The impact of the economic crisis on European SMEs

Does a country's innovativeness affect the reaction of enterprises to a major economic crisis?

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Contents

1 Introduction

Background

The crisis that started in autumn 2008 led to the most severe recession since more than 60 years. In EU, gross domestic production (GDP) fell by 4.2% in 2009. Production has declined in SMEs, but probably even more so in large enterprises: large enterprises are more oriented towards exports, which have declined more than domestic final demand. Employment levels also dropped in 2009, but not as strong as GDP levels. That the reduction in employment levels was less severe than the reduction in GDP levels, was possible (amongst others) because of a reduction in the number of hours worked per employee. For EU27, the employment growth rate in the first year after the crisis[1] was -2.1%, ranging from -14.7% for Latvia, -11.9% for Estonia and -8.1% for Lithuania and Ireland to 0.2% for Luxembourg (the only Member State with a positive growth rate over that period). (De Kok et al, 2011)

Since the start of the current crisis, unemployment rates within the EU have increased to 10.0% in December 2011 and 10.7% in December 2012. Again, the difference between Member States is considerable: the lowest unemployment rates were recorded in Austria (4.3 %), Germany and Luxembourg (both 5.3 %) and the Netherlands (5.8 %), and the highest rates in Greece (26.8 % in October 2012) and Spain (26.1 %). (Eurostat, 2012).

Lack of demand as major cause for increase in unemployment rates

A major cause for the current rise in unemployment levels is the reduction in the demand for products and services. By the end of 2010, 62% of all enterprises from the business economy of the European Union reported an overall negative impact of the economic crisis on total demand (De Kok et al, 2011). At the same time, this implies that almost 4 out of 10 enterprises did *not* report a negative impact of the economic crisis on total demand. This raises the question why some enterprises are faced with a reduction in demand whilst other are not. It stands to reason that this will partially depend on firm-specific factors (such as the reputation of a firm and/or its products) and country-specific factors (such as level and growth rate of a country's welfare). In addition, it is often argued that innovation may play an important role, not only at the enterprise level but also at country level.

Research question

In the current economic crisis, some enterprises are faced with a reduction in the demand for their products whilst others are not. The research question of this study is: to which extent does this depend on the innovativeness of the country of origin?

Regarding the innovativeness of a country, we will not only consider the average level of innovative activities, but also how even these innovative activities are distributed amongst the business economy of a country. This will be discussed in Chapter two. The research question will be examined for a sample of enterprises

[1] This refers to the employment growth between the final quarter of 2008 and the final quarter of 2009.

from 24 European countries; Chapter three presents the origins of this sample. The results of the empirical analysis are presented in Chapter four, after which Chapter five concludes with a summary of the main findings, limitations and suggestions for future research.

This paper reflects work in progress. The current version is mainly an empirical study that lacks a proper theoretical foundation. Such a foundation will be included in future versions of this paper.

2 Innovation and the impact of a major economic crisis

In case of a major crisis, innovation may be positive…

It is often assumed that innovation is an important means to overcome negative effects of an economic crisis. In this study, we will test to which extent the innovative activities of individual enterprises, as well as the average share of innovative enterprises within a country, help to soften the negative demand effects of a major economic crisis.

… but technological specialisation may have a negative overall effect

A high level of technological specialisation means that a country is highly innovative (and therefore competitive) in a limited number of technological fields, and (much) less innovative in many other fields (which may cover the greatest part of a country's economy). An important assumption that we want to examine in this study is that this would make them more vulnerable to an economic crisis, and lead to a relatively high share of enterprises that are faced with a serious reduction in the demand for their products and services.

In this study we will test the hypothesis that enterprises from highly specialized countries are more likely to be faced with a reduction in the demand for their products and services than enterprises from countries with a broader technological base of the economy. This effect is independent of the level of innovation in a country.

A model on the effects of innovation on the impact of the crisis on the demand for products and services by individual enterprises

The dependent variable that we want to explain, is whether individual enterprises were faced with an overall negative effect of the economic crisis on the demand for their products or services.

We will include enterprise characteristics and characteristics of the workforce as control variables in our model, however our main interest lies with innovation activities of individual enterprises, and technological specialisation and the average level of innovation activities at country level.

In addition, we will also examine the interaction between technological specialisation and the average level of innovation activities. By including the interaction term, we can examine to which extent the relationship between technological specialisation and being affected by the economic crisis is different for countries with different (average) levels of innovation. In the next chapter we will discuss the construction of these indicators.

3 Research Methodology

For this study, we have combined the results of a European enterprise survey with macro-economic statistics regarding the welfare and innovation of European countries. The origins of these data are presented in the first two sections of this chapter. The combination of these datasets resulted in a sample with observations on more than 4,000 SMEs for 24 European countries. In the final section we present descriptive statistics of this final sample.

3.1 Micro-economic data: Enterprise Survey 2010

The Enterprise Survey 2010 is a telephone survey that has been conducted during the final quarter of 2010 amongst more than 7,500 employer enterprises from 37 different European countries. The objective of the questionnaire was to obtain information on relevant indicators on the quantity and quality of jobs at enterprise level, and on the impact of (and the reaction to) the economic crisis that started in autumn 2008.[1]

Survey questionnaire

The questionnaire included questions on the following topics:

- general characteristics of the enterprise (including sector, age and innovative behaviour);
- general characteristics of the workforce (including decomposition by age, educational level and gender);
- indicators on quantity of jobs (including number of employees);
- indicators on quality of jobs (including the shares of employees with full-time contracts and of employees with fixed-term contracts);
- effects of the crisis (including various negative and positive effects encountered during the past twelve months, and layoffs due to the crisis).

The questionnaire asked for various negative effects of the crisis that might have occurred during the past two years[2]. This includes an under-utilisation of the labour force, increase in customers' payment terms, bankruptcy or closure of major business partners and shortage of working capital and/or long term finance. The main question was, however, whether enterprises were faced with an overall negative effect on the number of orders or total demand. This variable is used as the dependent variable for this study[3].

[1] This section contains a brief description of the Enterprise Survey 2010. It is based on the methodological paper by De Kok (2011), where more information regarding the Enterprise Survey 2010 can be found.

[2] Since the fieldwork took place in the final quarter of 2010, this implies that this question refers to the period that started in the final quarter of 2008, which can be seen as the starting-point of this economic crisis.

[3] Alternatively, changes in firm size (measured by number of employees) could be used as dependent variable. Available information is however limited to employment changes during the past year. Since the crisis started two years before the survey, this variable may not capture the full effect of the economic crisis. We therefore prefer to use the information on the self-reported effects of the economic crisis on the demand for their products or services, since this question explicitly relates to the past two years.

The questionnaire contains three questions on innovation: whether product innovation, process innovation and innovative activities had occurred during the past three years. These questions are aligned with the Community Innovation Survey. Next, respondents were asked how often their enterprise was engaged in activities to develop new goods, services, or production processes. Based on this question, we define frequent innovators as enterprises that were engaged in innovative activities at least once a month. This is one of the main independent variables in our study.

An overview of the variables from the Enterprise Survey 2010 that have been used for this study is presented in Table 1. These include characteristics of the enterprise (including size, age, sector and innovative behaviour) as well as characteristics of the workforce.

Table 1 Main variables based on the Enterprise Survey 2010

Variable	*Brief description*
Neg_effect (dummy)	Enterprise reported an overall negative effect on the number of orders or total demand during the past two years, due to the current economic crisis
Firm size (ln)	Natural logarithm of the total number of employees of the firm
Firm age (ln)	Natural logarithm of the age of the firm
Fixed-term	Share of employees with a fixed-term contract
Fulltime	Share of employees working on a fulltime basis
Edu_medium	Share of employees with a medium educational level
Edu_high	Share of employees with a high educational level
Age_medium	Share of employees between 25 and 50 years of age
age_high	Share of employees aged 50 years of more
Female	Share of female employees
Frequent innovator (dummy)	The enterprise is engaged in activities to develop new goods, services, or production processes at least once a month
Sector dummies:	
Manufacturing	Enterprise is in the manufacturing sector
Construction	Enterprise is in the construction sector
Wholesale	Enterprise is in the wholesale sector
Retail	Enterprise is in the retail sector
Transport	Enterprise is in the transport and communication sector
Business	Enterprise is in the business services sector
Personal	Enterprise is in the personal services sector

Note: all dummy variables are coded as 0/1 variables (0=no, 1=yes).
Source: Enterprise Survey 2010, SMEs and EU Labour Market, EIM/GDCC (N=7559); conducted during the final quarter of 2010 (2010Q4).

Stratified sample plan

The Enterprise Survey 2010 was conducted amongst 37 European countries: the 27 Member States of the EU and 10 non-EU countries[1]. The total enterprise population of these countries amounts to 15 million employer enterprises[2] in the business economy: 13 million (85%) in EU27 and 2 million in non-EU countries. Within EU27, 70% of the enterprises are located in the so-called 6 major economies (Poland, United Kingdom, Germany, France, Spain, and Italy).

The Enterprise Survey 2010 targeted enterprises from the business economy, which is defined in terms of the NACE sector classification[3] (NACE D, F -K, N, O excl. 91). Within the business economy, seven main sectors are distinguished: Manufacturing (NACE Section D), Construction (NACE Section F), Wholesale trade (NACE Division 51), Retail trade (NACE Divisions 50 and 52), Transport and communication (NACE Section I), Business services (NACE Sections J and K) and personal services (NACE Sections H, N and O (excl. 91)).

With respect to enterprise size, the following size classes are distinguished: micro enterprises, small and medium-sized enterprises, and large enterprises (LSEs). Micro enterprises and small and medium-sized enterprises make up the SME-sector of the business economy. The distribution of the enterprise population over size classes is skewed, with 86% of the enterprises being micro enterprises and 0.4% being LSEs.

The sample plan of the survey was stratified amongst these three dimensions (country, sector and size class), which resulted in a disproportionally stratified sample plan.

Survey fieldwork

Interviews in the 37 countries concerned were made using questionnaires and native speakers in all relevant languages. The average length of the interviews varied by country and language; the French version was relatively long for instance. On average, though, the interviews took 20 minutes.

After the pilot interviews were conducted and the final changes to the questionnaire had been made, the actual fieldwork started at the end of September 2010 and lasted until February 2011. In the final sample most quotas of the sample plan were satisfactorily covered, in particular for micro and small and medium-sized enterprises.

3.2 Macro-economic statistics

The extent to which individual enterprises were faced with negative demand effects due to the crisis, may not only be related to firm-specific characteristics, but also to country-specific characteristics. Table 2 presents an overview of the macro-economic indicators that we include in our model, regarding welfare, innovation and technological specialisation.

[1] The non-EU countries include Liechtenstein, Iceland, Montenegro, Albania, Serbia, Croatia, Norway, Israel, FYR of Macedonia and Turkey.

[2] Employer enterprises are enterprises with at least one employee.

[3] This classification is based on NACE rev. 1.1.

Table 2 Macro-economic statistics

Variable	*Brief description*
GDP per capita (2009)	GDP per capita in 2009 in purchasing power standards, where EU27 = 100
GDP growth (2009)	Real GDP growth rate of a country in 2009
GDP growth (2010)	Real GDP growth rate of a country in 2010
Freq_innovator_aggregate	The share of frequently innovative enterprises within a country (the aggregate of *Frequent innovator)*
Technological specialisation	A Gini-coefficient based on the number of patents in each technological field over all years, representing technological specialisation

Source: GDP data: Eurostat website; Freq_innovator _aggregate: own calculations, based on Enterprise Survey 2010; Technological specialisation: own calculations, based on PATSTAT

Welfare

A country's welfare is included through the level and growth rate of a country's gross domestic product, which have been obtained from Eurostat. This information is available for all EU Member States, but not for all of the remaining countries.

Innovation

We include the share of enterprises that is a frequent innovator as an indicator for the overall level of innovative activities that occur within a country's business economy. This indicator is based on the Enterprise Survey 2010 (it is the aggregate of the variable 'Frequent innovator'; see Table 1).

Technological specialisation

In order to capture a country's technological specialisation, we use a Gini-Coefficient that is based on patent data. Using an international database with patent information for the years 2000-2008, we first counted all transnational patent applications, differentiated by the country of the inventor and the technological field of the patent filing. This was done separately for each year. In a second step, we calculated the Gini-Coefficient per country and year to gain some insight into the equality of the distribution of patent filings across technological fields. We use this coefficient as a measure of technological specialisation.

We extracted the relevant patent data from the "EPO Worldwide Patent Statistical Database" (PATSTAT), which provides information about published patents collected from 81 patent authorities worldwide. The patent filings in the sample follow the concept of so-called "transnational patent applications" recently suggested by Frietsch and Schmoch (2010). This approach is able to overcome the home advantage and unequal market orientations of domestic applicants, so that a comparison of technological strengths and weaknesses between countries becomes possible. In detail, all applications at the World Intellectual Property Organisation (WIPO) under the Patent Cooperation Treaty (PCT) and all direct filings at the European Patent Office (EPO) without precursor PCT application are counted. This excludes double counting of transferred PCT applications to the EPO. Put more simply, all patent families with at least a PCT application or an EPO application are taken into account. The technology field differentiation is based on the 34 so-called WIPO classes (Schmoch, 2008). All the patents in the

dataset are counted according to their year of world wide first filing, the so-called priority year. This is the earliest registered date in the patent process and is therefore closest to the date of invention.

The resulting Gini-Coefficient ranges from zero to one, with a value of one indicating a highly unequal distribution of patent applications across technology fields and therefore a high technological specialisation of its patent portfolio and vice versa. Since not all of the countries file at least one transnational patent in each technological field in 2008, which is the case for some smaller countries, we had to treat those countries as missing. Calculating the Gini-Coefficient without excluding those countries would have led to biased results. We end up with a group of 25 European countries for which the Gini-Coefficient for 2008 is available (see the annex for a table with the Gini-Coefficients for these countries).

It should be noticed that the Gini-coefficient of technological specialisation does not measure the average level of specialisation. A high level of the Gini-coefficient does not exclude the possibility of having a relatively high number of patent applications in all technological fields, in comparison with other countries. In other words: being highly specialized does not exclude the possibility of having a broad technological base. It just indicates a high inequality across technological fields, and thus that one or more technological fields have more patent applications than the others. Thus, it could be that countries with the same Gini-coefficient in a certain year greatly differ in the absolute number of patent applications.

Therefore, we also need include an indicator for the average level of innovation. One option would be to use the average number of patent applications in a country. This would be consistent with how we measure technological specialisation. However, as we argue below, the use of the (average) number of patent applications may not be the best available indicator for the level of innovational output. Instead, we use the share of frequently innovative enterprises within a country.

Some comments on using patents to measure technological specialisation

The use of patent applications as an indicator for innovation and technological specialisation has several advantages. The most important advantages include the existence of consistent historical databases and the classification of patents by technological field.

Patent applications also face several major drawbacks as an indicator for innovation. First of all, it is an intermediate measure, i.e. the number of applications does not measure the innovative output in a country. Second, it does not include non-patented inventions and innovations. It could be the case that a relatively innovative technological field is falsely considered as being non-innovative, because nobody files for patents in that particular technological field (e.g. because of secrecy). Third, an absolute number of patent applications might not reflect the actual number of innovations, because often one new product asks for multiple patent applications.

For all these reasons, the number of patent applications is foremost an indicator of innovation activities: how active one country is regarding the fields of technology, as compared to other countries (with which it competes in international markets). The problem remains that technological specialisation is not only re-

flected in terms of patenting. Hence, it is an approximation due to the restrictions by available data.

3.3 Sample for analysis

The combination of the Enterprise Survey 2010 with the available macroeconomic statistics results in a sample of 5,423 enterprises from all size classes from 24 European countries[1]. These numbers refer to the total number of completed interviews. Not all enterprises have answered all questions, however. For example, 318 respondents could not tell whether the economic crisis had an overall negative effect on the number of orders or total demand during the past two years. Likewise, for 420 respondents we could not determine if they were frequent innovators or not. All in all, for approximately 25% of the total number of observations, at least one of the variables of interest could not be determined, which resulted in 4,067 observations that could be used for subsequent analyses (see Table 4 and Table 3).

Table 3 Sample size: number of available observations by sector

Sector	*Total*
Manufacturing	1,015
Construction	410
Wholesale trade	368
Retail trade	482
Transport and communication	339
Business services	866
Personal services	587
Total	4,067

Source: Enterprise Survey 2010.

[1] The indicator for Technological Specialisation is available for 25 countries, but for one of these countries (Israel) no information on GDP levels and growth rates was obtained.

Table 4 Sample size: number of available observations by country and size class

Country	*Micro (2 – 9)*	*Small and medium-sized (10 – 249)*	*Large (250+)*	*Total*
Austria	51	31	38	120
Belgium	65	21	13	99
Croatia	59	25	17	101
Cyprus	47	82	16	145
Czech Republic	78	51	57	186
Denmark	66	38	61	165
Finland	57	34	24	115
France	208	58	82	348
Germany	114	77	61	252
Greece	99	17	16	132
Hungary	74	30	23	127
Ireland	53	61	35	149
Luxembourg	12	53	14	79
Netherlands	71	33	19	123
Norway	31	40	9	80
Poland	286	56	82	424
Portugal	77	34	21	132
Romania	50	32	39	121
Slovakia	28	87	15	130
Slovenia	47	35	12	94
Spain	193	74	67	334
Sweden	65	25	15	105
Turkey	143	96	17	256
United Kingdom	163	57	30	250
Total	2,137	1,147	783	4,067

Source: Enterprise Survey 2010.

4 Results

4.1 Descriptive statistics

About two-thirds of the enterprises in our sample reported by the end of 2010 that the economic crisis had an overall negative effect on the total demand for their products or services. This share is somewhat higher for SMEs than for large enterprises (Table 5). About one in every five enterprises in our sample was engaged at least once a month in activities to develop new goods, services, or production processes. Large enterprises are twice as likely as micro enterprises to be a frequent innovator (Table 5). Notice that these statistics represent the unweighted distribution amongst the enterprises in our sample, and are therefore not representative for the business economy of the countries included.

Table 5 Frequent innovators and enterprises with negative demand effects of the crisis, by size class

Variable	*Micro (2 – 9)*	*Small and medium-sized (10 – 249)*	*Large (250+)*	*Total*
Share of enterprises that reported overall negative effect on total demand due to economic crisis (neg_effect)	66%	64%	58%	63%
Share of frequent innovators (freq_innovator _aggregate)	14%	20%	31%	19%

Note: the reported shares are unweighted and therefore not representative for the business economy of the countries included.
Source: Enterprise Survey 2010.

Our data includes three different indicators of innovation, two of which are defined at country level: technological innovation (measured by a Gini-Coefficient) and the average level of innovative activities by enterprises (measured by the share of frequent innovators). In theory, these two indicators refer to two different aspects. This raises the question how large the correlation between these two indicators is. According to our sample, the correlation is 0.19 (Table 6), which we consider to be rather low: it shows that countries with the same Gini-coefficient in a certain year can differ considerably in the share of enterprises that innovate frequently.

The correlations between the various macro-economic statistics are relatively low (Table 6). Only one correlation exceeds 0.5: the correlation between the share of frequent innovators and the interaction effect, which is 0.72. This suggests that multicollinearity might become an issue. However, to determine if this is indeed the case we have to consider the correlations at enterprise level rather than at country level[1]. At enterprise level, two different variables are available regarding the frequent innovators: besides the share of frequent innovators (defined at

[1] The model is estimated at enterprise level.

macro-level) there is also the variable 'frequent innovator' (defined at enterprise level).

Table 6 Descriptive statistics and correlations between country-specific variables, for 24 European countries

Variable	*Mean*	*Standard deviation*	*1*	*2*	*3*	*4*	*5*	*6*
1: Share of enterprises that reported overall negative effect on total demand due to economic crisis	63%	0.13	1					
2: Share of frequent innovators	21%	0.10	-0.13	1				
3: Technological specialisation	0.38	0.08	0.15	0.19	1			
4: (Share of frequent innovators)*(Technological specialisation)	0.06	0.04	0.22	0.72**	0.38*	1		
5: GDP per capita (2009) (EU27 = 100)	105.6	46.7	-0.5**	0.35*	0.20	-0.05	1	
6: GDP growth (2009)	-4.32	2.33	-0.28	-0.37*	-0.41**	-0.45**	0.12	1
7: GDP growth (2010)	1.72	2.44	-0.37*	0.12	0.06	-0.00	0.05	0.05

Based on 24 observations; **: significant at 5%; *: significant at 10%
Note: the reported shares are unweighted and therefore not representative for the business economy of the countries included.
Source: PATSTAT (3 and 4), Eurostat (5, 6 and 7) and Enterprise Survey 2010 (1, 2 and 4).

If we examine correlations between these two variables and the other variables from Table 6, we notice several things. First of all, the correlation between the interaction term and technological specialisation increases to 0.45. Next, the correlation between the interaction term and frequent innovators (defined at enterprise level) is 0.17[1]. More importantly, the correlation between the interaction term and the share of frequent innovators (defined at macro level) is now very high: 0.92. This implies that multicollinearity is likely to occur. The results of the model including the interaction term should therefore be interpreted with caution.

4.2 Regression results

To test our hypotheses, we have estimated various logistic regressions with the variable neg_effect as the dependent variable. These models try to explain the probability that enterprises were faced by a reduction in the total demand due to the crisis, by various enterprise characteristics, workforce characteristics, macro-economic conditions, and by innovation (Table 7).

[1] Notice, however, that a correlation is not a suitable statistic to examine the relationship between a continuous variable and a dummy variable.

Table 7: Regression results (dependent variable: *neg_effect*)

		Model 1		*Model 2*		*Model 3*
Variables	*Coefficient*	*Std error*	*Coefficient*	*Std error*	*Coefficient*	*Std error*
Constant	1,084***	0,170	-0,193	0,323	-0.717*	0.354
Firm size (ln)	-0,086***	0,018	-0,056**	0,019	-0.057**	0.019
Firm age (ln)	0,213***	0,042	0,193***	0,044	0.207***	0.044
Fixed term			0,001	0,001	0.001	0.001
fulltime			0,001	0,002	0.000	0.002
edu_medium			0,003*	0,002	0.003	0.002
edu_high			0,002	0,002	0.002	0.002
age_medium			0,011***	0,002	0.011***	0.002
age_high			0,012***	0,003	0.011***	0.003
female			-0,003*	0,001	-0.003*	0.001
Innovation-related variables						
Frequent innovator					-0.022	0.089
Freq_innovator _aggregate					0.429	0.496
Technological specialisation					2.011***	0.558
Macro-economic variables						
GDP per capita (2009)	-0,008***	0,001	-0,008***	0,001	-0.008***	0.001
GDP growth (2009)	-0,043***	0,014	-0,040**	0,014	-0.013	0.016
GDP growth (2010)	-0,094***	0,015	-0,088***	0,015	-0.102***	0.016
Sector dummies						
Manufacturing	(omitted)		(omitted)		(omitted)	
Construction	-0,047	0,125	-0,061	0,127	-0.06	0.128
Wholesale	-0,084	0,131	-0,077	0,132	-0.089	0.133
Retail	-0,012	0,120	0,051	0,121	0.053	0.122
Transport	0,202	0,137	0,183	0,139	0.164	0.139
Business	-0,271**	0,099	-0,241*	0,105	-0.237*	0.105
Personal	-0,112	0,111	-0,030	0,115	-0.009	0.116
Number of observations	4067		4067		4067	
Pseudo R^2	0,0283		0,0359		0,038	

Significance levels: * 0.01<p≤0.05; ** 0.001<p≤0.01; *** p≤0.001.

Source: Panteia/EIM.

Regarding the enterprise characteristics, the results consistently show that smaller and older firms were more often faced by a reduction in their demand than larger and younger firms. Enterprises from the business services sector where somewhat less often faced with these negative effects of the crisis, otherwise no sectoral differences are established. Next, a high GDP/capita level or growth rate had a positive effect, in that enterprises from countries with higher levels less often reported negative demand effects of the economic crisis. The GDP growth rate over 2010 has a larger effect than the growth rate over 2009.

If we consider the workforce characteristics (which are added in model 2), it seems that the nature of the labour contract (fixed term or not, fulltime or part-time) does not matter. Neither does the educational level of the employees. There is however a small gender effect and an age effect. The age effect indicates that enterprises with a higher share of young employees were less often

faced with a negative effect of the economic crisis on their total demand. This might suggest that young employees are better able to generate additional demand. It is however also possible that this relationship is actually due to reversed causality: firms that were faced with a negative demand effect of the crisis may have laid off part of their workforce (or did not renew fixed-term contracts). Typically, younger employees are easier to lay off, because it is cheaper and/or they often have a fixed-term contract.

One hypothesis accepted

Our main hypothesis is tested in model 3, where the various innovation-related variables are included. Our hypothesis is confirmed that enterprises from technologically more specialised countries, are more likely to have reported a negative effect of the crisis on the demand for their products or services. Whether or not an enterprise is a frequent innovator does not matter, neither does the share of frequent innovators in a country.

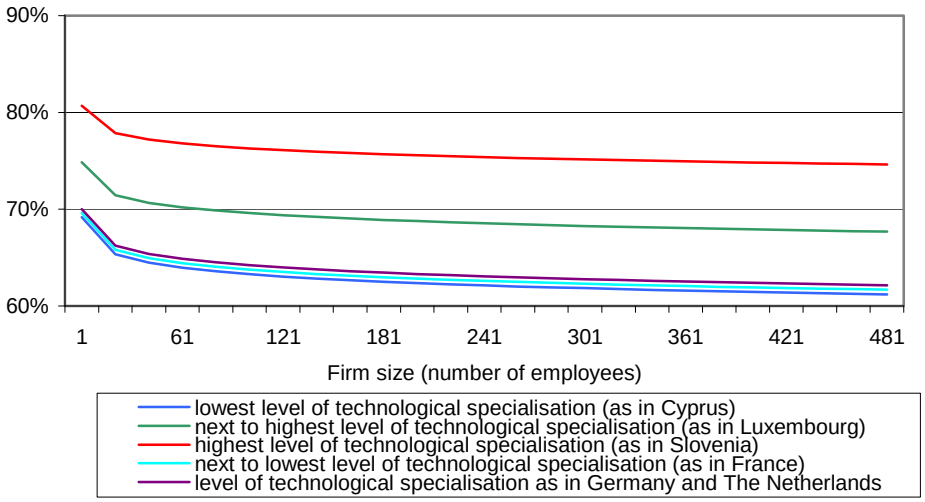
The parameters of a logistic regression are difficult to interpret. Figure 1 offers a better understanding of the order of magnitude of the effect of technological specialisation on the probability that enterprises are faced with negative demand effects. Figure 1 shows how this probability is related to technological specialisation and firm size, keeping all other variables of the model constant[1]. In particular, it shows how the probability of enterprises being faced with negative demand effects decreases with firm size, for different values of technological specialisation. On average, for large firms (with 500 employees) this probability is about 7% points lower than it is for firms with only one employee. It also shows that the effect of technological specialisation is somewhat larger than the firm size effect: given firm size, the difference in the probability that enterprises are faced with negative demand effects between the lowest and highest level of technical specialisation is approximately 12% points. At the same time, it should also be noticed that the difference between the lowest and the second-highest level is much lower at approximately 6% points.

Interaction between technological specialisation and frequent innovators not established

We have also estimated a fourth model, that includes the interaction effect between technological specialisation and frequent innovators. In this model, the parameter estimates for the three macro-economic innovation-related variables differ significantly from zero. We find a significant positive parameter for technological specialisation and for the share of frequent innovators (measured at country level), and a negative effect of the interaction term. The parameter estimates are however very high in the context of a logit regression (all parameter estimates exceed 4 in absolute value; the estimate for the interaction term is -14). In combination with the high risk for multicollinearity for this specification, we conclude that the model with interaction term does not work well. We therefore do not discuss the results of this model.

[1] We use the parameter estimates of model 3 to predict the probability of enterprises being faced with negative demand effects, given specific values for the independent variables. The values for firm size and technological specialisation vary. For all other independent variables the averages are used.

Figure 1 Probability that enterprises are faced with negative demand effects, for countries with different levels of technological specialisation



Note: The lines do not reflect differences between countries, they only reflect the effect of technological specialisation. Apart from technological specialisation, the different lines are all based on the same values for the other variables in the model (including GDP/capita level and growth rates).

5 Conclusions

5.1 Main findings

In the current economic crisis, some enterprises are faced with a reduction in the demand for their products whilst others are not. The purpose of this study was to examine to which extent this depends on the innovativeness of the country of origin. The innovativeness of a country is reflected by the share of frequent innovators in a country and by the level of technological specialisation of a country.

Our results show that the share of frequent innovators in a country does not effect the probability that individual enterprises are faced with negative demand effects of an economic crisis. If we interpret the share of frequent innovators as an indicator of the overall level of innovation of a country, this implies that the overall level of innovation in a country does not help to mitigate the effects of a major economic crisis on the turnover of individual enterprises.

Our results further show a negative effect of technological specialisation: higher levels of technological specialisation are associated with a higher probability for individual enterprises to be faced with negative demand effects of an economic crisis. The size of this effect is considerable: on average, the difference in the probability that enterprises are faced with negative demand effects between the lowest and highest level of technical specialisation is approximately 12% points.

5.2 Limitations and suggestions for future research

Limitations

Due to its binary form, the dependent variable of our study neglects the extent to which a firm is affected by the economic crisis.

In addition, the model misses a suitable indicator of the absorptive capacity of individual enterprises (the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends is critical to its innovative capabilities). This theoretical concept explains why some firms are more likely to absorb the available knowledge within a certain country/sector than other firms. Usable indicators of the absorptive capacity of individual enterprises are, however, not available in our dataset.

Future research

As we already mentioned in the introduction, this paper reflects work in progress. In particular, a proper theoretical foundation is missing. Future research should first of all focus on building such a foundation.

In addition, there are also several empirical issues that can be improved:

- The current indicator of the average level of innovative activities in a country (the share of frequent innovators) does not include innovation activities within universities and public research institutes, nor does it control for the fact that the macro-economic effects of innovation by a single multinational exceed the macro-economic effects of innovation by a single micro enterprise. Future

studies may therefore search for alternative indicators for the average level of innovative activities in a country.
- Additional macro-economic statistics may be included, such as the import share and export share in GDP (which would control for the openness of an economy) and whether a country belongs to the Eurozone.
- The current sector classification might be replaced by a dummy variable that differentiates between sheltered and exposed sectors.
- The model may be estimated separately for each sector and each size class, to see if the results differ strongly.
- Since the independent variables of interest are measured at country level rather than enterprise level, it may be more valid to estimate a multilevel model rather than estimating an equation at enterprise level only.

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ANNEX I Data

Table 8 Sample size: number of completed interviews by country and size class

Country	*Micro (2 – 9)*	*Small and medium-sized (10 – 249)*	*Large (250+)*	*Total*
Austria	59	41	77	177
Belgium	78	31	29	138
Croatia	60	32	23	115
Cyprus	52	99	20	171
Czech Republic	93	73	103	269
Denmark	75	45	92	212
Finland	74	42	44	160
France	246	84	177	507
Germany	135	113	108	356
Greece	105	28	23	156
Hungary	76	33	38	147
Ireland	62	77	63	202
Luxembourg	14	77	24	115
Netherlands	82	42	34	158
Norway	36	44	16	96
Poland	317	95	166	578
Portugal	91	39	29	159
Romania	55	45	50	150
Slovakia	42	147	41	230
Slovenia	50	40	16	106
Spain	217	106	108	431
Sweden	78	38	31	147
United Kingdom	188	72	79	339
Turkey	153	109	25	287
Total	2,438	1,555	1,416	5,406

Note: for 17 enterprises, the size class could not be determined.

Source: Enterprise Survey 2010.

Table 9 Sample size: number of completed interviews by sector

Sector	*Total*
Manufacturing	1,384
Construction	566
Wholesale trade	485
Retail trade	631
Transport and communication	471
Business services	1,133
Personal services	753
Total	*5,423*

Source: Enterprise Survey 2010.

Table 10 Innovative behaviour of enterprises and technological specialisation for 25 European countries (2008)

Country	*technological specialisation* (Gini-Coefficient)*		*Share of frequently innovative enterprises***	
Austria	0.292	(3)	0,073	(6)
Belgium	0.293	(4)	0,164	(13)
Cyprus	0.276	(1)	0,234	(21)
Czech Republic	0.378	(13)	0,127	(10)
Germany	0.296	(5)	0,162	(12)
Denmark	0.386	(15)	0,279	(23)
Spain	0.314	(8)	0,072	(5)
Finland	0.417	(18)	0,319	(24)
France	0.286	(2)	0,069	(3)
United Kingdom	0.309	(7)	0,197	(19)
Greece	0.360	(11)	0,187	(17)
Croatia	0.411	(16)	0,046	(2)
Hungary	0.420	(19)	0,168	(14)
Ireland	0.373	(12)	0,194	(18)
Israel	0.441	(22)	0,185	(16)
Luxembourg	0.570	(24)	0,017	(1)
Netherlands	0.296	(6)	0,264	(22)
Norway	0.442	(23)	0,180	(15)
Poland	0.334	(9)	0,105	(8)
Portugal	0.383	(14)	0,129	(11)
Romania	0.439	(20)	0,069	(4)
Sweden	0.351	(10)	0,220	(20)
Slovenia	0.588	(25)	0,342	(25)
Slovakia	0.414	(17)	0,077	(7)
Turkey	0.439	(21)	0,123	(9)

Source: *: own calculations, based on PATSTAT; **: Enterprise Survey 2010