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Measuring the macroeconomic resilience of industrial sectors in the EU and assessing the role of product market regulations

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Measuring the macroeconomic resilience of industrial sectors in the EU and assessing the role of product market regulations

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Executive Summary

During the past two decades there have been important changes in the European Union following the launching of the Single Market in 1992. The introduction of the euro in 1999, in particular, sealed the economic unification process, and created a large, unified, currency union which is now a key player in the international stage. These developments have undoubtedly brought significant benefits to EU Member States and created new opportunities across the European Union.

During these two decades, several institutional changes have also taken place. The most notable were, on the one hand, the establishment of the European Central Bank and, on the other hand, the enhanced economic coordination framework launched in 1997, under the so-called Stability and Growth Pact. These institutional changes were driven by the exchange rate crisis of 1992 which, in many ways, paved the way for the deeper economic integration subsequently. The introduction of the single currency has been considered a major success in European history, although it has been criticized on the ground that it was not accompanied by a deeper fiscal union, and structural reforms, both deemed essential to allow countries better handle asymmetric shocks either through transfers or by improving the adjustment capacity of countries.

In response, the European Commission launched several programs to enhance fiscal coordination and structural reforms, in the context of the Lisbon Agenda[1]. These efforts have often been undermined by lack of political will and national political considerations. While it is generally recognized that structural reforms are needed in Europe, there is no political will to pursue them in "good times", and reforms are typically stalled. In "bad" times, concerns about structural reforms become pressing, but other priorities and fiscal constraints prevent governments from taking important reform steps.

The current economic crisis which has affected considerably both the EU and the euro zone has brought again to the forefront of public discussion the issue of structural reforms. Although the crisis had severe consequences on the EU economy, its impact varied greatly across sectors and countries. The crisis has revealed significant differences within the industrial sector with a number of subsectors such as automobile and textiles experiencing large falls in output and others, such as food and beverages, chemicals and pharmaceuticals, displaying smaller changes.

This study examines the characteristics of sectoral cycles in EU countries and investigates the reasons which might explain differences in the adjustment capacity of sectors and countries to economic shocks; broadly defined as unforeseen changes to business conditions. In particular, it evaluates the role played by institutional factors and product market reforms in accelerating this adjustment capacity. Product market reforms are institutional changes of microeconomic (sectoral) nature implemented to improve the functioning of product markets. In Europe such reforms include a wide range of measures spanning from the creation of the Single Market, to liberalization and regulatory reforms in network industries, to reforms in the business environment, competition policy, and state aid.

The literature has discussed extensively the role that institutions play in ensuring the unfettered functioning of markets and the rapid and efficient adjustment of economic activity in the face of economic shocks. The latter issue is particularly relevant in a currency area, since individual countries' adjustments to shocks are constrained by the system of fixed nominal exchange rates and by the single monetary policy.

From the point of view of the optimal currency area literature, a number of conditions regulate the nature of the adjustment process to shocks. Price and wage flexibility are typically considered crucial in allowing countries (and sectors) to absorb external asymmetric shocks or common shocks with an asymmetric impact. Product market

[1] The Lisbon Agenda, also known as the Lisbon Strategy or the Lisbon Process, was an action plan for the economy of the European Union agreed in 2000, with the aim of making the EU "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion", by 2010. It has now been replaced by the Europe 2020 Strategy.

restrictions hinder price and wage flexibility and prevent markets from re-adjusting rapidly following a shock. Indeed, product market reforms that increase competition can lead to higher price and wage flexibility by, for instance, reducing oligopolistic behavior among firms, therefore improving country and sector adjustments to shocks. In addition, by facilitating entry and exit, product market reforms also ensure a more efficient reallocation of resources within and across sectors and may give firms greater incentives to adopt more efficient and flexible production techniques. Finally, product market restrictions may lead to market segmentation, thus delaying the process of economic integration within the European Union. Market segmentation within the EU hinders adjustment of relative prices and hence the movement of factors of production across countries, which is crucial in the face of asymmetric adjustment to shocks.

Labour market rigidities can also prevent needed adjustments in a common market area and can explain differences in the adjustment capacity of countries. Indeed, there is strong empirical evidence of a cross-country relationship between differences in labour market institutions and differences in labour market adjustment.

While the relationship between labour market institutions and macroeconomic adjustments has been extensively discussed in the literature, a new line of research has also tried to evaluate how macroeconomic adjustments are affected by the degree of product market competition. The conclusions that this literature reach are quite clear: competitive pressures improve the quality of adjustment because they foster the efficient re-allocation of resources that takes place through entry-and exit, and because they lead to higher efficiency in production.

The research we present complements this new body of literature by examining the resilience of adjustment taking place at sectoral rather than economy-wide level. The study attempts to identify and explain economic differences in the adjustment across sectors and countries in the EU, and to evaluate the role that product market regulations and other institutional constraints play in explaining these differences. The analysis we conduct is the first of this type in the literature and provides crucial information for policy design purposes

Business cycle fluctuations are studied within the tradition of "classical" cycles, that is, by analyzing absolute changes in output, rather than variations in "output gaps". The methodology we employ avoids the use of filters which would not allow us to capture changes in long-term trends, and, thus, potentially bias the conclusions.

In this study, resilience to shocks is defined using the estimated correlation between sectoral output changes over business cycle phases and common shocks. We consider only common disturbances to better isolate differences in the adjustment capacity of different sectors. This would not be possible, for example, if sector-specific idiosyncratic disturbances would be employed. Common disturbances are defined as euro area GDP shocks (but US shocks are also considered in sensitivity analysis). GDP shocks are defined as the change in output that cannot be predicted using information contained in current and past values of variables such as interest rates, money, credit, prices, inflation, or past values of output itself.

The analysis of sectoral business cycles reveals considerable heterogeneity and indicates that output at the sectoral level is much less stable than aggregate output (the number of cycles identified at the sectoral level is on average greater than the number of cycles typically identified in aggregate data, and their amplitude bigger). This result is important because monetary policy decisions are taken using aggregate euro-wide information. Thus, they suggest that monetary policy cannot effectively take care of these idiosyncrasies; hence the importance of structural reforms which allow a smoother adjustment at the sectoral level. The heterogeneity of sectoral cycles we discover may be due to three causes: asymmetric shocks; common shocks with asymmetric effects on different sectors or countries; or sector-specific policies at the national or EU-wide level (for example, specific national industrial policies).

To examine which are the most resilient sectors and to assess whether institutional factors and product market regulations affect this resilience, we study the correlation between the severity of common shocks with the sectoral cycle amplitude using disaggregated industry data for 21 subsectors.

We find that product market regulations at the national level affect resilience: for example, country differences within industrial sub-sectors

appear to be explained by how far product market reforms have advanced. Thus, countries which have advanced more in terms of product market reforms, such as Denmark, rank at the top of the resilience ranking.

Besides product market regulations, two other variables are important to explain resilience: financial development and openess (although the evidence presented is stronger for financial market development). While it is generally accepted that openness and financial development help to boost efficiency and competitiveness, the negative association between these two variables and resilience merely suggests that more open countries are more exposed to external shocks. In particular, our analysis reveals that, some countries which are advanced in terms of product market reforms, but have a large financial system, such as the Netherlands, are less resilient. These results are in line with the findings of international business cycle literature: cyclical fluctuations are more evident in countries and regions that are more open to trade and/or are more financially integrated.

The fact that openness to trade and financial development matter, suggest that product markets reforms become even more pressing as countries open up to trade in goods, and financial services. The processes of economic integration and globalization, which bring undeniable benefits to the European economy, must be accompanied by reforms in product markets which can render EU firms more flexible and competitive to withstand their increasing exposure to shocks through financial and trade flows.

Our results also demonstrate the presence of important differences within industry. For example, the chemicals, the mining and the textiles sub-sectors are more resilient than, the motor vehicle sub-sector. Indeed, the motor vehicle sub-sector is consistently found to be the least resilient sector in the EU.

When the sectors are grouped into those manufacturing consumer, investment, or intermediate goods, we find that consumer goods sectors are significantly more resilient, while investment goods are less resilient. This, in conjunction with the known theoretical prediction and empirical result that the income elasticity of demand is higher for investment goods than for consumer goods, could suggest that the income elasticity of demand may be an important determinant of sectoral resilience. Thus, when designing policies it may be crucial to take into account not only institutional and structural features but also other characteristics of demand for the goods produced by each sector.

In addition to product market regulations at national level, openness to trade, financial development and demand elasticities, a number of other factors could potentially account for the differences in the resilience across sectors. These include, for example, micro (sectoral)-level factors determining the dynamics of demand, vertical linkages across sectors, differences in state-aid intensity across sectors, and sectoral product and labour market regulations. These additional factors are not considered in this study, primarily because appropriate databases providing information about these sectoral characteristics across countries are not readily available.

Differences in resilience across sectors also help us to interpret the ranking of countries in terms of resilience. Since we find, for example, that the car industry, or more generally the investment-goods sector are less resilient, one would expect countries with large automobile industry or investment goods sectors to be less resilient to shocks. Indeed, our estimates confirm this intuition, and imply, for example, that Germany and France, which have very large automobile sectors, rank low in terms of overall resilience.[2] However, the results indicate that country-specific structural characteristics such as the level of product market regulations have a stronger impact on resilience than sectoral composition effects.

Examination of the 2008-09 downturn confirms that product market regulations play a significant role in determining the individual sector response to the shock. The least resilient sectors appear to be the motor vehicle and basic metals sectors. At the other end of the spectrum we have food and beverages, computer and electrical equipment. In terms of countries, Denmark comes again at the top of the ranking, while at the bottom we have countries which have advanced very little in

[2] We do several tests to ensure that this and the other results reported are not due to an accounting bias. We find that the correlations between sectoral output changes and common euro area shocks are not systematically related to the weight of the sector/country within the euro area.

product market reforms, such as Belgium, Greece, and Hungary.

A variable which is important in explaining the level of resilience in the last recession is the level of debt. We find that countries with higher debt levels appear to be less resilient to shocks, probably because they had little room to implement discretionary fiscal policies. High debt levels may also hinder the adjustment process by increasing uncertainty about the direction of future policies.

The analysis of the 2008-09 recession is also challenging in this regard since the exceptional public support measures which were taken in some countries and sectors, have certainly prevented a meltdown (for example in the banking sector) and subsequently more sizeable adjustments in other sectors of countries. In some sense, the expansion of debt levels in some countries may have helped absorb part of a very sizeable negative shock.

For policy purposes, it is important to single out the sectors which rank low in terms of resilience, but at the same time have more weight in the EU total production. Our investigation indicates that the five largest sectors which consistently rank below the EU average in terms of resilience are: motor vehicles, machinery and equipment, metal products, basic metals, and electric equipment. Germany, Italy, France, the UK and Spain are top producers in these industries, but some smaller countries also have some weight in this sectors, like Belgium in basic metals, Netherlands in metal products, Austria in electric equipment, and Sweden in machinery and equipment and motor vehicles.

Our findings stress the importance of pursuing decisive and timely product market reforms in all countries, but also indicate that it is particularly crucial to focus the reform effort on countries which are more open or more exposed to foreign shocks, due to their large financial sectors, and which are more integrated, for example within the Euro area. Reforms should also be given a priority in new EU member states, in particular those undergoing structural changes which render them more susceptible financial and international shocks. Within countries, emphasis could be given to reforms in less resilient industries. In this regard, extending this work by adding more sector-specific data will provide further evidence that sectoral reforms can affect resilience. Furthermore, within these industries, reforms focusing on those sectors which have more weight in overall industrial output in the EU, such as machinery and equipment, motor vehicles, and metal products, would have a greater impact at the EU level.

On the whole, given these differences across sectors, a sectoral approach to product market reforms may also build on existing EU policies and initiatives, thus boosting the overall resilience of the EU economy. Within this framework the directions and the orientations given by the European Commission and the European Council to Members States, within the Lisbon strategy and the National Reform Programmes, could be more focused on less resilient sectors.

The finding that perhaps the demand elasticity of income explains some of measured differences in resilience, suggests that fiscal policy could play a role in offsetting these effects during severe downturns. Well-designed policies could be introduced in such a way that they have a bigger impact to GDP, and at the same time minimise the fiscal impact, since they would cover only the most vulnerable sectors, and perhaps countries. These could include policies which help boost demand directly, for example through subsidies which encourage consumption or investment. Such schemes were used in some countries and specific sectors during the last recession. Some flexibility in the use of state aid could therefore be envisaged for crisis periods, on these grounds. Of course, such an approach requires countries to have considerable fiscal room to react in bad times, something which was absent in the recent recession.

1. Introduction

The main objective of this study is to examine the adjustment capacity, or resilience, of industrial sectors of the European Union (EU) to shocks and to analyze the role that institutional factors and, in particular, product market regulations, play in this adjustment process. The analysis is conducted at a sectoral as well as at country level: we wish to provide information about the resilience of different industrial sub-sectors for each of the countries analyzed. We rank industrial sectors in terms of resilience and attempt to explain what determines these rankings.

The topic of this study is of particular relevance at present, following the economic crisis which most countries experienced in recent years and which was admittedly one of the most severe of the past century, and also because of the particular challenges faced by the EU and the euro area, including fiscal sustainability, competitiveness, unemployment and long-run growth. Understanding which sectors of the economy are more constrained in their ability to adjust to adverse shocks and the role played by product market regulations in constraining adjustment capacity can help us to explain the differences in performance observed during the 2008-09 downturn and to design policy strategies for the future that reduce the negative effects of adverse shocks. The ranking across sectors in terms of resilience and size can also help us identify the sectors that face more severe adjustment problems and therefore where product market de-regulation may lead to more gains in terms of improving the overall resilience of the country and of the EU as a whole.

The introduction of the single currency was undoubtedly a great success in European history, though it was criticized by many observers because it did not lead to a deep fiscal union, and was not accompanied by structural reforms. A deeper fiscal union would have allowed an endogenous transfer mechanism which would have reduced potentially dangerous imbalances across countries; structural reforms, on the other hand, would have allowed countries to respond better to asymmetric shocks (see De Grauwe, 2006). Some of the problems that Euro area countries faced in recent years can be traced back to these two reasons.

The literature has discussed extensively the role that institutions play in ensuring the unfettered functioning of markets and the rapid and efficient adjustment of economic activity in the face of economic shocks. The latter issue is particularly relevant in a currency area, since individual countries' adjustments to shocks are constrained by the system of fixed nominal exchange rates and by the single monetary policy.

From the point of view of the optimal currency area literature (see Mundell, 1961, McKinnon, 1963, and Mongelli, 2008, for example), a number of conditions regulate the nature of the adjustment process to shocks. Price and wage flexibility are typically considered crucial in allowing countries (and sectors) to absorb external asymmetric shocks or common shocks with an asymmetric impact. Product market restrictions hinder price and wage flexibility and prevent markets from re-adjusting swiftly after a shock. Thus, product market restrictions may reduce economic efficiency and economic growth. By facilitating entry and exit, product market reforms permit a more efficient reallocation of resources within and across sectors. In addition, when product market reforms are undertaken, firms may have stronger incentives to adopt more efficient and flexible production techniques.

Finally, product market restrictions can lead to an undesired market segmentation thus delaying the process of economic integration which is taking place in the European Union.

Some work has tried to measure the effects of product market reforms in various countries (see, for example, Griffith et al., 2004 and 2006, Nicoletti and Scarpetta, 2005, and references therein for example). Most of this literature has focused on the impact of product market reforms on macroeconomic performance, on competition, and efficiency. Some of the studies, for instance, find a significant relationship between product market regulations and markups in the EU; others find that competitive pressures foster the efficient reallocation of resources and lead to higher efficiency in production. To the best of our knowledge, we are not aware of any study which has tried to directly associate product market reforms with the adjustment capacity of sectors and countries. Pelkmans et al (2009) attempt to relate sectoral adjustment to product market reforms by arguing that the relatively low resilience found in service sectors can be traced to slow progress in reforms.

The results of our investigation should be of particular interest to policy makers in the EU when designing the Europe 2020 strategy, which aims at making the European economy more competitive and efficient, and thus foster growth and employment. The study, in fact, sheds new light on the sectoral characteristics of the European economy and measures the impact that reforms have on sectoral output growth. Little is known, in general, about the characteristics of sectoral output growth. Even less is known about the impact that policies have on different sectors of the EU economy. Thus, our analysis fills an important gap, which can help to understand the differences we observe across countries and sectors and may provide information useful to pursue economic efficiency in the future. Further work is needed however in this area.

The analysis of this study is divided in three parts. In the first part, we document the characteristics of sectoral business cycles in several European countries and collect information about the amplitude and the duration of cyclical fluctuations across countries and sectors. The analysis we perform is carried out in the tradition of "classical" cycles, that is, by analyzing absolute changes in output, and not in the tradition of "growth" cycles or "output gaps", which are concerned with fluctuations of deviations of output from trends. We are the first to provide a systematic analysis of sectoral business cycles in the EU within this tradition. Thus, the information we present is both novel from an empirical point of view and relevant from a practical policy perspective.

In the second part of the analysis we will relate the characteristics of cyclical fluctuations we construct to shocks hitting the EU economy. Resilience to shocks will be measured by the estimated correlation between sectoral output changes over business cycle phases and common shocks. We consider only common disturbances to better isolate differences in the adjustment capacity of different sectors. This would not be possible, for example, if sector-specific idiosyncratic disturbances were employed. Common shocks are defined as aggregate euro-area GDP shocks (but US output shocks will be considered also in robustness checks). GDP shocks are defined as the change in output that cannot be predicted using information contained in current and past values of variables such as interest rates, money, credit, prices, inflation, and past values of output itself.

In the third part of the study we will use standard econometric techniques to relate sectoral resilience to product market regulation and other important sectoral and national characteristics, such as openness or financial development. This way we try to quantify how

much of the adjustment capacity of each sector is constrained by product market regulations.

Our analysis employs information from 21 industry subsectors, classified according to the 2-digit NACE classification. The sample period we consider is 1980-2008. The samples vary across countries as does the quality of the data. Because of its special interest, and also because we cannot yet, with the methodology employed, identify its trough for all of the countries considered, we examine the 2008-09 recession in isolation from the rest.

The rest of the study is organized as follows. Section 2 provides an extensive review of the existing theoretical and empirical literature. Section 3 describes the methodology employed in the study. Section 4 presents the data used in the analysis and a few stylized facts. Section 5 contains the results of the investigation for the sample 1980-2008; section 6 presents the conclusions when the 2008-09 downturn is considered. Section 7 summarizes the main conclusions concerning sectoral resilience highlighting which of the least resilient sectors are more important within the EU. Finally, section 8 presents the conclusions and main policy implications. The Appendix contains a variety of additional supporting material.[3]

[3] Additional estimations and discussion, including and analysis of aggregate NACE-6 economic sectors can be found in the extended report "Study on "Product market reforms and adjustment in the European economy", prepared by the European Commission, DGECFIN, by the same authors.

2. A Review of the Theoretical and Empirical Literature

2.1. Economic Adjustments and Institutional Reforms

The importance of institutions for the way markets function and for the adjustment capacity of countries in response to economic shocks is well understood in theory. Initial contributions to this literature have mainly focused on the relationship between institutional constraints and labor market adjustments. Bruno and Sachs (1985) are among the first to emphasize the role that institutions may have had in rising European unemployment in the 1970's. Layard et al. (1991) show that in the UK there is a relationship between institutional changes and unemployment changes, and Phelps (1994) shows evidence of a cross-country relationship between institutions and labour market adjustments. More recent studies along the same lines, are Nickell (1997) and Blanchard and Wolfers (2000). The importance of accounting for the interaction between shocks and institutions in explaining the adjustment process to shocks is well summarized in Blanchard and Wolfers (2000): adverse shocks can generally explain bad economic outcomes, but differences in institutions may explain why outcomes differ across countries.

While labour market institutions have been the main focus of many studies relating institutions and economic adjustments, recent research has also tried to discover channels through which labour market adjustments may be affected by the degree of product market competition (see e.g. Krueger and Pischke, 1997, Nickell, 1999, Pissarides, 2001, Spector, 2002, Blanchard and Giavazzi, 2003, and Nicoletti and Scarpeta, 2005). The general conclusion that these studies reach is strong: competitive pressures are beneficial and should help to increase employment, both by allowing new entrants in existing markets and by increasing the rivalry among firms in the market, at least in the long run.

2.2. Economic Adjustments and Product Markets Reforms

An economy with a high level of efficiency will be better suited to sustain adverse shocks than an economy where efficiency levels are low. By facilitating entry and exit, product market reforms may enable a quicker reallocation of resources within and across sectors. Firms in more competitive markets may also have better incentives to adopt more efficient and flexible production techniques (see Griffith at al., 2010) and this may foster growth and employment. There are several studies trying to relate product market reforms to efficiency, and a detailed survey of relevant papers is in Nicodeme and Sauner-Leroy (2007).
In this literature, product market reforms are typically institutional changes of microeconomic, sectoral, nature implemented to improve the functioning of product markets. In Europe product market reforms include the wide range of measures that go from the creation of the Single Market, to liberalization and regulatory reforms in network industries, to reductions in state aid, to reforms in competition policy, including entry requirements and privatizations.

According to Ahn (2002) product market reforms may improve economic efficiency via three separate channels: (i) an allocative efficiency channel - there is a better reallocation of resources; (ii) a productive efficiency channel - there is an improvement in the utilization of

factors of production by firms; and (iii) a dynamic efficiency channel- there is a stronger incentive for firms to innovate.

Product market reforms can improve allocative efficiency either if they increase the contestability of markets, forcing firms to set prices closer to marginal costs, or if they drive less productive firms out of the market (see Melitz, 2003).[4] Vickers (1995) argues however that driving firms out of the market can increase industry concentration and markups if new potential entrants are constrained by aggressive market strategies on the part of incumbents.

As far as the productive efficiency channel is concerned, Griffith and Harrison (2004) argue that higher product market competition should give incentives to both workers and managers to increase effort. This occurs because, in principle-agent models, as reviewed by Nickel (1996), the presence of monopoly rents gives managers and workers the potential to capture these rents in the form of lack of effort. According to Griffith and Harrison (2004), increased competition reduces these perverse incentives through three main channels: (i) by allowing owners (and agents) to better compare the performance of the firm with that of its competitors, thus reducing monitoring costs; (ii) by making the price elasticity of demand high, so that cost reducing productivity improvements generate large increases in market share and profits; and (iii) by increasing the probability of bankruptcy which managers and workers fear (see also Hart 1983; Aghion and Howitt, 1998; Meyer and Vickers, 1997; Nickel et al., 1997; and Winston, 1993).

There is weak evidence in favour of a positive relationship between product market reforms and dynamic efficiency, since the link between productivity and innovation is a controversial issue in the literature and data constraints prevent proper testing of this channel. On the one hand, more competition works to reduce the monopoly rents that can be used to finance innovation (see Aghion and Howitt, 1992; Romer, 1990; Dasgupta and Stiglitz, 1980). On the other hand, product market competition may force innovations, so that incumbent firms can always be one step ahead of potential entrants (Ahn, 2001), or give firms incentives to escape current competition through product differentiation - although these incentives would disappear when products are sufficiently differentiated (Aghion et al., 2005). Aghion at al. (2005) argue that the relationship between competition and innovation must be non-linear, with very high and very low levels of competition discouraging innovation.

Most empirical studies find that increased competition reduces markups (and therefore foster allocative efficiency). Oliveira Martins et al. (1996) find a negative correlation between entry rates and markups. Allen et al. (1998) and the European Commission (1996) document a correlation between the creation of the single market in Europe and reductions in cost-price margins. However, markups may be lower because prices are declining or because costs are increased, and the latter would imply smaller rather than greater industry efficiency, as argued in Machin and Van Reenen (1993). On this topic, Sauner-Leroy (2003) shows that markups and prices jointly declined in Europe with the advent of a single market.

[4] The Contestable Market Theory is a strand of microeconomic literature initiated by Baumol (1982) and further developed by Baumol, Panzar, and Willig (1982) which argues that markets can operate close to perfect competition even with a restricted number of firms, as long as there is a sufficiently credible threat that new firms can enter the market and replace the incumbents. In this case, the markets are called "contestable".

Another strand of the empirical literature has focused instead on the link between competitiveness and productivity. These studies document a positive relationship between entry and productivity. Barnes et al. (2001), Griliches and Regev (1995), and Baily et al. (1992) find evidence of significant within firm effect (increases in productivity within firms) and of a much smaller contributions of between firm effect (associated with market restructuring via entry and exit or changes in market share towards more efficient firms). Nickell et al. (1997, 1992) and Harrison (1994) found evidence of a positive link between trade liberalization and the productivity level of industrial firms. Cave and Barton (1990), Caves et al. (1992), and Green and Mayes (1991) study the relationship between market concentration and technical efficiency and find that market concentration tends to be associated with reductions in technical efficiency but only above a certain threshold. Griffith (2001) shows instead that productivity gains following product market competition in Europe have occurred more in firms where management and ownership are separated (principal-agent types of firms), which supports the idea that competition works to reduce agency costs. Jagannathan and Srinivasan (2000) provide similar evidence for the United States. Finally, Nicoletti and Scarpetta (2003) show strong evidence of significant relationship between product market regulations and productivity performance, with entry liberalization leading to total factor productivity gains in all countries, while Conway et al. (2006) show that competition has a strong positive impact on labour productivity growth.

Beside promoting efficiency in production, product market reforms that increase competition among firms can also improve the adjustment capacity to adverse macroeconomic shocks by promoting nominal flexibility, and thus eliminating persistent price and wage inflation differentials. There are many channels through which an increase in competition can lead to more price and wage flexibility. Higher competition reduces oligopolistic behaviour and coordination failures that prevent firms from adjusting prices in response to shocks (see Rotemberg and Woodford, 1991). In addition, in competitive markets firms reset their prices more frequently, reducing price stickiness. Thus competitive markets lead to a faster adjustment of relative prices and to an efficient reallocation of resources. Alvarez and Hernando (2006) show that product market regulations that restrict competition reduce price flexibility, and that in more competitive markets firm adjust prices faster in response to shocks. As far as wage flexibility is concerned, Boulhol et al. (2006) and Jean and Nicoletti (2004) show that product market competition may reduce wage premia and constrain the bargaining power of workers and unions.

2.3. Macroeconomic Adjustments to Shocks

How the macroeconomy adjusts to shocks has been studied in the literature in three different ways. First, via standard business cycle analysis, separating economic data into trend and cyclical components and associating the cyclical components with temporary deviations from trend due to macroeconomic shocks. Second, adjustments have been studied with a VAR methodology, analyzing the responses of macroeconomic variables to unpredictable shock impulses. Finally, the literature has also used dynamic stochastic general equilibrium modeling, where a structural model of the economy, whose parameters are either calibrated or estimated, is used to simulate the impact of shocks on the economy (see European Commission, 2006, and Grenouille at al., 2007).

In the first tradition, business-cycle fluctuations across countries are typically decomposed into a common component (which capture the synchronized part of responses across countries) and idiosyncratic components (which capture the unsynchronized part of the responses). Idiosyncratic components can exist for two reasons: because there are shocks which are specific to a country or a market, or because different countries or markets have different "resilience" to common shocks. While many empirical studies have shown that business cycle fluctuations across European countries are idiosyncratic (see Helbling and Bayoumi, 2003; Bergman, 2006; and Duval et al., 2007), much less is known about the differential resilience of country and sectors to common shocks. In general, the observation of idiosyncratic business cycle fluctuations has led researchers to try to evaluate macroeconomic performance in response to economic shocks in terms of the "resilience" with which the economy "resists" to the impact of common shocks. However, to evaluate economic performance in such a way, precise definitions of what "resilience" means and of what are the relevant shocks are needed.

Duval et al. (2007) adapt the methodology of Blanchard and Wolfers (2000) to study the impact of structural changes on countries' resilience to shocks. They define resilience as the ability of countries to maintain output close to potential in the aftermath of shocks, and measure it in two ways: by analyzing how strong is the impact of global shocks on national output gaps (amplification effect), and how fast national output gaps are eliminated in the aftermath of shocks (persistence effect). The amplification and the persistence effects are estimated with non-linear least square in panel regressions, where output gaps are regressed on their lags, on the shocks, and on country specific effects, allowing for both unobserved common disturbances and observed common and country-specific disturbances. The parameters associated with the lagged output gaps measure persistence; those associated with the shocks measures amplification.

The distinction between the amplification and the persistence of shocks is important because institutions that help dampen the impact of shocks may, at the same time, make shocks more persistent. Strict employment regulation, for instance, may deter firms from laying off workers, supporting employment and consumption in the short-run. However, they may lead to losses for the firms and a more lengthy adjustment in the long run, delaying the return of output to potential. Duval et al. (2007) analyze how institutions affect the amplification and the persistence effects of shocks by allowing these parameters to be determined by product and labour-market institutional characteristics. In the set of institutional variables they include: (i) the unemployment benefit replacement rate; (ii) the stringency of employment protection legislation (EPL); (iii) the stringency of product market regulation (PMR) across seven non-manufacturing industries; (iv) the collective bargaining coverage; and the (v) degree of centralization/co-ordination of wage bargaining. (ii), (iii), and (v) appear to be the most significant factors in explaining differences in amplification and persistence. To be able to account for other factor that may affect resilience, they also include as regressors the share of household mortgage debt to GDP, the share of total bank credit to stock market value traded (to control for differences in monetary policy transmission) and the share of overall tax receipts in GDP (to control for differences in the size of automatic stabilizers) in addition to dummies capturing the exchange rate regime. In general, the results indicate that stringent regulations dampen the short-run impact of shocks but make them more persistent.

2.4. Sectoral Adjustments to Shocks

Most of the existing studies which examine the adjustment to shocks focus on countries' aggregate performances. However, at the European level, where sector specific policies are designed, studies with a sectoral dimension may have an important role. For policy purposes, it important to identify the role played by product market reforms in the resilience of the various economic sectors, and indicate whether scope for further improvements exists. In addition, ranking sectors according to resilience can give policy makers important information on the most vulnerable sectors, thus allowing them to put more emphasis on those sectors facing the most severe adjustment problems. An analysis of this type requires a definition and an appropriate measurement of "resilience" by sectors. Due to data constraints, studies of sectoral adjustments to shocks are quite scarce.

Pelkmans et al. (2008) identify which sectors are least resilient to shocks, and hence more in need of structural reforms. Their analysis uses annual data for the period 1970-2005 for 12 sectors in 11 euro area countries from the EU KLEMS dataset. The data includes 3 goods producing sectors and 9 service producing sectors. The analysis is based on country and sector specific bivariate VARs for output and inflation. They measure resilience in two ways: via the "cumulative inflation change" following a supply and demand shock; and via the "cumulative output growth loss" in the case of supply shocks (demand shocks have no long run effects on output by construction). Demand and supply shocks are identified using the Blanchard-Quah method (see Blanchard and Quah, 1989). It turns out that "agriculture and mining" are the most resilient sectors while "trade" and "business services" are the least resilience, even though there are differences in the ranking of sectors depending on whether demand or supply shocks are considered. Pelkmans et al however do not link reforms and resilience directly. Thus, they are unable to measure the effectiveness of reforms on the adjustment capacity of sectors.

3. Study Methodology

The main aim of the study is to estimate and compare industrial sectors' resilience to shocks, and identify the links between estimated resilience and product market regulations. We will define resilience to shocks according to the estimated correlation between sectoral output changes over business cycle phases and common shocks. We have chosen to consider only common disturbances because this allows us to draw conclusions about differences in responses to shocks, without worrying about idiosyncratic disturbances that affect different sectors. This way we can isolate pure responses to common shocks. Resilience is defined by the degree of co-movement between shocks and sectoral output. In particular resilience is said to be higher where the correlation between shocks and output is low (meaning that the sector/country has its own dynamics). The report focuses on euro-area wide shocks, since these are most likely to capture all of the common disturbances hitting EU countries. In euro-area wide data, sectoral and country asymmetric shocks should cancel out, leaving mostly common disturbances; however, to test whether there could be a possible endogeneity problem in the analysis, arising from this methodology, we also examine how the results change when US shocks are considered and report these results in Appendix C.

To undertake this analysis we need to define and quantify common shocks, and to measure sectoral business cycle amplitudes: that is, output falls (increases) between peak (trough) and trough (peak). In order to measure business cycle amplitudes we have to define sectoral turning points, i.e. peaks and troughs. After that, we simply examine the correlation between the depth of a recession, for example, with the incidence of euro area shocks during that exact period.[5]

In order to undertake this analysis we have divided the work into four main steps which will be described in detail in the next sub-sections: (i) identification of business cycle phases; (ii) the construction of measures of sectoral output changes over the identified business cycle phases; (iii) the measurement of the sign and intensity of the common shocks over the identified business cycle phases; and finally (iv) the econometric analysis. The econometric analysis will help determine the correlation of sectoral output changes with shocks, and therefore their resilience. Furthermore, it will help explain variations in these correlations across countries and sectors, using a set of possible explanatory variables.

3.1. Establishing Business Cycle Chronologies

To establish business-cycle phases we use the concept of "classical" business cycles and apply it to the output series of the various sectors analyzed. In this way we establish sector-specific cycles. One advantage of calculating sector-based business-cycle phases is that it allows for differences in the timing of the transmission of common shocks to sectors, which would not be the case if we chose instead to impose common dates.

[5] An alternative procedure which is tested is to estimate turning points using euro-area GDP and impose these as common turning points for all the sectoral output series. This alternative methodology is very rigid though, since it does not consider any time-variation in the responses of sectors to shocks, and does not yield any significant results for the whole sample; but it will be used as a second-best alternative for analysing the 2008-09 business cycle downturn.

Identifying business cycles, however, is not an easy task in practice and entails, at times, a certain degree of judgment. Traditionally, in the United States the National Bureau of Economic Research (NBER) dates peaks and troughs with the corresponding cycles, representing periods of expansion and contraction in the level of activity, known also as ‘‘classical” business cycles. Recently a dating committee administered by the Centre for Economic Policy Research (CEPR) has taken up the dating of classical business cycle on a formal basis for the euro area.[6]

A number of alternative methods have been used to identify business cycle turning points. In the United States, the NBER Business Cycle Dating Committee meets on a regular basis to analyze available information for the United States and reach a consensus about the timing of turning points based, largely, on Burns and Mitchell’s (1946) definition of the business cycle. A similar committee has been established at European level by the CEPR. Although the NBER method and dates have sometimes aroused controversy, they are widely accepted and frequently used as a standard of comparison (see Boldin 1994, for example). Mechanical methods that have been used include simple *n*-consecutive-month change rules of thumb, and Markov switching models in the spirit of Hamilton (1989). These various mechanical methods differ substantially in terms of their underlying methodologies and can imply different results; Boldin (1994) compares some of these using U.S. data.

In this analysis we apply, where possible, the Bry and Boschan (1971, hereafter BB) method, which consists of a computerized procedure to emulate the decision process of the NBER committee in a univariate setting. The BB procedure has been used by Mintz (1969), King and Plosser (1994), and Watson (1994), and Artis et al. (1997) among many others. It provides researchers with a useful and widely accepted method explicitly designed for the task of identifying classical business cycles. The methodology has been found to largely replicate the NBER turning points, and therefore it is widely accepted as a reliable dating method. The procedure involves eliminating outliers, smoothing the series, applying dating rules, and imposing minimum duration of expansion and contractions. One important advantage of this method is that it allows us to examine the properties of the time series without resorting to any type of de-trending that may distort the time series properties of data, and affect the cyclical turns themselves (details can be found in Artis et al. 1997).

In some cases, however, the BB procedure cannot identify turning points in the data. This often occurs if the series are short, or interpolated. For the cases in which the BB procedure does not yield results we chose to identify cycles using a commonly used rule of thumb, the “two-consecutive-decline rule” according to which a recession is said to occut if output declines by at least two quarters; a minimum two-quarter positive growth is also imposed for expansions. This also requires subsequently checking and eliminating outliers (e.g. two or more consecutive downturns, etc).

[6] A related concept of “growth” cycles refers to cyclical movements around an underlying trend. It seems self-evident that recessions, in the sense of absolute declines in activity, are more important than declines relative to trend. This is especially true for sectoral fluctuations, which are relevant for the present study. There are also technical reasons why one may choose to analyze classical business cycles instead of growth cycles. In particular, different de-trending methods may yield different growth cycle chronologies (Canova 1998), which is a problem when the trend is a fuzzy concept. Further, commonly used de-trending methods may induce spurious cycles, as discussed in King and Rebello (1993) and Osborn (1995).

3.2. Constructing a Measure of Sectoral Output Changes: intensity and persistence

To capture the change of output from peak to trough, and the recovery from trough to peak, we construct a variable X, which is negative for business cycle downturns and positive for business cycle upturns. In the case of business cycle downturns X is equal to the difference between the sector's real output between trough and peak, normalized by the average between the trough and peak outputs, as shown in equation (1a), where *i* refers to the sector, *j* the country, and *k* the business cycle phase. For upturns, a symmetric definition, shown in equation (1b), is used.[7]

$$X_{ijk} = \frac{Y_{trough} - Y_{peak}}{(Y_{peak} + Y_{trough})/2} \quad \text{for business cycle downturns;} \qquad (1a)$$

$$X_{ijk} = \frac{Y_{peak} - Y_{trough}}{(Y_{peak} + Y_{trough})/2} \quad \text{for business cycle upturns;} \qquad (1b)$$

The advantage of the chosen normalization, as opposed to a standard percentage change, is that if the cycles are symmetric, X will be the same for downturns and upturns (even taking into account the presence of a long term trend).

To take into account differences in the length of adjustment we also construct a variable Xadj, in which the changes in output from peak to trough, and trough to peak, are divided by the duration of the phase. Denote $Xadj_{ijk}$ the change in output for sector i in country j, over the business cycle phase k, scaled by the length of the upturn/downturn, the $Xadj_{ijk}$ is given by (2a) and (2b):

$$Xadj_{ijk} = \frac{X_{ijk}}{\#\ quarters\ \ from\ \ peak\ \ to\ \ trough} \quad \text{for business cycle downturns;} \quad (2a)$$

$$Xadj_{ijk} = \frac{X_{ijk}}{\#\ quarters\ \ from\ \ trough\ \ to\ \ peak} \quad \text{for business cycle upturns;} \qquad (2b)$$

With this scaling factor, if in a business cycle downturn the output of two sectors declines by the same amount, the sector where the drop is faster will have a more negative Xadj. In a business cycle expansion if in two sectors output increases by the same amount, the one in which the recovery is faster will have a higher Xadj. In the empirical analysis that follows we will use Xadj as the measure of sectoral output changes, since it is a more comprehensive measure that combines information for the size and the duration of the each cycle phase.

[7] Following a symmetric definition, in upturns the variable X consists of the difference between the sector's real output in the peak quarter minus the sector's real output in the previous quarter of trough, also normalized by the average between the through and peak outputs.

3.3. Determining Common Shocks

To examine and compare the resilience of sectors one needs to consider the impact of common shocks on sectoral output. Common external shocks ensure that we can exclude idiosyncratic disturbances which are of little interest for the type of study we conduct here. Since we are dealing with European countries one natural disturbance to consider is a euro area aggregate GDP shock. The advantage of using euro area data is that it is available on an aggregated level, is constructed by the ECB, and is of a good quality. In euro area data, asymmetric shocks should average out, leaving mostly the common (symmetric) shocks.[8]

The construction of common GDP shocks for our analysis requires a two-step procedure. Firstly it is necessary to identify pure GDP shocks from other types of shocks, and we do this using a structural VAR methodology. Secondly we need to use the sectoral business-cycle dates, identified earlier, to measure the sign and intensity of the common shocks that hit the euro area over that specific period, that is to measure the "shock incidence and intensity" over the corresponding sectoral business cycle phase.

a. Identification of shocks

To extract common shocks a standard structural VAR was estimated. The data is quarterly covering the period 1980:Q1-2010:Q2, and include GDP at constant prices, GDP deflator or CPI for price series, a short-term interest rate, and M3. The VAR was estimated in levels, and the number of lags was determined by the Akaike and BIC criterion.[9]

The four-variable VAR takes the form:

$$X_t = A(L)X_{t-i} + e_t$$

where

$$X_t = \begin{bmatrix} y_t \\ p_t \\ r_t \\ m_t \end{bmatrix}$$

and

$$e_t = \begin{bmatrix} e_{yt} \\ e_{pt} \\ e_{rt} \\ e_{mt} \end{bmatrix}$$

The structural residuals e_t are obtained using a Choleski factorization. In terms of interpretation, having GDP first implies that the unforecastable part of GDP is due to only pure GDP shocks. For prices the unforecastable part is due to GDP and price shocks only,

[8] To assess the sensitivity of the results to alternative disturbances, we repeat the analysis using US GDP shocks estimated in the same way as euro area shocks, and present these results in Appendix.

[9] Note that for the purpose of extracting VAR shocks a model, the stationarity properites of the variables are not relevant since the estimates of VAR coefficients will be consistent even when unit roots are present (see Canova, 2007).

and so on. For money the interpretation of a money demand-type relationship is consistent with ranking money last.[10]

b. Construction of shock incidence and intensity variable

The second step after the identification of GDP shocks is to use them to construct series of output shocks associated with each sectoral business cycle phase k. This has been done using the following procedure:

1. Take each separate identified sectoral business cycle phase k (that is, downturn and upturn)

2. Cumulate the estimated structural residuals in differences (since the VAR was estimated in levels) so that to each X_{ijk} or $Xadj_{ijk}$ corresponds a cumulative shock S_{ijk} given by:

$$S_{ijk} = \sum_{t=start\ of\ phase\ k}^{end\ of\ phase\ k} \Delta e_t$$

   for all k, defined by consecutive peaks and troughs, such that, for downturns the start of phase k is the quarter after the peak, and the end is the following trough; while for upturns the start of phase k is the quarter after the trough, and the end is the following peak.

3. $S_{ijk} < 0$ indicates a downturn in the euro area and $S_{ijk} > 0$ an upturn in the euro area.

4. The S variable is used as the shock variable in the econometric analysis that follows.

3.4. Sectoral Resilience to Shocks

The purpose of the analysis will be to identify whether a given sector's output in a specific country co-moves with common euro area shocks. Due to the presence of asymmetric shocks, which become diluted when data is aggregated, sectoral output is not necessarily correlated to aggregate GDP shocks. What we want to understand here is how sectors and countries rank in terms of their correlations to common shocks (this will gives us our measure of resilience) and what characteristics determine this ranking, with particular emphasis on the role of product market regulations.

To carry out the analysis we set up a three dimensional panel, organized by sector (i), country (j), and business cycle phases (k), but since, as we will see later, the identified sectoral business cycle phases found for the various sectors and countries are not sufficiently synchronized it is not possible to give the panel a proper time dimension. Therefore, we analyze the panel by sectors, treating the observations for each sector as a large cross-section. This allows us to have a sufficiently large number of observations within

[10] In Appendix C we also describe the Blanchard and Quah (1989) identification method which imposes long-term restrictions (that distinguish between permanent and transitory shocks), rather than the short-term restrictions imposed by the Choleski factorization, and discuss how the results change.

each group. Due to this specification, we effectively allow only for sectoral fixed/random effects, but the results do not change significantly if we allow also for country fixed/random effects.

3.4.1. The Econometric Specification

The purpose of the econometric analysis we measure the responsiveness of sectoral output to shocks, allowing for variation across sectors and countries, by including dummy variables and by taking into account a range of country-specific characteristics. More importantly we allow the correlation to shocks to differ according to the country's index of product market regulations, which is the variable of interest of the study. More formally, the model can be summarized as follows:

$$Xadj_{i,jk} = a_i + bS_{i,jk} + gD_{i,jk}S_{i,jk} + dZ_jS_{i,jk} + l\ PMR_{i,jk}S_{i,jk} + e_{i,jk} \qquad (3)$$

In equation (3) a_i allows for sector fixed/random effects; $S_{i,jk}$ is the vector of the sum of shocks occurring during each business cycle phase k of sector i in country j; $D_{i,jk}$ is a matrix of dummy variables, controlling for certain sector, country, or cycle characteristics; Z_j is a vector of country characteristics, and $PMR_{i,jk}$ is a measure of product market regulations in country j, which is allowed to change over business cycle phases. As explained below in detail, this variable will be proxied by three alternative measures: an OECD index of product market regulations, which is country specific only (varies only across j); the World Bank Doing Business rankings, which is also available only at the country level; and markups, which are the only proxies which are sector and country specific (they vary across i and j) but which are available only for a smaller number of countries. This variable is our main focus of interest.[11]

Once equation (3) has been estimated, our measure of correlation with common shock S (the inverse of resilience to S) is given by (4):

$$b_{ijk} = b + gD_{ijk} + dZ_j + l\ PMR_{ijk} \qquad (4)$$

Notice that the estimated parameter b (the parameter associated with the shock variable alone) in itself is not of interest since the total marginal effect of the shock will be given by $b+gD_{ijk}+dZ_j+l\ PMR_{ijk}$. The parameter vectors g, d, and l allow this marginal effect and therefore sectoral resilience to be different across business cycle phases, sectors, and countries depending on their characteristics. For instance, significant and negative d parameters imply more resilience for countries with higher values of Zj. To be specific, if Zj

[11] To control for a possible accounting bias, due to the fact that in the absence of important asymmetric shocks, large sectors in euro area countries could be more correlated with euro area output shocks simply because they contribute more to euro area GDP, we also add as explanatory variable the interaction between the size of sector i in country j on the total euro area production, weuro, and the shock variable (the weight is zero if the country does not belong to the euro area). As shown below, though, this interaction is never significant, indicating that such an accounting bias is not of much importance in the analysis. We have also estimated the models weighted by inverse euro area GDP weights, so as to give less weight to larger euro area countries, and the results remain qualitatively the same, and are available upon request.

is a dummy for EMU membership, and d negative and significant, countries within EMU will have higher estimated resilience (that is lower correlation to common shocks).

In the case of GDP shocks, with which sectoral outputs are expected to be positively correlated, a high b_{ijk} implies a high correlation between sectoral output changes and common shocks and therefore low resilience of the sector to common shocks. Hence we can use as a measure of resilience $1/\exp(b_{ijk})$. This transformation avoids dealing with negative numbers if the estimated correlations are negative and preserves the ranking that would be given by comparing b_{ijk}: for countries with b_{ijk} lower or equal to zero (very high resilience), our resilience measure will be higher than or equal to 1; for countries with b_{ijk} higher than zero, the resilience measure will be lower than unity. Hence, sectors that show a negative correlation to common shocks (b_{ijk} lower than zero) will be interpreted as being very resilient, since they exhibit their own dynamics (expanding when everybody else is contracting, and vice versa).

Ideally we would like to allow for all the parameters to differ across sectors, but the sample does not permit to introduce such a large number of dummy variables. An alternative is to estimate a random coefficients model, which considers that the coefficients can vary randomly across sectors, such that:

$$coef_i = coef + h_i$$

where h_i is a random variation, hence $E[h|W]=0$ and $E[hh'|W] = S$, with W being the information set, S *the variance-covariance matrix,* and $coef=b,g,d,$ *and* l. We will use this model to better understand heterogeneities across sectors.

3.4.2. Description of the Variables

Dummy Variables

The first type of dummy variables considered are sector-specific dummies. Here we consider two-sets of dummies. The first set distinguishes industries according to their sectoral classification, using the 2-digit NACE classification (see Table 1); while the second set groups sectors into Main Industrial Groupings (MIG), using the European Commission's definition (see Table 2). For the sectoral classification dummies, we decided to consider sector 12-13 "Chemicals and Pharmaceuticals" as the benchmark sector and include twenty dummies for each of the other remaining sub-industry sectors. For the Main Industrial Groupings (MIG) classification dummies, we then take the group of intermediate goods as the benchmark group, and consider dummies for the other two groups (consumption and investment).

Table 1: List of 2-Digit Industry Sub-Sectors

Sector	Name	Short Name
01	Mining and quarrying	Mining & Quarrying
02-03	Manufacture of food and beverages	Food & Beverages
04	Manufacture of tobacco products	Tobacco
05	Manufacture of textiles	Textiles
06	Manufacture of wearing apparel	Wearing Apparel
07	Manufacture of leather and related products	Leather
08	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Wood,Cork & Straw
09	Manufacture of paper and paper products	Paper
10	Printing and reproduction of recorded media	Printing & Recording
11	Manufacture of coke and refined petroleum products	Coke & Petrol. Products
12-13	Manufacture of chemicals and chemical and pharmaceutical products	Chemicals & Pharm.
14	Manufacture of rubber and plastic products	Rubber & Plastic
15	Manufacture of other non-metallic mineral products	Non-Metallic Mineral Prod.
16	Manufacture of basic metals	Basic Metals
17	Manufacture of fabricated metal products, except machinery and equipment	Metal Products
18	Manufacture of computer, electronic and optical products	Computer, Electron., etc.
19	Manufacture of electrical equipment	Electric Equipment
20	Manufacture of machinery and equipment n.e.c.	Machinery & Equipment
21	Manufacture of motor vehicles, trailers and semi-trailers	Motor Vehicles, etc.
22	Manufacture of other transport equipment	Other Transport Equipm.
23	Manufacture of furniture	Furniture

Source: Eurostat, Short-term business statistics, Industry (Nace Rev.2).

We also include a dummy for business cycle upturns to test for an asymmetric response to shocks for upturns and downturns (Dup); a positive coefficient associated with the interaction between this dummy and the shock, would indicate that the sector responds

more to upturns and can therefore be considered more resilient (recovers fast), while a negative coefficient would indicate the opposite.

Finally we consider dummies controlling for EU and EMU membership. The EU membership dummy takes the value zero before EU membership and the value 1 after and if EU membership; while the EMU membership dummy takes the value zero before EMU membership and the value 1 after and if EMU membership. Since the EU and the EMU dummy are much correlated, they are not used simultaneously in the main specifications that have been estimated. These dummies can control for the fact that countries within EMU and the EU should show higher correlation to euro-area wide shocks.

Table 2: Main Industrial Groupings Classification

Class	Sector	Name	EU weight
CONS	02-03	Food & Beverages	13.41
CONS	04	Tobacco	1.19
CONS	06	Wearing Apparel	1.44
CONS	07	Leather	0.85
CONS	10	Printing & Recording	4.45
CONS	23	Furniture	2.89
			24.22
INT	01	Mining & Quarrying*	2.80
INT	05	Textiles	2.04
INT	08	Wood,Cork & Straw	2.02
INT	09	Paper	2.72
INT	11	Coke & Petroleum Products*	6.03
INT	12-13	Chemicals & Pharmaceutical	10.25
INT	14	Rubber & Plastic	3.97
INT	15	Non-Metallic Mineral Products	3.58
INT	16	Basic Metals	4.69
INT	17	Metal Products	6.99
INT	19	Electric Equipment	4.12
			49.21
INV	18	Computer, Electronic & Optical	3.26
INV	20	Machinery & Equipment	9.02
INV	21	Motor Vehicles, etc.	11.41
INV	22	Other Transport Equipment	2.88
			26.57

* Not included in the EU MIG classification. Source: Eurostat.

Country Characteristics

To account for the effect of additional factors which may affect the ability of different countries to adjust to shocks, we include in the analysis a set of country characteristics (Z_j) which can be expected to affect the transmission mechanism of shocks, in part because they affect policy responses. Following the literature, we consider in this set of country characteristics measures of: fiscal sustainability, openness, financial development, and labour market institutions. As a measure of fiscal sustainability we include the average debt-to-GDP ratio (debt) experienced by the countries between 1995 and 2008. A positive coefficient associated with the interaction between the debt-to-GDP ratios would indicate

that sectors in countries with a worse sustainability position respond more to shocks and are therefore less resilient. It is possible to argue that this would be a reasonable prior for this coefficient, since lower debt levels give better access to financial markets to smooth the impact of shocks, and allow for more room for short-term stabilization policies. On the other hand, a negative coefficient could be explained if countries with high debt levels are those using fiscal policy more actively to support their sectors in the short run, therefore smoothing business cycle phases, even if this can be detrimental for long term growth, as some growth studies have reported (seen for instance Fischer, 1993.[12]

As a measure of openness to trade (open), we use the average across 1995 and 2008 (for consistency with the fiscal sustainability indicator) of countries' imports and exports of goods and services as a percentage to GDP. A positive coefficient associated with the interaction between openness and the shock, would indicate that sectors in countries that are more open to external trade are more exposed to shocks, and therefore less resilient, but a negative coefficient could also be justifiable by the fact that in countries more open to trade, sectors have to be more efficient in order to compete in world markets.

As a proxy for financial development (findev) we use ratios of market capitalization to GDP, also averaged across 1995 and 2008. Relative to financial development it is more plausible to expect a negative coefficient associated with the interaction between financial development and the shock, since these would mean a lower correlation to shocks, and therefore more resilience, in countries where access to financial markets is easier, but it is possible that this variable may also be capturing the countries' globalization, and therefore exposure to external shocks.

Finally, we consider three alternative measures of labour market institutions. The first (epl) is the OECD Index of Labour Market Regulations; the second (barg1) is an indicator of collective bargaining power measuring the statutory protection and power of unions; while the third (barg2) is a more comprehensive indicator of collective bargaining power measuring the protection of collective relations laws as the average of: (i) labor union power and (ii) collective disputes. The two indicators of collective bargaining power were obtained from Botero et al. (2004). Relative to labour market institutions we would expect sectors to be less resilient in sectors with more strict regulations (higher epl), and higher union density (barg1, and barg2), although unionized behavior could also facilitate coordination in periods of crisis.

Product Market Regulation Indicators

To measure product market regulations (PMR) we consider a composite variable consisting of the OECD product market regulations indexes for 1998, 2003, and 2008; labeled pmrt in the analysis that follows.[13] This measure reflects an average of indicators of state controls (including state ownership and control regulation); barriers to entrepreneurship (including regulatory and administrative opacity; burdens on start-ups, and barriers to competition);

[12] We have also estimates of the model using the deficit-to-GDP ratio as a measure of fiscal sustainability, but the results for this variable proved to be less robust. These are available upon request.

[13] We also tried using a non-time varying measure of product market regulations by using each of this indicators separately in the analysis, and also the average of the three, and the results do not change significantly.

and barriers to trade and investment (including tariffs, discriminatory procedures, barriers to FDI, and regulatory barriers). In theory, the coefficient on the interaction between product market regulations and shocks could be expected to be positive: stricter regulations reduce the ability of sectors to adapt to shocks, implying a higher correlation between output changes and shocks, and therefore less resilience. However, strict regulations could also be working as a form of protectionism insulating inefficient sectors from the impact of shocks, rendering them more resilient, even if their prospects for sustainable long term growth are low. As alternative measures of product market regulations we also consider the 2009 World Bank Doing Business ranking (db1), which can be interpreted in the same way as the pmrt, since a low value means a better ranking in terms of conditions for businesses to operate, while a high value implies a worse ranking (worse business conditions). The Doing Business rankings reflect the average of country performances on various indicators aggregated into nine broad categories, which include: starting a business, dealing with construction permits, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts and closing a business. [14] Finally we also test a specification in which we use as a measure of product market regulations the Markups estimated by Cristopoulou and Vermeulen (2008), which distinguish between two periods: 1981-1992; and 1993-2004. High Markups are usually correlated with more market power and therefore lower competition and more stringent product market regulations, hence the coefficient associated with the interaction between this variable and the shock can also be interpreted in the same way as that of the PMR interaction. This measure has the advantage of varying by sector, but the disadvantage of being available for eight countries only (Austria, Belgium, Finland, France, Germany, Italy, Netherlands, and Spain).

[14] The World Bank business rankings are available in aggregate for 2009 and 2010, but do not change significantly across these two years. Here the 2009 rankings are used because these are more consistent with the rest of the sample.

4. Data and a Few Stylized Facts

4.1. Industry Data

The dataset consists of output data for industry sub-sectors, classified according to the NACE 2-Digit classification. The list of these sub-sectors is shown in Table 1. The coverage of the data is generally quite restrictive across time, and it varies significantly across countries. The effective samples, which are shown in Appendix A, are somewhat limited, with the longest sample running from 1980Q1 to 2010Q2. For 2-digit industry subsectors the output data available is mostly volume indexes. To construct country and sector weights we average the available data on output at constant prices between 1999 and 2006, for each country.[15] Hence the weights correspond to the ratio between these country averages and the averages for the relevant total.

In Table 3 we show the composition of countries output by industry subsector, estimated using this procedure. Within industry itself one can observe again sizeable differences across countries, for example in food (2% in the UK, 8 percent in Finland compared with around 20 percent in Denmark, Ireland, Netherlands and Poland, and 40 percent in Sweden), chemicals (33 percent in Ireland compared with most countries in the 5-10 percent range), and motor vehicles (very small shares in many countries, compared with 16-17 percent in France and Germany and 11 percent in Spain). These imply considerable differences in the responses of countries to sector-specific and, to the extent that there existing structural differences across these sectors or countries, to common shocks.

In the next subsections we describe in detail the stylized facts associated with both sectoral datasets. We also give descriptive statistics for the indicators of product market reforms which are used in the analysis, as well as for the set of control variables included.

4.2. Stylized Facts for Sectoral Cycles

This section presents stylized facts for the data: it includes the turning point identification results for industry sub-sectors and provides descriptive statistics for the estimated sectoral output changes and common shocks.

4.2.1. Sectoral Cycles

We utilize first the BB method for identifying turning points with mixed results. The only two countries for which the BB procedure worked properly were Ireland and Spain, for which longer time series are available spanning the whole period 1980-2010Q2. As a second best althernative we identify turning points using the two-consecutive decline rule.[16]

[15] It is important to note that data on output at constant prices for 2-digit NACE sub-sectors is limited, with many missing observations.

[16] For some output series, no turning points could be identified even with the two-consecutive change rule. A list of these series is available from the authors.

Table 3: Composition of Industrial Output by 2-Digit Industry Subsectors, in percent.
Weights Constructed from Average Output for 1999-2006

	Sector\Country	Aus	Bel	Cze	Den	Fin	Fra	Ger	Gre	Hun	Ire	Ita	Net	Nor	Pol	Por	Spa	Swe	Swi	UK
1	Mining & Quarrying	1.21	0.43	2.96	7.12	0.79	1.00	0.98	3.12	0.63	1.62	4.59	4.55	55.39	5.68	1.77	1.14	0.85	1.05	8.89
2	Food & Beverages	10.02	14.68	11.18	22.82	8.25	14.81	10.25	19.75	14.33	20.67	10.76	20.23	6.36	21.40	15.48	17.83	39.65	11.88	2.01
4	Tobacco	0.35	0.80	0.89	2.01	0.10	1.17	1.09	0.96	1.33	1.63	0.60	2.54	0.59	2.16	0.57	0.32	2.03	0.30	2.14
5	Textiles	2.05	3.54	2.40	1.40	0.70	1.62	1.10	2.76	1.06	0.49	4.45	1.27	0.42	1.74	6.21	2.22	0.41	1.64	1.85
6	Wearing Apparel	0.73	0.93	0.84	0.78	0.53	1.33	0.75	3.65	1.47	0.30	3.49	0.28	0.13	1.47	5.27	1.85	0.12	0.77	1.08
7	Leather	0.74	0.18	0.33	0.50	0.23	0.45	0.25	0.66	0.52	0.07	3.07	0.16	0.04	0.57	3.65	1.29	0.07	0.20	0.28
8	Wood,Cork & Straw	5.06	1.67	3.01	2.49	5.89	1.38	1.57	1.41	1.32	1.17	2.02	1.20	2.11	3.10	4.89	2.32	3.22	3.25	1.66
9	Paper	4.44	2.31	2.14	1.91	14.64	2.17	2.31	1.77	1.67	0.86	2.21	2.53	1.80	2.37	3.41	2.64	5.15	2.52	2.85
10	Printing & Recording	3.87	3.42	2.58	5.99	4.29	3.88	3.78	6.19	2.64	13.39	3.18	5.95	3.81	3.14	3.74	4.03	3.01	5.71	8.42
11	Coke & Petroleum Prod.	4.87	11.64	3.13	0.06	4.67	6.74	5.63	14.47	8.38	6.39	5.00	7.86	0.44	7.20	8.00	5.57	0.43	4.24	7.44
12	Chemicals & Pharm.	6.31	17.04	5.76	10.14	5.67	11.89	9.49	5.54	7.26	32.30	8.03	17.88	4.72	6.92	5.38	8.90	5.56	19.92	11.62
14	Rubber & Plastic	3.78	3.89	5.95	4.09	2.58	4.17	4.11	2.57	3.79	1.53	4.18	2.78	0.79	4.62	3.20	4.01	1.56	3.51	4.94
15	Non-Metallic Min. Prod.	4.70	3.96	5.49	3.43	2.74	2.87	2.83	6.28	2.99	2.21	4.59	2.74	1.67	4.63	6.78	6.70	1.19	2.36	3.05
16	Basic Metals	7.72	8.24	7.47	1.69	6.61	3.68	4.99	8.89	4.10	0.52	5.22	2.85	5.05	4.65	2.54	5.57	4.26	2.71	3.67
17	Metal Products	7.85	5.33	8.32	6.93	5.21	6.21	7.07	8.13	4.25	1.79	9.53	6.81	2.23	5.93	6.24	8.13	4.13	8.79	6.67
18	Computer, Electr., etc.	5.16	2.73	3.17	2.19	17.42	3.67	2.47	0.94	14.12	5.30	1.81	3.24	0.97	2.19	4.30	1.26	5.80	2.94	3.52
19	Electric Equipment	4.29	2.13	6.17	5.79	3.37	3.25	6.38	2.09	8.75	3.39	3.68	1.61	1.11	3.33	3.27	3.61	1.94	7.40	3.45
20	Machinery & Equipment	11.63	4.83	8.57	12.21	11.54	6.06	12.61	3.02	5.21	2.18	11.96	7.51	4.11	5.20	4.29	5.69	7.63	15.61	8.06
21	Motor Vehicles, etc.	9.62	9.21	15.15	1.35	1.04	16.07	17.90	0.57	14.36	0.66	5.22	3.66	0.74	7.87	6.28	11.57	9.95	0.70	9.40
22	Other Transport Equipm.	1.76	0.94	1.26	1.93	2.04	5.42	2.20	2.27	0.61	0.59	2.12	2.26	6.23	1.97	1.05	2.06	1.48	1.66	5.45
23	Furniture	3.85	2.11	3.24	5.18	1.69	2.17	2.23	4.95	1.22	2.95	4.28	2.08	1.29	3.86	3.69	3.30	1.55	2.85	3.53
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Eurostat, Short-term business statistics, Industry (Nace Rev.2)., Production Value, Annual Data, and Authors' calculations..

Table 4 shows, for each sector, the average number of turning points identified by country (that is the total number of turning points identified in total divided by the number of countries).The synchronization of turning points across countries and sectors appears to be relatively low, as indicated by the very different number of turning points found within similar time periods (e.g. "tobacco" has 5 turning points within the period 1981-2009; while "metal products" and "basic metals" have 7 and 9 cycles repectively over the same period; and even more significant differences show up across countries).

Table 4: Description of Identified Turning Points by 2-Digit Industry Subsector

Sector	*Name*	*Average Number of Turning Points Identified by country*	*First turning point*	*Last turning point*
01	Mining & Quarrying	7	1982/Q1	2008/Q4
02-03	Food & Beverages	8	1980/Q3	2009/Q1
04	Tobacco	5	1981/Q3	2009/Q1
05	Textiles	7	1980/Q4	2008/Q2
06	Wearing Apparel	6	1980/Q4	2008/Q4
07	Leather	6	1982/Q1	2008/Q2
08	Wood,Cork & Straw	6	1981/Q1	2008/Q4
09	Paper	7	1980/Q4	2008/Q4
10	Printing & Recording	6	1981/Q3	2008/Q4
11	Coke & Petroleum Products	5	1982/Q4	2008/Q4
12-13	Chemicals & Pharmaceutical	7	1980/Q3	2008/Q4
14	Rubber & Plastic	7	1980/Q3	2008/Q4
15	Non-Metallic Mineral Products	7	1980/Q3	2008/Q2
16	Basic Metals	9	1981/Q1	2008/Q2
17	Metal Products	7	1981/Q1	2008/Q3
18	Computer, Electronic & Optical	6	1980/Q3	2008/Q4
19	Electric Equipment	6	1980/Q4	2008/Q3
20	Machinery & Equipment	6	1980/Q4	2008/Q4
21	Motor Vehicles, etc.	6	1980/Q4	2008/Q3
22	Other Transport Equipment	6	1980/Q3	2008/Q4
23	Furniture	5	1981/Q4	2008/Q3

Source: Sectoral output Data is from Eurostat, Short-term business statistics, Industry (Nace Rev.2).

4.2.2. Sectoral Output Changes and Common Shocks

Table 5 summarizes the sectoral output changes (X and Xadj) and the shocks, for downturns and upturns, separately; for comparison we also report statistics for US GDP shocks. On average, sector downturns correspond to negative common shocks, and sector upturns correspond to positive common shocks. However as can be observed in the maximum (max) and minimum (min) statistics, not all sector downturns correspond to negative shocks; and not all sector upturns correspond to positive shocks.

Table 5: Business Downturn, Upturns, and Common Output Shocks, 2-Digit Industry Data Summary Statistics.

Downturns						
		Obs	Mean	Std.Dev.	Min	Max
Cyclical change	x	1180	-14.15	18.85	-174.71	-0.01
	xadj	1180	-3.13	3.97	-53.97	-0.00
Common shocks	sy	1180	-0.11	1.15	-5.18	3.48
	syus	1180	-0.05	1.29	-4.29	3.10

Upturns						
		Obs	Mean	Std.Dev.	Min	Max
Cyclical change	x	1332	18.50	19.86	0.23	186.27
	xadj	1332	3.11	3.47	0.04	46.57
Common shocks	sy	1329	0.16	1.23	-4.54	4.77
	syus	1329	0.21	1.24	-3.69	4.66

Source: Sectoral output Data is from Eurostat, Short-term business statistics, Industry (Nace Rev.2). Sectoral output changes and shocks are constructed by the authors as it is described in section 3.

Table 6: Correlations between sectoral output changes and shocks by 2-Digit Industry Sectors

Correlations between Xadj and Shock:		*Sy*	*Syus*	
01	Mining & Quarrying	-0.22	0.03	(obs=135)
02-03	Food & Beverages	-0.07	0.05	(obs=143)
04	Tobacco	0.10	0.03	(obs=90)
05	Textiles	-0.13	0.19	(obs=131)
06	Wearing Apparel	-0.15	0.02	(obs=111)
07	Leather	-0.13	-0.08	(obs=100)
08	Wood,Cork & Straw	0.30	0.23	(obs=115)
09	Paper	0.17	-0.03	(obs=125)
10	Printing & Recording	0.08	0.05	(obs=118)
11	Coke & Petroleum Products	-0.06	-0.02	(obs=98)
12-13	Chemicals & Pharmaceutical	0.34	0.15	(obs=135)
14	Rubber & Plastic	0.33	-0.09	(obs=131)
15	Non-Metallic Mineral Products	0.24	0.07	(obs=131)
16	Basic Metals	0.22	0.07	(obs=174)
17	Metal Products	0.10	0.05	(obs=128)
18	Computer, Electronic & Optical	0.22	0.20	(obs=111)
19	Electric Equipment	0.07	0.05	(obs=101)
20	Machinery & Equipment	0.04	0.10	(obs=113)
21	Motor Vehicles, etc.	0.39	0.03	(obs=108)
22	Other Transport Equipment	-0.06	-0.05	(obs=113)
23	Furniture	0.10	0.06	(obs=98)
All Sectors		0.06	0.04	(obs=2509)
Excluding sectors 1, 2, 5, 6, 7, 11, and 22		0.19	0.07	(obs=1678)

To give a better picture of the unconditional correlations between sector output changes and common shocks, Table 6 reports the correlation between the variable Xadj and euro area GDP shocks (Sy). Correlations to US GDP shocks, Syus, are also shown to serve again as a useful comparison. On average the unconditional correlations are positive, although a

number of sectors do show negative correlations, which could indicate that, on average, these sectors are extremely "resilient" to common GDP shocks, and follow their own dynamics. One can also see that positive correlations with euro area GDP shocks are highest for "Motor Vehicles", "Chemicals and Pharmaceuticals", "Wood, Cork, and Straw", and "Rubber and Plastics". The econometric work will allow to identify whether these differences across sectors are statistically significant. Table 7 shows the unconditional correlations between sectoral output changes (Xadj) and euro area GDP shocks, by country (independently of the sector). Correlations to US GDP shocks are shown once more to serve as a benchmark. Industrial sectors in the largest euro area countries like France and Germany do show positive correlations with common euro area GDP shocks, as would be expected, but their correlations are comparable to those in some non-euro area countries like Lithuania, Poland, and Switzerland.

Table 7: Correlations by Country in the 2-Digit Industry Data (sectoral output changes Xadj and shocks)

Country	Sy	Syus	Country	Sy	Syus
Austria	0.02	0.07	Italy	0.02	0.03
Belgium	0.23	0.05	Latvia	-0.02	-0.03
Czech Republic	-0.01	0.08	Lithuania	0.2	0.06
Denmark	-0.06	-0.06	Netherlands	-0.1	0.11
Estonia	-0.06	-0.16	Norway	-0.17	0.03
Finland	0.06	0.15	Poland	0.42	0.33
France	0.17	0.16	Portugal	0.33	0.03
Germany	0.3	0.09	Spain	0.16	0.09
Greece	-0.02	0.08	Sweden	0.13	-0.05
Hungary	-0.05	0.19	Switzerland	0.27	0.22
Ireland	-0.04	0.00	United Kingdom	0.07	-0.02

4.2.3. Output Dynamics During the 2008-09

Table 8 summarizes the quarterly sectoral output changes during the 2008-09 recession. All sectors experienced negative growth, although there are significant differences in terms of the extent of the output declines across different industries.[17] The sectors experiencing the largest drops were Motor Vehicles, Machinery and Equipment, and Basic Metals; while those experiencing the smallest were Tobacco, Other Transport Equipment, and Food and Beverages.

Table 8: Output Decline during the 2008-09 Downturn, by 2-Digit Industry subsectors

(EU countries). Annual percentage changes (quarter on quarter).

Sector		2008/Q1	2008/Q2	2008/Q3	2008/Q4	2009/Q1	2009/Q2	2008/Q1 - 2009/Q2
01	Mining & Quarrying	1.9	-1.0	-5.4	-9.8	-10.2	-13.2	-13.4
02-03	Food & Beverages	1.2	-1.2	-1.0	-2.9	-2.6	-1.0	-2.8
04	Tobacco	-13.0	-18.3	-19.1	-14.5	-4.9	0.7	-5.4
05	Textiles	-4.3	-7.2	-11.5	-17.3	-23.9	-22.7	-26.3
06	Wearing Apparel	-1.2	-3.1	-5.1	-4.4	-13.0	-10.8	-13.7
07	Leather	-3.0	-7.8	-10.8	-10.1	-17.4	-16.8	-19.7
08	Wood,Cork & Straw	-3.4	-6.7	-10.8	-14.5	-21.5	-17.2	-21.9
09	Paper	0.9	-2.0	-3.2	-9.3	-14.3	-11.9	-14.0
10	Printing & Recording	0.1	-0.9	-2.5	-6.0	-7.2	-8.0	-9.4
11	Coke & Petrol. Prod.	5.8	3.3	1.8	1.9	-8.7	-8.9	-8.8
12-13	Chemicals & Pharm.	1.1	0.4	0.0	-7.5	-10.3	-7.0	-8.9
14	Rubber & Plastic	1.5	-1.4	-4.6	-14.9	-21.1	-18.7	-21.4
15	Non-Metallic Min.	-1.2	-4.9	-7.3	-13.5	-23.1	-21.4	-25.8
16	Basic Metals	2.7	1.7	-0.9	-13.9	-28.5	-28.7	-29.5
17	Metal Products	3.7	0.9	-2.3	-12.0	-25.7	-25.8	-27.9
18	Comp., Electr., etc.	8.8	4.6	1.5	-4.1	-18.7	-18.2	-19.3
19	Electric Equipment	4.0	4.6	-0.4	-8.6	-21.5	-25.8	-25.9
20	Machinery & Equip.	5.5	5.8	-0.1	-5.4	-22.7	-29.6	-29.8
21	Motor Vehicles, etc.	6.0	1.2	-5.9	-25.9	-39.9	-31.5	-34.9
22	Other Transp. Equip.	3.9	4.9	5.0	3.5	-3.1	-4.9	-4.1
23	Furniture	0.9	-1.8	-6.7	-11.9	-18.3	-19.6	-21.5

Source: Eurostat, Short-term business statistics, Industry, Nace (Rev.2), EU-27

[17] Given that in both those tables the changes are taken in the same predetermined period of time for all sectors, then from simple sectoral output growth rates we can infer and contrast the performance of sectors also in terms of velocity of adjustment.

4.3. Product Market Regulations Data and Statistics

Table 9 presents the basic statistics for the OECD product market indexes and the World Bank doing Business Rankings. As mentioned earlier the OECD PMR reflects an average of indicators of state controls (including state ownership and control regulation); barriers to entrepreneurship (including regulatory and administrative opacity; burdens on start-ups, and barriers to competition); and barriers to trade and investment (including tariffs, discriminatory procedures, barriers to FDI, and regulatory barriers). The doing business rankings reflect the average of country performances on a set of indicators aggregated into nine broad categories, which include: starting a business, dealing with construction permits, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts and closing a business.

In Table 9 it is possible to observe that there is substantial variation in product market regulations across countries as seen from the distribution of the data. Although the units are not comparable, the standard deviation of the PMR indicators are about 25% of the mean, and the standard deviation of the db1 is about 69% of the mean.

Table 9: Product Market Regulations and Competitiveness Indicators
Summary Statistics for the OECD PMR indexes and the Doing Business rankings

		Countries	Mean	Std.Dev.	Min	Max
Product Market Regulation Indicators	pmr98	21	2.2	0.6	1.1	4.0
	pmr03	21	1.6	0.4	0.8	3.0
	pmr08	21	1.4	0.4	0.8	2.4
	db1	26	37.9	26.0	5.0	109.0

Source: OECD (for PMR); and the World Bank (for db1). The Doing Business Rankings (db1), are for 2009.

Table 10 shows summary statistics for markups by 2-digit industry subsectors. Amongst the sectors with the largest markups are Tobacco Products, Basic Metals, Computer and Electronic Products; while amongst those with the lowest markups are Food and Beverages, Other Transport Equipment, and Motor Vehicles. In industry subsectors it is possible to see more variation in the ranking of markups over time. While between 1981 and 1992, the Coke and Petroleum Products sector, for instance, was amongst the sectors with the lowest markups, between 1993 and 2004, this sector was amongst the sectors with the largest markups.

Table 10: Summary Statistics for Sectoral Mark-ups, 2-digit Industry sub-sectors

			Countries	Mean	Std.Dev.	Min	Max
2-3	Food & Beverages	1981-1992	7	1.10	0.03	1.06	1.13
		1993-2004	8	1.11	0.04	1.07	1.18
4	Tobacco	1981-1992	6	1.37	0.26	1.12	1.87
		1993-2004	6	1.48	0.39	1.04	2.11
5	Textiles	1981-1992	7	1.15	0.08	1.07	1.30
		1993-2004	8	1.16	0.09	1.07	1.35
6	Wearing Apparel	1981-1992	7	1.14	0.11	1.03	1.35
		1993-2004	8	1.16	0.11	1.06	1.39
7	Leather	1981-1992	8	1.11	0.05	1.05	1.21
		1993-2004	8	1.17	0.12	1.09	1.47
8	Wood,Cork & Straw	1981-1992	8	1.16	0.08	1.09	1.28
		1993-2004	8	1.21	0.07	1.11	1.30
9	Paper	1981-1992	7	1.20	0.09	1.07	1.31
		1993-2004	8	1.24	0.15	1.07	1.51
10	Printing & Recording	1981-1992	7	1.15	0.02	1.12	1.19
		1993-2004	8	1.20	0.09	1.10	1.34
11	Coke & Petroleum Products	1981-1992	6	1.12	0.11	1.02	1.30
		1993-2004	6	1.21	0.24	1.04	1.69
12-13	Chemicals & Pharmaceutical	1981-1992	8	1.20	0.07	1.11	1.27
		1993-2004	8	1.16	0.05	1.06	1.22
14	Rubber & Plastic	1981-1992	7	1.16	0.06	1.08	1.26
		1993-2004	7	1.15	0.06	1.06	1.22
15	Non-Metallic Mineral Products	1981-1992	8	1.24	0.07	1.11	1.34
		1993-2004	8	1.20	0.08	1.08	1.35
16	Basic Metals	1981-1992	7	1.23	0.14	1.05	1.43
		1993-2004	8	1.27	0.16	1.04	1.52
17	Metal Products	1981-1992	7	1.16	0.05	1.05	1.22
		1993-2004	8	1.19	0.10	1.08	1.33
18	Computer, Electronic & Optical	1981-1992	6	1.27	0.38	0.90	1.96
		1993-2004	7	1.23	0.16	1.03	1.42
19	Electric Equipment	1981-1992	6	1.16	0.07	1.09	1.29
		1993-2004	7	1.17	0.12	1.06	1.39
20	Machinery & Equipment	1981-1992	8	1.13	0.07	1.05	1.21
		1993-2004	8	1.15	0.06	1.07	1.27
21	Motor Vehicles, etc.	1981-1992	7	1.12	0.06	1.06	1.23
		1993-2004	8	1.11	0.05	1.02	1.10
22	Other Transport Equipment	1981-1992	7	1.03	0.04	0.94	1.07
		1993-2004	8	1.12	0.14	0.92	1.38
23	Furniture	1981-1992	6	1.19	0.09	1.07	1.31
		1993-2004	7	1.17	0.04	1.11	1.24

Source: Cristopoulou and Vermeulen (2008),

4.4. Country Characteristics

As mentioned earlier, we account for the effect of additional factors that may affect the ability of different countries to adjust to shocks, with a set of country characteristics, that include: the debt-to GDP ratio (Debt), openness (Open), financial development (Findev), and labour market institution indicators (EPL, Barg1, Barg2). We introduce these characteristics in the analysis as time-invariant, by taking the time-series averages between 1995-2008. The summary statistics for these variables are presented in Table 11.[18]

Table 11: Selected Country Characteristics, Summary Statistics

	Variable	Number of Countries	Mean	Std.Dev.	Min	Max
Country Characteristics	Debt	26	48.6	26.9	5.3	109.3
	Open	26	50.8	23.7	25.5	131.4
	Findev	26	64.1	53.6	7.7	232.3
	EPL	23	2.2	0.7	0.7	3.6
	Barg1	22	0.5	0.1	0.3	0.7
	Barg2	23	0.5	0.1	0.2	0.7

Source: AMECO database (European Commission, DGEcFin), and IFS database (International Monetary Fund).

Table 11 shows that the heterogeneity across countries regarding the set of characteristics included in the panel is substantial, especially with respect to financial development, openness, and debt to GDP ratios.

5. The Empirical Results

5.1. The Relationship between Resilience and Product Market Regulations

In this section we try to distinguish between the resilience of different industry subsectors in two alternative ways. Firstly by including dummies for each sub-sector individually, except for sector 12-13 "Chemicals and Pharmaceuticals" which is taken as the benchmark sector; this is the "Sectoral Classification Analysis". Second, we group sectors into three main industrial groupings: consumption goods; intermediate goods; and investment goods. In this case we use the "intermediate goods" group as the benchmark group and include dummies for the other two groupings. The results from both analyses are shown below in separate subsections.

[18] The data sources are AMECO for EU countries, IFS for Norway and Switzerland, and World Bank for the financial development indicator.

5.1.1. Sectoral Classification

Table 12 shows the results obtained when sectoral dummies are included in the analysis. We report only the results for statistically significant sectoral dummies. Since several dummies come out insignificant, we cannot identify statistically significant differences in resilience for many of the sectors. There are some exceptions though, including the sectors of "mining", "food & beverages", and "motor vehicles", for which the dummies do have significant coefficients, indicating that the resilience of these sectors is substantially different from that of the benchmark sector ("chemicals and pharmaceuticals"). Sectoral dummy variables that are negative and significant indicate a lower response to euro area common GDP shocks, and therefore higher resilience than the benchmark. Sectoral dummies that are positive and significant show a higher responsiveness to shocks, and therefore lower resilience than the benchmark.

Regarding other model variables, we have estimated various specifications which are reported in columns (1) to (9) in Table 12. Overall, the regression results show evidence that product market regulations, when measured by the OECD PMR index, negatively impact on the resilience of industrial sectors: the coefficient of the "pmr" interaction is always positive and significant. When the alternative Doing Business indicator (db1) is used the interactions, although still positive, are statistically insignificant; similarly, the coefficient on the markups interaction (markup) is negative and insignificant. Also we find that the labour market variables considered are insignificant, a finding which possibly merits further investigation.

The openness variable is not statistically significant, contrary to the financial development interaction which has a coefficient that is positive and significant. This is somewhat counterintuitive since financial development should help to smooth the response to shocks, although this could also be related to the fact that countries with more developed financial systems are more open and, hence, more exposed to external financial shocks (e.g. through portfolio and investment flows, and through the activities of multinational companies); see section 7 for more discussion. Another interaction which appears always significant and with a positive sign is that for EMU membership.[19] The positive sign of the EMU interaction shows that, everything else equal, industrial sectoral output responds more to euro area GDP shocks in countries that belong to EMU, whether large or small.[20] This should not necessarily be the case since asymmetric responses to common shocks, or asymmetric shocks, would not show up in aggregate euro area data, and in fact, when the last recession is analyzed, this coefficient is not significant.

[19] Except when the PMR indicator is replaced by markups, reducing the number of countries in the sample.

[20] We have tested for size effects and more details can be found in the extended report "Study on Product market reforms and adjustment in the European economy", prepared by the authors for DGECFIN.

Table 12: Random Effects Estimates, Xadj and euro area GDP shocks (SY), Sectoral Clasiification. Constants Omitted.

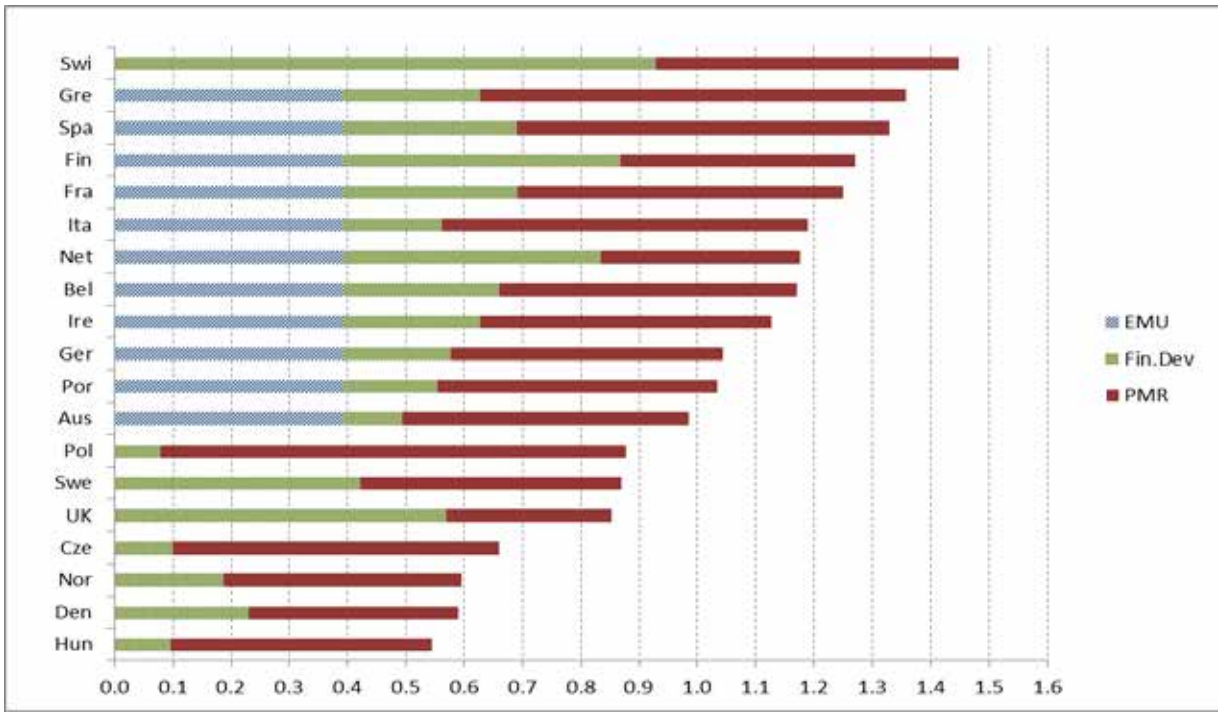
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
sy	-0.152	-0.213	-1.559	-0.003	-0.243	0.368	0.975	-0.340	-0.533
	[0.633]	[0.589]	[1.147]	[0.666]	[0.567]	[0.498]	[1.075]	[0.558]	[0.371]
D1xsy	-2.005***	-2.012***	-2.018***	-1.933***	-1.954***	-1.832***		-1.959***	-1.722***
	[0.409]	[0.408]	[0.425]	[0.403]	[0.402]	[0.452]		[0.402]	[0.324]
D2xsy	-0.813**	-0.820**	-0.877**	-0.811**	-0.813**	-0.895**	-0.154	-0.827**	-0.595**
	[0.368]	[0.367]	[0.395]	[0.365]	[0.365]	[0.409]	[0.408]	[0.364]	[0.278]
D5xsy	-1.352***	-1.359***	-1.371***	-1.290***	-1.296***	-1.321***	-0.335	-1.296***	-1.056***
	[0.457]	[0.456]	[0.471]	[0.450]	[0.450]	[0.501]	[0.475]	[0.450]	[0.382]
D6xsy	-1.186***	-1.190***	-1.240***	-1.125***	-1.122***	-1.234***	-0.427	-1.154***	-0.927***
	[0.385]	[0.384]	[0.403]	[0.374]	[0.374]	[0.425]	[0.410]	[0.373]	[0.286]
D7xsy	-1.277***	-1.284***	-1.265**	-1.206**	-1.213**	-1.870***	0.799	-1.219**	-0.979**
	[0.490]	[0.489]	[0.511]	[0.481]	[0.480]	[0.532]	[0.496]	[0.480]	[0.417]
D11xsy	-0.824*	-0.832*	-0.954*	-0.795*	-0.787*	-1.330**	0.479	-0.808*	-0.573
	[0.463]	[0.462]	[0.492]	[0.456]	[0.456]	[0.523]	[0.480]	[0.455]	[0.389]
D18xsy	0.200	0.191	0.126	0.287	0.268	0.519	1.271***	0.257	0.489
	[0.480]	[0.478]	[0.490]	[0.468]	[0.468]	[0.494]	[0.480]	[0.467]	[0.404]
D21xsy	1.224***	1.225***	1.135**	1.217***	1.193***	1.259**	1.361***	1.191***	1.412***
	[0.457]	[0.457]	[0.476]	[0.453]	[0.452]	[0.501]	[0.466]	[0.452]	[0.384]
Other Dixsy	(			Included but not significant					
Dupxsy	-0.140	-0.135	-0.138	-0.137	-0.142	-0.143	-0.206		
	[0.147]	[0.145]	[0.153]	[0.145]	[0.145]	[0.165]	[0.156]		
euxsy	-0.063								
	[0.243]								
emuxsy	0.422*	0.414*	0.590***	0.453**	0.424**	0.273	0.022	0.427**	0.393**
	[0.217]	[0.215]	[0.223]	[0.195]	[0.191]	[0.195]	[0.164]	[0.191]	[0.180]
debtxsy	-0.000	-0.001	0.001	-0.001	-0.001	-0.001	-0.002	-0.001	
	[0.004]	[0.004]	[0.004]	[0.003]	[0.003]	[0.004]	[0.004]	[0.003]	
openxsy	0.001	0.001	0.008	0.000	0.001	0.002	0.006	0.001	
	[0.005]	[0.005]	[0.006]	[0.004]	[0.004]	[0.005]	[0.005]	[0.004]	
findevxsy	0.004*	0.004*	0.005*	0.003	0.004**	0.003	0.001	0.004**	0.004**
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.004]	[0.002]	[0.002]
eplxsy	0.024	0.029							
	[0.143]	[0.141]							
barg1xsy			0.931						
			[0.820]						
barg2xsy				-0.529					
				[0.770]					
pmrtxsy	0.331	0.336*	0.516**	0.393**	0.342*			0.358**	0.336**
	[0.204]	[0.203]	[0.221]	[0.190]	[0.175]			[0.174]	[0.151]
db1xsy						0.005			
						[0.004]			
markuptxsy							-0.835		
							[0.707]		
euweightsxsy	-0.090	-0.095							
	[0.121]	[0.119]							
Observations	2,313	2,313	2,166	2,313	2,313	2,509	1,164	2,313	2,313
Number of sectors	21	21	21	21	21	21	20	21	21
R-within	0.0465	0.0463	0.0482	0.0466	0.0460	0.0375	0.0588	0.0461	0.0431
R overall	0.0423	0.0422	0.0442	0.0421	0.0419	0.0340	0.0551	0.0415	0.0388
Rbetween model	0.0440	0.0461	0.0529	0.0388	0.0434	0.0233	0.0119	0.0344	0.0360

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

The combined (significant) coefficients of the model variables provide a measure of the marginal effect of shocks: essentially this measures the overall correlation between shocks and output, after controlling for all variables of interest. Using (average-across-the-sample) country data for the (significant) variables we can estimate country-specific correlations; the results are depicted in Figure 1, which also provides a breakdown of this in terms of the contribution of each significant variable.[21]

Figure 1: Sectoral Output Correlations with Common Shocks



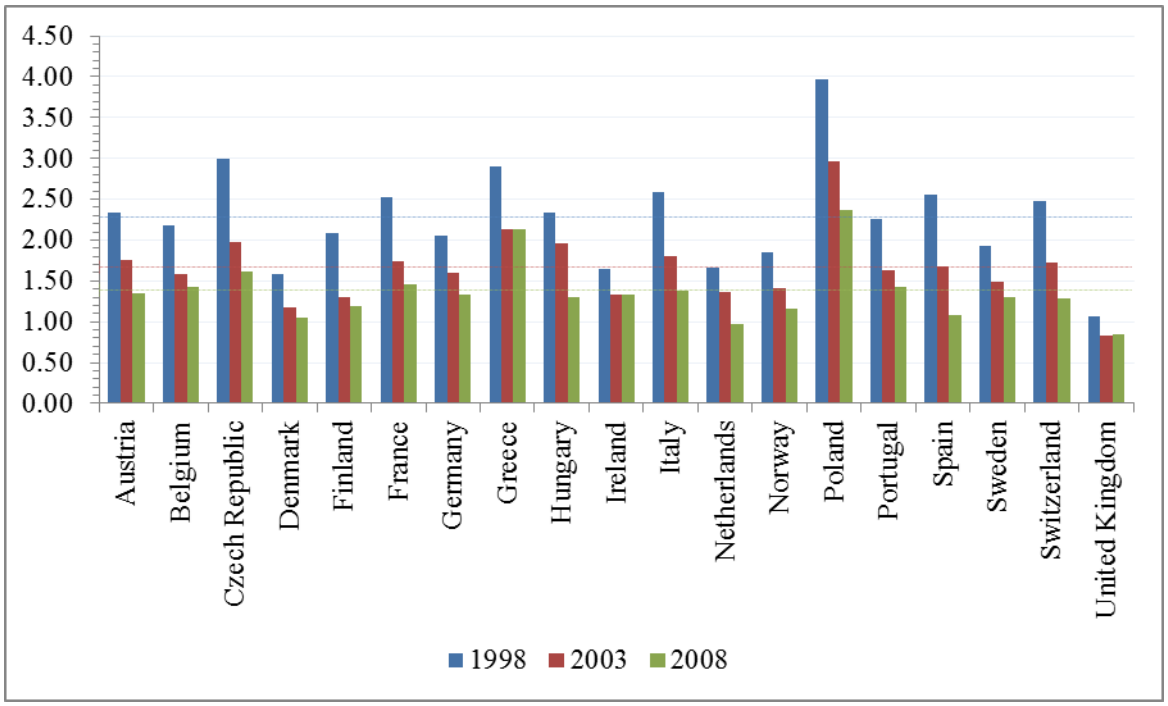
The correlation is highest in the case of Switzerland and Finland and lowest for Norway and Denmark. Low correlation would point to greater resilience, based on our definition for resilience.

Based on the contributions shown in Figure 1 it is evident that product market regulations play a very important role is determining the resilience of sectors and, of course, countries. The countries which display low correlation (e.g., Norway, Denmark, Hungary, and the UK, for example) are the ones for which the average levels of PMR over the sample are relatively low. In contrast others which are at the bottom of the ranking (e.g., Spain, Greece, Italy, and France) had on average relatively high PMR levels over the sample. These countries, with the exception of Greece have, nevertheless, progressed significantly in lowering their levels of regulation (see Figure 2), and this moves them up in the resilience scale if we consider only the most recent PMR levels. The other two significant determinants are financial development and membership to EMU, both of which we interpret as implying more susceptibility to shocks. It is evident, based on that interpretation, that those countries more exposed to shocks (especially those which have adopted the euro) can offset

[21] The average country characteristics over the sample are used for this calculations, except for euro membership where 2009 is taken as a reference year.

this source of vulnerability by pursuing more vigorously reforms, especially in the area of product markets which, as we find here, seem to impact positively on the ability of sectors and countries to respond to shocks.

Figure 2: Product market Regulations over Time



Source: OECD

Using the marginal effect of the benchmark sector, and the significant sectoral dummy coefficients estimated, , and taking the weighted averages of sectoral resilience for each country, we then calculate a measure of the country's resilience (details are given in Appendix B). The results are depicted in Figure 3, as deviations from the estimated resilience for the EU (weighted average of EU countries' resilience).

The ranking of countries in Figure 3, according to resilience, is not exactly the inverse of the ranking of correlations to shocks, depicted in Figure 1. This is due to sectoral composition effects, since in this case the measure of country's resilience takes into account the sectoral differences in correlations to shocks, estimated using the sectoral dummy interactions. Countries where less resilient sectors have a larger weight show less resilience than they would have shown if all sectors had the same resilience as the benchmark sector (Chemicals and Pharmaceuticals in this case). These composition effects, however are only significant in some of the countries.

Figure 4 highlights the differences in sectoral resilience that could be identified using sectoral dummy variables.[22] While most of the "outlier" sectors identified display resilience

[22] The average resilience for the EU is calculated using EU sector weights; sectors for which dummy variables were not significant are assumed to have resilience equal to the baseline.

above that of the average for the EU, Sector 18 (Computers and Electronic Products) and most importantly Sector 21 (Motor vehicles, etc.) show below average resilience.[23]

Figure 3: Resilience of Countries Relative to the EU Average, Sectoral Classification

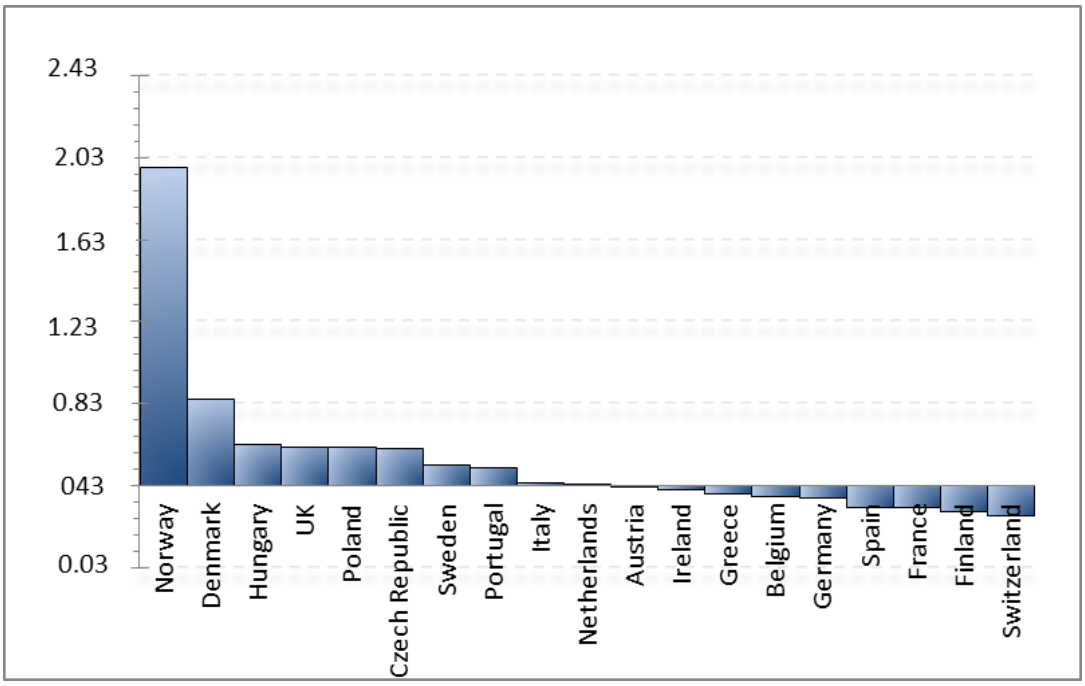
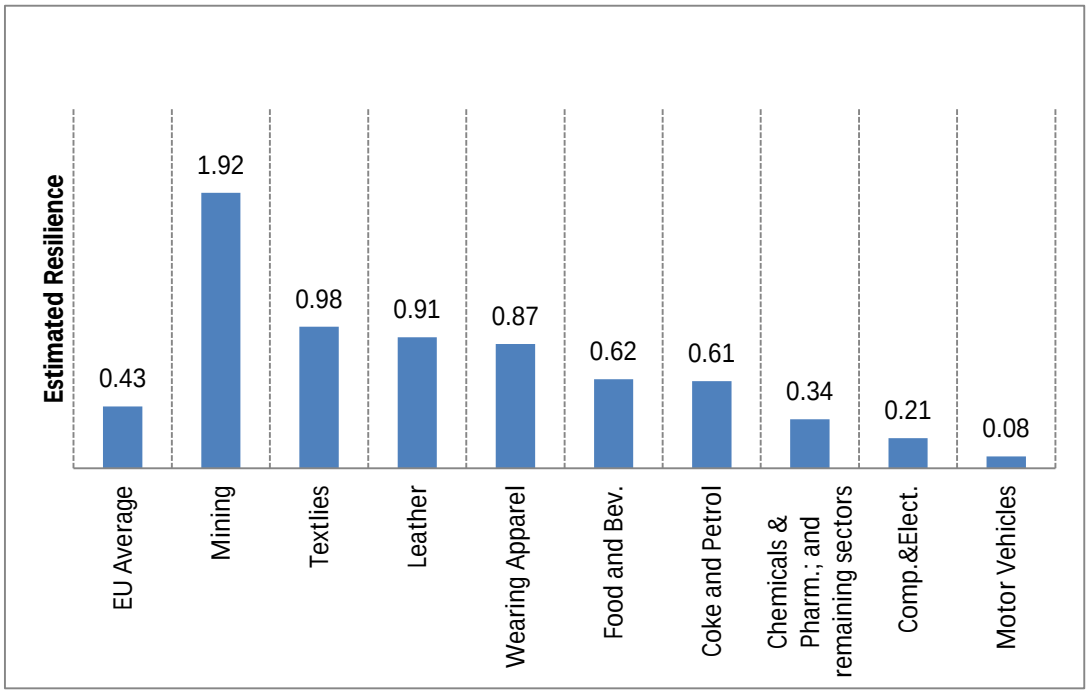


Figure 4: Identified Differences in Sectoral Resilience



[23] We have also estimated random coeffficients models using the 2-digit disaggregate industry data and these also reveal some heterogeneity in the effects of country characteristics on sectoral resilience. These estimates are shown in Appendix F.

5.1.2. Main Industrial Groupings Classification

Another way to analyze resilience is to cluster sectors into Main Industrial Groupings (MIG classification): that is, intermediate goods, investment goods, and consumption goods. The results shown in assume that the intermediate goods category is the benchmark for estimation purposes.

Table 13: Random Effects Estimates, Xadj and euro area GDP shocks (SY), MIG classification.

	(1)	(2)	(3)	(4)	(5)	(6)
sy	-0.546	-0.678	-0.661	-0.800	-0.877*	-1.027***
	[0.603]	[0.546]	[0.518]	[0.507]	[0.491]	[0.370]
Dconsxsy	-0.347**	-0.349**	-0.350**	-0.360**	-0.364**	-0.362**
	[0.168]	[0.168]	[0.167]	[0.167]	[0.167]	[0.166]
Dinvxsy	0.425**	0.427**	0.432**	0.425**	0.420**	0.421**
	[0.199]	[0.199]	[0.197]	[0.197]	[0.197]	[0.197]
Dupxsy	-0.201	-0.191	-0.188			
	[0.146]	[0.145]	[0.144]			
euxsy	-0.124					
	[0.242]					
emuxsy	0.457**	0.441**	0.448**	0.455**	0.427**	0.443**
	[0.217]	[0.214]	[0.190]	[0.190]	[0.184]	[0.181]
debtxsy	-0.002	-0.002	-0.002	-0.002		
	[0.004]	[0.004]	[0.003]	[0.003]		
openxsy	-0.002	-0.002	-0.002	-0.002	-0.002	
	[0.005]	[0.005]	[0.004]	[0.004]	[0.004]	
findevxsy	0.004**	0.004**	0.004**	0.004**	0.004**	0.005**
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
eplxsy	-0.004	0.008				
	[0.141]	[0.140]				
pmrtxsy	0.431**	0.441**	0.452***	0.477***	0.442***	0.471***
	[0.202]	[0.201]	[0.174]	[0.173]	[0.164]	[0.151]
weuroxsy	0.038	0.031				
	[0.110]	[0.109]				
Observations	2,313	2,313	2,313	2,313	2,313	2,313
N. sectors	21	21	21	21	21	21
R-within	0.0171	0.0170	0.0169	0.0159	0.0157	0.0156
R overall	0.0165	0.0164	0.0164	0.0156	0.0155	0.0154
Rbetween	0.146	0.151	0.154	0.0109	0.0122	0.0194

Standard errors in brackets

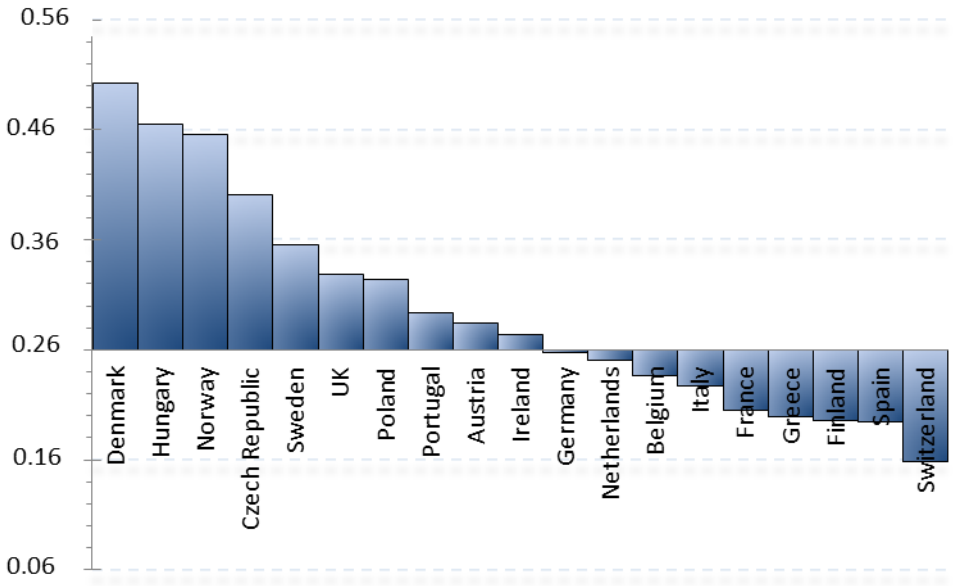
*** p<0.01, ** p<0.05, * p<0.1

From the econometric results shown in Table 13 it is evident that the interactions between the MIG classification dummies and the shock variable are always significant while the other results remain broadly unchanged. The coefficient of the interaction of *Dcons* and the shock is negative and significant indicating that the consumer goods sectors' output is less correlated to common GDP shocks than that of intermediate goods sectors; while the coefficient on *Dinv*, which is positive and significant indicates the opposite. That is to say, other things equal, investment goods industries are more prone to external shocks, while consumption goods industries are significantly more resilient. This finding is consistent with

our prior that, in the face of output shocks, investment usually sustains a more pronounced fall compared to consumption (more discussion in Section 7).

Figure 5 shows the resilience of countries relative to the EU average, using the estimates obtained in colum (6) of Table 13 (the details are presented in Appendix B). The ranking of countries does not change substantially compared with the previous estimation, because the coefficients obtained are very similar. The estimated coefficients obtained on the MIG dummies, which indicate that, other things equal, those countries like Germany which have a bigger concentration of investment goods industries appear to be, ceteris paribus, less resilient than those with more consumption goods industries.

Figure 5: Resilience of Countries Relative to the EU average, using the MIG sector classification



In summary, the various estimates presented support the view that stringent product market regulations limit sectoral resilience. Besides product market regulations, financial development also emerges as playing a role in determining resilience. Countries with more developed financial markets like the UK and the Netherlands, which are relatively well positioned in terms of product market regulations, move down the resilience scale (i.e., the marginal effect of the shock, independently of sectoral composition, increases when the level of financial development is taken into account) due to, presumably, their greater exposure to shocks through financial market linkages.

In addition we uncover some differences across the sub-sectors of industry. For example, the chemicals, mining and textiles sectors seem to be more resilient compared with, for example, the motor vehicle sector. Indeed, the motor vehicle sector, is found consistently to be the least resilient sector in the EU. When the sectors are grouped into main industrial grouping (consumer, investment, or intermediate goods), we find that consumer goods industries are significantly more resilient, while investment goods are less. This is interesting and confirms our prior that consumer goods industries are more resilient, essentially due to the more inelastic demand for such goods. Naturally, since some sectors are found to be consistently less resilient than others, countries which are more specialized in these sectors seem to be affected more by common shocks. This is why, if we rank countries according to

the marginal effect of shocks for the benchmark sector from low to high, we do not find the same ranking as the one found for overall country resilience, because this ranking takes into account sectoral differences in resilience captured by sectoral dummies.

Table 14 shows the effects of sectoral composition on the rankings of resilience by comparing the ranking determined by country characteristics only, to the ranking that takes into account the sectoral composition of output, using the sectoral classification (Appendix B provides details on th estimations). For most countries the sectoral composition does not significantly affect the ranking of countries, hence the effect of country characteristics dominates, but there are countries for which the composition effects are more important. The most significant movements in ranking (changes by five places in raking up or down) are marked by arrows in Table 14. When the sectoral composition of industrial output is considered, Germany, for instance, drops five places in the ranking, due to the relatively large weight of less-resilient industries, such as "motor vehicles". Conversely, for countries like Greece and Italy sectoral composition has a positive effect on resilience due to the predominance of relatively more resilience industries in these countries, particularly "food and beverages" and "wearing apparel". This effect is also present, but somehow muted through aggregation, in the rankings obtained when industries are groups according to the MIG classification.

Table 14: Effects of the Sectoral Composition of Industrial Output on Country Rankings

Ranking of Resilience according to country characteristics, without taking into account of sectoral composition (benchmark sector).	Ranking of Resilience taking into account of sectoral composition (country average).
Hungary	Norway
Denmark	Denmark
Norway	Hungary
Czech Republic	United Kingdom
United Kingdom	Poland
Sweden	Czech Republic
Poland	Sweden
Austria	Portugal
Portugal	Italy
Germany	Netherlands
Ireland	Austria
Belgium	Ireland
Netherlands	Greece
Italy	Belgium
France	Germany
Finland	Spain
Spain	France
Greece	Finland
Switzerland	Switzerland

6. The 2008-09 Downturn

During 2008-09 the world economy experienced a severe recession which affected most countries around the world, albeit with different intensity. This downturn, the worst since the Great Depression, was triggered by a banking crisis in the United States and was caused by massive defaults in the mortgage market first in the US and then in other regions, including the EU.

This recession presents us with a good example of a common synchronised or symmetric external shock which can be analysed in order to examine countries' and sectors' response to such events and to help us gauge important differences in their adjustment capacity. Although it should be noted that the particular circumstances which triggered this recession, namely a banking crisis and ensuing financial turmoil, may make it unique for drawing generalized conclusions.

As noted earlier, the 2008-09 downturn is not included in the analysis so far, due to the fact that with the available data it is not generally possible to identify, with neither dating rule, the trough that marks the end of this downturn. For this reason we proceed by analysing this cycle phase in isolation using as common turning points across countries those derived by the structural GDP shocks obtained in the VAR analysis: that is, we assume the trough occurs where negative shocks fade away, and are followed by positive ones. This simple method implies that the peak is 2008Q1, and the trough is 2009Q1. These dates turn out to be almost identical to those marked "officially" by the CEPR for Europe.[24] This method ignores idiosyncrasies in the timing of the recession, but avoids a selection bias that would result from the exclusion of sectors in countries for which the end of the downturn could not be identified.

The regression results for this downturn are shown in Table 15. From the results it is evident that the product market regulations variables remains significant and maintains the same sign as when we consider previous cycle phases, implying that also in the 2008-09 downturn, sectors in countries which have advanced in their product market reforms appear to be more resilient to shocks.[25] Also the financial development interaction remains significant and with a positive sign, indicating as before that higher financial development is associated with lower resilience. This is especially plausible for this period, since the global downturn originated from a negative shock in financial markets. The openness interaction is strongly significant in this analysis, with a positive sign, indicating that sectors in countries

[24] See http://www.cepr.org/data/dating/default.asp. Although the CEPR has dated the trough in 2009 Q2, our vector of VAR disturbances indicates a trough in 2009 Q1, and we use this date for consistency, otherwise we would be missing the intensity of the recession.

[24] If we use instead the Doing Business Rankings as a measure of market institutions, its interaction with the shocks does not come out significant in any specification, as it happened in the 2-digit analysis of the previous cycle phases.

[25] If we use instead the Doing Business Rankings as a measure of market institutions, its interaction with the shocks does not come out significant in any specification, as it happened in the 2-digit analysis of the previous cycle phases.

Table 15: Estimates for the 2008-09 Downturn, Xadj and euro area GDP shocks (SY)

	(1)	(2)	(3)	(4)	(5)	(6)
sy	-0.832**	-0.791**	-0.803**	-0.679**	-0.587*	-0.484*
	[0.337]	[0.335]	[0.335]	[0.311]	[0.303]	[0.257]
D2xsy	-0.341	-0.347	-0.338	-0.343	-0.357	-0.441***
	[0.226]	[0.226]	[0.226]	[0.226]	[0.226]	[0.168]
D5xsy	0.754***	0.752***	0.706***	0.708***	0.696***	0.611***
	[0.217]	[0.217]	[0.215]	[0.215]	[0.215]	[0.153]
D8xsy	0.847***	0.845***	0.800***	0.800***	0.779***	0.695***
	[0.218]	[0.218]	[0.215]	[0.215]	[0.215]	[0.153]
D14xsy	0.716***	0.723***	0.687***	0.686***	0.675***	0.590***
	[0.223]	[0.223]	[0.222]	[0.222]	[0.222]	[0.163]
D15xsy	0.830***	0.832***	0.794***	0.794***	0.772***	0.688***
	[0.217]	[0.217]	[0.215]	[0.215]	[0.215]	[0.153]
D16xsy	0.906***	0.902***	0.867***	0.865***	0.849***	0.766***
	[0.220]	[0.220]	[0.219]	[0.218]	[0.218]	[0.158]
D17xsy	0.644***	0.641***	0.618***	0.621***	0.609***	0.525***
	[0.212]	[0.212]	[0.212]	[0.212]	[0.212]	[0.149]
D18xsy	0.435**	0.431**	0.389*	0.392*	0.380*	0.296*
	[0.217]	[0.217]	[0.215]	[0.215]	[0.215]	[0.153]
D19xsy	0.493**	0.493**	0.458**	0.461**	0.449**	0.364**
	[0.216]	[0.216]	[0.215]	[0.215]	[0.215]	[0.153]
D20xsy	0.476**	0.471**	0.463**	0.463**	0.442**	0.357**
	[0.215]	[0.215]	[0.215]	[0.215]	[0.215]	[0.153]
D21xsy	1.777***	1.780***	1.783***	1.786***	1.777***	1.692***
	[0.218]	[0.218]	[0.218]	[0.218]	[0.218]	[0.157]
D23xsy	0.723***	0.722***	0.680***	0.684***	0.675***	0.590***
	[0.220]	[0.220]	[0.218]	[0.218]	[0.218]	[0.157]
Other Dixsy	(	Included but not significant)			)	
euxsy	0.244	0.191	0.204	0.177		
	[0.149]	[0.139]	[0.139]	[0.136]		
emuxsy	-0.099					
	[0.099]					
debtxsy	0.003	0.002	0.003	0.004*	0.004**	0.004**
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
openxsy	0.007***	0.007***	0.007***	0.006**	0.007***	0.007***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
findevxsy	0.002**	0.003**	0.003**	0.002**	0.003**	0.003**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
eplxsy	0.083	0.045	0.052			
	[0.065]	[0.052]	[0.052]			
pmrtxsy	0.128	0.178**	0.193**	0.204***	0.213***	0.210***
	[0.094]	[0.080]	[0.079]	[0.078]	[0.078]	[0.077]
weuroxsy	0.080	0.078				
	[0.062]	[0.062]				
Observations	312	312	312	312	312	312
R-squared	0.763	0.762	0.760	0.760	0.758	0.755

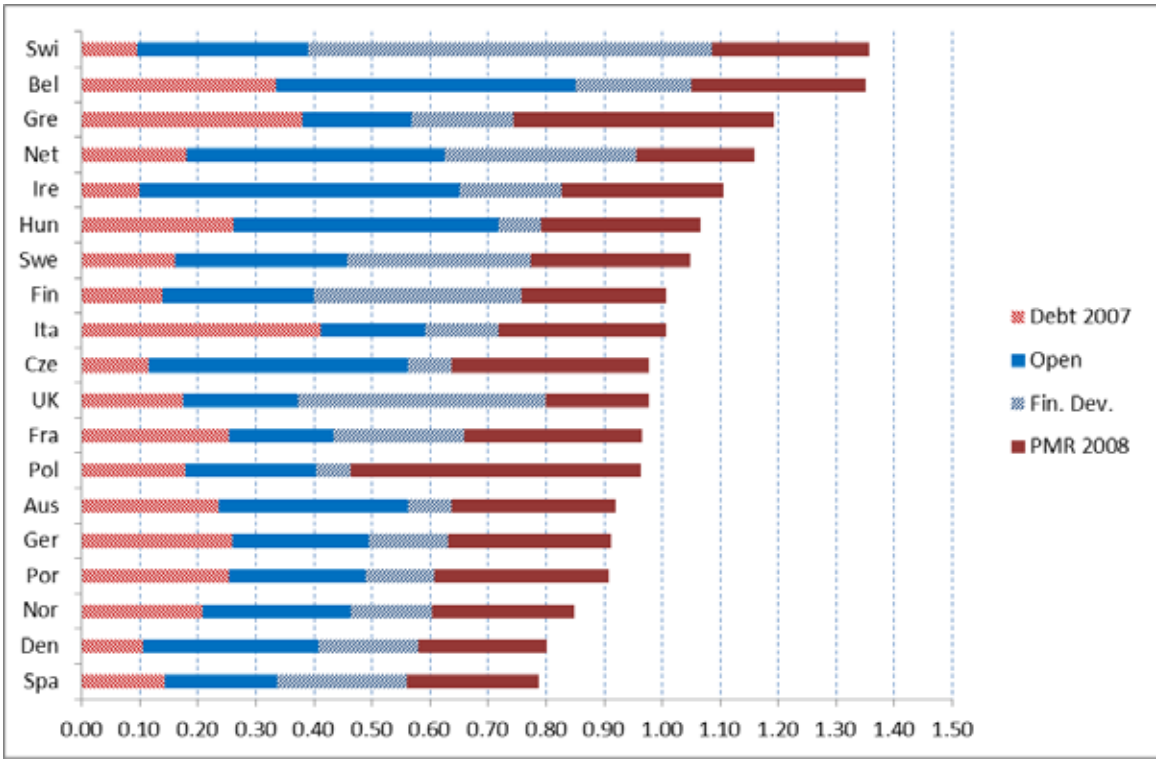
Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

more open to trade have been less resilient to the downturn. For this cycle phase the debt variable also shows significance, and its positive coefficient indicates that higher debt levels are associated with less resilience in this downturn. This may be explained by the fact that countries with higher debt levels were constrained in their use of use fiscal policy to stabilize sectors' output. High debt levels may also have deterred adjustment by increasing uncertainty about the actions that the government may take to meet its debt obligations, e.g. raise taxes (see Carruth et al., 2000).

In Figure 6, we depict the correlations to common shocks (marginal effect of Sy) estimated using the coefficients obtained in column (6) of Table 15.

Figure 6: Correlations to Common Shocks, 2008-2009 Downturn

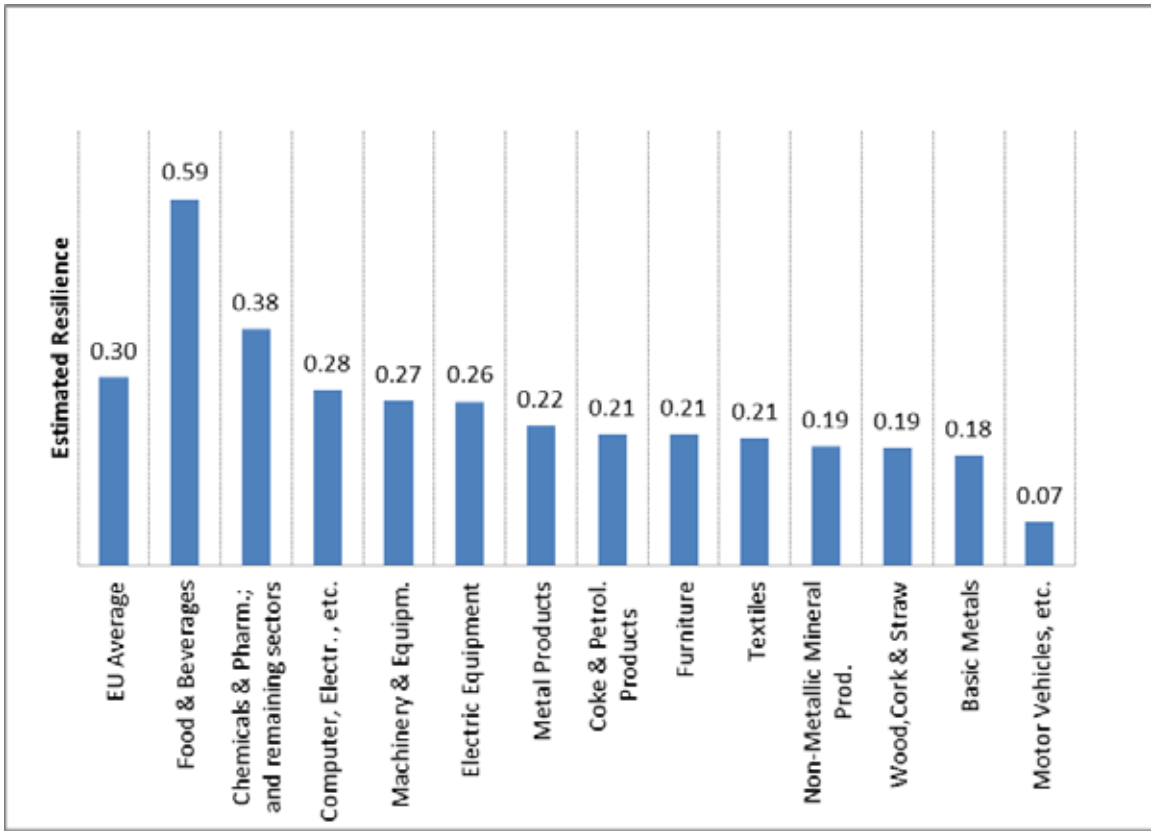


The correlations paint, in general, similar picture as before, except that now the public debt situation seems be an important determinant of this ranking. Countries with high GDP ratios, such as Greece, Italy and Belgium, are found to exhibit higher correlations to common shocks, although as before the role played by product market reforms in offsetting this correlation is important. For countries like Spain, for instance, correlations to shocks are lower in this cycle, due to an important improvement in terms of product market deregulation. Further notice the important contribution played by openness and financial development in the case of some countries which have even very low debt levels (e.g., Ireland, the UK, Switzerland, for example).

Furthermore, for this specific period it is possible to identify larger differences in sectoral resilience to shocks (Figure 7). From the sectors that could be identified as having a different resilience from the benchmark, only the sector of "Food & Beverages" shows relatively more resilience than the benchmark, while all the others show less resilience. The sector

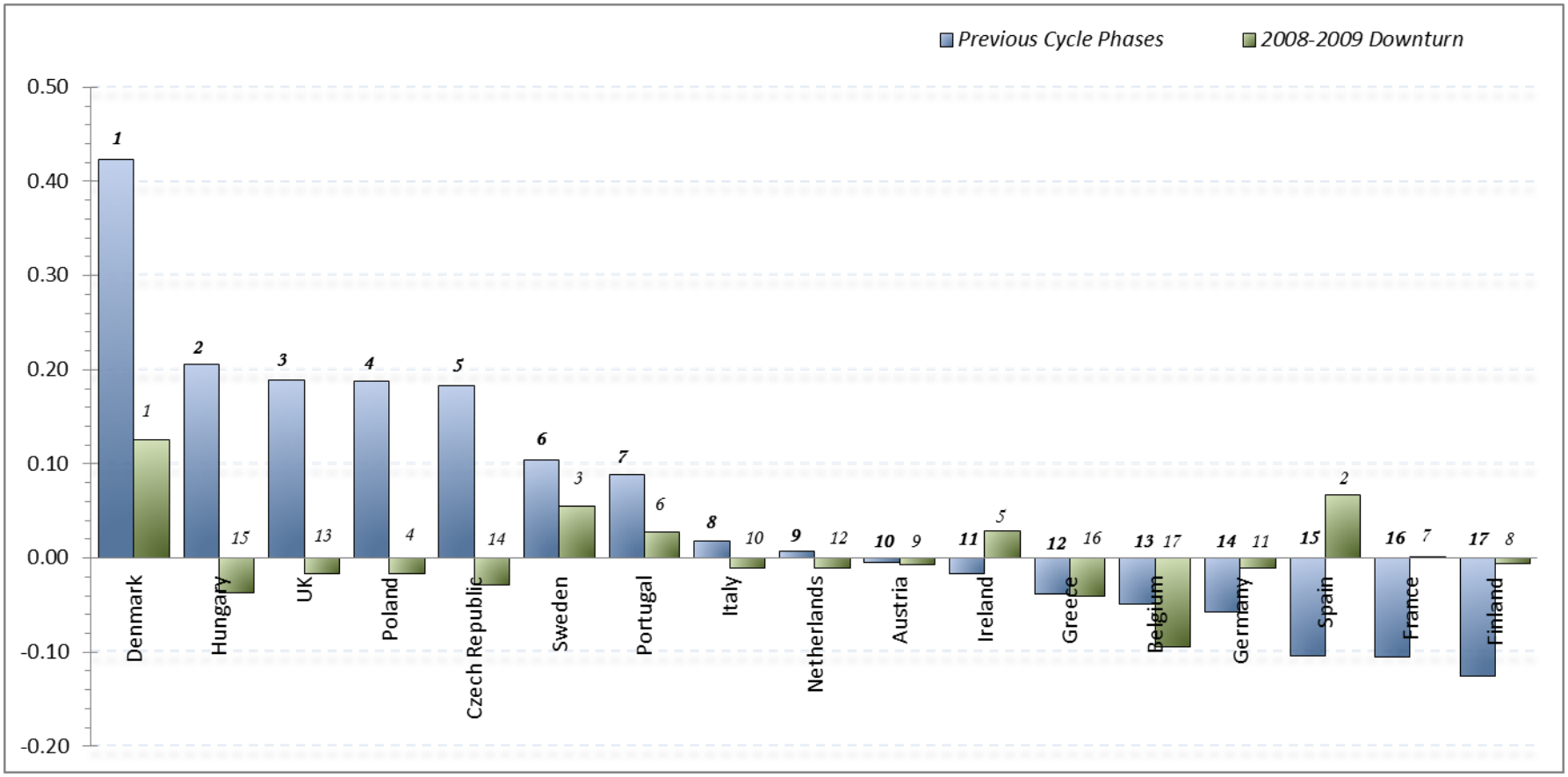
with the lowest level of resilience continues to be the sector of “Motors Vehicles”. In Figure 7 we compare the estimated resilience of sectors with the average calculated for the EU. “Food & Beverages" shows an estimated resilience significantly above the average.

Figure 7: Identified Differences in Sectoral Resilience, 2008-09 Downturn



A comparison between the estimated resilience of countries relative to the EU average, for the 2008-09 downturn and previous cycle phases (as obtained from previous sections), is plotted in Figure 8 (details about the resilience estimates for the 2008-2009 downturn and previous cycles phases are given in Appendix B). One thing that stands out, is that deviations from the EU average appear less marked for the last downturn while also a number of countries which are now expected to score poorly in severe shocks, are found to have performed better. Ironically, two of these countries are Ireland and Spain, and this result can be explained by the fact both, especially Spain, have actually made significant progress in deregulating product market since 1998; Spain has lowered its PMR index from 2.55 in 1998 to 1.09 in 2008, significantly below the EU average; and Ireland has lowered it from 1.65 in 1998 to 1.33 in 2008).

Figure 8: Comparing Resilience of EU countries: 2008-09 Downturn vs Previous Periods. Deviations from EU mean resilience.



Ranking among EU countries only, excludes Norway and Switzerland.
EU Mean Resilience for "Previous Cycle Phases": 0.431
EU Mean Resilience for "2008-09 Downturn": 0.304

7. Country and Sectoral Resilience: Summary of Findings and Explanations

This section provides analysis of the rankings of countries and sectors according to resilience. It also highlights those sectors which appear relatively less resilient, but at the same time have a large weight in the total EU production. To show the robustness of results the analysis also considers estimates of resilience to US GDP shocks (estimates given in the Appendix)

7.1. Country Resilience Rankings

Table 16 displays the rankings of countries according to the different resilience measures obtained (for previous cycle phases and the last recession). A dotted line signals where the EU average lies. Norway and Denmark rank consistently on the top of the ranking, while Switzerland Greece, and Belgium lie consistently below the EU average.

Table 16: Country Resilience Rankings

Resilience to euro area GDP shock, previous phases	Resilience to euro area GDP shock, last recession
Norway	Denmark
Denmark	Norway
Hungary	Spain
UK	Sweden
Poland	Poland
Czech Republic	Ireland
Sweden	Portugal
Portugal	France
Italy	Finland
Netherlands	Austria
Austria	Italy
Ireland	Germany
Greece	Netherlands
Belgium	UK
Germany	Czech Republic
Spain	Hungary
France	Greece
Finland	Switzerland
Switzerland	Belgium

It is interesting to note, however, that the 2008-09 downturn seems to have been a rather distinct event compared to previous cycle phases in the sense that countries that were more resilient before, like the UK, turned out to be relatively less resilience to this downturn; while countries relatively less resilient before like the Finland and France, turned out to be relatively more resilient to this specific episode. Further notice that Ireland and Spain are found to have been more resilient during the 2008-09 downturn; for Ireland this is due to its sectoral composition (with a relatively large weight on more resilient sectors, like food and

beverages); for Spain it is mainly due to its relatively low debt to GDP ratio (which may have provided more room of maneuver for the government in certain areas and had a positive effect on private sector expectations).

7.2. Sector Resilience Rankings

The econometric analysis could identify important differences in resilience across 2-digit industry subsectors, and the rankings of industry sub-sectors according to resilience appear relatively consistent. Table 17 shows the two rankings of sectors obtained (for previous cycle phases, and based on the last recession). The Table also shows the weight of each sector in total EU industrial production. The dotted lines indicate where the EU average lies in each case. The five largest sectors which rank consistently below the EU average are, by size: motor vehicles, machinery and equipment, metal products, basic metals, and electric equipment.

Table 17: Rankings of Sectors according to Resilience and EU Industry weights

Rank	Resilience to euro area GDP shock, previous phases	EU weight	Rank	Resilience to euro area GDP shock, last recession	EU weight
1	Mining & Quarrying	2.8	1	Food & Beverages	13.4
2	Textiles	2.0	2	Mining & Quarrying	2.8
3	Leather	0.8	2	Tobacco	1.2
4	Wearing Apparel	1.4	2	Wearing Apparel	1.4
5	Food & Beverages	13.4	2	Leather	0.8
6	Coke & Petrol. Products	6.0	2	Paper	2.7
7	Tobacco	1.2	2	Printing & Recording	4.4
7	Wood,Cork & Straw	2.0	2	Chemicals & Pharm.	10.3
7	Paper	2.7	2	Rubber & Plastic	4.0
7	Printing & Recording	4.4	2	Other Transport Equipm.	2.9
7	Chemicals & Pharm.	10.3	3	Computer, Electron., etc.	3.3
7	Rubber & Plastic	4.0	4	Machinery & Equipment	9.0
7	Non-Metallic Mineral Prod.	3.6	5	Electric Equipment	4.1
7	Basic Metals	4.7	6	Metal Products	7.0
7	Metal Products	7.0	7	Coke & Petrol. Products	6.0
7	Electric Equipment	4.1	7	Furniture	2.9
7	Machinery & Equipment	9.0	8	Textiles	2.0
7	Other Transport Equipm.	2.9	9	Non-Metallic Mineral Prod.	3.6
7	Furniture	2.9	10	Wood,Cork & Straw	2.0
8	Computer, Electron., etc.	3.3	11	Basic Metals	4.7
9	Motor Vehicles, etc.	11.4	12	Motor Vehicles, etc.	11.4

In Table 18 we use the first ranking of countries shown in Table 17, but also list the top 5 EU producers in each specific sector: Germany, Italy, France, the UK and Spain are, as one would expect, the top producers in the largest, and least resilient, industries. Other smaller countries also seem to be highly exposed, for example, Belgium in “Basic Metals”,

Netherlands in "Metal Products", Austria in "Electric Equipment", and Sweden in "Machinery and Equipment" and "Motor Vehicles".

Table 18: Sectoral Ranking of Resilience and Top-5 EU producers by sector

Rank	Resilience to euro area GDP shock	EU weight	Top 5 EU producers
1	Mining & Quarrying	2.8	UK, Ita, Ger, Net, Fra, Pol
2	Textiles	2	Ita, Ger, Fra, UK, Spa, Bel
3	Leather	0.8	Ita, Spa, Fra, Ger, Por, UK
4	Wearing Apparel	1.4	Ita, Fra, Ger, Spa, UK, Por
5	Food & Beverages	13.4	Ger, Fra, Swe, Ita, Spa, Net
6	Coke & Petrol. Products	6	Ger, Fra, UK, Ita, Spa, Bel
7	Tobacco	1.2	Ger, UK, Fra, Net, Ita, Swe
7	Wood,Cork & Straw	2	Ger, Ita, Fra, UK, Spa, Swe
7	Paper	2.7	Ger, Fra, Ita, UK, Fin, Swe
7	Printing & Recording	4.4	Ger, UK, Fra, Ita, Spa, Net
7	Chemicals & Pharm.	10.3	Ger, Fra, UK, Ita, Net, Spa
7	Rubber & Plastic	4	Ger, Fra, Ita, UK, Spa, Bel
7	Non-Metallic Mineral Prod.	3.6	Ger, Ita, Spa, Fra, UK, Bel
7	Basic Metals	4.7	Ger, Ita, Fra, Spa, UK, Bel
7	Metal Products	7	Ger, Ita, Fra, UK, Spa, Net
7	Electric Equipment	4.1	Ger, Ita, Fra, UK, Spa, Aus
7	Machinery & Equipment	9	Ger, Ita, Fra, UK, Spa, Swe
7	Other Transport Equipm.	2.9	Fra, UK, Ger, Ita, Spa, Net
7	Furniture	2.9	Ita, Ger, UK, Fra, Spa, Pol
8	Computer, Electron., etc.	3.3	Ger, Fra, UK, Fin, Ita, Swe
9	Motor Vehicles, etc.	11.4	Ger, Fra, UK, Spa, Ita, Swe

In summary, the analysis could pinpoint some key sectors as systematically less resilient. These are sectors that can be classified as producing mainly investment or intermediate goods. The top producers in those sectors tend to be large EU countries, but the sectors are also significant for some of the smaller countries in the EU. Sequenced reforms could therefore start by tackling adjustment bottlenecks in these sectors, specifically "motor vehicles", "machinery and equipment", "electric equipment", "metal products", and "basic metals".

7.3. Understanding the Results: some theoretical underpinnings

The study has revealed that differences in resilience are attributed to country characteristics (openness and/or financial development, as well as to differences in terms of progress in reforming product markets) and sectoral differences captured by dummy variables. In this section we provide a non-exhaustive list of possible explanations for the effects of openness, financial development, and product market regulations on countries' resilience, and discuss reasons that might explain sectoral differences.

7.3.1. Differences Across Countries

Product Market Regulations and Countries' Resilience

The econometric analysis has identified a robust negative relationship between product market regulations and resilience to shocks. Reforms that liberalize product markets can improve economic resilience through at least two channels proposed by Ahn(2002): the channel of allocative efficiency, and the channel of productive efficiency. The third channel of dynamic efficiency, also proposed by Ahn (2002) is more controversial and the effects of regulations on efficiency through this channel, as discussed in the literature review are ambiguous also empirically.

The liberalization of product markets can improve allocative efficiency, and therefore the ability of sectors and countries to adjust by facilitating entry and exit, and by increasing the contestability of markets (as argued by Melitz, 2003), therefore ensuring a quicker reallocation of resources within and across sectors. In addition product market reforms aimed at increasing competition can lead to an increase in price and wage flexibility which also facilitates resource reallocation (see Rottemberg and Woodford, 2001; Alvarez and Hernando, 2006; Bulhol et al., 2006; and Jean and Nicoletti, 2004).

Product market reforms are also said to increase productive efficiency. The main channels, which are present in the principal-agent models reviewed by Nickel (1996) and further discussed in Griffith and Harrison (2004), are the incentives given to workers and managers to increase productivity and structure production more efficiently.

Financial Development, openness, and Countries' Resilience

The results of the econometric analysis imply that financial development and to a lesser extent openness are associated with more correlation to shocks. This is in line with the findings of international business cycle literature according to which cycles are more correlated for countries and regions that are more open to trade and/or are more financially integrated. Both current account transactions in goods and services and financial account transactions in assets can serve as channels for the transmission of shocks (see Canova and Dellas, 1993, and references therein).

Canova and Dellas (1993), Frankel and Rose (1998) and Camacho et al. (2006), for instance, highlight the importance of trade in explaining output correlations, and hence of business cycle synchronization across countries. More recently, Artis and Okubo (2009) also suggest

that openness in trade and finance constitute positive indicators of business cycle transmission. More openness and financial integration, imply more common shocks and tend to induce a "global business cycle". Related studies are those of Heathcote and Perri (2002), Kose et al. (2003), Baxter and Kouparitsas (2004), and Inklaar et al. (2008), who further show that trade and/or financial integration has led to business cycle synchronization in the post-war period.

Economic theory provides mixed guidance concerning the impact of increased trade on the degree of business-cycle synchronization (see discussion in Kose et al. , 2003, and references therein). International trade linkages generate both demand- and supply-side spillovers across countries. Increased demand in one country, for example, can lead to an increased demand for imports, and hence exports elsewhere. On the other hand more openness can induce more specialisation of production, which could imply, especially if industry specific shocks are important, a lowering of business cycle co-movements.

Similarly, financial development and financial linkages could further boost business-cycle synchronization. With greater financial integration and deeper financial markets, consumers and corporations can benefit from having access to various products and markets in different countries, but at the same time are more exposed to external shocks which can influence their own economic wellbeing and behaviour. Financial development and financial linkages increase also the risk of contagion which can spill over to the real economy, as we have seen during the 2008-2009 recession. Additionally, financial development and international financial linkages, which stimulate specialization of production through the reallocation of capital, could result in more exposure to industry- or country-specific shocks and greater use of international financial markets to diversify consumption risk. This implies that financial integration, in particular, should result in stronger co-movement of consumption across countries (see Kose et al., 2003).

Specialization of Production and international spillovers

Financial integration and financial development can undoubtedly promote a more efficient allocation of resources which can stimulate the specialization of production through capital reallocation. This, partly, explains the important differences in economic structures documented in the first part of the study. The implication is that common shocks are likely to have differentiated effects across countries, while asymmetric shocks will have a more pronounced impact both on sectors and countries: indeed, we find that sectoral cycles are more heterogeneous, something which underscores the relative importance of sector-specific shocks. Asymmetsic shocks (say to the car industry) will of course affect a number of countries with large automobile sectors, while there will be other spillover effects to sectors producing intermediate inputs, and of course to consumption.

Deeper financial integration in the EU will likely to further accelerate these trends toward more specialisation within a large common market, something which underscores the need for structural reforms which will help countries minimise the impact of exogenous shocks and become more resilient. To this end product market reforms are key in improving the functioning of markets, while reforms of labour markets help in soothing the impact of shocks and thus are to be seen even more important than in less integration, or open regions or countries.

From an EU perspective specialisation is not a negative development: obviously negative shocks are compensated by positive shocks elsewhere, while more flexible sectors offset the impact of less flexible ones on aggregate. However, as was mentioned above, it crucial that this trend is accompanied by those reforms needed to make countries and sectors more resilient.

7.3.2. Sectoral Differences in Resilience: Demand, Structure, Institutions

Elasticities of Demand and Sectoral Resilience

Fundamental microeconomic theory links the responsiveness of demand to income changes, namely the *income (or expenditure) elasticity of demand*, with individuals' preferences for different goods (see for instance Varian, 1992).[26] The literature classifies goods into different categories with respect to their income elasticity, attributing, for example, the differences to the level of necessity of each good reflected by the preferences of each consumer.

Table 19: Estimated Expenditure Elasticities by Commodity Group for the US

Commodity Group	*Expenditure Elasticities*
Food	0.37
Alcohol plus Tobacco	0.24
Clothing	0.75
Housing	0.01
Utilities	0.62
Transportation	0.44
Medical Care	0.31
Durable Goods	4.42
Other Nondurable Goods	1.13
Other Services	0.71
Other Miscellaneous Goods	0.39

Source: Blanciforti and Green (1983)

During economic downturns, when individuals see their personal incomes falling, relative demand for goods and services changes according to the respective income elasticity of demand for each product. Our results indicate that consumer goods sectors appear to be more resilient than investment or intermediate goods sectors. It seems plausible, although this is not tested here, that these differences are related to differences in income or expenditure elasticities.

[26] The income elasticity for a good at an aggregated economy level is measured as the percentage change of its quantity demanded over the percentage change in the overall income.

Indeed there is empirical evidence from demand analysis that expenditure, or income elasticities, vary considerably across sectors and types of good. Table 19 shows estimated elasticities for eleven aggregate commodity groups for the United States (Blanciforti and Green,1983). It is clear from these estimates that food, housing and medical care have low estimated expenditure elasticities compared with, for example, durable goods which have very high elasticities (as must as 12 times bigger than food).

This corroborates our assertion that the underlying demand characteristics, and in particular expenditure elasticities can explain some of the apparent differences in sectoral resilience.

Vertical Linkages and Sectoral Resilience

Another important factor that can contribute to differences in the extent to which changes in output are correlated with shocks across sectors is the existence of vertical linkages across sectors. For instance, if the car sector is less resilience, demand for steel and the resilience of the steel sector should also be lower as a result (Shea, 2002, assesses the importance of input-output linkages in the propagation of shocks). These imply more correlation across some sectors leading perhaps to groupings of vertically integrated sectors. Further research could investigate whether resilience upstream is correlated with resilience downstream, while controlling for a range of other factors. Understanding upstream/downstream linkages would be important for policy design, given that reforms upstream for instance can potentially yield insignificant results without coordinated reform efforts downstream.

State aid: the importance of the size of the sector in terms of output and employment

Political economy considerations very often compel governments into supporting ailing or politically important sectors. There is evidence that some state aid does take place in Europe, though in the EU the competition framework limits considerably the size and scope of such aid.[27] It is also a well-known fact that the pressure to intervene and support a sector can be related to the importance of a specific sector in terms of employment: an example from the recent crisis is the ample support provided in the car industry both in the EU and the USA.

Indeed, one could expect that higher aid would imply faster economic adjustment for the beneficiary sector. However, the opposite could be true if governments tend to support, purely for political reasons, ailing sectors with low productivity and profitability; or if the extent of the aid small relatively to the impact of shocks on the sector. Another, popular side effect in the microeconomic theory impelled by governmental aid is the problem of moral hazard. Sectors that enjoy increased governmental help tend to undertake riskier projects, being more confident that the government would finance them in case of emergency. Such projects are more likely to lead to a deeper contraction in output and a slower recovery during crises. Assessing which effect dominates empirically would require collecting information on sector and country specific state aid.

[27] Several examples can given from the 2008-09 financial crises, see for instance European Commission (2010).

Sectoral Differences in Labour Market Institutions

Labour market rigidities can be an important factor explaining sectoral differences, although we do not uncover such evidence in this paper. In countries with high employment protection legislation, employers are usually more conservative in the posting of new vacancies. In countries that are subject to high employment protection laws, employers can only fire personnel under a very specific and well-defined legislative framework. Economies with such frictions discourage the creation of new jobs and deter the efficient and rapid reallocation of labor. These rigidities constrain firms from adjusting as needed, either during downturns or in the recovery phase, and can be re-enforced at sectoral level if there are other factors at play (e.g unionization at certain sectors).

We consider the possible impact of employment protection legislation on resilience, but do not take into account possible institutional differences across sectors, nor differences in the labour intensity of sectors, which might explain the insignificance of the results found for this variable.

Apart from employment protection legislation trade unions could also be enhancing employment protection practices and preventing necessary adjustments in wages, resulting in the slower reallocation of an economy's resources and production factors. Although we did try to account for differences in collective bargaining practices across countries, there is evidence that these practices can vary significantly across sectors within a country (Fitzenberg and Franz, 1999, for instance document sectoral differences in collective bargaining coverage in Germany). This may explain why the country specific variables included to account for differences in resilience turned out to be insignificant in the analysis.

Sector Specific Product Market Regulations

As mentioned earlier, in general stricter product market regulations tend to lower sectors' efficiency and the ability to adjust to shocks. These regulations not only vary across countries but also across sectors within a country (licenses for instance are sector specific). Such sector-specific data is not readily available and has not been utilized in this study; although sectoral markups have been incorporated, these have not been found significant.

8. Conclusions and Policy Implications

This study examined sectoral cycles across EU countries and investigated the reasons behind differences in the adjustment capacity of sectors and countries to shocks. In particular, it studied the role played by institutional factors and product market reforms in accelerating this adjustment capacity. The issue is particularly relevant currently, in light of the recent economic crisis which has affected considerably both the EU and the Eurozone and which has brought to the forefront of public debate the issue of structural and of broader institutional reforms.

Although the crisis had severe consequences on the EU economy, its impact varied greatly across industrial sectors and countries. A number of subsectors such as automobile and

textiles have experienced large falls in output and others, such as food and beverages, chemicals and pharmaceuticals displayed less significant changes.

We summarize the results of our analysis under various headings, and present in the end some broader policy recommendations.

Sectoral business cycles are heterogeneous

Cycles at the sectoral level are quite heterogeneous and sectoral output appears much less stable than aggregate output. This result is interesting since monetary policy is conducted using aggregate euro-wide information and hence, it does not have the tools to effectively take care of these idiosyncrasies. The heterogeneity of sectoral cycles can be explained by three different causes: asymmetric shocks (e.g., change in tastes); common shocks with idiosyncratic impact across sectors and countries (e.g., oil price shocks that affect sectors differently depending on the energy intensity of production); or policies at the national or EU-wide level which are sector-specific (e.g. specific national industrial policies).

There are also important cross-country differences in the sectoral composition of output. Within the industrial sector, one can observe large differences across countries; for example in food, chemicals, and motor vehicles. These compositional differences imply considerable differences in the responses of countries to sector-specific shocks, and, to the extent that there exist structural differences across these sectors or countries, also to common shocks.

Product market reforms improve resilience

We find that product market regulations at the national level affect resilience. The results show for example, that country differences within industrial sub-sectors appear to be explained by how far product market reforms have advanced.

Other factors also affect resilience

Besides product market regulations, cross-country differences in resilience can be explained by financial development and to a lesser extent by openness to trade. While it is generally accepted that financial development and openness boost efficiency and competitiveness, the association between these two variables and resilience merely confirms that more open countries are more exposed to external shocks. The results are in line with those presented in the international business cycle literature: cyclical fluctuations are more correlated in countries and regions that are more open to trade and/or are more financially integrated.

The fact that financial development and openness to trade matter indicate the importance of promoting product markets reforms, in particular, in countries and sectors more exposed to trade and to financial shocks.

A number of other factors could potentially account for the differences in the resilience across sectors. These include micro-level factors determining the dynamics of demand, for example, differences in state-aid intensity across sectors, and product and labour market regulations at the sectoral level. Because appropriate databases providing information about these sectoral characteristics across countries are not available, investigating their importance is left for future research.

Industry sub-sectoral differences in resilience are considerable

There are important differences in the ability of sub-sectors of industry to adjust to shocks. For example, the chemicals, the mining and the textiles sub-sectors are more resilient than, the motor vehicle sub-sector. Indeed, the motor vehicle sector is consistently found to be the least resilient sector in the EU.

When the sectors are grouped into those manufacturing consumer, investment, or intermediate goods, we find that the consumer goods sector is significantly more resilient, while the investment goods sector is the least resilient. This fact, in conjunction with the known theoretical prediction and empirical result that the income elasticity of demand is higher for investment goods than for consumer goods, indicates that the income elasticity of demand may be an important determinant of sectoral resilience.

For policy purposes, it is also important to single out the sectors which rank relatively low in terms of resilience, but at the same time have more weight in EU total production. Our analysis finds that the five largest sectors which consistently rank below the EU average in terms of resilience are: motor vehicles, machinery and equipment, metal products, basic metals, and electric equipment. Germany, Italy, France, the UK and Spain are top producers in these industries, but some smaller countries also have some weight in this sectors, like Belgium in basic metals, Netherlands in metal products, Austria in electric equipment, and Sweden in machinery and equipment and motor vehicles.

Advancement in product market reforms can offset idiosyncratic features which could make adjustment to shocks slower

Once the estimated sectoral resilience rankings are aggregated using country weights, we find a number of countries consistently ranking above average: these are the UK, Norway, Denmark, and Sweden.

Some of these differences across countries are partly explained by the sectoral composition of their economies: for example, since we find that the car industry, or more generally investment goods sectors are less resilient sectors, countries with a large automobile sector or other investment goods sectors, turn out to be less resilient to shocks. Indeed, Germany and France, which both have large automobile sectors, rank relatively low in terms of overall resilience.

Notwithstanding these sectoral composition differences, differences in resilience across countries are related to the degree of product market regulation. The automobile sector, for instance, is found to be more resilient in the UK and Sweden than in France or Spain, two countries that have advanced less in terms of product market reforms. Thus, it can be inferred that national advancement in product market reforms can help offset other idiosyncratic features of sectors or countries which could make adjustment to shocks slow. Product market reforms in specific sectors could therefore help offset the idiosyncrasies of these sectors, such as more elastic income demands that results in more volatility in production.

Another example is financial sector development: because of the very advanced nature of product market reforms, the UK ranks relatively high in terms of resilience even though, because of its financial sector development, it is perhaps more vulnerable to external shocks

than Germany, France or Spain. Product market reforms help the UK offset the negative impact of this additional exposure to shocks on resilience.

Analysis of the 2008-09 recession confirms previous conclusions

Examination of the 2008-09 downturn confirms that product market regulations play a significant role in determining responses to the shock. The least resilient sectors appear to be again the motor vehicle and basic metals sectors. At the other end of the spectrum we have food and beverages, computer and electrical equipment sectors. In terms of countries, Denmark comes again at the top of the ranking, while at the bottom we have countries which have advanced very little in product market reforms, such as Belgium and Hungary.

The level of debt is also important in explaining cross country differences in resilience in the last recession. In particular, countries with higher debt levels appear to be less resilient to shocks, probably because they had little room to implement discretionary fiscal policies. High debt levels may have also prevented a smoother adjustment to this particular large shock by increasing uncertainty about the direction of future policies.

The analysis of the 2008-09 recession is also challenging in this regard since the exceptional public support measures which were taken in some countries and sectors, have certainly prevented a meltdown (for example in the banking sector) and subsequently more sizeable adjustments in other sectors of countries. In some sense, the expansion of debt levels in some countries has helped absorb part of a very sizeable negative shock, and this is confirmed by the evidence presented here.

Policy recommendations

Our findings stress the importance of pursuing decisive product market reforms in all countries. Nevertheless, they also underline that it is crucial to focus the reform effort on more exposed/open countries, on countries with large financial sectors, and on economies which are more integrated within the euro area. Reforms should also be given priority in new EU member states which are undergoing structural changes. This is because structural changes are more likely to make them more open and more susceptible to shocks emanating from financial markets.

Since the demand elasticity of income may explain some of the measured differences in resilience, domestic fiscal policy could play a role in dampening the impact, especially during times of severe downturns. This implies that, in addition to pursuing reforms which help in any event, policy makers could pursue also demand management policies concentrated in particular on those sectors, and only in times of severe economic disruption. This should be undertaken, for example, not by helping directly businesses but rather by providing subsidies to purchase vehicles to households or businesses, or for investing in machinery and equipment, thus offsetting the precipitous fall in demand. Well-designed fiscal policies can maximize the impact on GDP, and at the same time, minimise the costs if they cover only the most vulnerable sector or countries. Some policies designed within the recent European Recovery Plan, such as motor vehicles sector aid, make a lot of sense from this perspective, since they have helped limit the abrupt and sizeable fall in demand.

To accommodate such selective approach, there could be a case for state aid rules to be made more flexible, where needed, as in the Temporary Community Framework for State

Aid (see European Commission, 2009). Clearly, such a recommendation requires countries to be able to react through fiscal policy swiftly in bad times, which was not the case in the recent recession due to fiscal constraints in some countries. Thus, fiscal prudence in good times is a prerequisite, and should be pursued both a national and at EU level.

Given the limited will for structural reforms, a more selective approach to reforms could also be contemplated. For instance, the reform effort could be directed towards less resilient industries, such as investment and intermediate goods. Within these industries focus on those sectors which have more weight in overall industrial output in the EU, for example, machinery and equipment, motor vehicles, metal products etc., would have the strongest impact on improving resilience at the EU level.

Overall, a more sectoral approach to reforms, whereby the directions and orientations given by the EU to Members States within the Lisbon strategy and the National Reform Programmes could focus primarily on less resilient sectors, may be warranted and could complement existing policies. Even if strict regulations may not be the fundamental reasons for more vulnerability in those sectors, targeted regulatory reforms can offset other idiosyncratic features of sectors, such as a high income elasticity of demand, which render the sector particularly vulnerable to demand swings. Indeed, it appears to be more sensible to think of policy recommendations in terms of sectors and to design the least distortionary response that suits the profile of a specific sector. Such policies may have a stronger and economically more efficient impact on the economy.

Further work could shed more light in to these important matters

This work has revealed a number of avenues for improvement and more interesting questions for future research. Depending on data availability the work can be extended to cover other sectors in more detail, for example services. In addition, in order to be able to extract more information concerning sectoral differences, more sectoral data is required, both covering product market reforms, and other characteristics including from labour markets at a sectoral level. If such data is not available, it would be desirable to devote resources in putting together such a sectoral database. Finally, the existing product market reform database can be extended to cover non-OECD countries so as to enlarge the dataset.

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Appendix

A. Country and Sample Availability

Table A: Data on output volume indexes by 2-digit industry sub-sectors: country and sample availability

Belgium	1991/Q1 – 2010/Q1
Bulgaria	2000/Q1 – 2010/Q1
Denmark	1985/Q1 – 2010/Q1
Germany (inc. ex-GDR from 1991)	1978/Q1 – 2010/Q1
Estonia	2000/Q1 – 2010/Q1
Greece	2000/Q1 – 2010/Q1
Spain	1980/Q1 – 2010/Q1
France	1990/Q1 – 2010/Q1
Italy	1990/Q1 – 2010/Q1
Latvia	1996/Q1 – 2010/Q1
Lithuania	2000/Q1 – 2010/Q1
Hungary	2000/Q1 – 2010/Q1
Netherlands	2000/Q1 – 2010/Q1
Austria	1996/Q1 – 2010/Q1
Poland	1995/Q1 – 2010/Q1
Portugal	1990/Q1 – 2010/Q1
Finland	1990/Q1 – 2010/Q1
Sweden	2000/Q1 – 2010/Q1
United Kingdom	1986/Q1 – 2010/Q1
Ireland	1980/Q1 – 2010/Q1
Switzerland	1996/Q1 – 2010/Q1

B. Estimates of Resilience

This Appendix gives details on how the resilience of countries is estimated. First we calculate the overall marginal effect of shocks on the benchmark sector, by countries, b_{ij}, where $_{i=12/13}$. The marginal effect estimated using alternative models are shown in Tables B.1 to B.X. We then calculate the marginal effect for sectors for which the dummy interactions were significant, and therefore for which the marginal effect is different than that of the benchmark sector. The marginal effect for these sectors is given by ($b_{12/13,j}$+D_i). We the calculate the reliance of sector i in country j, as defined in the text, that is as 1/exp(b_{ij}). These estimates of resilience are shown in Tables B.1 to B.3, for alternative models. Finally we calculate the country's resilience as the weighted average of the resilience estimated for each of the country's sectors. We also calculate the resilience of the EU, by sectors and in total; the estimated figures correspond to the weighted average of EU country's results. Countries in Tables B.1. to B.3. are ranked according to resilience, from higher to lower.

Table B.1.: Estimates of Resilience to an euro area GDP Shock, Sectoral Classification

Estimated Parameters:	Column (9), Table 12												
	EMUxSy	FindevxSy	PMRtxSy		D1xSy	D5xSy	D7xSy	D6xSy	D2xSy	D11xSy	D18xSy	D21xSy	
	0.393	0.004	0.336		-1.722	-1.056	-0.979	-0.927	-0.595	-0.573	0.489	1.412	
	Measuring correlation to Shocks				Resilience								
	EMU	Fin. Dev.	PMR	Marginal Effect	Chemicals & Pharm.; and remaining sectors	Mining	Textiles	Leather	Wearing App.	Food&Bev.	Coke& Petrol.	Computer &Electr.	Motor Vehicles	Country Average
Nor	0.00	46.89	1.21	0.595	0.552	3.086	1.586	1.468	1.394	1.000	0.978	0.338	0.134	1.987
Den	0.00	57.71	1.07	0.589	0.555	3.104	1.595	1.476	1.402	1.006	0.984	0.340	0.135	0.855
Hun	0.00	24.21	1.33	0.544	0.580	3.248	1.669	1.545	1.467	1.052	1.030	0.356	0.141	0.637
UK	0.00	142.53	0.84	0.852	0.426	2.386	1.226	1.135	1.077	0.773	0.756	0.261	0.104	0.620
Pol	0.00	19.86	2.38	0.878	0.416	2.327	1.195	1.107	1.051	0.754	0.737	0.255	0.101	0.618
Cze	0.00	25.13	1.67	0.660	0.517	2.892	1.486	1.376	1.306	0.937	0.917	0.317	0.126	0.614
Swe	0.00	105.45	1.33	0.869	0.419	2.346	1.205	1.116	1.059	0.760	0.744	0.257	0.102	0.536
Por	1.00	40.08	1.44	1.036	0.355	1.987	1.021	0.945	0.897	0.644	0.630	0.218	0.087	0.519
Ita	1.00	42.33	1.87	1.191	0.304	1.701	0.874	0.809	0.768	0.551	0.539	0.186	0.074	0.450
Net	1.00	110.51	1.02	1.177	0.308	1.724	0.886	0.820	0.779	0.559	0.546	0.189	0.075	0.439
Aus	1.00	24.97	1.46	0.985	0.374	2.090	1.074	0.994	0.944	0.677	0.662	0.229	0.091	0.427
Ire	1.00	58.53	1.49	1.128	0.324	1.812	0.931	0.862	0.818	0.587	0.574	0.199	0.079	0.415
Gre	1.00	58.76	2.17	1.357	0.257	1.440	0.740	0.685	0.650	0.467	0.456	0.158	0.063	0.393
Bel	1.00	66.64	1.52	1.170	0.310	1.736	0.892	0.826	0.784	0.563	0.550	0.190	0.076	0.382
Ger	1.00	46.05	1.39	1.044	0.352	1.970	1.012	0.937	0.890	0.638	0.624	0.216	0.086	0.374
Spa	1.00	74.29	1.90	1.330	0.265	1.480	0.761	0.704	0.669	0.480	0.469	0.162	0.064	0.328
Fra	1.00	74.93	1.66	1.251	0.286	1.602	0.823	0.762	0.723	0.519	0.508	0.176	0.070	0.327
Fin	1.00	118.99	1.20	1.271	0.281	1.570	0.807	0.747	0.709	0.509	0.498	0.172	0.068	0.306
Swi	0.00	232.25	1.55	1.449	0.235	1.314	0.675	0.625	0.593	0.426	0.417	0.144	0.057	0.283
EU average					0.343	1.917	0.985	0.912	0.866	0.621	0.608	0.210	0.083	0.431

Table B.2.: Estimates of Resilience to an euro area GDP Shock, MIG Classification

Estimated Parameters: Column (6), Table 14								
	EMUxSy	FindevxSy	PMRtxSy			Dconsxsy	Dinvxsy	
	0.443	0.005	0.471			-0.362	0.421	
Measuring correlation to Shocks					Resilience			
	EMU	Fin. Dev.	PMR	Marginal Effect	Intermediate Goods	Consumer Goods	Investment Goods	Country Average
Den	0.00	57.71	1.07	0.791	0.453	0.651	0.298	0.500
Hun	0.00	24.21	1.33	0.748	0.473	0.680	0.311	0.462
Nor	0.00	46.89	1.21	0.806	0.447	0.642	0.293	0.452
Cze	0.00	25.13	1.67	0.910	0.402	0.578	0.264	0.397
Swe	0.00	105.45	1.33	1.155	0.315	0.453	0.207	0.352
UK	0.00	142.53	0.84	1.108	0.330	0.474	0.217	0.325
Pol	0.00	19.86	2.38	1.218	0.296	0.425	0.194	0.320
Por	1.00	40.08	1.44	1.319	0.267	0.384	0.175	0.290
Aus	1.00	24.97	1.46	1.257	0.284	0.408	0.187	0.281
Ire	1.00	58.53	1.49	1.437	0.238	0.341	0.156	0.271
Ger	1.00	46.05	1.39	1.327	0.265	0.381	0.174	0.254
Net	1.00	110.51	1.02	1.475	0.229	0.328	0.150	0.247
Bel	1.00	66.64	1.52	1.492	0.225	0.323	0.148	0.233
Ita	1.00	42.33	1.87	1.535	0.215	0.309	0.141	0.224
Fra	1.00	74.93	1.66	1.600	0.202	0.290	0.133	0.201
Gre	1.00	58.76	2.17	1.759	0.172	0.247	0.113	0.195
Fin	1.00	118.99	1.20	1.601	0.202	0.290	0.132	0.193
Spa	1.00	74.29	1.90	1.711	0.181	0.260	0.119	0.190
Swi	0.00	232.25	1.55	1.890	0.151	0.217	0.099	0.155
EU average					0.252	0.362	0.166	0.256

Table B.3.: Estimates of Resilience to an euro area GDP Shock, Sectoral Classification, 2008-2009 Downturn

Estimated Parameters	Column (6), Table 15																	
	DebtxSy	Openxsy	FindevxSy	PMRtxSy			D2xSy	D18xSy	D20xSy	D19xSy	D17xSy	D14xSy	D23xSy	D5xSy	D15xSy	D8xSy	D16xSy	D21xSy	
	0.004	0.007	0.003	0.210			-0.441	0.296	0.357	0.364	0.525	0.590	0.590	0.611	0.688	0.695	0.766	1.692	
						Resilience													
	Debt 2007	Open	Fin. Dev.	PMR	Marginal Effect	Chemicals & Pharm.; and remaining sectors	Food&Bev.	Computer &Electr.	Machinery & Equip.	Electric Equip.	Metal Products	Coke& Petrol.	Furniture	Textiles	Non-Metalic Minerals	Wood, Cork, etc.	Basic Metals	Motor Vehicles	Country Average
Den	26.80	43.01	57.71	1.06	0.803	0.448	0.696	0.333	0.313	0.311	0.265	0.248	0.248	0.243	0.225	0.224	0.208	0.082	0.429
Nor	52.30	36.43	46.89	1.16	0.849	0.428	0.665	0.318	0.299	0.297	0.253	0.237	0.237	0.232	0.215	0.213	0.199	0.079	0.405
Spa	36.10	27.70	74.29	1.09	0.789	0.454	0.706	0.338	0.318	0.316	0.269	0.252	0.252	0.247	0.228	0.227	0.211	0.084	0.370
Swe	40.50	42.26	105.45	1.31	1.049	0.350	0.544	0.261	0.245	0.243	0.207	0.194	0.194	0.190	0.176	0.175	0.163	0.065	0.358
Pol	45.00	32.28	19.86	2.38	0.964	0.381	0.593	0.284	0.267	0.265	0.226	0.211	0.211	0.207	0.192	0.190	0.177	0.070	0.335
Ire	25.10	78.92	58.53	1.33	1.108	0.330	0.513	0.246	0.231	0.230	0.195	0.183	0.183	0.179	0.166	0.165	0.154	0.061	0.333
Por	63.60	33.56	40.08	1.43	0.909	0.403	0.626	0.300	0.282	0.280	0.238	0.223	0.223	0.219	0.202	0.201	0.187	0.074	0.332
Fra	63.80	25.76	74.93	1.45	0.966	0.381	0.592	0.283	0.266	0.265	0.225	0.211	0.211	0.207	0.191	0.190	0.177	0.070	0.305
Fin	35.20	37.27	118.99	1.19	1.009	0.365	0.567	0.271	0.255	0.253	0.216	0.202	0.202	0.198	0.183	0.182	0.169	0.067	0.298
Aus	59.50	46.44	24.97	1.35	0.921	0.398	0.619	0.296	0.279	0.277	0.235	0.221	0.221	0.216	0.200	0.199	0.185	0.073	0.297
Ita	103.50	25.47	42.33	1.38	1.008	0.365	0.567	0.271	0.255	0.253	0.216	0.202	0.202	0.198	0.183	0.182	0.170	0.067	0.293
Ger	65.00	33.60	46.05	1.33	0.912	0.402	0.624	0.299	0.281	0.279	0.238	0.223	0.223	0.218	0.202	0.200	0.187	0.074	0.293
Net	45.50	63.41	110.51	0.97	1.161	0.313	0.487	0.233	0.219	0.218	0.185	0.174	0.174	0.170	0.157	0.156	0.146	0.058	0.292
UK	44.20	28.14	142.53	0.84	0.978	0.376	0.584	0.280	0.263	0.261	0.222	0.208	0.208	0.204	0.189	0.188	0.175	0.069	0.287
Cze	29.00	63.83	25.13	1.62	0.979	0.376	0.584	0.280	0.263	0.261	0.222	0.208	0.208	0.204	0.189	0.188	0.175	0.069	0.274
Hun	65.90	65.26	24.21	1.30	1.067	0.344	0.535	0.256	0.241	0.239	0.204	0.191	0.191	0.187	0.173	0.172	0.160	0.063	0.267
Gre	95.60	26.67	58.76	2.14	1.194	0.303	0.471	0.225	0.212	0.210	0.179	0.168	0.168	0.164	0.152	0.151	0.141	0.056	0.263
Swi	24.00	42.15	232.25	1.29	1.359	0.257	0.399	0.191	0.180	0.179	0.152	0.142	0.142	0.139	0.129	0.128	0.119	0.047	0.222
Bel	84.20	73.56	66.64	1.43	1.351	0.259	0.402	0.193	0.181	0.180	0.153	0.144	0.144	0.141	0.130	0.129	0.120	0.048	0.209
EU						0.380	0.590	0.282	0.266	0.264	0.225	0.210	0.210	0.206	0.191	0.189	0.176	0.070	0.304

C. Resilience to US Shocks

We examined the robustness of our conclusions repeating the analysis using US GDP shocks (SYus).[28] The results also reaffirm the previous findings although some of the variables become less significant, as seen inTable C1. The coefficient on the product market reforms interaction is positive and significant in all the specifications shown, and close to what was obtained for euro area GDP shocks. However, the coefficients on the EMU and financial development interactions, although close to what was estimated using euro area GDP shocks, never show up as significant, and if we drop these variables the statistical significance of the PMR interaction weakens. Table C2 displays the estimated resilience to US GDP shocks using the same model used for euro area shocks. Since the relative roles of openness and product market reforms are different, and the EMU effect is weaker, the rankings of resilience differ slightly, with Belgium, Portugal, and Poland showing less resilience to US GDP shocks.

[28] The focus of this study is on GDP shocks. An extended analysis considering other types of shocks can be found in the Appendix of XXX.

Table C.1: Random Effects Estimates, Xadj and US GDP shocks (Syus), 2-digit Industry data.
Constants Omitted.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
syus	-0.200	-0.377	-0.286	-0.500	-0.640	-0.129	1.600	-0.590	-0.531
	[0.641]	[0.617]	[1.082]	[0.651]	[0.568]	[0.514]	[0.991]	[0.565]	[0.474]
D1xsyus	-0.543	-0.579	-0.418	-0.426	-0.423	-0.340		-0.417	-0.397
	[0.426]	[0.425]	[0.431]	[0.408]	[0.408]	[0.463]		[0.408]	[0.408]
D2xsyus	-0.089	-0.105	-0.102	-0.095	-0.089	-0.299	-0.623	-0.089	-0.100
	[0.422]	[0.422]	[0.458]	[0.422]	[0.422]	[0.470]	[0.468]	[0.422]	[0.422]
D5xsyus	0.005	-0.008	0.151	0.139	0.140	0.232	0.260	0.148	0.161
	[0.433]	[0.433]	[0.441]	[0.420]	[0.420]	[0.472]	[0.430]	[0.419]	[0.419]
D6xsyus	-0.535	-0.557	-0.357	-0.408	-0.405	-0.330	-0.392	-0.395	-0.372
	[0.474]	[0.473]	[0.481]	[0.459]	[0.459]	[0.510]	[0.463]	[0.459]	[0.457]
D7xsyus	-1.341**	-1.368***	-1.035*	-1.214**	-1.208**	-1.085*	-0.443	-1.187**	-1.169**
	[0.528]	[0.527]	[0.560]	[0.515]	[0.514]	[0.559]	[0.579]	[0.514]	[0.513]
D11xsyus	0.128	0.088	0.228	0.179	0.175	-0.564	0.027	0.173	0.154
	[0.496]	[0.495]	[0.523]	[0.488]	[0.488]	[0.534]	[0.472]	[0.488]	[0.487]
D18xsyus	0.777*	0.750*	0.880*	0.901**	0.902**	0.592	0.618	0.898**	0.896**
	[0.445]	[0.444]	[0.464]	[0.430]	[0.430]	[0.486]	[0.454]	[0.430]	[0.429]
D21xsyus	0.183	0.188	0.213	0.291	0.288	-0.249	-0.893*	0.288	0.271
	[0.446]	[0.446]	[0.473]	[0.440]	[0.440]	[0.498]	[0.485]	[0.440]	[0.440]
Other Dixsy	(			Included but not significant					
Dupxsyus	0.117	0.119	0.117	0.114	0.114	0.203	0.049		
	[0.136]	[0.136]	[0.145]	[0.136]	[0.136]	[0.154]	[0.150]		
euxsyus	-0.212								
	[0.210]								
emuxsyus	0.352*	0.319*	0.223	0.264	0.243	0.150	0.109	0.239	0.191
	[0.190]	[0.187]	[0.193]	[0.171]	[0.165]	[0.175]	[0.157]	[0.165]	[0.159]
debtxsyus	-0.001	-0.002	-0.004	-0.003	-0.003	-0.001	-0.005	-0.003	
	[0.004]	[0.003]	[0.004]	[0.003]	[0.003]	[0.004]	[0.004]	[0.003]	
openxsyus	-0.000	-0.000	0.001	0.002	0.002	0.001	0.005	0.002	
	[0.005]	[0.005]	[0.006]	[0.004]	[0.004]	[0.005]	[0.005]	[0.004]	
findevxsyus	0.001	0.002	0.001	0.002	0.002	0.003	0.000	0.002	0.002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.004]	[0.002]	[0.002]
eplxsyus	-0.075	-0.055							
	[0.145]	[0.144]							
barg1xsyus			-0.352						
			[0.768]						
barg2xsyus				-0.307					
				[0.699]					
pmrtxsyus	0.429**	0.466**	0.387*	0.431**	0.395**			0.398**	0.316**
	[0.202]	[0.199]	[0.218]	[0.185]	[0.165]			[0.165]	[0.149]
db1xsyus						0.006			
						[0.004]			
markuptxsy							-1.010		
							[0.621]		
euweightsx	-0.181	-0.199							
	[0.139]	[0.138]							
Observatior	2,313	2,313	2,166	2,313	2,313	2,509	1,164	2,313	2,313
Number of i	344	344	323	344	344	397	150	344	344
R-within	0.0227	0.0217	0.0187	0.0210	0.0209	0.0138	0.0309	0.0200	0.0190
R overall	0.0193	0.0189	0.0159	0.0180	0.0180	0.0108	0.0286	0.0177	0.0171
Rbetween r	8.53e-05	0.00138	2.21e-05	6.88e-06	8.42e-08	2.34e-06	0.00660	0.000723	0.00352

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table C.2: Estimates of Resilience in Industry to a US GDP shock (2-digit industry data)

Estimated Parameters	Column (9), Table C1													
Syus	EMUxSyus	FindevxSyu	PMRtxSyus		D7xSy	D1xSy	D6xSy	D2xSy	D11xSy	D5xSy	D21xSy	D18xSy		
0	0.191	0.002	0.316		-1.169	-0.397	-0.372	-0.1	0.154	0.161	0.271	0.896		
Measuring correlation to Shocks					Resilience									
	EMU	Fin. Dev.	PMR	Marginal Effect	Chemicals & Pharm.; and remaining sectors	Leather	Mining	Wearing App.	Food&Bev.	Coke& Petrol.	Textiles	Motor Vehicles	Computer &Electr.	Country Average
Nor	0.00	46.89	1.21	0.477	0.621	1.998	0.923	0.900	0.686	0.532	0.528	0.473	0.253	0.788
Den	0.00	57.71	1.07	0.453	0.636	2.047	0.946	0.923	0.703	0.545	0.541	0.485	0.260	0.671
UK	0.00	142.53	0.84	0.551	0.577	1.856	0.858	0.836	0.637	0.494	0.491	0.440	0.235	0.577
Hun	0.00	24.21	1.33	0.469	0.626	2.014	0.931	0.908	0.692	0.536	0.533	0.477	0.255	0.566
Cze	0.00	25.13	1.67	0.577	0.562	1.808	0.836	0.815	0.621	0.482	0.478	0.428	0.229	0.548
Swe	0.00	105.45	1.33	0.632	0.532	1.711	0.791	0.771	0.588	0.456	0.453	0.405	0.217	0.526
Por	1.00	40.08	1.44	0.725	0.484	1.559	0.721	0.703	0.535	0.415	0.412	0.369	0.198	0.518
Net	1.00	110.51	1.02	0.734	0.480	1.545	0.714	0.696	0.531	0.412	0.409	0.366	0.196	0.484
Aus	1.00	24.97	1.46	0.704	0.495	1.593	0.736	0.718	0.547	0.424	0.421	0.377	0.202	0.481
Ger	1.00	46.05	1.39	0.722	0.486	1.564	0.723	0.705	0.537	0.416	0.414	0.370	0.198	0.465
Pol	0.00	19.86	2.38	0.790	0.454	1.460	0.675	0.658	0.501	0.389	0.386	0.346	0.185	0.465
Ita	1.00	42.33	1.87	0.866	0.420	1.353	0.625	0.610	0.465	0.360	0.358	0.321	0.172	0.454
Ire	1.00	58.53	1.49	0.779	0.459	1.477	0.683	0.666	0.507	0.393	0.391	0.350	0.187	0.454
Bel	1.00	66.64	1.52	0.805	0.447	1.440	0.665	0.649	0.494	0.383	0.381	0.341	0.183	0.432
Fra	1.00	74.93	1.66	0.866	0.421	1.354	0.626	0.610	0.465	0.361	0.358	0.321	0.172	0.406
Fin	1.00	118.99	1.20	0.807	0.446	1.436	0.664	0.647	0.493	0.382	0.380	0.340	0.182	0.405
Spa	1.00	74.29	1.90	0.941	0.390	1.256	0.580	0.566	0.431	0.335	0.332	0.298	0.159	0.396
Swi	0.00	232.25	1.55	0.953	0.385	1.241	0.573	0.559	0.426	0.330	0.328	0.294	0.157	0.385
Gre	1.00	58.76	2.17	0.994	0.370	1.191	0.550	0.537	0.409	0.317	0.315	0.282	0.151	0.383
EU average					0.471	1.514	0.700	0.683	0.520	0.403	0.401	0.359	0.192	0.468

Note: only the coefficient associated with the PMR_t interaction is significant

D. Blanchard and Quah Identification of Shocks

Blanchard and Quah (1989) provide an alternative way to obtain a structural identification. The difference between this method and the structural VAR method is that this imposes long-run restrictions, while the structural VAR forecast method imposes short-run restrictions.

Let{*yt*} and {*pt*} be difference-stationary series. Ignoring any deterministic regressors, we can estimate a 2-variable VAR of the form:

$$\Delta y_t = \sum_{i=1}^{p} a_{11}(i)\,\Delta y_{t-i} + \sum_{i=1}^{p} a_{12}(i)\,\Delta p_{t-i} + e_{1t}$$

$$\Delta p_t = \sum_{i=1}^{p} a_{21}(i)\,\Delta y_{t-i} + \sum_{i=1}^{p} a_{22}(i)\,\Delta p_{t-i} + e_{2t}$$

In order to use the Blanchard-Quah technique, both variables must be in a stationary format. Although the structural innovations are unobserved, they are related to the regression residuals by:

$$\begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} = \begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

Changes in ε_{2t} will have no long-run effect on the {*yt*} sequence if a certain restriction holds, that is to say, if inflation shocks have no long-run impact on GDP, something which is widely accepted as a sensible and economic meaningful restriction. This is the needed piece of information that allows us to identify the four elements in G (the matrix of coefficients g_{xz}, where x=1,2 and z=1,2) and therefore the structural innovations. This method allows us to differentiate transitory or demand, which have no long-run impact shock on output, from permanent shocks.

We tested the robustness of the results to using the Blanchard-Quah identification method. We constructed in particular, for each business cycle phase, permanent euro area output shocks (SP), and transitory euro area output shocks (ST).

The results using 2-digit industry sub-sector data and permanent output shocks (SP) are given in Table E.1. The results imply that the negative relationship between product market regulations and resilience remains robust in this analysis. Also the coefficient on the EMU dummy interaction remains and with a positive sign. Openness remains marginally significant, with a coefficient close to that found in other 2-digit regressions; while financial development also appears significant and with a positive sign in some specification. These results continue to indicate that openness and financial development seem to increase the correlation to shocks. In terms of sectors, the results are not very different compared with

those reported in the main report: the mining, food and beverages, wearing apparel, and coke petroleum sectors are found to be more resilient, in contrast to motor vehicles which are the least resilient.

The results for temporary output shocks (ST) are shown in Table E.2. These results are quite different than what was found in previous estimates. Product market reforms do not seems associated with resilience to temporary shocks. In fact differences in resilience to temporary shocks across countries cannot be captured with the country characteristics that have been considered. Interestingly there is evidence of an asymmetric response to temporary output shocks (ST), with the correlation with shocks stronger in downturns than in upturns.

This is an interesting result given that, a priori, it is anticipated that transitory shocks will have a lesser impact on sectoral output and GDP, compared to permanent shocks. Indeed, these results confirm that there is no association between transitory shocks and sectoral output, as defined based on the "classical" business cycle definition.

Table D. 1: Random Effect Estimates, Xadj and Permanent euro area Output Shocks, 2-digit Industry

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
sp	-0.416	-0.250	-0.050	-0.101	-0.399	-0.148	-0.461	-0.470	-0.179	-0.179	-0.174
	[0.380]	[0.357]	[0.640]	[0.407]	[0.331]	[0.289]	[0.328]	[0.320]	[0.263]	[0.263]	[0.212]
D1xsp	-0.604**	-0.595**	-0.635**	-0.573**	-0.595**	-0.527*	-0.589**	-0.590**	-0.573**	-0.573**	-0.567***
	[0.260]	[0.260]	[0.269]	[0.256]	[0.256]	[0.285]	[0.256]	[0.256]	[0.256]	[0.256]	[0.207]
D2xsp	-0.231	-0.220	-0.278	-0.246	-0.247	-0.189	-0.260	-0.260	-0.253	-0.253	-0.248*
	[0.210]	[0.210]	[0.219]	[0.208]	[0.208]	[0.234]	[0.208]	[0.208]	[0.208]	[0.208]	[0.145]
D5xsp	-0.195	-0.197	-0.239	-0.188	-0.198	0.028	-0.167	-0.168	-0.147	-0.147	-0.140
	[0.268]	[0.268]	[0.276]	[0.265]	[0.265]	[0.299]	[0.264]	[0.264]	[0.263]	[0.263]	[0.216]
D6xsp	-0.482*	-0.472*	-0.565**	-0.483**	-0.474*	-0.520*	-0.466*	-0.469*	-0.460*	-0.460*	-0.454**
	[0.248]	[0.248]	[0.264]	[0.243]	[0.243]	[0.277]	[0.243]	[0.242]	[0.242]	[0.242]	[0.190]
D7xsp	0.072	0.066	-0.009	0.060	0.058	-0.125	0.067	0.068	0.088	0.088	0.094
	[0.273]	[0.273]	[0.279]	[0.267]	[0.267]	[0.296]	[0.267]	[0.267]	[0.267]	[0.267]	[0.221]
D11xsp	-0.541**	-0.525*	-0.622**	-0.559**	-0.551**	-0.852***	-0.546**	-0.545**	-0.554**	-0.554**	-0.547**
	[0.274]	[0.274]	[0.287]	[0.271]	[0.271]	[0.308]	[0.271]	[0.271]	[0.271]	[0.271]	[0.225]
D18xsp	0.278	0.286	0.214	0.301	0.278	0.282	0.280	0.281	0.292	0.292	0.299
	[0.245]	[0.245]	[0.252]	[0.242]	[0.241]	[0.265]	[0.241]	[0.241]	[0.241]	[0.241]	[0.187]
D21xsp	0.596**	0.587**	0.548**	0.572**	0.560**	0.586**	0.571**	0.569**	0.565**	0.565**	0.572***
	[0.241]	[0.240]	[0.250]	[0.239]	[0.239]	[0.271]	[0.238]	[0.238]	[0.238]	[0.238]	[0.185]
D22xsp	-0.444*	-0.429*	-0.486*	-0.427*	-0.431*	-0.713***	-0.435*	-0.437*	-0.435*	-0.435*	-0.428**
	[0.246]	[0.246]	[0.257]	[0.242]	[0.242]	[0.268]	[0.242]	[0.241]	[0.241]	[0.241]	[0.188]
Other Dixsp	(				Included but insignificant					)	
Dupxsp	-0.088	-0.100	-0.090	-0.108	-0.109	-0.220**					
	[0.084]	[0.084]	[0.087]	[0.083]	[0.083]	[0.096]					
euxsp	0.157										
	[0.124]										
emuxsp	0.305**	0.323***	0.323**	0.293**	0.263**	0.156	0.276**	0.273**	0.240**	0.240**	0.231**
	[0.126]	[0.125]	[0.129]	[0.116]	[0.114]	[0.120]	[0.113]	[0.111]	[0.109]	[0.109]	[0.107]
debtxsp	-0.001	0.000	-0.002	-0.001	-0.000	0.002	-0.000				
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]				
openxsp	0.002	0.002	0.003	0.003	0.004*	0.004	0.004	0.004			
	[0.003]	[0.003]	[0.003]	[0.002]	[0.002]	[0.003]	[0.002]	[0.002]			
findevxsp	0.002	0.002	0.001	0.001	0.002*	0.003**	0.002*	0.002*	0.002	0.002	0.002
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
eplxsp	-0.083	-0.100									
	[0.087]	[0.086]									
barg1xsp			-0.511								
			[0.463]								
barg2xsp				-0.584							
				[0.462]							
pmrtxsp	0.376***	0.352***	0.375***	0.331***	0.275***		0.275***	0.271***	0.208**	0.208**	0.204**
	[0.121]	[0.119]	[0.127]	[0.109]	[0.100]		[0.100]	[0.096]	[0.087]	[0.087]	[0.086]
db1xsp						0.004*					
						[0.002]					
weuroxsp	-0.036	-0.022									
	[0.059]	[0.058]									
Observations	2,313	2,313	2,166	2,313	2,313	2,509	2,313	2,313	2,313	2,313	2,313
N. of sectors	21	21	21	21	21	21	21	21	21	21	21
R-within	0.0571	0.0566	0.0580	0.0570	0.0559	0.0423	0.0555	0.0556	0.0536	0.0536	0.0524
R overall	0.0531	0.0524	0.0536	0.0525	0.0518	0.0391	0.0511	0.0511	0.0501	0.0501	0.0492
R between	0.0691	0.0674	0.0698	0.0655	0.0716	0.0416	0.0637	0.0629	0.0759	0.0759	0.0801

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table D. 2: Random Effects Estimates, Xadj and Temporary euro area Output Shocks (ST) , 2-digit Industry

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
st	0.684	0.619	2.151**	1.096*	0.622	0.412	0.601	0.295	0.406	0.446	0.487*
	[0.588]	[0.548]	[1.026]	[0.635]	[0.506]	[0.453]	[0.498]	[0.407]	[0.358]	[0.338]	[0.251]
D1xst	-0.120	-0.129	-0.066	-0.006	-0.043	-0.304	-0.042	-0.080	-0.063	-0.054	-0.103
	[0.396]	[0.395]	[0.406]	[0.386]	[0.385]	[0.445]	[0.385]	[0.384]	[0.382]	[0.381]	[0.302]
D2xst	-0.365	-0.364	-0.376	-0.345	-0.358	-0.453	-0.356	-0.364	-0.356	-0.357	-0.406*
	[0.335]	[0.335]	[0.362]	[0.335]	[0.335]	[0.386]	[0.334]	[0.334]	[0.334]	[0.334]	[0.239]
D5xst	-0.019	-0.021	0.116	0.078	0.062	-0.250	0.068	0.032	0.034	0.040	-0.009
	[0.382]	[0.382]	[0.395]	[0.373]	[0.372]	[0.431]	[0.371]	[0.370]	[0.370]	[0.369]	[0.286]
D6xst	0.189	0.182	0.335	0.279	0.264	0.131	0.263	0.201	0.199	0.199	0.150
	[0.356]	[0.355]	[0.371]	[0.346]	[0.345]	[0.400]	[0.345]	[0.340]	[0.340]	[0.340]	[0.248]
D7xst	0.815*	0.805*	0.847*	0.937**	0.893**	0.812	0.897**	0.869**	0.886**	0.888**	0.839**
	[0.442]	[0.441]	[0.454]	[0.432]	[0.431]	[0.496]	[0.430]	[0.430]	[0.429]	[0.428]	[0.359]
D11xst	-0.147	-0.154	-0.057	-0.061	-0.090	0.261	-0.089	-0.096	-0.096	-0.085	-0.133
	[0.453]	[0.452]	[0.474]	[0.449]	[0.449]	[0.517]	[0.448]	[0.448]	[0.448]	[0.447]	[0.381]
D18xst	-0.772**	-0.775**	-0.624	-0.659*	-0.690*	-0.988**	-0.685*	-0.724*	-0.726*	-0.718*	-0.766**
	[0.393]	[0.393]	[0.403]	[0.384]	[0.383]	[0.439]	[0.383]	[0.381]	[0.381]	[0.380]	[0.300]
D21xst	0.273	0.274	0.251	0.332	0.297	-0.215	0.289	0.256	0.264	0.272	0.223
	[0.411]	[0.411]	[0.434]	[0.411]	[0.410]	[0.470]	[0.408]	[0.407]	[0.406]	[0.406]	[0.332]
Other Dixsp	(				Included but insignificant					)	
Dupxst	-0.329***	-0.323***	-0.338***	-0.313**	-0.316**	-0.327**	-0.315**	-0.332***	-0.332***	-0.332***	-0.333***
	[0.126]	[0.125]	[0.130]	[0.124]	[0.124]	[0.144]	[0.124]	[0.123]	[0.123]	[0.123]	[0.123]
euxst	-0.060										
	[0.195]										
emuxst	-0.033	-0.039	-0.214	0.106	0.040	0.020	0.030	0.082	0.064		
	[0.222]	[0.222]	[0.223]	[0.202]	[0.195]	[0.196]	[0.190]	[0.183]	[0.180]		
debtxst	-0.000	-0.001	-0.001	-0.001	-0.001	-0.003					
	[0.003]	[0.003]	[0.004]	[0.003]	[0.003]	[0.003]					
openxst	-0.002	-0.003	-0.012**	-0.005	-0.004	0.001	-0.004				
	[0.004]	[0.004]	[0.005]	[0.004]	[0.003]	[0.005]	[0.003]				
findevxst	0.000	0.000	0.000	-0.001	0.000	0.001	0.000	0.001			
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]			
eplxst	0.108	0.114									
	[0.143]	[0.142]									
barg1xst			-0.830								
			[0.762]								
barg2xst				-0.974							
				[0.786]							
pmrtxst	-0.072	-0.063	-0.271	0.130	0.023		0.011	0.084	0.062	0.044	0.049
	[0.204]	[0.201]	[0.208]	[0.182]	[0.161]		[0.150]	[0.133]	[0.128]	[0.117]	[0.116]
db1xst						0.008**					
						[0.004]					
weuroxst	-0.079	-0.084									
	[0.103]	[0.102]									
Observations	2,313	2,313	2,166	2,313	2,313	2,509	2,313	2,313	2,313	2,313	2,313
N. of sectors	21	21	21	21	21	21	21	21	21	21	21
R-within	0.0353	0.0352	0.0383	0.0354	0.0347	0.0280	0.0348	0.0343	0.0340	0.0341	0.0302
R overall	0.0326	0.0325	0.0349	0.0326	0.0319	0.0259	0.0319	0.0314	0.0313	0.0313	0.0278
R between	0.0363	0.0360	0.0295	0.0324	0.0357	0.0287	0.0334	0.0312	0.0343	0.0315	0.0335

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

E. Macroeconomic Impact of Micro Level Reforms

In this section we analyse whether our measure of countries' micro-level resilience, estimated using countries' sectoral developments, can be related to the countries' performance at the macroeconomic level. For this we regress countries' GDP changes over business cycle phases on common shocks and on the interaction between shocks and the estimated measures of micro-resilience. The aim is to see whether these measures of resilience can be used to explain differences at the macro level.

Since we are now looking at aggregate output data we take as a measure of common shocks the US GDP shocks identified with our VAR analysis. Using US shocks is important to avoid any biases which could be present if we used instead aggregate euro area or EU shocks that, by construction, are highly correlated to euro area or EU countries' GDP.

We then use econometric analysis to relate the GDP output changes (Y) to common shocks (S). As in the previous analysis, the Y variable is the cumulated change over the specific aggregate GDP business cycle phase, corrected for the length of the phase. The S variable is the cumulative shock over the specific business cycle phase. The model we estimate to analyze the link between macro and micro resilience is summarized in equation (5):

$$Y_{jt} = a_j + bS_t + f\,Res_jS_t + \delta Z_j + e_{jt} \qquad (5)$$

where, the S and Xadj variables are (US) shocks and GDP changes over the respective business cycle phases defined by CEPR turning points for the euro area, Res_j is weighted average in i of the estimated resilience of sector i in country j, for each j, where the weights are the weights of each sector i in country j.[29] We use herethe country resilience estimated excluding the 2008-09 downturn.[30] If f is negative and significant the estimated (micro) resilience explains countries business cycles. In this model we allow for country fixed/random effects a_j and for country's Z_j characteristics to also directly affect resilience ate the macro level.

The results are shown in Table E.1. Since the estimated micro resilience is based on the econometric analysis which excludes the last recession we control for the last recession by adding a dummy specific to that period (Dlast).[31]

From the results we can see that the interaction between this variable S and the estimated micro-country-resilience is significant and negative suggesting that countries with higher micro resilience have a lower correlation between shocks and GDP changes; that is to say, higher micro resilience implies also higher macro resilience.

[29] We define GDP business cycles in this section using the CEPR dates for peaks and throughs for the euro area. The CEPR peaks are 1974Q3, 1980Q1, 1992Q1, and 08Q1; the CEPR troughs are 75Q1, 82Q3, 93Q3, and 09Q2.

[30] The results are similar but less significant if we use other estimated measures of country resilience.

[31] The results are almost identical when, instead adding a dummy for the last recession, we estimate the regression over a sample which excludes the last recession.

Table E.1: Macroeconomic Resilience (US output shocks). Constants Omitted.

	(1)	(2)	(3)	(4)	(5)	(6)
syus	0.271	0.273	0.308	0.469**	0.428***	0.382***
	[0.280]	[0.268]	[0.235]	[0.197]	[0.108]	[0.070]
Dlastxsyus	1.371***	1.374***	1.375***	1.373***	1.380***	1.564***
	[0.121]	[0.119]	[0.118]	[0.118]	[0.114]	[0.247]
Resiliencexsyus	-0.239	-0.234	-0.249*	-0.263*	-0.244**	
	[0.161]	[0.147]	[0.137]	[0.137]	[0.118]	
Dupxsyus	0.105	0.100	0.093	0.083	0.066	
	[0.084]	[0.084]	[0.079]	[0.080]	[0.078]	
euxsyus	0.009					
	[0.092]					
emuxsyus	0.021	0.024				
	[0.098]	[0.084]				
debtxsyus	0.002	0.002	0.002			
	[0.002]	[0.002]	[0.002]			
openxsyus	-0.001	-0.001	-0.001	0.000		
	[0.003]	[0.003]	[0.003]	[0.002]		
findevxsyus	0.000	0.000	0.000	-0.000		
	[0.001]	[0.001]	[0.001]	[0.001]		
Observations	58	58	58	58	58	76
N. countries	16	16	16	16	16	26
R-within	0.860	0.860	0.860	0.859	0.857	0.631
R overall	0.798	0.797	0.797	0.787	0.784	0.454
R-between	0.339	0.339	0.333	0.306	0.296	0.0863

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

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