to all public sector bodies and enterprises with 250 or more employees, as well as to firms whose core activity involves the monitoring of data subjects. The controller (the entity that determines the purposes, conditions and means of the processing of personal data) and the processor (the entity that actually processes personal data on behalf of the controller) will be subject to different obligations and, possibly also to different supervisory authorities (which still can create useless duplication costs),[3] and

[2] See http://ec.europa.eu/justice/data-protection/document/review2012/com_2012_11_en.pdf.

[3] Problems of duplication are reduced in many cases with this new regulation, but not for entities that happen to be both controllers and processors. A clearer distinction between the status of controller and the status of processor would be useful to identify which supervisory authority has jurisdiction. The controller should

will have to ensure that the DPO is involved in all issues that relate to the protection of personal data and maintain detailed documentation on all processing operations. Substantial costs of the regulation will be associated also with the compulsory notification of any data breach in 24 hours to the supervisory authority and without undue delay to the data subjects, which is extremely demanding, especially for non-serious data breaches. Together, these and several additional articles will result in additional added costs for firms, depending on the type and amount of information processed.

However, it should be noted that some of the proposed articles within the legislation will reduce costs for firms. For example, the "one-stop-shop" principle reduces some compliance costs ensuring that data controllers and data processors that operate across countries are typically regulated by a single supervisory authority, though this is not the case for companies that happen to be both data controllers and data processors in different countries (for instance cloud computing providers). Moreover, binding corporate rules will potentially reduce legal ambiguity surrounding data transfers, and joint operations on the part of supervisory authorities will reduce bureaucratic burdens. There is an important effort in promoting secure data transfers, which is crucial for the development and the diffusion of cloud computing; however more needs to be done, for instance supporting and standardizing a stronger and more transparent protection of data that are transfered outside the E.U. for cloud computing services. Both the costs and the benefits of the proposed regulation have been taken into consideration in our analysis. Finally, it is important to remark that we did not take in consideration the expected costs associated with the administrative sanctions, whose homogenous application to all companies (without distinction between intentional and unintentional harm) may create unfair and disproportionate burden on SMEs that will not comply with the regulation for reasons different from repeated negligence.

Our estimates of the average expected costs and benefits of compliance for SMEs suggest that the net costs are large and, most of all, larger than what could be expected for instance from the evaluation of the Impact Assessment prepared by the European Commission. However, beyond these direct costs, there are indirect macroeconomic costs that are more difficult to measure: these are due to the impact that these additional costs have on the process of business creation and job creation, and they are the main focus of this work.

We simulate the impact of the new regulation on the process of busi-

be the entity that determines the reason why data are processed and the processor the entity that determines how the same data are actually processed.

ness and job creation using a dynamic stochastic general equilibrium model with endogenous market structures and search frictions in the labor market.[4] The production structure of the final goods is based on Etro and Colciago (2010), augmented with a description of the labor market with search frictions and endogenous unemployment as in Colciago and Rossi (2010).

The economy features four types of firms. The producers of intermediate goods, the final good producer, the producers of IT material and the providers of data management services. The intermediate goods industry, features many sectors where the dynamics of the number of market competitors is endogenous. In this industry firms face a sunk cost of entry in the market, which they decide to incur if sufficiently compensated by the expectation of future profits. Goods are produced using labor and IT which can be interpreted as hardware but also as the stock of data stored at each firm.

The industry producing IT adopts physical capital as the only input, while in the industry providing data management services the input is labor. The labor market is characterized by frictions as in the literature on job search and matching (see Mortensen and Pissarides, 1994; Merz, 1995; Andolfatto, 1996; Pissarides, 2000). In the intermediate goods industry, both new firms and incumbent firms need to hire workers from the pool of unemployed agents who are looking for a job and to set up a stock of IT before starting production. Similarly, the industry providing data management services faces labor market frictions.

The model counterpart of the introduction of the EU Data Protection Regulation data protection legislative framework can be is illustrated in the following as follows. In order to mimic the need to install a DPO, we assume that the intermediate goods producers will incur a period fixed cost. The designation of a DPO can be regarded as a fixed cost since it does not scale with the size of the firm or the number of data records. The development of a data management systems is, instead, a variable cost for the firm, which depends on the amount of data processed, or more generally on the number of projects currently developed at a firm. For this reason, the model counterpart of this requirement will be an increase in the units of data management services necessary to deal with each unit of information involved in the production process.

Since the introduction of the EU Data Protection Regulation data protection act represents a permanent shock to the cost function of firms, we compute numerically a transition from the pre-reform steady state to the post reform steady state of the economy we have just described.

[4]For a survey of the literature on endogenous market structures and its applications see Etro (2013).

We consider two possible scenarios. A baseline case where the increase in costs for the firms is calibrated according to the estimates that we provide in Section 2, and an alternative scenario where the increase in costs represents half of the estimated value.

Our simulation shows a substantial negative impact of the introduction of the EU Data Protection Regulation data protection legislative framework on business creation and employment under both scenarios. Among the industrial sectors that we consider, the one most severely affected by the regulation is the Real Estate and Business Activities sector. The latter displays a reduction in the long-run sectoral employment from 0.2 to 0.6 percent, together with a reduction in the number of market competitors ranging from 3 to 5 percent. The reduction in employment and the number of operating firms is particularly severe in those sectors where compliance with the EU Data Protection Regulation data protection act will imply higher operating fixed costs for firms. For example, the effect is stronger in sectors where a large fraction of firms will be subject to the designation of a DPO. As a result, policymakers should promote fiscal incentives for those firms which will be subject to high implementation costs, with particular reference to those subject to the DPO requirement.

Notice that the empirical literature supports the view that firms dynamics is an important factor to take into account when explaining the dynamics of job creation and hence unemployment. Haltiwanger *et al.* (2010), on the basis of U.S. manufacturing data between 1972 and 1986, estimate that 25 percent of annual gross job creation is due to the creation of new establishments. Similarly, Jaimovich and Floetotto (2008) focus on employment data at the establishment level; they estimate that the average fraction of quarterly job-gains (losses) that can be explained by the opening (closing) of establishments is about 20 percent. Therefore, our analysis of job creation derived from business creation is well founded in the macroeconomic empirical literature.

The remainder of the paper is organized as follows. Section 2 estimates the cost impact of the compliance with the new rules. Section 3 provides a non-technical summary of the modelling approach and of the main results. Section 4 develops the analysis at a more technical level. The reader not interested in technical details can safely skip section 4. Section 5 concludes.

2 The Effects of the Data protection Legislative Framework and its Costs

The proposed EU Data Protection Regulation contains a number of articles and clauses that will significantly impact small and medium sized

enterprises (SMEs) in the EU.[5] We provide here a brief descriptions of the most relevant, for our analysis, articles of the data protection regulation.

Articles 5, 19, 20: Principle of minimization of data processing and right to object to profiling.

Personal data must be processed for specified, explicit and legitimate purposes only and limited to the minimum necessary in relation to their purposes. The data subject has the right to object free of charge to data processing for purposes of direct marketing or targeted advertising.

Article 7: Conditions for consent.

Clarifies the conditions for consent to be valid as a legal ground for lawful processing: the controller bears the burden of proof for the data subject's consent to data processing and this consent can be withdrawn at any time.

Article 8: Processing of personal data of a child.

Processing of children's' personal data in relation to information services offered directly to them.

Article 11: Principle of transparency of information and communication.

The controller shall have transparent and easily accessibly policies for processing personal data and shall provide information related to this data to the data subject.

Articles 12, 17, 18: Right to data portability and right to be forgotten.

Right to receive information within a month and free of charge for data subjects, right to obtain erasure of personal data, right to data portability, i.e. to transfer data from one electronic processing system to and into another, and to obtain data in structured, commonly used electronic format.

Article 22: Responsibility of the controller.

Obligation of the controller to comply with the Regulation by way of adoption of internal policies and mechanisms for ensuring compliance, including keeping the necessary documentation, implementing the data security requirements, performing a data protection impact assessment, complying with the requirements for prior authorization of the supervisory authority and designating a DPO.

Articles 23, 33: Data protection by design and by default and the Data protection impact assessment (DPIA).

[5] "SMEs are defined by the European Commission as having less than 250 persons employed." Eurostat Small and Medium Sized Businesses, accessed Nov 20, 2012, http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/special_sbs_topics/small_medium_sized_enterprises_SMEs.

Obligations of data controller from principles of data protection by design and by default: data protection by design involves taking data protection into account in the design of systems and procedures; data protection by default requires that mechanisms are established by the data controller to ensure a minimum amount of processing of personal data. Requirement that data controllers must undertake a DPIA (data protection impact assessment) on data processing which presents specific risks to the rights and freedoms of data subjects by virtue of their nature, scope or purposes (for instance monitoring publicly accessible areas, especially when using optic-electronic devices on a large scale).

Articles 24, 25: Joint controllers; Representatives of controllers not established in the Union.

When a controller processes data jointly with others, the joint controllers shall determine their respective responsibilities for compliance under the Regulation. Where the Regulation applies to their processing activities, controllers not established in the Union must designate a representative in the Union.

Articles 28, 35, 36, 37: Designation of the data protection officer (DPO); Position of the data protection officer; Tasks of the data protection officer. Documentation.

Mandatory data protection officer for public sector bodies and enterprises with 250 or more employees, and for any SMEs with core activities consisting of processing operations which, by virtue of their nature, their scope and or their purposes require regular and systematic monitoring of data subjects. The controller or processor shall ensure that the DPO is involved in all issues that relate to the protection of personal data and provide staff, premises, equipment and any other resources. The controller must maintain all documentation for processing operations (very detailed documentations required); there are exceptions for certain parties. The tasks of the DPO include, for example, to inform and advise the controller or processor of their obligations, monitor the implementation and application of the policies and to document this activity, monitor the documentation, notification and communication of personal data, the performance of the DPIA and the response to requests from the supervisory authoroty.

Articles 31, 32: Notification of Data Breach:

In the case of a personal data breach, the data controller must notify the supervisory authorities within 24 hours and data subjects "without undue delay."

Article 34. Prior authorization and prior consultation.

Specific cases in which authorization by and consultation of the supervisory authority is mandatory prior to processing.

Article 43: Transfers by way of binding corporate rules (BCR).

A supervisory authority shall approve binding corporate rules under certain conditions: BCR specify the structure of the group, the data transfers (purposes, data subjects affected, third countries, etc.), legal binding nature of data transfers, data protection principles, etc. The Commission may specify the format and procedures for the exchange of information between controllers, processors and supervisory authorities for BCR.

Articles 55, 56, 57, 58, 76: Mutual Assistance, Joint operations of supervisory authorities; Consistency mechanism. Opinion by the European Data Protection Board. Common Rules for court proceedings.

Supervisory authorities will co-operate and provide mutual assistance concerning data requests from one authority to another. They cannot charge a fee for complying with a request. In order to step up cooperation and mutual assistance, the supervisory authorities shall carry out joint investigative tasks, joint enforcement measures and other joint operations, in which designated members or staff from other Member States' supervisory authorities are involved. For the purposes set out in Article 46(1), the supervisory authorities shall cooperate with each other and the Commission through the consistency mechanism as set out in this section. Member States must ensure rapid court actions. Common rules include the right of the data subject to be represented before the courts, the right of supervisory authorities to engage in legal proceedings and the information of a court's parallel proceedings in another Member State."

Article 77: Right to compensation and liability.

Sets out the right to compensation and liability from the controller for any person who has suffered damage as a result of an unlawful processing operation or an action incompatible with the Regulation.

Article 79: Administrative sanctions.

Each supervisory authority must sanction the administrative offences listed, imposing fines up to maximum amounts, with consideration of circumstances of each individual case.

Compliance with these new rules will impose a number of costs on SMEs including the need to hire additional personnel, purchase new IT software, and consult with data protection authorities in advance of certain new projects. Furthermore, rules limiting the use of personal information, particularly in advertising, will impact all business engaged in targeted consumer marketing. Given that SMEs increasingly rely on online advertising to drive revenue growth, the economic impact will be

substantial and widespread; for example, a survey of 453 firms in the UK estimated that the proposed legislation could cost the UK economy £47 billion, with the costs concentrated mostly amongst SMEs.[6] However, it should be noted that the regulation also contains articles that aim to reduce costs by, for example, making it easier for businesses to transfer personal data within the EU. Our analysis estimates both the expected annual costs and benefits associated with most impactful articles in the proposed proposed legislation for a typical SME across five industrial categories.[7] These industrial categories are:

- Transport, storage, and communications
- Hotels and restaurants
- Real estate, renting, and business activities
- Wholesale and retail trade; repair of motor vehicles and motorcycles
- Manufacturing

In what follows, we first describe the methodology used to estimate costs and benefits. We then provide ao detailed descriptions for three article groups expected to have a substantial impact on SMEs in order to illustrate this methodology. We conclude by summarizing the cost impact for all articles.

To calculate the total cost of the proposed legislation, we first estimated the annual costs and benefits of individual articles within the legislation. Each article within the regulation was reviewed and only articles deemed to have significant costs or benefits were selected. The selected articles were then grouped together based on a common theme or based on costs that would be shared across the group of articles. Costs and benefits were then calculated for each article group and totaled. Where possible, we used the EC Impact Assessment on the reform of the data protection regulatory framework report (commissioned by the EC to assess the impact of the EU Data Protection Regulation) as a starting point for our own cost calculations. Baseline costs and benefits were reviewed and modified based on third party research to estimate the cost of each article group to an SME. For articles that were not referred to in the EC Impact Assessment report, we used the International Standard Cost Model methodology together with external research to estimate costs. Costs were then separated into fixed and variablecosts, since these costs have different economy-wide impacts. Finally, the costs were summed across all article groups and presented as a total cost and as a percentage of annual IT spend for a typical SME. Presented be-

[6] *Putting a price on direct marketing 2012*, Direct Marketing Association (UK) Ltd, July 2012

[7] Industrial categories selected from the "Classification of Economic Activities in the European Community," (NACE rev 1.1) Final Version, 2002.

Number of enterprises in EU	Micro: 18,040,000	Small: 1,350,000	Medium: 210,000
% who are data controllers	50%	50%	50%
% requiring validation	0.10%	0.10%	0.10%
Number of data controllers	9,020	675	105
Risk processing operations (annual)	1	1	1
External hours required	4	4	4
Total Charges to firm	€1,000	€1,000	€1,000
Total cost	€9,020,000	€675,000	€105,000

Figure 1: DPO Cost Estimates from EC Impact Assessment

low are three article groups that illustrate the application of our cost estimation methodology.

2.1 Results for the main Articles

Costs for Documentation and the Data Protection Officer: Articles 28, 35, 36 and 37

Articles 35, 36, and 37 relate to the duties of the Data Protection Officer (DPO). Under the proposed regulation, an enterprise or an organization employing more than 250 persons, or one that is processing personal data as part of their core activities, must designate a data protection officer. Article 35 describes the employment requirements of the DPO, while articles 36 and 37 detail the tasks and duties of the DPO, which include the monitoring and implementation of data protection policies, informing the data controller of obligations under the legislation, and communicating with data protection authorities.[8]

In estimating the costs of the DPO, we first assumed that the cost of hiring a DPO was a fixed cost since it does not scale with the size of the firm or the number of data records held by the firm; it only depends on whether a firm meets the criteria set forth in article 35.

The EC Impact Assessment report provides an estimate for the number of SMEs in the EU that would require a data protection officer and the associated costs. The report assumes that rather than hiring a full-time DPO, firms would contract out the position on a per hour basis. The values estimated in the report are provided in Figure 1.

The EC Impact Assessment provides no formal justification for any of the underlying values used to calculate total cost. For example, the report assumed that "only 0.1% of SME who are data controllers require validation in terms of processing risky data," yet no third party data or

[8]EU General Data Protection Regulation, p. 66

survey data cited were cited.[9] The report explained that only four hours of work per year was required by citing the fact that many of the DPO duties could be fulfilled by existing staff. However, this assumes the firm is not currently fully utilizing its staff and that there are no costs associated with assigning more work to existing employees. Furthermore, the legislation states that the DPO must be independent of IT management and the use of existing staff could raise conflicts of interest.[10]

Based on our analysis of the DPO duties contained in articles 35-37, four hours is a large underestimate of the time required. Duties of the DPO include the training of staff on data protection policies, data security assessments, investigation of data breaches, and the signing of data protection impact assessments. Estimates for the time required for each of these DPO responsibilities are provided below

- The training of staff at most SMEs will require one week since in addition to new employees, existing employees would also be expected to receive an annual refresher course on data processing compliance. This estimate includes the time required to prepare and update training materials.
- DPOs will take one week or longer to review a firm's data processing operations and ensure compliance with existing data protection regulations.
- Investigation of a data breach will require two to three weeks minimum since the DPO must not only investigate the breach, but also be a point of contact for the data protection authority.
- DPOs will require a minimum of one week to sign off on security protocols and communicate any issues with senior management as part of the data protection impact assessment.

Considering the estimates above, together with data provided in the 2010 IAPP Europe Data Protection Professional's Role, Function and Salary Survey, we conservatively estimate these tasks to take a minimum of 100 hours per year for a typical data controller/processor (and likely even more for a data intensive firm).[11]

To calculate industry-level costs, we utilize a bottom-up approach by first calculating the cost for a typical SME classified as a data controller or a data processor, and then estimating the percentage of firms requiring a DPO in each of the five industrial sectors. The values from our analysis are provided in Figure 2.

[9] EC Impact Assessment, p.209.

[10] EC Impact Assessment, p.209.

[11] "The 2010 IAPP Europe Data Protection Professional's Role, Function and Salary Survey," https://www.privacyassociation.org/media/pdf/knowledge_center/IAPP_2010EuropeSalarySurvey_final.pdf.

	Enterprise Size		
	Micro	Small	Medium
Cost per hour for DPO	€250/hour	€250/hour	€250/hour
External hours required for DPO	100	200	200
Total charges to firm for Articles 35,36,37	€25,000	€50,000	€50,000

Figure 2: Revised DPO Cost Estimates (per firm)

To calculate the cost in each of the five industries of interest, the percent of firms requiring a DPO in each industry is estimated using Eurostat industrial subsector data. For example, within the twenty-eight industrial subcategories listed under "Transport, storage and communications," the only subcategory identified as needing a DPO under the new regulation is "Data processing, hosting and other related activities." SMEs in this subcategory represent two percent of all SMEs in this industry.

Documentation: Article 28

Article 28 states that each data controller must maintain documentation of all processing operations under its responsibility including documentation about the DPO, categories of data subjects, and recipients of personal data. Documentation costs vary by the number of processing operations, number of data subjects, and the number of recipients of personal data. The larger the number of records stored or processed, the more documentation will be required. The EC Impact Assessment does not explicitly assess the impact of Article 28; most of Article 28's costs may, however, be included in assessments of the cost for a DPO. These costs should be considered variable costs since the documentation increases as the number of records increases. The total cost assessment for these articles is provided below.

According to the PwC Information Security Breaches Survey 2010, 67% of small organizations reported having a "formally documented information security policy".[12] Although the information security policy differs slightly from the clauses in Article 28, it is a suitable proxy for establishing the baseline for Article 28. Let us assume that, there is sufficient documentation required to hire 1/2 of a full-time employee at a cost of €50,000 per year for small and medium sized firms and 1/8th of an employee's time for mirco firms. Of the firms that could be impacted, we know that 67% are already in compliance with this article.

[12]Data was for firms in the U.K. See Appendix for details.

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€594
Hotels and restaurants	€0
Real estate, renting and business activities	€3,017
Manufacturing	€0
Wholesale and retail trade	€0

Figure 3: Documentation and the DPO Estimates Across Five Industrial Sectors (per firm)

Therefore:

$$\text{expected compliance cost}_{\text{SMEs}} = (100 - 67\%) \times 1/2 €50,000 = €8,250$$

$$\text{expected compliance cost}_{\text{micro firms}} = (100 - 67\%) \times 1/8 \times €50,000 = €2,062$$

By expanding the results for Articles 28, 35-37 to SMEs across the 5 industrial sectors analyzed in the EU, we estimate the impact from Articles 28, 35-37 to be approximately €1.7 billion.[13] The EC Impact Assessment report estimated the total impact of the DPO segment of the legislation to be €9.8 million. Though our estimate is several orders of magnitude higher than the EC's estimate, it should be noted that a survey of businesses cited earlier suggests the impact of the regulation on the UK alone to be at least £47 billion.[14] Given that the costs associated with the DPO make up a significant portion of total costs in our analysis, our estimate more closely aligns with what businesses believe the total cost impact will be, compared to the EC's estimate.

Personal Data Processing and Profiling: Articles 5,19 and 20

Articles 5,19, and 20 were grouped together since they all impact the ability of firms to engage in data profiling. Article 5 describes principals related to personal data processing and in particular the data minimization principle which states personal data should be "limited to the minimum necessary".[15] Article 19 describes data subjects' right to object stating "the data subject has the right to object, on request and free of charge, to the processing of personal data relating to him which the controller anticipates being processed for the purposes of direct marketing".[16] Finally, Article 20 describes a data subject's right to

[13] This figure is calculated by taking the average SME cost and multiplying it by the total number of SMEs for each of the 5 industrial sectors analyzed in the EU.

[14] "Putting a price on direct marketing 2012," Direct Marketing Association (UK) Ltd, July 2012.

[15] EU General Data Protection Regulation p. 44

[16] EU General Data Protection Regulation p. 53

not be subjected to profiling which includes measures "intended to evaluate or predict in particular the natural person's performance at work, economic situation, location, health, personal preferences, reliability or behavior".[17]The costs associated with these articles largely result from lost revenue due to a firm's inability to engage in targeted advertising and other direct marketing activities that require profiling. These costs vary depending on the degree of targeted advertising a firm engages in and are, therefore, classified as variable costs.

While the EC Impact Assessment does not provide an explicit cost to firms associated with these articles, the Direct Marketing Association (UK) published a report titled "Putting a price on direct marketing 2012," which explicitly calculated the costs to SMEs in the UK due to these articles.[18]The study surveyed 600 UK based companies (no public sector firms) of which a majority were SMEs. The purpose of the study was to understand the number of firms engaged in direct marketing activity and the impact of pending EU legislation on these firms. The study found that because the definition of personal data detailed in the legislation could be interpreted as including IP addresses, it would limit web analytics and most personal services. "The impact of the Regulation would be most strongly felt by SMEs which typically employ 250 or fewer people. Of the companies polled – the majority of which were SMEs – 22% stated that the average likely cost to their businesses would be just over £76,000 – equivalent to 11% of their turnovers. This translates to an estimated potential cost of £47 billion to all UK businesses."[19] Since the survey likely included a few large firms, we conservatively assumed that 20% of SMEs estimated their cost to be £76,000 or €94,000.[20] Therefore:

$$Exptected\ Cost\ to\ SME = 20\% \times €94,000 = €18,800$$

If we assume costs for firms in the rest of the EU are similar to costs in the UK, then the cost of Articles 5,19, and 20 is equal to €18,800 per firm.

The percent of firms impacted across the 5 industrial sectors depends on the degree to which firms in each sector collect personal data, and engage in direct marketing. By analyzing the industrial sub-categories

[17]EU General Data Protection Regulation p. 55

[18] "Putting a price on direct marketing 2012" Direct Marketing Association (UK) Ltd, July 2012

[19] "Putting a price on direct marketing 2012" Direct Marketing Association (UK) Ltd, July 2012, p 13

[20]Based on conversion rate of 1 pound to 1.24 euros. Yahoo Finance http://finance.yahoo.com/q?s=GBPEUR=X Accessed October 15, 2012

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€565
Hotels and restaurants	€2,049
Real estate, renting and business activities	€694
Manufacturing	€0
Wholesale and retail trade	€1,366

Figure 4: Personal Data Processing and Profiling Cost Estimates Across Five Industrial Sectors (per firm)

listed under each sector, we determined which of the subsectors are likely to contain firms engaged in e-commerce. In addition, Eurostat data suggests that approximately 11% of SMEs are engaged in e-commerce of some kind.[21] Using this data we have the following formula:

$$\begin{aligned} &Average\ Expected\ Cost\ per\ Firm_{per\ sector} \\ &= 11\% \times €18,800 \times Percent\ of\ firms\ impacted_{per\ sector} \end{aligned}$$

Listed below are the compliance costs associated with Articles 5,19 and 20.

Personal Protection by Design and Data Protection Impact Assessment: Articles 23 and 33

Article 23 and 33 were grouped together since they both relate to process changes firms must make in order to fulfill compliance. Article 23 involves taking protection into account in the design of systems and procedures. Article 33 introduces the obligation of controllers and processors to carry out a data protection impact assessment prior to risky processing operations. Since these costs can change depending on the number of projects the firm initiates a year, they are classified as variable costs.

The EC Impact Assessment admits the DPIA costs are very "context-specific,"[22] and does not provide a single expected value for costs. It instead provides example for the type of costs that a firm may experience (summarized below).

- Small scale DPIA - Commercial and innovative uses of sensitive data: Total Cost = €14,000
- Medium scale DPIA - Location based data and services: Total Cost = €34,000

[21] Eurostat Data: Percent of Enterprises selling via Internet and/or networks other than Internet. Accessed on October 5 2012 http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes

[22] EC Impact Assessment PDF, p. 215.

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€1,056
Hotels and restaurants	€688
Real estate, renting and business activities	€2,236
Manufacturing	€0
Wholesale and retail trade	€1,462

Figure 5: Personal Protection by Design and Data Protection Impact Assessment Cost Estimates Across Five Industrial Sectors (per firm)

- Large scale DPIA - Security and biometrics: Total Cost = €149,000

In assessing the underlying assumptions across the three example provided in the EC Impact Assessment, we noted some inconsistencies, including the fact that the auditing task takes 10 hours in all three examples (regardless of firm size) and the costs for engaging stakeholders increase seven-fold between the small and large scale DPIA. However, to be conservative, we have used the costs provided by the EC Impact Assessment without modification. We assigned one of these costs (small, medium, or large) for firms in each of the industrial subsectors likely to be impacted by the articles. For example in the "Transport, storage and communication" industrial sector, firms in the "Passenger air transport" and "Wireless telecom activities" subsectors are likely to process personal data and will therefore be impacted by the legislation whereas firms in "Freight rail transport" subsector will not be impacted. The final compliance costs associated with Articles 23 and 33 are presented below.

2.2 Results for other Articles

In this section we present brief summaries of the remaining articles in the EU Data Protection Regulation estimated to have significant costs or benefits. For a full description of the underlying calculations and the total cost impact, see Appendix C.

Notification of Data Breach: Articles 31, 32

Articles 31 and 32 state that in the case of a personal data breach, the data controller must notify the supervisory authorities within 24 hours and data subjects "without undue delay." Substantial costs will be associated also with this articles, whose implementation is extremely demanding, especially for non-serious data breaches.The EC Impact Assessment estimated 1,000 data breaches per year in the EU at a cost of €20,000 each. Based on data from a PricewaterhouseCoopers survey for

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€542
Hotels and restaurants	€546
Real estate, renting and business activities	€1,194
Manufacturing	€0
Wholesale and retail trade	€1,105

Figure 6: Notification of Data Breach Cost Estimates Across Five Industrial Sectors (per firm)

the EU titled "Information Security Breaches Survey"[23] the average median number of data breaches per year for an SME that processes data was 14. The same survey provided figures for reputational damage to these breaches, and based on these figures we estimated the incremental reputation damage to be in the range of €625 to €2,500. The additional cost of responding to the incident was estimated to be €100. Averaging these costs across the total number of micro, small, and medium sized firms, the average cost of compliance for an SME in each industrial sector is provided below.

Conditions for Consent: Article 7

Article 7 clarifies the "conditions for consent to be valid as a legal ground for lawful processing." The EC Impact Assessment provides a baseline cost for "initially collecting, compiling and subsequently reproducing and providing the information to data subjects every time personal data are collected, including costs of legal validation." The report estimates 4 hours of additional work every 3 years which will cost approximately €67 per year for a SME. The EC Cost Impact assessment assumes there will be no scenarios where a data controller will have to introduce new consent forms. Given the article mandates "explicit" consent, it is likely that many firms will have to introduce new consent forms asking for explicit consent. We estimated that the additional clerical and legal validation costs stemming from this article to be €633 per year for an SME. Averaging these costs across the total number of micro, small, and medium sized firms, the average cost of compliance for an SME in each industrial sector is as follows.

Processing Personal Data of a Child: Article 8

Similar to Article 7, this article discusses specific rules and conditions for processing personal data belonging to a child. Specifically, "the processing of personal data of a child below the age of 13 years shall

[23]Information Security Breaches Survey 2010 technical report, Pricewaterhousecoopers, April 28, 2010

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€173
Hotels and restaurants	€627
Real estate, renting and business activities	€212
Manufacturing	€0
Wholesale and retail trade	€418

Figure 7: Conditions for Consent Cost Estimates Across Five Industrial Sectors (per firm)

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€43
Hotels and restaurants	€0
Real estate, renting and business activities	€30
Manufacturing	€0
Wholesale and retail trade	€124

Figure 8: Processing Personal Data of a Child Cost Estimates Across Five Industrial Sectors (per firm)

only be lawful if and to the extent that consent is given or authorised by the child's parent or custodian." The EC Impact Assessment does not provide an estimate for this article. We assumed that a firm experiences the same compliance costs as those experienced with Article 7 but the number of firms impacted is smaller. Averaging these costs across the total number of micro, small, and medium sized firms, the average cost of compliance for an SME in each industrial sector is provided below.

Data Portability and the Right to be Forgotten: Articles 12, 17, and 18

Articles 12, 17, and 18 grant data subjects the "right to withdraw and transfer data to other controllers" and to "request that organizations delete personal information."[24] The EC Impact assessment does not specifically estimate a cost for this article and instead provides a baseline cost of €67 per year for all additional clerical work (see Conditions for Consent: Article 7). Given that most SMEs do not currently have the capability to transfer data between incompatible software systems, there will be an estimated IT cost of €2,000 as well as a small cost of processing a user's request (approximately €10-€50 per request [25]). Based on a range of estimates of user requests from various UK sources, we estimate the average data controller to field between 50 and 5,000 re-

[24] EC Impact Assessment, PDF p. 69.

[25] UK Data Protection Act of 1998, http://www.ico.gov.uk/for_the_public/personal_information/how_manage/access_info.aspx

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€144
Hotels and restaurants	€98
Real estate, renting and business activities	€312
Manufacturing	€0
Wholesale and retail trade	€282

Figure 9: Data Portability and the Right to be Forgotten Cost Estimates Across Five Industrial Sectors (per firm)

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€92
Hotels and restaurants	€103
Real estate, renting and business activities	€237
Manufacturing	€0
Wholesale and retail trade	€219

Figure 10: Transparent Information and Communication Cost Estimates Across Five Industrial Sectors (per firm)

quests (depending on size of the SME). Averaging these costs across the total number of micro, small, and medium sized firms, the average cost of compliance for an SME in each industrial sector is provided below.

Transparent Information and Communication: Article 11

Article 11 ensures "individuals are well informed in a transparent way" concerning how their data is utilized. Furthermore, it mandates the "controller shall have transparent and easily accessibly policies for processing personal data and shall provide information related to this data to the data subject."[26] The EC Impact Assessment provides a cost estimate of €100 (based on 2 hours of work every 2 years) and estimates that 8,821,638 SMEs would be impacted. This estimate seems low given the need to deploy new corporate policies which may also require legal advice, and updates to websites.[27] Averaging our estimated costs across the total number of micro, small, and medium sized firms, the average cost of compliance for an SME in each industrial sector is provided below.

Prior Authorization and Prior Consultation: Article 34

Article 34 stipulates the data controller "shall consult the supervisory authority prior to the processing of personal data in order to ensure the compliance of the intended processing." The EC Cost Impact

[26] EC Impact Assessment, PDF p. 120.

[27] Based on Global PwC Survey, 53% of firms globally have a written privacy policy in place and published on external website

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€65
Hotels and restaurants	€73
Real estate, renting and business activities	€168
Manufacturing	€0
Wholesale and retail trade	€156

Figure 11: Prior Authorization and Prior Consultation Cost Estimates Across Five Industrial Sectors (per firm)

Assessment calculates the "cost of notifications of processing activities by data controllers" as savings to be realized by the implementation of the new legislation (estimated at €200 per controller).[28] However, Article 34 clearly provides evidence that not all these notifications will be eliminated since some firms will still have to consult with supervisory authorities in certain circumstances. We assumes 50% of firms who declared processing to a DPA will still experience one instance of additional consultation with a supervisory authority due to Article 34, which means 14.6% of data controllers will be impacted. The costs of compliance include the cost of informing the supervisory authority and potential delays in project timelines was estimated at €1,489 per data controller. Averaging these costs across the total number of micro, small, and medium sized firms, the average cost of compliance for an SME in each industrial sector is provided below.

Transfers by Way of Binding Corporate Rules: Article 43

Article 43 stipulates that "a supervisory authority shall approve binding corporate rules under certain conditions described by this Article." The EC Impact Assessment states that in general Articles 40-44 will "have a positive impact both on relations with third countries and on non-EU businesses and will boost the competitiveness of EU economic operators internationally, as they will find it easier to transfer personal data outside of the EU." While we agreed that in general this Article will lead to benefits, we believe there will be costs associated with point 4 of the article which states all data controllers must adopt a uniform format for transfer of data. Based on surveys from the EC Impact Assessment, approximately 24% of SMEs reported transferring data within the EU. We estimated the savings associated with this article to be €50,000 for a data controller and subtracted €5,000 for the cost of complying with point 4 (attributed to software upgrades and associated clerical costs). Averaging these costs across the total number of micro, small,

[28] Based on EC Stakeholder Feedback and Survey results

Industrial Sector	Average Expected Benefit of Compliance for SME
Transport, storage and communications	€471
Hotels and restaurants	€531
Real estate, renting and business activities	€1,218
Manufacturing	€0
Wholesale and retail trade	€1,128

Figure 12: Transfers by way of Binding Corporate Rules Cost Estimates Across Five Industrial Sectors (per firm)

and medium sized firms, the average benefit for an SME in each industrial sector is provided below.In conclusion on the general topic of data protection across countries, we may notice that the regulation shows an important effort in promoting secure data transfers, which is crucial for instance for the development and the diffusion of cloud computing. However more needs to be done, for instance supporting and standardizing a correct and transparent protection of data that are transfered outside the E.U. for cloud computing services, for instance through forms of certification of the procedures.

Mutual Assistance, Joint Operations of Supervisory Authorities: Articles 55, 56, and 57

These articles relate to the conduct of supervisory authorities. They state that "authorities shall provide each other relevant information and mutual assistance" and "shall have the right to participate in the joint investigative tasks or joint operations." The EC Cost Impact Assessment does not explicitly list the costs/benefits for these articles; it does state that the overall effect of the articles will be to reduce costs for businesses. We assumed the articles will lead to savings in clerical work and legal fees as a result of common legal proceedings and reduced fragmentation. Of the firms who engage in cross border transfer of data, we assumed 10% are investigated by data protection authorities and would therefore benefit from the article. The net benefit for a data controller was estimated to be €40,000. Averaging these costs across the total number of micro, small, and medium sized firms, the average benefit for an SME in each industrial sector is provided below.

Joint Controllers and Representatives in the Union: Articles 24 and 25

These articles are about the role of controllers[29] and they state that

[29]Incidentally, the controller should be the entity that determines the reason why data are processed and the processor the entity that determines how the same data are actually processed. This would clarify the differences in a more appropriate way.

Industrial Sector	Average Expected Benefit of Compliance for SME
Transport, storage and communications	€42
Hotels and restaurants	€47
Real estate, renting and business activities	€108
Manufacturing	€0
Wholesale and retail trade	€100

Figure 13: Mutual Assistance, Joint Operations of Supervisory Authorities Cost Estimates Across Five Industrial Sectors (per firm)

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€63
Hotels and restaurants	€71
Real estate, renting and business activities	€164
Manufacturing	€0
Wholesale and retail trade	€151

Figure 14: Joint Controllers and Representatives in the Union Cost Estimates Across Five Industrial Sectors (per firm)

when a "controller processes data jointly with others, the joint controllers shall determine their respective responsibilities for compliance under the Regulation." This is an overhead cost that must be factored in anytime data is processed jointly between two firms or is outsourced from one firm to another. We assumed that the additional cost for a controller is approximately €5,000. Based on EU survey data, 73.6% of SMEs responded they would be willing to outsource to multiple cloud providers and 38.9% responded they would outsource payroll data.[30] Since these are overlapping groups, we conservatively estimated 29% of SMEs outsource personal data. Averaging these values across the total number of micro, small, and medium sized firms, the average cost of compliance for an SME in each industrial sector is provided below.

Right to Compensation and Liability: Article 77

Article 77 stipulates that "any person who has suffered damage as a result of an unlawful processing operation or an action incompatible with the Regulation has the right to receive compensation from the controller or processor." The EC Cost Impact Assessment does not provide a cost estimate for this article. Currently damages are only applied to data controllers but with passage of this legislation, damages will also apply

[30] An SME perspective on Cloud Computing, The European Network and Information Security Agency (ENISA, Nov 2009).

Industrial Sector	Average Expected Cost of Compliance for SME
Transport, storage and communications	€127
Hotels and restaurants	€143
Real estate, renting and business activities	€327
Manufacturing	€0
Wholesale and retail trade	€303

Figure 15: Right to Compensation and Liability Cost Estimates Across Five Industrial Sectors (per firm)

to data processors. While the law attempts to clarify the liability of joint controllers and joint processors, the growth of cloud computing has created a gray area in terms of whether a cloud provider is a data controller, or data processor.[31] [32]. Therefore, even though the number of data processing firms in the EU (as a % of all SMEs) is small, there could be additional legal costs for data controllers due to legal ambiguity. Conservatively, we assumed the additional cost for a firm caught in the dispute described above was €10,000 and that 29% of SMEs would be impacted (since this is the estimated fraction of firms that outsource personal data).[33] Averaging these values across the total number of micro, small, and medium sized firms, the average cost of compliance for an SME in each industrial sector is provided below.

Administrative Sanctions: Article 79

The article states that "each supervisory authority shall be empowered to impose administrative sanctions" including a fine up to €1,000,000, or up to 2% of a firm's annual worldwide turnover. The EC Impact Assessment does not provide a cost for this article and simply describes the variations in fines across different EU member states. We estimate this article may actually lower the expected fine for an SME. This is due to the fact that most firms are micro-sized firms and therefore 2% of revenue is actually smaller than the current fines in most member states. Furthermore, most authorities rarely issue maximum penalties. The net effect of this however will be negligible on the average SME since the number of firms affected is so small.[34] Therefore, we

[31] EUROPE 'S DATA PROTECT ION FUTURE: PROSPECTS AND IMPL ICAT IONS FOR BUSINES S, February 7, 2012

[32] Who is responsible for 'personal data' in cloud computing?—The cloud of unknowing, Part 2, Millard et al, IDPL 2011

[33] See Articles 24 and 25

[34] In 2011, the UK issued 7 fines of which only 2 were for private enterprises.(http://www.pcpro.co.uk/news/375691/has-the-ico-finally-found-its-teeth-with-150-000-fine)

estimate this article to have no impact on costs. Nevertheless, it is important to remark that the proposed system of administrative sanctions implies a homogenous application to all companies, without distinction between intentional and unintentional harm: this may create unfair and disproportionate burden on SMEs that will not follow parts of the new regulation for reasons different from negligence.

Responsibility of the Controller: Articles 22

The responsibilities of the controller include adopting policies and implementing appropriate measures to ensure compliance. The EC Impact Assessment does not provide estimates for this article, but it does provide cost estimates for other underlying articles we have evaluated. Since we have already provided estimates for the articles deemed to have a cost impact, it is redundant to include costs related to the implementation of these measures. Therefore, we estimate the incremental cost of this act to be zero.

2.3 Summary of the Compliance Costs

The percentage of firms impacted as well as the average expected costs and benefits were estimated for each of the fifteen article groups deemed important in the EU Data Protection Regulation (see appendix).[35] We also calculated the costs as a percentage of IT budget for use in the general equilibrium model. To do so, we first estimated the average IT budget for a SME using data from the Voice of IT State of SMB IT 2H 2012 report provided by Spiceworks Inc.11 By taking a weighted average of the survey results and using the mix of micro, small, and medium sized businesses in the EU as weights, we calculated an average annual IT budget of €18,000. We then used this value to calculate total costs as a percent of IT budget; these estimates are provided below. These figures are the inputs for the model presented in Section 3.

[35] The fifteen groups (along with their corresponding article numbers) are Data Protection Impact Assessment (23,33), Data Protection Officer and Documentation (28,35,36,37), Notification of Data Breach (31,32), Data Portability and Right to be Forgotten (12, 17, 18), Conditions for Consent (7), Transparent Information and Communication (11), Principles of Personal Data (5,19,20), Transfers by Binding Corporate Rules (43), Processing of Personal Data of a Child (8), Responsibility of the Controller (22), Joint Controllers (24,25), Prior Authorization (24), Mutual Assistance and Common Rules (55,56,57,58,76), Right to Compensation (77), and Administrative Sanctions (79).

	Fixed Annual Cost (Euros)				Variable Annual Cost (Euros)			
Article Group	Wholesale and retail trade	Hotels and Restaurants	Transport, storage and communication	Real Estate, renting and business activities	Wholesale and retail trade	Hotels and Restaurants	Transport, storage and communication	Real Estate, renting and business activities
23, 33					1,462	688	1,056	2,236
28, 35, 36, 37,	-	-	539	2,763	-	-	56	254
31, 32	100	100	100	100	1,005	446	442	1,094
12, 17, 18	97	46	41	105	185	52	103	207
7	418	627	173	212				
11	219	103	92	237				
5, 19, 20					1,366	2,049	565	694
43					(1,128)	(531)	(471)	(1,218)
8	124	-	43	30				
22	-	-	-	-	-	-	-	-
24, 25	151	71	63	164				
34					156	73	65	168
55, 56, 57, 58, 76					(100)	(47)	(42)	(108)
77					303	143	127	327
79	-	-	-	-	-	-	-	-
Total	**€ 1,109**	**€ 947**	**€ 1,051**	**€ 3,611**	**€ 3,249**	**€ 2,873**	**€ 1,901**	**€ 3,654**
% of IT Budget	**6%**	**5%**	**6%**	**20%**	**18%**	**16%**	**11%**	**20%**

*No firms related to manufacturing are thought to be impacted and all costs for this sector will be zero.

Figure 16: Summary of Average Expected Fixed and Variable Costs

3 The Economics Impact of the proposed EU Data Protection Regulation

3.1 Non-Technical Outline and Results

In this section we propose a non-technical summary of the modelling framework adopted in the analysis and a discussion of the main results. The interested reader can find the technical details underlying the numerical simulations in Section 4.

In order to evaluate the impact of the proposed EU Data Protection Regulation on business creation and employment we have to build a model which satisfies at least two desiderata. The first one is that the model must be able to account for the dynamics of the number of firms in the economy. This allows to evaluate whether the implementation of the data protection framework has an impact on net business creation. The second one is that the model has to deliver an endogenous dynamics for unemployment. This, in turn, allows to asses the effect of the new rules on the level of unemployment.

Accomplishing these tasks requires to depart from the assumption of perfect competition in the goods market and from that of a perfectly competitive labor market. For this reason, our analysis takes a general equilibrium approach (meaning that we consider all markets in the economy simultaneously) characterized by the presence of frictions both in

the goods market and in the labor market.

We consider a framework where setting up a firm in order to serve the market is costly. As a result, just those firms whose expected profits cover the entry cost will decide to start production. We show that the introduction of more restrictive norms on data protection affects the expected profits of firms and through this channel it affects the number of producers entering in the economy.

The labor market is also characterized by frictions. Finding appropriate candidates for a new job opening requires time. This is of course costly for firms. The presence of search costs in the labor market leads to a frictional level of unemployment. Any event that affects the expected surplus that a newly created job could deliver may impact on firms' job creation decisions. This is the channel through which regulation could affect job creation.

Importantly, there is also an interaction channel between the dynamics in the number of businesses and job creation. As mentioned in the Introduction, new firms, which are mainly small, are the engine of job creation. Policy measures which ultimately lead to a reduction in firm creation will impact on job creation as well. Finally, since the data protection act is more likely to affect firms which use intensively technology in the form of hardware and software for data management, we assume that IT is an essential input for production.

We formalize the introduction of the data regulation act as follows. Installing a DPO office will represent an additional fixed operating costs for those firms subject to the regulation. The development of a data management systems is, instead, a variable cost for the firm, which depends on the amount of data processed. For this reason the increase in variable costs faced by the firm will depend on the amount of IT used in the production process.

The introduction of the regulation act represents a change in the cost function of firms which will have permanent effects. This affects the business and job creation channel described above. In particular the economy will shift to a new allocation, characterized by a different number of firms and a different level of unemployment.

Using the cost impact evaluation displayed in the previous section we can assess the change in the number of business and in the level of unemployment that would be implied by the data regulation framework. In what follows we summarize the main results of this study.

Our analysis shows a substantial negative impact of the introduction of the data protection legislative framework on business creation and employment. The reduction in employment and the number of operating firms is particularly strong in sectors where a large fraction of firms

will be subject to the designation of a DOP, such as the Real Estate, Renting and Business Activities sector. We also translate our analysis in the number of jobs and firms lost due to the introduction of the data protection legislation. According to our model, the number of jobs destroyed ranges between more than one hundred thousands in the short run to more than three hundreds thousands in the long run. This suggests that the introduction of the new norms should be crafted with care. It should be accompanied by other measures aimed at reducing the impact, in terms of higher costs, for firms. As an example, policymakers should promote fiscal incentives for those firms which will be subject to high implementation costs, with particular reference to those subject to the DPO requirement.

3.2 Simulations

The analysis in Section 2 highlights that a relevant fraction of firms in the Real Estate, Renting and Business Activities and the Wholesale and Retail Trade Sector will require a DPO office. Other sectors will be affected by the legislation because of the need to conform to the data protection standards. For this reason in what follows we show the effects of the introduction of the reform at the sectoral level distinguishing two cases. The first case, depicted in Figure 7, is meant to be representative of the impact of the regulation in the two sectors where both fixed and variable costs will be affected, the second one is depicted in Figure 8 and it is meant to be representative of the effects in other sector which will mainly experience a change in variable costs.[36]

We numerically compute an exact transition from the pre-reform steady state to the post reform steady state.[37] This is possible since we interpreted the introduction of the data protection act as a permanent shock that hits the cost function of firms. The Figures below report the percentage variations of the main variables with respect to the initial (pre-reform) steady state. Time on the horizontal axis is marked in quarters.

Figure 7 refers to the Real Estate, Renting and Business Activities sector. Solid lines refer to our baseline case, where we target a cost increase in terms of initial IT budget equal to 40 percent on average, as reported in Figure 6. As a robustness check, dashed lines report the case where the increase in IT budget equals 20 percent on average, half of our estimate.[38] While dynamics are similar under both scenarios,

[36] In this case the share of the change in the IT budget shown in Figure 6 is entirely attributed to a change in variable costs.

[37] To do so we use DYNARE version 4.3.

[38] Under the alternative scenario the magnitude of the change in variable costs with

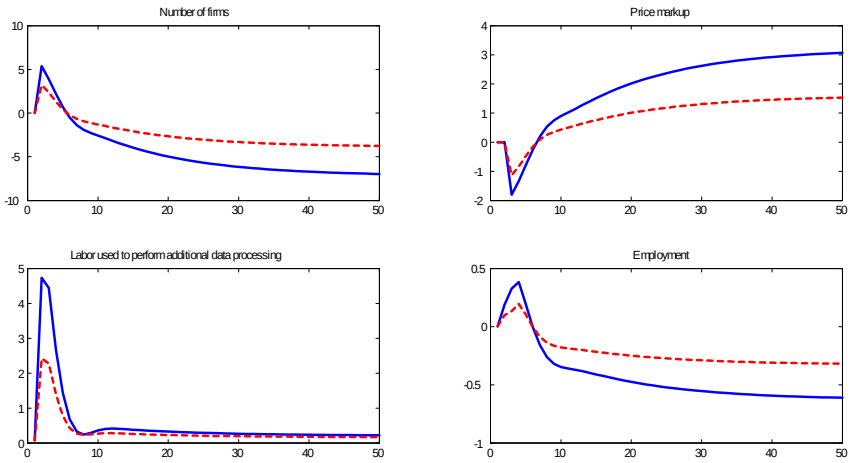

Figure 17: Real Estate Renting and Business Activities sector. Percentage deviations of the main sectoral variables in response to the introduction of the data protection act. Solid Lines refer to the baseline case scenario, dashed lines to the lower impact scenario.

our baseline case implies a much stronger reduction in the number of firms and sectoral employment in the medium and the long-run. In the aftermath of the introduction of the new regulation the need to perform additional monitoring activities leads to an increase in demand for workers involved in these tasks. This has an initial positive impact on sectoral employment. However as the cost pressure leads firms to exit from the market, sectoral employment decreases while, due to lower competition in the sector, we observe an increase in the price markup.

Figure 8 depicts the case of Hotels and Restaurants, where the regulation will affect uniquely variable costs. As above we consider two possible scenarios: a baseline case where the increase in variable costs amounts to our estimate of 21 percent of the initial IT budget (solid lines), and a low impact scenario where the increase in variable costs represents half of this estimate (dashed lines).

Dynamics are similar to those depicted above. A joint analysis of the two figures leads to the following results: (i) the variable cost dimension drives the dynamics response of the economy to the introduction of the regulation; (ii) fixed costs reduce profits and hence leads to a more pronounced reduction in the number of firms in the market; (iii) even in the case of a cost impact much lower than that estimated in Figures 1-6

respect to that in fixed costs is identical to the baseline one.

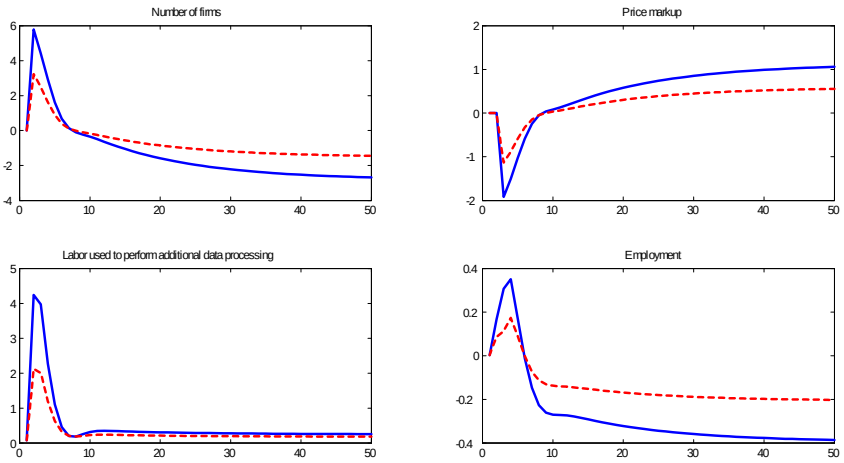

Figure 18: Hotel and Restaurants. Percentage deviations of the main sectoral variables in response to the introduction of the data protection regulation. Solid Lines refer to the baseline case scenario, dashed lines to the lower impact scenario.

the impact on both employment and the number of competitors would be substantial.

In Tables 1 and 2, we provide for each sector, the percentage change in the number of employed persons and the number of firms after 8 and 20 quarters from the introduction of the reform. This allows to evaluate the effects of the new legislation in both the short and the long run. Table 3 reports, instead, the corresponding change in the absolute number of employed persons in each sector.[39] Based on the cost impact estimates presented in Section 2, the impact of the regulations on SMEs in the manufacturing sectors is estimated to be approximately zero. Therefore, there is no simulated impact from the proposed regulation on employment levels or number of firms for this industrial sector.

The introduction of the legislation shows its negative effects on employment and the business environment even after eight quarters, but it has a particularly sizeable effect in the long run, after twenty quarters, where there is a large destruction of businesses and jobs. Consider the two industrial sectors analyzed above. In the Real Estate, Renting and

[39] To compute these values we multyply the most recent data on the number of employed persons per sector in the EU 27 by the percentage variations reported in Tables 1 and 2. Data for employed persons and number of firms by sector can be found at http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/main_tables

Number of Employed Persons	Baseline Impact		Low Impact	
Quarters	8	20	8	20
Sector				
Wholesale and retail trade	-0.25	-0.41	-0.13	-0.21
Hotels and restaurants	-0.26	-0.37	-0.12	-0.19
Transport Storage and communication	-0.20	-0.29	-0.01	-0.15
Real Estate, renting and Business activities	-0.30	-0.54	-0.15	-0.28

Table 1: Percentage change in the number of employed persons due to the introduction of the legislation on data protection in the EU 27

Number of Firms	Baseline Impact		Low Impact	
Quarters	8	20	8	20
Sector				
Wholesale and retail trade	-0.63	-2.55	-0.27	-1.34
Hotels and restaurants	-0.01	-1.59	-0.008	-0.85
Transport Storage and communication	-0.05	-1.28	0.003	-0.67
Real Estate, renting and Business activities	-1.92	-4.98	-0.94	-2.64

Table 2: Percentage change in the number of firms due to the introduction of the legislation on data protection in the EU 27

Business activities sector, the reduction in the number of firms ranges from 2.6 percent in the low impact scenario to almost 5 percent in the baseline scenario. We observe a reduction in the long-run sectoral employment ranging from 0.3 percent in the low impact case to more than half percentage point in the baseline case. Eurostat data suggest that in 2007, before the financial crisis, this sector employed about 23 millions workers. As a result, our simulation suggests that in the baseline impact scenario the introduction of the legislation would lead to a loss of more than one hundred and twenty thousands jobs in this sector. In the Hotels and Restaurants sector the reduction in long run employment ranges from 0.2 to 0.4 percent, with a reduction in market competitors from 1 to 2 percent. This implies a destruction of 16 to 32 thousands jobs and an exit from the market of 8 to 15 thousands business activities.

Overall our computations entail a short run loss of jobs ranging from 90 thousands in the low impact scenario to 196 thousands in the baseline scenario. A much stronger loss should be expected in the long run, where job losses range from 166 thousand in the low impact scenario to 320 thousands in the baseline case.

Number of Employed Persons	Baseline Impact		Low Impact	
Quarters	8	20	8	20
Sector				
Wholesale and retail trade	-81352	-133420	-42303	-68336
Hotels and restaurants	-22562	-32108	-10413	-16488
Transport Storage and communication	-23459	-34016	-1173	-17594
Real Estate, renting and Business activities	-68762	-123770	-34381	-64178
Total	-196135	-323314	-88270	-166596

Table 3: Absolute change in the number of employed persons due to the introduction of the legislation on data protection in the EU 27

4 Technical Details

In this section we describe the model used for our simulations, further technical details and the calibration of parameters can be found in the Appendix.

4.1 The Model

The structure of the model is a basic Dynamic Stochastic General Equilibrium (DSGE) model that is standard in the macroeconomic analysis (see Kydland and Prescott, 1982; Christiano, Eichenbaum and Evans, 2005) augmented with endogenous market structures as opposed to perfectly competitive or monopolistically competitive markets (Colciago and Etro, 2010, and Etro and Colciago, 2010).[40] The economy features a continuum of atomistics sectors, or industries, on the unit interval. Each sector is characterized by different firms producing a good in different varieties, using labor and IT material as input. In turn, the sectoral goods are imperfect substitutes for each other and are aggregated into a final good. The IT material in produced by a perfectly competitive firm using physical capital as the only input.

Households use the final good for consumption and investment purposes. Price competition and endogenous firms' entry is modeled at the sectoral level, where firms also face search and matching frictions in hiring workers, modeled in the tradition of the literature on job search (see Mortensen and Pissarides, 1994; Pissarides, 2000).

[40] See Etro (2009b) for a survey of the related literature on endogenous market structures in general equilibrium. Colciago and Etro (2012) analyze a related model of technology adoption.

4.1.1 Labor Market and Job Matching

The labor market is characterized by search and matching frictions, as in Andolfatto (1996) and Merz (1995). Firms producing in t need to post vacancies in order to hire new workers. Unemployed workers and vacancies combine according to a CRS matching function and deliver m_t new hires, or matches, in each period. The matching function is assumed a Cobb-Douglas one:

$$m_t = (\gamma_m) \left(v_t^{tot}\right)^{1-\gamma} u_t^{\gamma} \tag{1}$$

where γ_m reflects the efficiency of the matching process, v_t^{tot} is the total number of vacancies created at time t and u_t is the unemployment rate. The probability that a firm fills a vacancy is given by $q_t = \frac{m_t}{v_t^{tot}}$, while the probability to find a job for an unemployed worker reads as $z_t = \frac{m_t}{u_t}$. Firms and individuals take both probabilities as given. Matches become productive in the same period in which they are formed. Each firm separates exogenously from a fraction $1 - \varrho$ of existing workers each period, where ϱ is the probability that a worker stays with a firm until the next period. As a result a worker may separate from a job for two reasons: either because the firm where the job is located exits from the market or because the match is destroyed. Given that population is normalized to one, the number of unemployed workers and the unemployment rate are identical. Therefore, given labor at time t as L_t, the unemployment rate is:

$$u_t = 1 - L_{t-1}$$

and represents also the fraction of agents searching for a job.

Given our functional form, we can express the probability of filling a vacancy as:

$$q_t = \gamma_m \left(\frac{v_t^{tot}}{u_t}\right)^{-\gamma} = \gamma_m \left(\theta_t\right)^{-\gamma} \tag{2}$$

where we define $\theta_t = v_t^{tot}/u_t$, the probability of finding a job as:

$$z_t = \frac{(\gamma_m) \left(v_t^{tot}\right)^{1-\gamma} u_t^{\gamma}}{u_t} = \gamma_m \left(\theta_t\right)^{1-\gamma} \tag{3}$$

and their ratio as:

$$\frac{z_t}{q_t} = \frac{\gamma_m \left(\theta_t\right)^{-\gamma}}{\gamma_m \left(\theta_t\right)^{1-\gamma}} = \theta_t$$

4.1.2 Households

Using the family construct of Merz (1995) we can refer to a representative household as consisting of a continuum of individuals of mass one. Members of the household insure each other against the risk of being unemployed. The representative family has lifetime utility:

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \log C_t - \chi L_t \frac{h_t^{1+1/\varphi}}{1+1/\varphi} dj \right\} \quad \chi, \varphi \geq 0 \tag{4}$$

where $\beta \in (0,1)$ is the discount factor, the variable h_t represents individual hours worked and C_t is the consumption of the final good. The family receives real labor income $w_t h_t L_t$, where w_t is the real wage, and profits Π_t from the ownership of firms. Unemployed individuals receive a real unemployment benefit b, hence the overall benefit for the household is $b(1-L_t)$. This is financed through lump sum taxation by the government. The households hold the stock of physical capital, K_t, which evolves according to

$$K_t = \left(1-\delta^k\right) K_{t-1} + I_t^k \tag{5}$$

where I_t^k is investment in capital. The household chooses how much to save in riskless bonds, physical capital and in the creation of new firms according to standard Euler and asset pricing equations. The first order condition (FOC) with respect to employment, L_t, is

$$\Gamma_t = \frac{w_t h_t}{C_t} - \chi \frac{h_t^{1+1/\varphi}}{1+1/\varphi} - \frac{b}{C_t} + \beta E_t \left[(1-\delta)\rho - z_{t+1}\right] \Gamma_{t+1} \tag{6}$$

where Γ_t is the marginal value to the household of having one member employed rather than unemployed and $1/C_t$ is the marginal utility of consumption. Equation (6) indicates that the household's shadow value of one additional employed member (the left hand side) has four components: first, the increase in utility generated by having an additional member employed, given by the real wage expressed in utils; second, the decrease in utility due to more hours dedicated to work, given by the marginal disutility of employment; third the foregone utility value of the unemployment benefit; fourth, the continuation utility value, given by the contribution of a current match to next period household's employment.

4.1.3 Production, IT Provision and Data Management Services

There are four types of firms in the economy. The producers of intermediate goods, the final good producer, the producers of IT material

and the providers of data management services. The final good is an aggregate of a continuum of mass one of sectoral goods defined as

$$Y_t = \left[\int_0^1 \ln Y_{jt}^{\frac{\omega-1}{\omega}} dj \right]^{\frac{\omega}{\omega-1}} \tag{7}$$

where Y_{jt} denotes output of sector j and ω is the elasticity of substitution between any two different sectoral goods. The final good producers behave competitively. In each sector j, there are $N_{jt} > 1$ firms producing differentiated goods that are aggregated into a sectoral good by a CES aggregating function defined as

$$Y_{jt} = \left[\sum_{i=1}^{N_{jt}} y_{jt}(i)^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{8}$$

where $y_{jt}(i)$ is the production of good i in sector j, $\varepsilon > 1$ is the elasticity of substitution between sectoral goods. As in Etro and Colciago (2010), we assume a unit elasticity of substitution between goods belonging to different sectors. This allows to realistically separate limited substitutability at the aggregated level, and high substitutability at the disaggregated level. Each firm i in sector j produces a (intermediate) differentiated good with the following production function

$$y_{jt}(i) = A_t \left[n_{jt}(i)\, h_{jt}(i) \right]^{1-\alpha} \left[IT_{jt-1}(i) \right]^{\alpha} \tag{9}$$

where A_t represents technology which is common across sectors and evolves exogenously over time. The variable $l_{jt}(i)$ is firm i's time-t workforce used for the production of the final good, and $h_{jt}(i)$ represents hours per employee. In the remainder we will refer to firms in the intermediate goods sector as producers. The variable $IT_{jt}(i)$ is the amount of IT capacity involved in the production process.

The latter is produced by a perfectly competitive firm which uses physical capital as the only input. In each period a flow of IT, defined as ΔIT_t, is produced with technology

$$\Delta IT_t = A_t^{IT} K_{t-1} \tag{10}$$

where K_t is the stock of capital in the economy and A_t^{IT} is the productivity of the IT industry. Given perfect competition the price of IT material is the marginal cost of production. The latter can be obtained by profit maximization of the producer of IT services as $p_t^{IT} = \frac{r_t^k}{A_t^{IT}}$. Period-$t$ real profits of a producer are defined as

$$\pi_{jt}(i) = \rho_{jt}(i)\, y_{jt}(i) - w_{jt} h_t n_t - p_t^{IPC} M_{jt}(i) - \kappa v_{jt}(i) - p_t^{IT} I_{jt}^{IT}(i) \tag{11}$$

where $w_{jt}(i)$ is the real wage paid by firm i, $v_{jt}(i)$ represents the number of vacancies posted at time t, κ is the output cost of keeping a vacancy open, $I_{jt}^{IT}(i)$ is period t investment in IT and p_t^{IT} is the price of a unit of IT in terms of the final good. Notice that $\rho_{jt}(i)$ is the real price of firm i's output.

The term $p_{jt}^{IPC}(i) M_{jt}(i)$ represents the cost of processing the data stored at a firm, but also the cost of maintenance and development of the IT material. For simplicity we assume that these activities are outsourced by the firm to what we define an Information Processing Company (IPC). The IPC operates in a perfectly competitive environment with a production function of the form $M_t = n_t^{IPC} h_t$, where n_{jt}^{IPC} represents the number of workers employed in the IPC. The IPC also faces search costs in the labor market. It hires workers by posting vacancies at an output cost equal to κ, taking as given hours and the real wage determined in the bargaining process between the firm and the workers operating in the final good industry.[41] Its workforce evolves according to $n_t^{IPC} = \varrho n_{t-1}^{IPC} + v_t^{IPC} q_t$. The problem faced by IPC can thus be written as

$$\max_{\{n_s^{IPC}, v_s^{IPC}\}_{s=t}^{\infty}} E_t \sum \Lambda_{t,s} \left(p_s^{IPC} M_s - w_s h_s n_t^{IPC} - \kappa v_s^{IPC} \right)$$
$$s.t.\ n_s^{IPC} = \varrho n_{s-1}^{IPC} + v_s^{IPC} q_s$$

Profit maximization requires

$$\frac{\kappa}{q_t} = \left(p_t^{IPC} h_t - w_t h_t \right) + \varrho E_t \frac{\kappa}{q_{t+1}} \Lambda_{t,t+1}$$

this condition equates the marginal cost of hiring a worker with the marginal benefit. The latter is given by a discounted stream of firm's expected future net earnings from the marginal worker. We assume that the final good firm is characterized by a technology such that it must acquire $\frac{m}{A_t}$ units of information processing services for each unit of IT_t involved in the production process. As a result the individual demand of information management services is $\frac{m}{A_t} IT_{jt}(i)$ and we can rewrite profits of the final good producer as

$$\pi_{jt}(i) = \rho_{jt}(i) y_{jt}(i) - w_{jt} h_t n_t - p_t^{IPC} \frac{m}{A_t^{IT}} IT_{jt-1}(i) - \kappa v_{jt}(i) - p_t^{IT} I_{jt}^{IT}(i)$$

The value of a final good producer is the expected discounted value of its future profits

$$V_{jt}(i) = E_t \sum_{s=t+1}^{\infty} \Lambda_{t,s} \pi_{js}(i) \tag{12}$$

[41] In this case it is indifferent for a member of the household to work in a production line or in the IPC.

where $\Lambda_{t,t+1} = (1-\delta)\,\beta\left(\frac{C_{t+1}}{C_t}\right)^{-1}$ is the households' stochastic discount factor which takes into account that firms' survival probability is $1-\delta$. Firms which do not exit from the market have a time-t individual workforce given by

$$n_{jt}(i) = \varrho n_{jt-1}(i) + v_{jt}(i)\, q_t \tag{13}$$

and a stock of IT equal to

$$IT_{jt}(i) = \left(1-\delta^{IT}\right) IT_{jt-1}(i) + I^{IT}_{jt}(i) \tag{14}$$

where δ^{IT} is the depreciation rate of IT material. The unit intersectoral elasticity of substitution implies that the nominal expenditure, EXP_t, is identical across sectors. Thus, the final producer's demand for each sectoral good is

$$P_{jt}Y_{jt} = P_tY_t = EXP_t \tag{15}$$

where P_{jt} is the price index of sector j and P_t is the price of the final good at period t. Denoting with $p_{jt}(i)$ the price of good i in sector j, the demand faced by the producer of each variant is

$$y_{jt}(i) = \left(\frac{p_{jt}}{P_{jt}}\right)^{-\varepsilon} Y_{jt} \tag{16}$$

where P_{jt} is defined as

$$P_{jt} = \left[\sum_{i=1}^{N_{jt}} \left(p_{jt}(i)\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \tag{17}$$

Using (16) and (15) the individual demand of good i can be written as a function of aggregate expenditure,

$$y_{jt}(i) = \frac{p_{jt}^{-\varepsilon}}{P_{jt}^{1-\varepsilon}} EXP_t \tag{18}$$

4.1.4 Business and Job Creation

At the beginning of each period N^e_{jt} new firms enter into sector $j \in (0,1)$, while at the end of the period a fraction $\delta \in (0,1)$ of market participants exits from the market for exogenous reasons.[42] As a result, the number of firms in a sector N_{jt}, follows the equation of motion:

$$N_{jt+1} = (1-\delta)(N_{jt} + N^e_{jt}) \tag{19}$$

[42] As discussed in Bilbiie *et al.* (2012), if macroeconomic shocks are small enough $N^e_{j,t}$ is positive in every period. New entrants finance entry on the stock market.

where N_{jt}^e is the number of new entrants in sector j at time t. Following Bilbiie *et al.* (2012) we assume that new entrants at time t will only start producing at time $t+1$ and that the probability of exit from the market, δ, is independent of the period of entry and identical across sectors. The assumption of an exogenous constant exit rate in adopted for tractability, but it also has empirical support. Using U.S. annual data on manufacturing, Lee and Mukoyama (2007) find that, while the entry rate is procyclical, annual exit rates are similar across booms and recessions. Below we describe the entry process and the mode of competition within in each sector in detail. Prior to entry, firms face a sunk entry cost ϕ_t^e to be paid in order to serve the market. It is made by two components:

$$\phi_t^e = \phi_t^{ad} + p_t^{IT}\left(I_{jt}^{IT}(i)\right)^{new}$$

The first term ϕ_t^{ad} represents the cost associated with regulation and barriers to entry, which is common across sectors. It is exogenous and expressed in units of the final good. The second component of the entry cost reflects instead the fact that in order to start production in the next period new firms must set up a stock of IT. This requires an amount of investment in IT given by $\left(I_{jt}^{IT}(i)\right)^{new}$.[43] If the firm exits from the market its IT stock is lost. Firms will enter into the market up to the point where their value, represented by the discounted value of their future profits, equals the sunk entry cost ϕ_t^e.

Let us consider competition *à la* Bertrand. Each firm i chooses $p_{jt}(i)$, $n_{jt}(i)$, $v_{jt}(i)$ and $IT_{jt}(i)$ to maximize $\pi_t(i) + V_t(i)$, taking as given the price of the other firms in the sector. In a symmetric equilibrium optimal pricing implies that the relative price chosen by firms is

$$\rho_t(\varepsilon, N_t) = \mu_t mc_t \tag{20}$$

where μ_t the markup over the marginal cost is given by

$$\mu_t(\varepsilon, N_t) = \frac{\varepsilon(N_t - 1) + 1}{(\varepsilon - 1)(N_t - 1)} \tag{21}$$

The latter is decreasing in the number of firms in the sector. Further, when $N_t \to \infty$ the markup tends to $\varepsilon/(\varepsilon - 1)$, i.e. the traditional one under monopolistic competition. The first order condition (FOC) with

[43] The parameter Φ is an indicator variable which takes value 0 or 1 and allows to nest the post-cloud economy into the pro-cloud economy. As it will be clear below it takes value 1 before the introduction of cloud services and value 0 after the introduction of the cloud.

respect to vacancies reads as

$$\phi_t = \frac{\kappa}{q_t} \tag{22}$$

Thus, the firm sets the value of the marginal worker, ϕ_t, equal to the expected cost of hiring the worker, $\frac{\kappa}{q_t}$. The FOC with respect to n_t delivers

$$\phi_t = \left[(1-\alpha)\, mc_t A_t \left(\frac{IT_{t-1}}{n_t h_t}\right)^{\alpha} h_t - w_t h_t\right] + \beta\rho \frac{C_t}{C_{t+1}} E_t \phi_{t+1} \tag{23}$$

Combining the latter two equations delivers the following *Job Creation Condition* (JCC)

$$\frac{\kappa}{q_t} = (1-\alpha)\frac{\rho_t}{\mu_t} A_t \left(\frac{IT_{t-1}}{n_t h_t}\right)^{\alpha} h_t - w_t h_t + \varrho E_t \Lambda_{t,t+1} \frac{\kappa}{q_{t+1}}$$

where we used the pricing condition to substitute for $mc_t = \frac{\rho_t}{\mu_t}$. Since the ratio $\frac{\rho_t}{\mu_t}$ increases in the number of firms, it follows that competition leads to a rise in the marginal cost and hence in the equilibrium marginal revenue. For this reason the marginal revenue product of labor (MRP), given by $(1-\alpha)\frac{\rho_t}{\mu_t} A_t \left(\frac{IT_{t-1}}{n_t h_t}\right)^{\alpha} h_t$, also rises with competition. Thus, stronger competition promotes the creation of vacancies and employment due to its positive effect on the MRP of labor. The firm will invest in IT up to the point where

$$p_t^{IT} = \Lambda_{t,t+1}\left[\frac{\rho_{t+1}}{\mu_{t+1}} A_{t+1}\alpha \left(\frac{IT_t}{n_{t+1}h_{t+1}}\right)^{\alpha-1} - p_{t+1}^{IPC}\frac{m}{A_{t+1}^{IT}}\right] + \Lambda_{t,t+1} p_{t+1}^{IT}\left(1-\delta^{IT}\right) \tag{24}$$

Increasing IT by one unit today costs p_t^{IT}. The benefit associated to the marginal unit of IT is given by the discounted marginal revenue product of IT net of data processing and maintenance costs, the first term at the RHS, summed to the discounted value that the additional unit of IT will have tomorrow, $\Lambda_{t,t+1} p_{t+1}^{IT}\left(1-\delta^{IT}\right)$. Since IT is a stock variable, the firm is forced to look ahead when taking decisions concerning optimal investment in IT.

As in Trigari (2009), bargaining takes place along two dimensions: the real wage and the hours of work. We assume Nash bargaining. That is, the firm and the worker choose the wage w_t and the hours of work h_t to maximize the Nash product

$$(\phi_t)^{1-\eta}(\Gamma_t C_t)^{\eta} \tag{25}$$

where ϕ_t is firm value of having an additional worker, while $\Gamma_t C_t$ is the household's surplus expressed in units of consumption**.** The parameter η reflects the parties' relative bargaining power. The FOC with respect to the real wage is

$$\eta\phi_t = (1-\eta)\,\Gamma_t C_t \tag{26}$$

Using the definition of ϕ_t in equation (23) and that of Γ_t given by equation (6), after some manipulations, yields the wage equation

$$w_t = (1-\eta)\,\frac{b}{h_t} + (1-\eta)\,\chi C_t \frac{h_t^{1/\varphi}}{1+1/\varphi} + \tag{27}$$

$$+\frac{\eta\kappa}{1-\delta} E_t \Lambda_{t,t+1} \frac{\theta_{t+1}}{h_t} + (1-\alpha)\,\eta \frac{\rho_t}{\mu_t} A_t \left(\frac{IT_{t-1}^A}{n_t N_t h_t}\right)^{\alpha} \tag{28}$$

where $\phi_t = \frac{\kappa}{q_t}$, $\frac{z_t}{q_t} = \theta_t$, $IT_{t-1}^A = N_t IT_{t-1}$. The wage shares costs and benefits associated to the match according to the parameter η. The worker is rewarded for a fraction η of the firm's revenues and savings of hiring costs and compensated for a fraction $1-\eta$ of the disutility he suffers from supplying labor and the foregone unemployment benefits. A distinguishing feature of our approach is that the wage depends on the degree of competition in the goods market. The direct effect of competition on the real wage is captured through the term $\eta\frac{\rho_t}{\mu_t}(1-\alpha)\,A_t\left(\frac{IT_{t-1}^A}{n_t N_t h_t}\right)^{\alpha}$, which represents the share of the MRP which goes to workers. Entry leads to an increase in the ratio $\frac{\rho_t}{\mu_t}$ and hence in the MRP. Thus, everything else equal, stronger competition shifts the wage curve up. This result is similar to that in the static model by Blanchard and Giavazzi (2003), who find a positive effect of competition on the real wage. The FOC with respect to h_t yields

$$h_t = \left[\frac{(1-\alpha)^2}{\chi C_t}\frac{\rho_t}{\mu_t} A_t \left(\frac{IT_{t-1}^A}{n_t N_t h_t}\right)^{\alpha}\right]^{\varphi}. \tag{29}$$

Because the firm and the worker bargain simultaneously about wages and hours, the outcome is (privately) efficient and the wage does not play an allocational role for hours. Stronger competition leads to an increase in hours bargained between the workers and firms for the same reasons for which competition positively affects the wage schedule.

4.1.5 Hiring Policy and IT Policy

Let π_t^{new}, v_t^{new} and $\left(I_t^{IT}\right)^{new}$ be, respectively, the real profits, the number of vacancies posted by a new firm and investment in IT. Symmetrically, π_t,v_t and I_t^{IT} define, respectively, the individual profits and vacancies posted by an incumbent producer. New firms and incumbent firms are

characterized by the same size, n_t. Thus, the optimal hiring policy of new firms, which have no initial workforce, consists in posting at time t as many vacancies as required to hire n_t workers. As a result $v_t^{new} = \frac{n_t}{q_t}$. Since $n_t = \varrho n_{t-1} + v_t q_t$, it has to be the case that

$$v_t^{new} = v_t + \varrho \frac{n_{t-1}}{q_t} \tag{30}$$

Hence, a new firm posts more vacancies than an incumbent producer. For this reason, and given vacancy posting is costly, the profit of new firms are lower than those of incumbent firms, in particular

$$\pi_t^{new} = \pi_t - k \frac{\varrho n_{t-1}}{q_t}$$

Notice also that a new entrant must set up a stock of IT before starting production next period. Given the IT choice is symmetric across producers they have to invest during time t as much as required to reach a stock of IT identical to that held by incumbent producers at the end of time t, that is $\left(I_t^{IT}\right)^{new} = IT_t$. The sunk entry cost for a new firm can thus be written as

$$\phi_t^e = \phi^{ad} + p_t^{IT} IT_t$$

In each period the level of entry is determined endogenously to equate the value of a new entrant, V_t^e, to the entry cost

$$V_t^e = \phi_t^e \tag{31}$$

Notice that perspective new entrants have lower value than producing firms because they will have, in case they do not exit from the market before starting production, to set up a workforce in their first period of activity. The difference in the value between a firm which is already producing and a perspective entrant is, in fact, the discounted value of the higher vacancy posting cost that the latter will suffer, with respect to the former, in the first period of activity. Formally

$$V_t = V_t^e + \kappa \varrho E_t \Lambda_{t,t+1} \frac{n_t}{q_{t+1}} = \phi_t^e + \kappa \varrho E_t \Lambda_{t,t+1} \frac{n_t}{q_{t+1}} \tag{32}$$

where V_t is the value of a producing firm (both new firms and incumbent firms) at time t.

In order to mimic the need to install and run a DPO, we assume that final good producers will incur a period fixed cost, which we define as Φ. As already mentioned in Section 2, the designation of a DPO can be regarded as a fixed cost since it does not scale with the size of the

firm or the number of data records. Compliance with other articles in the regulation require a mix of fixed costs and variable costs that scale with the amount of data processed, or more generally with the number of projects initiated by a firm. For this reason, the model counterpart of this requirement will be an increase in the units of information processing services for each unit of IT_t involved in the production process. As a result we can rewrite profits of a final good producer as

$$\pi_{jt}(i) = \rho_{jt}(i) y_{jt}(i) - w_{jt} h_t n_t - p_t^{IPC} \frac{\Xi}{A_t^{IT}} IT_{jt-1}(i) - \kappa v_{jt}(i) - p_t^{IT} I_{jt-1}^{IT}(i) - \Phi$$

where $\Xi \geq m$. Aggregate profits will now read as

$$\Pi_t = Y_t - w_t N_t n_t h_t - p_t^{IPC} \frac{\Xi}{A_t^{IT}} IT_{t-1}^A - p_t^{IT} N_t I_t^{IT} - \kappa v_t^F - N_t \Phi$$

while the aggregate accounting equation translates into

$$Y_t = C_t + \phi^{ad} N_t^e + I_t^k + \kappa v_t^F + \left(\frac{\kappa}{q_t} - \varrho \Lambda_{t,t+1} \frac{\kappa}{q_{t+1}} \right) \frac{\Xi}{A_t^{IT}} \frac{IT_{t-1}}{h_t} + N_t \Phi$$

In the Appendix we provide the value of parameters and the long-run equilibrium of the economy. As in the bulk of the literature we log-linearize equilibrium conditions and solve the resulting system of liner difference equations.

The dynamics of the main sectoral variables in the aftermath of the introduction of the data protection act are those depicted in Figure 5 and 6.

5 Conclusions

In this article we have simulated the economic impact of the introduction of the EU Data Protection Regulation. Compliance with the regulation poses a number of challenges for SMEs. The first one concerns the design of systems and procedures for data protection. The second is about data protection impact assessments which must be incorporated into IT project management so that firms can identify and mitigate specific risks on data processing. Another major challenge is the designation of a data protection officer. Substantial costs will be associated also with the compulsory notification of any data breach in 24 hours to the supervisory authority and without undue delay to the data subjects, which is extremely demanding, especially for minor data breaches. These and several additional elements will result in substantial compliance costs for firms and SMEs in particular. Nevertheless, the "one-stop-shop" principle will reduce some compliance costs ensuring that data controllers

and data processors that operate across countries will be regulated by a single supervisory authority (though this is not the case for companies that happen to be both data controllers and data processors in different countries). There is also an important effort in promoting secure data transfers (but it would be usefull to support and standardize a stronger protection of data moved in the cloud). Overall, we emphasize how the net compliance costs remain positive and extremely large for European SMEs, something that must be taken into account when evaluating cost and benefits of the new regulation.

Beyond these direct costs, there are indirect macroeconomic costs of the regulation that are more difficult to measure: these are due to the impact that these additional costs have on the process of business creation and job creation. We have evaluated the impact of the regulation on output, employment and business creation using a macroeconomic model characterized by endogenous market structures and job matching. This setting features an economy with many sectors, where the dynamics of the number of market competitors is endogenous. Firms face a cost of entry in the market which they will decide to afford just if compensated by the expectation of future profits. In our model firms produce the final goods using labor and IT. The stock of IT takes the form of IT hardware, but also of data stored by firms which represent an essential input for the production process. Firms employ multiple workers and the labor market is characterized by frictions. Both new firms and incumbent firms need to hire workers from the pool of unemployed agents who are looking for a job and to set up a stock of IT material before starting production. The simulation shows a substantial negative impact of the EU Data Protection Regulation on the number of business and the number of jobs.

References

Alesina, A., I. Angeloni and F. Etro, 2005, International Unions, *American Economic Review*, 95, 602-15

Andolfatto, D., 1996, Business Cycles and Labor Market Search, *American Economic Review*, 86, 112-32

Bell B. and J. Smith, 2002, On Gross Worker Flows in the United Kingdom: Evidence from the Labour Force Survey, Bank of England WP 160, Bank of England

Bilbiie, F., F. Ghironi and M. Melitz, 2012, Endogenous Entry, Product Variety, and Business Cycles, *Journal of Political Economy*, 120, 2, 304-44

Bils, M., 1987, The Cyclical Behavior of Marginal Cost and Price, *American Economic Review*, 77, 838-55

Bils M., Chang Y., and Kim S.B., 2011, Worker Heterogeneity and Endogenous Separations in a Matching Model of Unemployment Fluctuations, *American Economic Journal: Macroeconomics,* 3, 128-54

Blanchard, O. and Galì J., 2010, Labor Market Frictions and Monetary Policy: A New Keynesian Model with Unemployment, *American Economic Journal: Macroeconomics*, 2, 2, 1-30

Blanchard, O. and Giavazzi, F., 2003, Macroeconomic Effects of Regulation and Deregulation in Goods and Labor Markets, *Quarterly Journal of Economics*, 118, 3, 879-907

Borek, C. L. Christensen, P. Hess, G. Rafert and J. Lerner, 2012, Lost in the Clouds: The Impact of Copyright Scope on Investment in Cloud Computing Ventures, mimeo, Harvard University

Christiano, L., M. Eichenbaum, and C. Evans, 2005, Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy, *Journal of Political Economy*, 113, 1-45

Colciago, A. and F. Etro, 2010, Real Business Cycles with Cournot Competition and Endogenous Entry, *Journal of Macroeconomics*, 32, 4, 1101-17

Colciago, A. and F. Etro, 2012, Technology Adoption, Job Matching Frictions and Business Creation, W.P. 30, University of Venice

Colciago, A. and L. Rossi, 2011, Endogenous Market Structures and Labor Market Dynamics, mimeo, University of Milano Bicocca

Costain, J. and M. Reiter, 2008, Business Cycles, Unemployment Insurance, and the Calibration of Matching Models, *Journal of Economic Dynamics and Control*, 32, 4, 1120-55

Davis, S.J., Haltiwanger, J.C. and Schuh, S., 1996, *Job Creation and Job Destruction*, The MIT Press,Cambridge

Den Haan, W., Ramey, G., Watson, J., 2000, Job Destruction and the Propagation of Shocks, *American Economic Review*, 90, 482-98

ECB, 2002, Labor Market Mismatches in the Euro Area Countries, European Central Bank

Etro, F., 2009a, The Economic Impact of Cloud Computing on Business Creation, Employment and Output in the E.U., *Review of Business and Economics*, 54, 2, 179-208

Etro, F., 2009b, *Endogenous Market Structures and the Macroeconomy*, New York and Berlin, Springer

Etro, F. and A. Colciago, 2010, Endogenous Market Structure and the Business Cycle, *The Economic Journal*, 120, 549, 1201-33

Etro, F., 2013, The Theory of Endogenous Market Structures, *Journal of Economic Surveys*, in press

European Commission, 2007, The European e-Business Report, 2006/07. *A portrait of e-business in 10 sectors of the EU economy, 5th Synthesis*

Report of the Sectoral e-Business Watch, Brussels, European Commission

Ghironi, F. and M. Melitz, 2005, International Trade and Macroeconomic Dynamics with Heterogenous Firms, *Quarterly Journal of Economics*, 120, 865-915

Hagedorn, M. and Manovski, J., 2008, The Cyclical Behavior of Equilibrium Unemployment and Vacancies Revisited, *American Economic Review*, 98, 4, 1692-706

Hall R., 1995, Lost Jobs, *Brookings Papers on Economic Activity*, Economic Studies Program, The Brookings Institution, 26, 221-74

Haltiwanger,J. C. Jarmin, R. S. and Miranda, J. 2010, Who Creates Jobs? Small vs. Large vs. Young, NBER Working Paper No. 16300

Jaimovich, N. and M. Floetotto, 2008, Firm Dynamics, mark up Variations, and the Business Cycle, *Journal of Monetary Economics*, 55, 7, 1238-52

Kydland, F. and E. Prescott, 1982, Time to Build and Aggregate Fluctuations, *Econometrica*, 50, 6, 1345-70

Lee, Y. and T. Mukoyama, 2012, Entry, Exit, and Plant-level Dynamics over the Business Cycle, mimeo, Federal Reserve Bank of Cleveland

Merz, Monica, 1995, Search in the Labor Market and the Real Business Cycle, *Journal of Monetary Economics*, 36, 269-300

Mortensen, D. and C. Pissarides, 1994, Job Creation and Job Destruction in the Theory of Unemployment, *Review of Economic Studies*, 61, 3, 397-415

Oliveira Martins, J. and S. Scarpetta, 1999, The level and Cyclical Behavior of Mark-ups Across Countries and Market Structures, OECD Working Paper No. 213, OECD Publishing

Petrongolo, B. and C. Pissarides, 2001, Looking into the Black Box: A Survey of the Matching Function, *Journal of Economic Literature*, 39, 2, 390-431

Pissarides, Christopher, 2000, *Equilibrium Unemployment Theory*, Cambridge: MIT Press

Shimer, R., 2005, The Cyclical Behavior of Equilibrium Unemployment and Vacancies, *American Economic Review*, 95, 1, 25-49

Thomas, C., and F. Zanetti (2009), Labor Market Reform and Price Stability: An Application to the Euro Area, *Journal of Monetary Economics*, 56, 6, 885-99

Trigari, A., 2009, Equilibrium Unemployment, Job flows and Inflation Dynamics, *Journal of Money, Credit and Banking*, 41, 1, 1-33

Appendix

Appendix A: Model Appendix

Aggregation and Market Clearing

Considering that sectors are symmetric and have a unit mass, the sectoral number of firms and new entrants also represents their aggregate counterpart. Thus, the dynamics of the aggregate number of firms is

$$N_t = (1-\delta)\left(N_t + N_t^e\right)$$

As aggregate expenditure and sectoral expenditure are identical, it follows that $EXP_t = \sum_{i=1}^{N_t} p_t y_t = N_t p_t y_t$. Considering $\rho_t = p_t/P_t$ and the individual production function we obtain

$$Y_t = \rho_t N_t y_t = \rho_t A_t \left(IT_{t-1}^A\right)^{\alpha} \left(N_t n_t h_t\right)^{1-\alpha} \tag{33}$$

The aggregate production function features a form of increasing returns. In this case a productivity shock impacts directly on output, but also through the firm creation channel. Total vacancies posted at period t are

$$v_t^{tot} = (1-\delta) N_{t-1} v_t + (1-\delta) N_{t-1}^e v_{t-1}^{new} + v_t^{IPC},$$

where $(1-\delta) N_{t-1}$ is the number of incumbent producers, $(1-\delta) N_{t-1}^e$ is the number of new firms and v^{IPC} is the total number of vacancies posted by the IPC. Aggregating the budget constraints of households we obtain the aggregate resource constraint of the economy

$$C_t + \left(\phi^{ad} + p_t^{IT}\frac{IT_t}{N_t}\right) N_t^e + I_t^k = w_t h_t L_t + r_t^k K_{t-1} + \Pi_t \tag{34}$$

which states that the sum of consumption and investment in new entrants and capital must equal the sum between labor income and aggregate profits, Π_t, distributed to households at time t. Aggregate profits are defined as[44]

$$\Pi_t = (1-\delta) N_{t-1} \pi_t + (1-\delta) N_{t-1}^e \pi_t^{new} \tag{35}$$

where

$$\pi_t = \rho_t y_t - w_t n_t h_t - \kappa v_t - p_t^{IPC}\frac{m}{A_t^{IT}} IT_{t-1} - p_t^{IT} I_t^{IT}$$

and

$$\pi_t^{new} = \rho_t y_t - w_t n_t h_t - \kappa v_t^{new} - p_t^{IPC}\frac{m}{A_t^{IT}} IT_{t-1} - p_t^{IT} I_t^{IT}$$

[44] Since the producer of IT material and the provider of IT services operate in perfect competition they make no profits.

In this case

$$\Pi_t = (1-\delta)\, N_{t-1}\left[\rho_t y_t - w_t n_t h_t - \kappa v_t - p_t^{IPC}\frac{m}{A_t^{IT}} IT_{t-1} - p_t^{IT} I_t^{IT}\right] +$$
$$+ (1-\delta)\, N_{t-1}^{e}\left[\rho_t y_t - w_t n_t h_t - \kappa v_t^{new} - p_t^{IPC}\frac{m}{A_t^{IT}} IT_{t-1} - p_t^{IT} I_t^{IT}\right]$$

Since $IT_{t-1}^{A} = N_t IT_{t-1}$, and defining

$$v_t^F = (1-\delta)\, N_{t-1} v_t + (1-\delta)\, N_{t-1}^{e} v_t^{new}$$

as the number of vacancies created by the producers of the final good, it follows that

$$\Pi_t = Y_t - w_t N_t n_t h_t - p_t^{IPC}\frac{m}{A_t^{IT}} IT_{t-1}^{A} - p_t^{IT} N_t I_t^{IT} - \kappa v_t^F$$

Notice that

$$p_t^{IMC} h_t = \frac{\kappa}{q_t} - \varrho \Lambda_{t,t+1}\frac{\kappa}{q_{t+1}} + w_t h_t$$

hence

$$\Pi_t = Y_t - w_t N_t n_t h_t - w_t\left(\frac{m}{A_t^{IT}} IT_{t-1}^{A}\right) +$$
$$- \left(\frac{\kappa}{q_t} - \varrho \Lambda_{t,t+1}\frac{\kappa}{q_{t+1}}\right)\frac{1}{h_t}\left(\frac{m}{A_t^{IT}} IT_{t-1}^{A}\right) - p_t^{IT} N_t I_t^{IT} - \kappa v_t^F$$

Since $M_t = n_t^{IPC} h_t = \left(m/A_t^{IT}\right) IT_{t-1}^{A}$, we can express aggregate profits as

$$\Pi_t = Y_t - w_t N_t n_t h_t - w_t n_t^{IPC} h_t - \left(\frac{\kappa}{q_t} - \varrho \Lambda_{t,t+1}\frac{\kappa}{q_{t+1}}\right) n_t^{IPC} - p_t^{IT} N_t I_t^{IT} - \kappa v_t^F$$

The aggregate number of workers is $L_t = n_t N_t + n^{IPC}$, which leads finally to

$$\Pi_t = Y_t - w_t L_t h_t - \left(\frac{\kappa}{q_t} - \varrho \Lambda_{t,t+1}\frac{\kappa}{q_{t+1}}\right) n_t^{IPC} - p_t^{IT} N_t I_t^{IT} - \kappa v_t^F$$

As a result, the clearing of the market for the final good requires

$$C_t + \left(\phi^{ad} + p_t^{IT}\frac{IT_t^A}{N_t}\right) N_t^e + I_t^k \tag{36}$$
$$= r_t^k K_{t-1} + Y_t - \left(\frac{\kappa}{q_t} - \varrho \Lambda_{t,t+1}\frac{\kappa}{q_{t+1}}\right) n_t^{IPC} - p_t^{IT} N_t I_t^{IT} - \kappa v_t^F \tag{37}$$

or

$$C_t + \phi^{ad} N_t^e + p_t^{IT} \left(\frac{IT_t^A}{N_t} N_t^e + N_t I_t^{IT} \right) + I_t^k \tag{38}$$

$$= r_t^k K_{t-1} + Y_t - \frac{\kappa}{q_t} \frac{m}{A_t^{IT}} \frac{IT_{t-1}}{h_t} + \varrho \Lambda_{t,t+1} \frac{\kappa}{q_{t+1}} \frac{m}{A_t^{IT}} \frac{IT_{t-1}}{h_t} - \kappa v_t^F \tag{39}$$

Notice that the total IT produced at time t must be equal to the sum between investment by incumbent firms and that of new entrants, that is

$$\Delta IT_t^A = \frac{IT_t^A}{N_t} N_t^e + N_t I_t^{IT}$$

thus, using $\Delta IT_t^A = A_t^{IT} K_{t-1}$ and $p_t^{IT} = \frac{r_t^k}{A_t^{IT}}$, it follows

$$C_t + \phi^{ad} N_t^e + I_t^k = Y_t - \frac{\kappa}{q_t} \frac{m}{A_t^{IT}} \frac{IT_{t-1}}{h_t} + \varrho \Lambda_{t,t+1} \frac{\kappa}{q_{t+1}} \frac{m}{A_t^{IT}} \frac{IT_{t-1}}{h_t} - \kappa v_t^F$$

and finally

$$Y_t = C_t + \phi^{ad} N_t^e + I_t^k + \kappa v_t^F + \left(\frac{\kappa}{q_t} - \varrho \Lambda_{t,t+1} \frac{\kappa}{q_{t+1}} \right) \frac{m}{A_t^{IT}} \frac{IT_{t-1}}{h_t} \tag{40}$$

The dynamics of the aggregate stock of IT reads as follows

$$IT_t^A = (1 - \delta) \left[\left(1 - \delta^{IT} \right) IT_{t-1}^A + \Delta IT_t^A \right]$$

Equilibrium conditions

This section reports the conditions defining the equilibrium of the model economy.

$$\mu_t (\varepsilon, N_t) = \frac{\varepsilon (N_t - 1) + 1}{(\varepsilon - 1)(N_t - 1)}$$

$$\rho_t = N_t^{\frac{1}{\theta - 1}}$$

$$Y_t = A_t \left(IT_{t-1}^A \right)^{\alpha} (N_t n_t h_t)^{1-\alpha}$$

$$y_t = \frac{Y_t}{\rho_t N_t}$$

$$Y_t = C_t + \phi^{ad} N_t^e + I_t^k + \kappa v_t^F + \left(\frac{\kappa}{q_t} - \varrho \Lambda_{t,t+1} \frac{\kappa}{q_{t+1}} \right) \frac{m}{A_t^{IT}} \frac{IT_{t-1}}{h_t} + \tag{41}$$

$$p_t^{IT} = \frac{r_t^k}{A_t^{IT}}$$

$$K_t = \left(1-\delta^k\right) K_{t-1} + I_t^k$$

$$v_t^{tot} = v_t^i + v_t^e + v_t^{IPC}$$

$$v_t^e = (1-\delta)\frac{N_{t-1}^e}{N_t}\frac{N_t n_t}{q_t}$$

$$N_t^e = \frac{N_{t+1}}{(1-\delta)} - N_t$$

$$L_t = N_t n_t + n_t^{IMC}$$

$$n_t = \rho n_{t-1} + v_t^i\,(i)\,q_t$$

$$n_t^{IPC} = \rho n_{t-1}^{IPC} + v_t^{IPC} q_t$$

$$n_t^{IMC} = \frac{m}{A_t^{IT}}\frac{IT_t}{h_t}$$

$$\frac{\kappa}{q_t} = (1-\alpha)\,\frac{\rho_t}{\mu_t} A_t \left(\frac{IT_{t-1}}{n_t h_t}\right)^{\alpha} h_t - w_t h_t + \varrho E_t \Lambda_{t,t+1}\frac{\kappa}{q_{t+1}}$$

$$q_t = \gamma_m \theta_t^{-\gamma}$$

$$w_t h_t = (1-\eta)\,b + (1-\eta)\,\chi C_t \frac{h_t^{1+1/\varphi}}{1+1/\varphi} + \\ + \frac{\eta\kappa}{1-\delta} E_t \Lambda_{t,t+1}\theta_{t+1} + (1-\alpha)\,\eta\frac{\rho_t}{\mu_t} A_t \left(\frac{IT_{t-1}^A}{N_t n_t h_t}\right)^{\alpha} h_t$$

$$\theta_t = \frac{v_t^{tot}}{(1-L_{t-1})}$$

$$\frac{1}{C_t} = \beta(1+r_t)\frac{1}{C_{t+1}}$$

$$\frac{1}{C_t} = \beta(1+r_t^k-\delta^k)\frac{1}{C_{t+1}}$$

$$V_t = (1-\delta)\,\beta\frac{C_t}{C_{t+1}}\left(\pi_{t+1} + V_{t+1}\right)$$

$$\phi_t^e = (1-\delta)\,\beta\frac{C_t}{C_{t+1}}\left(\pi_{t+1}^{new} + V_{t+1}\right)$$

$$IT_t^A = (1-\delta\Phi)\left[\left(1-\delta^{IT}\right) IT_{t-1}^A + \Delta IT_t\right]$$

$$p_t^{IT} = (1-\delta)\,\beta\frac{C_t}{C_{t+1}}\left[\alpha\frac{\rho_{t+1}}{\mu_{t+1}} A_{t+1}\left(\frac{IT_t^A}{N_{t+1}n_{t+1}h_{t+1}}\right)^{\alpha-1} - p_{t+1}^{IPC}\frac{m}{A_{t+1}^{IT}} + p_{t+1}^{IT}\left(1-\delta^{IT}\right)\right]$$

$$\Delta IT_t = A_t^{IT} K_{t-1}$$

$$K_t = \left(1-\delta^k\right) K_{t-1} + I_t^k$$

$$\pi_t = \rho_t y_t - w_t n_t h_t - \kappa v_t\left(i\right) - p_t^{IPC}\frac{m}{A_t^{IT}}\frac{IT_{t-1}^A}{N_t} - p_t^{IT} I_t^{IT}$$

$$I_t^{IT} = \frac{IT_t^A}{N_{t+1}} - \left(1-\delta^{IT}\right)\frac{IT_{t-1}^A}{N_t}$$

$$h_t = \left[\frac{\left(1-\alpha\right)^2}{\chi C_t}\frac{\rho_t}{\mu_t} A_t \left(\frac{IT_{t-1}^A}{N_t n_t h_t}\right)^{\alpha}\right]^{\varphi}$$

$$\Pi_t = \left(1-\delta\right) N_{t-1}\pi_t + \left(1-\delta\right) N_{t-1}^e \pi_t^{new}$$

$$\phi_t^e = \phi^{ad} + \Phi p_t^{IT}\frac{IT_t}{N_t}$$

Model Calibration

Calibration is conducted on a quarterly basis as in Shimer (2005) and Blanchard and Galì (2010) among others. The discount factor, β, is set to the standard value of 0.99. The exit rate is set at $\delta = 0.025$ which implies an yearly rate of business destruction rate of 10 percent as reported by Bilbiie *et al.* (2012) for the US. The baseline value for the entry cost is set such that the ratio of investment in new firms and physical capital is close to 15 per cent, as in Bilbiie *et al.* (2012). The implied steady state price markup is about 35 per cent. This value is within the range estimated by Oliveira Martins and Scarpetta (1999) for a large number of U.S. manufacturing sectors. With no loss of generality, the value of χ is such that steady state hours equals one. In this case the Frisch elasticity of labor supply reduces to φ, to which we assign a low value of 0.5 in line with the evidence. We take as the baseline value for the intersectoral elasticity of substitution $\varepsilon = 6$, as estimated by Christiano, Eichenbaum and Evans (2005) using U.S. quarterly data between 1965 and 1995. We set $\alpha = 0.15$, which delivers a steady state labor income share equal to 65 percent, in line with the evidence. As standard in the literature we set the steady state marginal productivity of labor, A, to 1. The same value is set for the marginal productivity of capital in the IT producing sector, A^{IT}.

The elasticity of matches to unemployment is $\gamma = \frac{1}{2}$, within the range of the plausible values of 0.5 to 0.7 reported by Petrongolo and Pissarides (2001) in their survey of the literature on the estimation of the matching function. In the baseline parameterization we impose symmetry in bargaining and set $\eta = \frac{1}{2}$, as in the bulk of the literature.

Next we turn to parameters that characterize the dynamics in the labor market. We set the efficiency parameter in matching, γ_m, and

the steady state job market tightness to target an average job finding rate, z, equal to 0.7 and a vacancy filling rate, q, equal to 0.9. We draw the latter value from Andolfatto (1996) and Dee Haan et al. (2000), while the former from Blanchard and Galì (2010). Since we consider a labor-leisure choice, the overall replacement rate is given by the sum of the unemployment insurance benefit and the disutility cost of working. We calibrate the latter to 0.4. We select a quarterly job separation rate equal to 0.1. Both the latter figures are consistent with Shimer (2005).

The cost of posting a vacancy κ is obtained by equating the steady state version of the JCC and the steady state wage setting equation. Finally we set $m = 0.025$ and $\delta^{IT} = 0.025$. These figures imply that data processing costs make up about 10 percent of the value of the IT stock each year, and that the IT stock of a firm fully depreciates in about ten years.

Finally we turn to the baseline calibration of Ξ and Φ, which determine the aggregate economic impact of the introduction of the regulation act. The calibration of these parameters differs according to the sector under analysis. To pin down Φ, we target the share of the overall increase in IT budget (reported in Table 2) which can be attributed to additional fixed costs. Consider for example the Real Estate, Renting and Business Activities sector. The overall change in IT budget for the typical firm is estimated to be 7265 euros per year, 2763 of which are attributable to fixed cost, as reported in Figure 3. Hence 38 percent of the change in the IT budget is due to fixed costs. We target this ratio in order to fix the parameter Φ. The remaining change in the IT budget is due to a change in variable costs which can be target by choosing an appropriate value of Ξ.

Appendix B

The table below provides the estimated percent of firms impacted in each sector by the various articles in the EU Data Protection Regulation. The figures were calculated by first assessing the percentage of firms impacted in the subsectors within an industrial sector and then taking a weighted average.

Percent of Firms Impacted in each Industrial Sector*

Article Group	Transport, storage and communications	Hotels and Restaurants	Real estate, renting and business activities	Wholesale and retail trade; repair of motor vehicles and motorcycles	Across all 5 industrial sectors (includes manufacturing)
23, 33	4%	5%	11%	10%	8%
34	4%	5%	11%	10%	8%
31, 32	4%	5%	11%	10%	8%
12, 17, 18	4%	5%	11%	10%	8%
11	4%	5%	11%	10%	8%
77	1%	1%	3%	3%	2%
43	1%	1%	3%	3%	2%
24, 25	1%	1%	3%	3%	2%
7	27%	99%	34%	66%	48%
5, 19, 20	27%	99%	34%	66%	48%
8	7%	0%	5%	20%	9%
28, 35, 36, 37,	2%	0%	10%	0%	4%
55, 56, 57, 58, 76	0.1%	0.1%	0.3%	0.3%	0.2%
79	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%

*No firms related to manufacturing are thought to be impacted and all percentages for this sector will be zero.

From the table above, one can see that there are logical groupings among certain article groups related to the nature of the legislation. For example all articles related to the transfer of data between EU member states will impact the same subset of firms (Articles 77,43, 24, and 25). It should also be noted that the percentages across all 5 industrial sectors would be higher if manufacturing were excluded since none of the article groups impact this industrial sector.

Appendix C

In the appendix below, we have provided details on the calculations for estimating the total economic cost of the relevant article groups as well as the estimated average cost for an SME. To calculate the total impact, we first determined the industrial subsectors within each of the 5 industrial sectors that will be affected by the article group (using NACE_Revision 2 data from the EU). Within each individual industrial subsector we multiplied number of SME's impacted by the estimated cost faced by an impacted firm. Depending on the article group, these calculations were sometimes also weighted by the size of the firm (micro, small or medium). Finally the costs across the affected industrial subsectors were summed up to obtain the total cost impact for each industrial sector. This data is shown in the first table for each article group. The average cost per SME values (used in the model) were calculated by taking the total cost impact in each industrial sector and dividing it by the total number of SMEs in the industrial sector (not just the SMEs in the subcategories impacted). The average cost per SME data is shown in the second table for each article group.

Articles 5, 19, 20

Cost Impact of Articles 5, 19, 20

Transport, storage and communications		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (18,800 x 11% x [a])
Passenger air transport	3,166	€ 6,547,288
Motion picture, video and television programme activities	76,342	€ 157,875,256
Sound recording and music publishing activities	18,884	€ 39,052,112
Television programming and broadcasting activities	5,238	€ 10,832,184
Wireless telecommunications activities	5,772	€ 11,936,496
Satellite telecommunications activities	70	€ 144,760
Computer programming, consultancy and related activities	314,000	€ 649,352,000
Data processing, hosting and related activities; web portals	31,774	€ 65,708,632
Other information service activities	7,040	€ 14,558,720
Total impact to Transport, storage and communications		€ 956,007,448

Hotels and Restaurants		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (18,800 x 11% x [a])
Hotels and similar accommodation	150,729	€ 311,707,572
Holiday and other short-stay accommodation	85,974	€ 177,794,232
Other accommodation	10,322	€ 21,345,896
Restaurants and mobile food service activities	815,758	€1,686,987,544
Event catering and other food service activities	63,972	€ 132,294,096
Beverage serving activities	606,526	€ 1,254,295,768
Total impact to Hotels and Restaurants		€ 3,584,425,108

Real estate, renting and business activities		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (18,800 x 11% x [a])
Buying and selling of own real estate	93,274	€ 192,890,632
Renting and operating of own or leased real estate	664,702	€ 1,374,603,736
Advertising	217,905	€ 450,627,540
Market research and public opinion polling	34,342	€ 71,019,256
Renting and leasing of motor vehicles	31,758	€ 65,675,544
Renting and leasing of personal and household goods	40,814	€ 84,403,352
Activities of employment placement agencies	24,509	€ 50,684,612
Temporary employment agency activities	31,253	€ 64,631,204
Travel agency and tour operator activities	65,090	€ 134,606,120
Cleaning activities	187,529	€ 387,809,972
Landscape service activities	122,434	€ 253,193,512
Organisation of conventions and trade shows	31,257	€ 64,639,476
Business support service activities n.e.c.	261,874	€ 541,555,432
Total impact to Real estate, renting and business activities		€ 3,736,340,388

Wholesale and retail trade; repair of motor vehicles and motorcycles		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (18,800 x 11% x [a])
Retail sale of other goods in specialised stores	1,145,144	€ 2,368,157,792
Retail sale in non-specialised stores	553,379	€ 1,144,387,772
Retail sale of food, beverages and tobacco in specialised stores	476,437	€ 985,271,695
Retail sale of other household equipment in specialised stores	465,486	€ 962,625,048
Retail sale via stalls and markets	349,487	€ 722,739,116
Retail sale of cultural and recreation goods in specialised stores	210,406	€ 435,119,608
Sale of motor vehicles	196,497	€ 406,355,796
Retail trade not in stores, stalls or markets	185,919	€ 384,480,492
Sale of motor vehicle parts and accessories	111,119	€ 229,794,092
Retail sale of information and communication equipment in specialised stores	97,222	€ 201,055,096
Retail sale of automotive fuel in specialised stores	71,696	€ 148,267,328
Sale, maintenance and repair of motorcycles and related parts and accessories	37,431	€ 77,407,308
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles		€ 8,056,661,143

Total Impact across all 5 industries	€ **16,3452,434,087**

Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average cost per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 956,007,448	€ 565
Hotels and Restaurants	1,749,151	€ 3,584,425,108	€ 2,049
Real estate, renting and business activities	5,385,648	€ 3,736,340,388	€ 694
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 8,056,661,143	€ 1,366

Articles 28, 35, 36, 37

Cost Impact of Articles 35, 36, 37

Transport, storage and communications				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (25,000 x [a] + 50,000 x [b] + 50,000 x [c])
Data processing, hosting and related activities; web portals	27,118	3,982	674	€ 910,750,000
Total impact to Transport, storage and communications				€ 910,750,000

Real estate, renting and business activities				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (25,000 x [a] + 50,000 x [b] + 50,000 x [c])
Accounting, bookkeeping and auditing activities; tax consultancy	481,115	22,985	0	€ 13,177,125,000
Market research and public opinion polling	32,515	1,827	0	€ 904,225,000
Other human resources provision	2,000	1,128	900	€ 151,400,000
Private security activities	10,083	5,422	2,464	€ 646,375,000
Total Impact to Real estate, renting and business activities				€ 14,879,125,000
Total Impact across all 5 industries (sum of transport and real estate)				**€ 15,789,875,000**

The costs for Article 28 were calculated in a similar manner described above. They impacted the same businesses as those impacted by the DPO (Articles 28, 35, 36, 37). When those costs are added in to the costs of Articles 35, 36, 37, we have the final average cost per firm values shown below.

Average Cost per SME (including Article 28)

Industrial Sector	Total Expected Cost of Compliance for SME
Transport, storage and communications	€594
Hotels and restaurants	€0
Real estate, renting and business activities	€3,017
Manufacturing	€0
Wholesale and retail trade	€0

Articles 23, 33

Cost Impact of Articles 23, 33

Transport, storage and communications				
Industrial Sector	# of SMEs [a]	Expected Cost per firm (euros)[b]		Total Cost Impact ([a] x [b])(euros)
Passenger rail transport, interurban	256	14000		€ 3,584,000
Passenger air transport	3,166	14000		€ 44,324,000
Wired telecommunications activities	11,071	14000		€ 154,994,000
Wireless telecommunications activities	5,772	34000		€ 196,248,000
Satellite telecommunications activities	70	34000		€ 2,380,000
Other telecommunications activities	21,664	14000		€ 303,296,000
Data processing, hosting and related activities; web portals	31,774	34000		€ 1,080,316,000
Total impact to Transport, storage and communications				€ 1,785,142,000

Hotels and Restaurants				
Industrial Sector	# of SMEs [a]	Expected Cost per firm (euros)[b]		Total Cost Impact ([a] x [b])(euros)
Holiday and other short-stay accommodation	85,974	14000		€ 1,203,636,000
Total impact to Hotels and Restaurants				€ 1,203,636,000

Real estate, renting and business activities				
Industrial Sector	# of SMEs [a]	Expected Cost per firm (euros)[b]		Total Cost Impact ([a] x [b])(euros)
Accounting, bookkeeping and auditing activities; tax consultancy	504,100	14,000		€ 7,057,400,000
Market research and public opinion polling	34,342	14,000		€ 480,788,000
Temporary employment agency activities	31,253	14,000		€ 437,542,000
Other human resources provision	4,028	14,000		€ 56,392,000
Private security activities	17,969	149,000		€ 2,677,381,000
Security systems service activities	8,237	149,000		€ 1,227,313,000
Activities of call centres	7,361	14,000		€ 103,054,000
Total impact to Real estate, renting and business activities				€ 12,039,870,000

Wholesale and retail trade; repair of motor vehicles and motorcycles				
Industrial Sector	# of SMEs [a]	Expected Cost per firm (euros)[b]		Total Cost Impact ([a] x [b])(euros)
Maintenance and repair of motor vehicles	419,998	14,000		€ 5,879,972,000
Sale of motor vehicles	196,497	14,000		€ 2,750,958,000
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles				€ 8,630,930,000

Total Impact across all 5 industries	€ **23,659,575,000**

Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average cost per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 1,785,142,000	€ 1,056
Hotels and Restaurants	1,749,151	€ 1,203,636,000	€ 688
Real estate, renting and business activities	5,385,648	€ 12,039,870,000	€ 2,236
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 8,630,930,000	€ 1,462

Article 7

Cost Impact of Article 7

Transport, storage and communications		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (633x [a])
Passenger air transport	3,166	€ 2,004,078.00
Motion picture, video and television programme activities	76,342	€ 48,324,486.00
Sound recording and music publishing activities	18,884	€ 11,953,572.00
Television programming and broadcasting activities	5,238	€ 3,315,654.00
Wireless telecommunications activities	5,772	€ 3,653,676.00
Satellite telecommunications activities	70	€ 44,310.00
J620 - Computer programming, consultancy and related activities	314,000	€ 198,762,000.00
Data processing, hosting and related activities; web portals	31,774	€ 20,112,942.00
Other information service activities	7,040	€ 4,456,320.00
Total impact to Transport, storage and communications		€ 292,627,038

Hotels and Restaurants		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (633x [a])
Hotels and similar accommodation	150,729	€ 95,411,457.00
Holiday and other short-stay accommodation	85,974	€ 54,421,542.00
Other accommodation	10,322	€ 6,533,826.00
Restaurants and mobile food service activities	815,758	€ 516,374,814.00
Event catering and other food service activities	63,972	€ 40,494,276.00
Beverage serving activities	606,526	€ 383,930,958.00
Total impact to Hotels and Restaurants		€ 1,097,166,873

Real estate, renting and business activities		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (633x [a])
Buying and selling of own real estate	93,274	€ 59,042,442.00
Renting and operating of own or leased real estate	664,702	€ 420,756,366.00
Advertising	217,905	€ 137,933,865.00
Market research and public opinion polling	34,342	€ 21,738,486.00
Renting and leasing of motor vehicles	31,758	€ 20,102,814.00
Renting and leasing of personal and household goods	40,814	€ 25,835,262.00
Activities of employment placement agencies	24,509	€ 15,514,197.00
Temporary employment agency activities	31,253	€ 19,783,149.00
Travel agency and tour operator activities	65,090	€ 41,201,970.00
Cleaning activities	187,529	€ 118,705,857.00
Landscape service activities	122,434	€ 77,500,722.00
Organisation of conventions and trade shows	31,257	€ 19,785,681.00
Business support service activities n.e.c.	261,874	€ 165,766,242.00
Total impact to Real estate, renting and business activities		€ 1,143,667,053

Wholesale and retail trade; repair of motor vehicles and motorcycles		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (633x [a])
Retail sale of other goods in specialised stores	1,145,144	€ 724,876,152.00
Retail sale in non-specialised stores	553,379	€ 350,288,907.00
Retail sale of food, beverages and tobacco in specialised stores	476,437	€ 301,584,614.67
Retail sale of other household equipment in specialised stores	465,486	€ 294,652,638.00
Retail sale via stalls and markets	349,487	€ 221,225,271.00
Retail sale of cultural and recreation goods in specialised stores	210,406	€ 133,186,998.00
Sale of motor vehicles	196,497	€ 124,382,601.00
Retail trade not in stores, stalls or markets	185,919	€ 117,686,727.00
Sale of motor vehicle parts and accessories	111,119	€ 70,338,327.00
Retail sale of information and communication equipment in specialised stores	97,222	€ 61,541,526.00
Retail sale of automotive fuel in specialised stores	71,696	€ 45,383,568.00
Sale, maintenance and repair of motorcycles and related parts and accessories	37,431	€ 23,693,823.00
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles		€ 2,468,841,153

Total Impact across all 5 industries	**€ 5,002,302,116**

Table 1. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average cost per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 243,167,459	€ 173
Hotels and Restaurants	1,749,151	€ 171,787,242	€ 627
Real estate, renting and business activities	5,385,648	€ 1,143,667,053	€ 212
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 2,468,841,153	€ 418

Article 8

Table 2. Cost Impact of Article 8

Transport, storage and communications				
Industrial Sector	# of SMEs [a]	Weighting factor [b]	Estimated Cost (euros) [c]	Total Cost Impact ([a] x [b] x [c])
Motion picture, video and television programme activities	76,342	0.20	633	€ 9,664,897
Sound recording and music publishing activities	18,884	0.20	633	€ 2,390,714
Television programming and broadcasting activities	5,238	0.20	633	€ 663,131
Wireless telecommunications activities	5,772	0.20	633	€ 730,735
Satellite telecommunications activities	70	1.00	633	€ 44,310
Computer programming, consultancy and related activities	314,000	0.20	633	€ 39,752,400
Data processing, hosting and related activities; web portals	31,774	1.00	633	€ 20,112,942
Total impact to Transport, storage and communications				€ 73,359,130

Real estate, renting and business activities				
Industrial Sector	# of SMEs [a]	Weighting factor [b]	Estimated Cost (euros) [c]	Total Cost Impact ([a] x [b] x [c])
Advertising	217,905	1.00	633	€ 137,933,865
Market research and public opinion polling	34,342	1.00	633	€ 21,738,486
Total Impact to Real estate, renting and business activities				€ 159,672,351

Wholesale and retail trade; repair of motor vehicles and motorcycles				
Industrial Sector	# of SMEs [a]	Weighting factor [b]	Estimated Cost (euros) [c]	Total Cost Impact ([a] x [b] x [c])
Retail sale of other goods in specialised stores	1,145,144	0.20	633	€ 144,975,230
Retail sale in non-specialised stores	553,379	0.20	633	€ 70,057,781
Retail sale of food, beverages and tobacco in specialised stores	476,437	1.00	633	€ 301,584,615
Retail sale of other household equipment in specialised stores	465,486	0.20	633	€ 58,930,528
Retail sale of cultural and recreation goods in specialised stores	210,406	1.00	633	€ 133,186,998
Retail trade not in stores, stalls or markets	185,919	0.20	633	€ 23,537,345
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles				€ 737,272,497

Total Impact across all 5 industries	**€ 965,303,978**

Table 3. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average cost per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 73,359,130	€ 43
Real estate, renting and business activities	5,385,648	€ 159,672,351	€ 30
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 737,272,497	€ 124

Articles 12, 17, 18

Table 4. Cost Impact of Articles 12, 17, 18

Transport, storage and communications				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (1,558 x [a] + 14,433 x [b] + 25,933 x [c])
Passenger rail transport, interurban	182	19	55	€ 1,984,098
Passenger air transport	2,639	361	166	€ 13,626,753
Wired telecommunications activities	9,931	890	250	€ 34,801,118
Wireless telecommunications activities	5,323	345	104	€ 15,969,651
Satellite telecommunications activities	0	42	28	€ 1,332,310
Other telecommunications activities	20,021	1,352	291	€ 58,252,637
Data processing, hosting and related activities; web portals	27,118	3,982	674	€ 117,200,892
Total impact to Transport, storage and communications				€ 243,167,459

Hotels and Restaurants				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (1,558 x [a] + 14,433 x [b] + 25,933 x [c])
Holiday and other short-stay accommodation	83,244	2,496	234	€ 171,787,242
Total impact to Hotels and Restaurants				€ 171,787,242

Real estate, renting and business activities				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (1,558 x [a] + 14,433 x [b] + 25,933 x [c])
Accounting, bookkeeping and auditing activities; tax consultancy	481,115	22,985	0	€ 1,081,319,675
Market research and public opinion polling	32,515	1,827	0	€ 77,027,461
Temporary employment agency activities	20,058	7,131	4,064	€ 239,563,799
Other human resources provision	2,000	1,128	900	€ 42,736,124
Private security activities	10,083	5,422	2,464	€ 157,863,952
Security systems service activities	6,816	1,118	303	€ 34,613,121
Activities of call centres	5,313	1,399	649	€ 45,299,938
Total impact to Real estate, renting and business activities				€ 1,678,424,070

Wholesale and retail trade; repair of motor vehicles and motorcycles				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (1,558 x [a] + 14,433 x [b] + 25,933 x [c])
Maintenance and repair of motor vehicles	398,215	20,908	875	€ 944,875,509
Sale of motor vehicles	168,780	22,573	5,144	€ 722,154,701
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles				€ 1,667,030,210

Total Impact across all 5 industries	**€ 3,760,408,981**

Table 5. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average cost per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 243,167,459	€ 144
Hotels and Restaurants	1,749,151	€ 171,787,242	€ 98
Real estate, renting and business activities	5,385,648	€ 1,678,424,070	€ 312
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 1,667,030,210	€ 282

Articles 31, 32

Table 6. Cost Impact of Articles 31, 32

Transport, storage and communications				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (8,750 x [a] + 17,500 x [b] + 35,000 x [c])
Passenger rail transport, interurban	182	19	55	€ 3,850,000
Passenger air transport	2,639	361	166	€ 35,218,750
Wired telecommunications activities	9,931	890	250	€ 111,221,250
Wireless telecommunications activities	5,323	345	104	€ 56,253,750
Satellite telecommunications activities	0	42	28	€ 1,715,000
Other telecommunications activities	20,021	1,352	291	€ 209,028,750
Data processing, hosting and related activities; web portals	27,118	3,982	674	€ 330,557,500
Total impact to Transport, storage and communications				€ 787,845,000

Hotels and Restaurants				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (8,750 x [a] + 17,500 x [b] + 35,000 x [c])
Holiday and other short-stay accommodation	83,244	2,496	234	€ 780,255,000
Total impact to Hotels and Restaurants				€ 780,255,000

Real estate, renting and business activities				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (8,750 x [a] + 17,500 x [b] + 35,000 x [c])
Accounting, bookkeeping and auditing activities; tax consultancy	481,115	22,985	0	€ 4,611,993,750
Market research and public opinion polling	32,515	1,827	0	€ 316,478,750
Temporary employment agency activities	20,058	7,131	4,064	€ 442,540,000
Other human resources provision	2,000	1,128	900	€ 68,740,000
Private security activities	10,083	5,422	2,464	€ 269,351,250
Security systems service activities	6,816	1,118	303	€ 89,810,000
Activities of call centres	5,313	1,399	649	€ 93,686,250
Total impact to Real estate, renting and business activities				€ 5,892,600,000

Wholesale and retail trade; repair of motor vehicles and motorcycles				
Industrial Sector	# of micro firms [a]	# of small firms [b]	# of medium firms [c]	Total Cost Impact (8,750 x [a] + 17,500 x [b] + 35,000 x [c])
Maintenance and repair of motor vehicles	398,215	20,908	875	€ 3,880,896,250
Sale of motor vehicles	168,780	22,573	5,144	€ 2,051,892,500
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles				€ 5,932,788,750

Total Impact across all 5 industries	**13,353,488,750**

Table 7. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average cost per SME [b]/[a] + €100
Transport, storage and communications	1,690,890	€ 787,845,000	€ 542
Hotels and Restaurants	1,749,151	€ 780,255,000	€ 546
Real estate, renting and business activities	5,385,648	€ 5,892,600,000	€ 1,194
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 5,932,788,750	€ 1,105

Article 11

Table 8. Cost Impact of Article 11

Transport, storage and communications		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (633x [a]) (in euros)
Passenger rail transport, interurban	256	€ 537,600
Passenger air transport	3,166	€ 6,648,600
Wired telecommunications activities	11,071	€ 23,249,100
Wireless telecommunications activities	5,772	€ 12,121,200
Satellite telecommunications activities	70	€ 147,000
Other telecommunications activities	21,664	€ 45,494,400
Data processing, hosting and related activities; web portals	31,774	€ 66,725,400
Total impact to Transport, storage and communications		€ 154,923,300

Hotels and Restaurants		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (633x [a]) (in euros)
Holiday and other short-stay accommodation	85,974	€ 180,545,400
Total impact to Hotels and Restaurants		€ 180,545,400

Real estate, renting and business activities		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (633x [a]) (in euros)
Accounting, bookkeeping and auditing activities; tax consultancy	504,100	€ 1,058,610,000
Market research and public opinion polling	34,342	€ 72,118,200
Temporary employment agency activities	31,253	€ 65,631,300
Other human resources provision	4,028	€ 8,458,800
Private security activities	17,969	€ 37,734,900
Security systems service activities	8,237	€ 17,297,700
Activities of call centres	7,361	€ 15,458,100
Total impact to Real estate, renting and business activities		€ 1,275,309,000

Wholesale and retail trade; repair of motor vehicles and motorcycles		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (633x [a]) (in euros)
Maintenance and repair of motor vehicles	419,998	€ 881,995,800
Sale of motor vehicles	196,497	€ 412,643,700
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles		€ 1,294,639,500
Total Impact across all 5 industries		**€ 2,905,417,200**

Table 9. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average cost per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 154,923,300	€ 92
Hotels and Restaurants	1,749,151	€ 180,545,400	€ 103
Real estate, renting and business activities	5,385,648	€ 1,275,309,000	€ 237
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 1,294,639,500	€ 219

Article 34

Table 10. Cost Impact of Article 34

Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (1,489 x [a])
Transport, storage and communications		
Passenger rail transport, interurban	256	€ 381,235
Passenger air transport	3,166	€ 4,714,807
Wired telecommunications activities	11,071	€ 16,486,933
Wireless telecommunications activities	5,772	€ 8,595,662
Satellite telecommunications activities	70	€ 104,244
Other telecommunications activities	21,664	€ 32,262,029
Data processing, hosting and related activities; web portals	31,774	€ 47,317,841
Total impact to Transport, storage and communications		€ 109,862,752

Hotels and Restaurants		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (1,489 x [a])
I552 - Holiday and other short-stay accommodation	85,974	€ 128,032,481
Total impact to Hotels and Restaurants		€ 128,032,481

Real estate, renting and business activities		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (1,489 x [a])
Accounting, bookkeeping and auditing activities; tax consultancy	504,100	€ 750,705,720
Market research and public opinion polling	34,342	€ 51,142,106
Temporary employment agency activities	31,253	€ 46,541,968
Other human resources provision	4,028	€ 5,998,498
Private security activities	17,969	26,759,435
Security systems service activities	8,237	€ 12,266,540
Activities of call centres	7,361	€ 10,962,001
Total impact to Real estate, renting and business activities		€ 904,376,268

Wholesale and retail trade; repair of motor vehicles and motorcycles		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (1,489 x [a])
Maintenance and repair of motor vehicles	419,998	€ 625,461,022
Sale of motor vehicles	196,497	€ 292,623,332
		€ 918,084,354
Total Impact across all 5 industries		**€ 2,060,355,854**

Table 11. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average benefit per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 109,862,752	€ 65
Hotels and Restaurants	1,749,151	€ 128,032,481	€ 73
Real estate, renting and business activities	5,385,648	€ 904,376,268	€ 168
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 918,084,354	€ 156

Article 43

Table 12. Cost Impact of Article 43

Transport, storage and communications		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (45,000 x 0.24 x [a]) (in euros)
Passenger rail transport, interurban	256	€ 2,764,800
Passenger air transport	3,166	€ 34,192,800
Wired telecommunications activities	11,071	€ 119,566,800
Wireless telecommunications activities	5,772	€ 62,337,600
Satellite telecommunications activities	70	€ 756,000
Other telecommunications activities	21,664	€ 233,971,200
Data processing, hosting and related activities; web portals	31,774	€ 343,159,200
Total impact to Transport, storage and communications		€ 796,748,400

Hotels and Restaurants		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (45,000 x 0.24 x [a]) (in euros)
Holiday and other short-stay accommodation	85,974	€ 928,519,200
Total impact to Hotels and Restaurants		€ 928,519,200

Real estate, renting and business activities		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (45,000 x 0.24 x [a]) (in euros)
Accounting, bookkeeping and auditing activities; tax consultancy	504,100	€ 5,444,280,000
Market research and public opinion polling	34,342	€ 370,893,600
Temporary employment agency activities	31,253	€ 337,532,400
Other human resources provision	4,028	€ 43,502,400
Private security activities	17,969	€ 194,065,200
Security systems service activities	8,237	€ 88,959,600
Activities of call centres	7,361	€ 79,498,800
Total impact to Real estate, renting and business activities		€ 6,588,732,000

Wholesale and retail trade; repair of motor vehicles and motorcycles		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (45,000 x 0.24 x [a]) (in euros)
Maintenance and repair of motor vehicles	419,998	€ 4,535,978,400
Sale of motor vehicles	196,497	€ 2,122,167,600
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles		€ 6,658,146,000

Total Impact across all 5 industries	**€ 14,942,145,600**

Table 13. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Benefit of Articles [b]	Average benefit per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 796,748,400	€ 471
Hotels and Restaurants	1,749,151	€ 928,519,200	€ 531
Real estate, renting and business activities	5,385,648	€ 6,588,732,000	€ 1,128
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 6,658,146,000	€ 1,128

Articles 55, 56, 57, 76

Table 14. Cost Impact of Articles 55, 56, 57, 76

Transport, storage and communications		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (40,000 x 0.024 x [a]) (in euros)
Passenger rail transport, interurban	256	€ 245,760
Passenger air transport	3,166	€ 3,039,360
Wired telecommunications activities	11,071	€ 10,628,160
Wireless telecommunications activities	5,772	€ 5,541,120
Satellite telecommunications activities	70	€ 67,200
Other telecommunications activities	21,664	€ 20,797,440
Data processing, hosting and related activities; web portals	31,774	€ 30,503,040
Total impact to Transport, storage and communications		€ 70,822,080

Hotels and Restaurants		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (40,000 x 0.024 x [a]) (in euros)
Holiday and other short-stay accommodation	85,974	€ 82,535,040
Total impact to Hotels and Restaurants		€ 82,535,040

Real estate, renting and business activities		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (40,000 x 0.024 x [a]) (in euros)
Accounting, bookkeeping and auditing activities; tax consultancy	504,100	€ 483,936,000
Market research and public opinion polling	34,342	€ 32,968,320
Temporary employment agency activities	31,253	€ 30,002,880
Other human resources provision	4,028	€ 3,866,880
Private security activities	17,969	€ 17,250,240
Security systems service activities	8,237	€ 7,907,520
Activities of call centres	7,361	€ 7,066,560
Total impact to Real estate, renting and business activities		€ 582,998,400

Wholesale and retail trade; repair of motor vehicles and motorcycles		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (40,000 x 0.024 x [a]) (in euros)
Maintenance and repair of motor vehicles	419,998	€ 403,198,080
Sale of motor vehicles	196,497	€ 188,637,120
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles		€ 591,835,200

Total Impact across all 5 industries	**1,328,190,720**

Table 15. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average benefit per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 70,822,080	€ 42
Hotels and Restaurants	1,749,151	€ 82,535,040	€ 47
Real estate, renting and business activities	5,385,648	€ 582,998,400	€ 108
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 591,835,200	€ 100

Articles 24, 25

Table 16. Cost Impact of Articles 24, 25

Transport, storage and communications		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (5,000 x 29% x [a])
Passenger rail transport, interurban	256	€ 371,200
Passenger air transport	3,166	€ 4,590,700
Wired telecommunications activities	11,071	€ 16,052,950
Wireless telecommunications activities	5,772	€ 8,369,400
Satellite telecommunications activities	70	€ 101,500
Other telecommunications activities	21,664	€ 31,412,800
Data processing, hosting and related activities; web portals	31,774	€ 46,072,300
Total impact to Transport, storage and communications		€ 106,970,850

Hotels and Restaurants		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (5,000 x 29% x [a])
Holiday and other short-stay accommodation	85,974	€ 124,662,300
Total impact to Hotels and Restaurants		€ 3,584,425,108

Real estate, renting and business activities		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (5,000 x 29% x [a])
Accounting, bookkeeping and auditing activities; tax consultancy	504,100	€ 730,945,000
Market research and public opinion polling	34,342	€ 49,795,900
Temporary employment agency activities	31,253	€ 45,316,850
Other human resources provision	4,028	€ 5,840,600
Private security activities	17,969	€ 26,055,050
Security systems service activities	8,237	€ 11,943,650
Activities of call centres	7,361	€ 10,673,450
Total impact to Real estate, renting and business activities		€ 880,570,500

Wholesale and retail trade; repair of motor vehicles and motorcycles		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Cost Impact (5,000 x 29% x [a])
Maintenance and repair of motor vehicles	419,998	€ 608,997,100
Sale of motor vehicles	196,497	€ 284,920,650
Total impact to Wholesale and retail trade; repair of motor vehicles and motorcycles		€ 893,917,750

Total Impact across all 5 industries	**€ 2,006,121,400**

Table 17. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average benefit per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 106,970,850	€ 63
Hotels and Restaurants	1,749,151	€ 3,584,425,108	€ 71
Real estate, renting and business activities	5,385,648	€ 880,570,500	€ 164
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 893,917,750	€ 151

Article 77

Table 18. Cost Impact of Article 77

Transport, storage and communications		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (10,000 x 0.29 x [a]) (in euros)
Passenger rail transport, interurban	256	€ 742,400
Passenger air transport	3,166	€ 9,181,400
Wired telecommunications activities	11,071	€ 32,105,900
Wireless telecommunications activities	5,772	€ 16,738,800
Satellite telecommunications activities	70	€ 203,000
Other telecommunications activities	21,664	€ 62,825,600
Data processing, hosting and related activities; web portals	31,774	€ 92,144,600
Total impact to Transport, storage and communications		€ 213,941,700

Hotels and Restaurants		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (10,000 x 0.29 x [a]) (in euros)
Holiday and other short-stay accommodation	85,974	€ 249,324,600
Total impact to Hotels and Restaurants		€ 249,324,600

Real estate, renting and business activities		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (10,000 x 0.29 x [a]) (in euros)
Accounting, bookkeeping and auditing activities; tax consultancy	504,100	€ 1,461,890,000
Market research and public opinion polling	34,342	€ 99,591,800
Temporary employment agency activities	31,253	€ 90,633,700
Other human resources provision	4,028	€ 11,681,200
N801 - Private security activities	17,969	€ 52,110,100
Security systems service activities	8,237	€ 23,887,300
Activities of call centres	7,361	€ 21,346,900
Total impact to Real estate, renting and business activities		€ 1,761,141,000

Wholesale and retail trade; repair of motor vehicles and motorcycles		
Industrial Sector	# of firms (micro, small and medium)[a]	Total Benefit Impact (10,000 x 0.29 x [a]) (in euros)
Maintenance and repair of motor vehicles	419,998	€ 1,217,994,200
Sale of motor vehicles	196,497	€ 569,841,300
Total Impact to Wholesale and retail trade; repair of motor vehicles and motorcycles		€ 1,787,835,500

Total Impact across all 5 industries	**€ 4,012,242,800**

Table 19. Average Cost per SME

Industrial Sector	Total # of SMEs [a]	Total Cost of Articles [b]	Average benefit per SME [b]/[a]
Transport, storage and communications	1,690,890	€ 213,941,700	€ 127
Hotels and Restaurants	1,749,151	€ 249,324,600	€ 143
Real estate, renting and business activities	5,385,648	€ 1,761,141,000	€ 327
Wholesale and retail trade; repair of motor vehicles and motorcycles	5,903,649	€ 1,787,835,500	€ 303