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Economic Resilience of Automotive Manufacturing Specialized Regions in EU and Turkey¹

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Abstract

Since the globalization and global production chains have dominated the world, crisis have bigger effects on economies. In 70's, 80's, 90's and now in 2000's global financial crisis affect not only countries economies but also global economy. It has become a must for countries and economies to take precautions to stop system failure or to take less damage from big scale impact crisis.

In order to lower the possibility of systems malfunctions in economies in case of crisis, countries or regions have to prepare themselves to reduce their vulnerability to external disturbances. Regional resilience, as the term of resilience generated in biology, describes the phenomenon of adapting capacity of a habitat against external effects. In common use it is the ability of a system to leap back or to rebound or to recover after any kind of external and internal disturb shocks and effects. Concerning the regional resilience, a diverse business structure, economy's innovation capacity and generated added value are beneficial.

In this article, the response of the specialized regions in automotive manufacturing has been analyzed in terms of regional resilience. Not only by having specialized production process, innovative designs, technology and a diversified economy within the region, but also being one of the most important economic sectors by revenue, the automotive manufactory has been a key sector for measuring regional resilience.

In addition to measure the effect of automotive industry on regional resilience, the automotive manufacturing specialized regions in European Union and Turkey have been defined with location quotient technique by the employment numbers of automotive manufacturing (C29, manufacturing of motor vehicles as defined in NACE Rev.2 by Eurostat) in year 2010. Secondly, the economic performance of 20 top automotive manufacturing specialized regions across the global financial crisis in 2008 have been analyzed in years between 2006 and 2010 with shift-share analysis by employment numbers in automotive manufacturing. Therefore, the pre-shock and post-shock positions of the regions are defined. Finally, an evaluation of the economic resilience performance of the automotive specialized regions has been applied to clarify the reasons of the performances of the automotive manufacturing specialized regions, which have the different characteristic although they have same sectorial specialization, that shift-share analysis could not explain.

Eventually, this article clarifies the good and the bad performance of the automotive industry specialized regions; and factors behind their performance, which build their regional economic resilience strong or weak against 2008 global financial crisis.

Keywords: Automotive industry, regional resilience, economic crisis, location quotient, performance measurement, shift-share analysis.

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Introduction

The World has become much more connected than before and global networks build the base of this system, which is the key element of today's production and economy. This structure makes economies much more connected than before; but also resulting in a system that can be complex and fragile. Any external disturbance to an economic system can have a resulting butterfly effect hence the whole economic system is considered as integrated. In an increasingly connected, global world, crises occur more frequently and economies face new difficulties every day. In order to reduce the impact of any external disturbances, economies must be resilient, which is a concept derived within the last decade. Although consisting of broad level environmental, social and economic concepts, usage has been adapted to a regional economic level. It has been perceived as the main notion of an economy's capacity to overcome crisis.

Economic systems are assumed to be in equilibrium during regular periods. In case of crisis or external shock situations, systems lose their stability and ability to act along development paths. More resilient systems can get over the effects of a crisis much quicker than a system that is less resilient. Recent trends toward globalization have made places and regions more permeable to the effects of what were once thought to be external and disconnected. Regional economic resilience is therefore no longer simply a matter of internal factors and localized requirements, but rather relates to a complex, potentially global, network. The concept of 'resilience' as a measurable trait is hard to define, generally conceptualized as the ability of a region to recover successfully from shocks to its economy that either throw it off its growth path or have the potential to throw it off its growth path (Foster, 2007; Hill, Wial, & Wolman, 2008; Martin, 2012). . This is ever more complicated in the face of increasing globalization. Thus, it is wrong to accept resilience as an ability of a region to simply recover to its pre-shock growth path. Economic resilience depends on the aspects which are used to define features of a region (Bruneau et al., 2003; Christopherson, Michie, & Tyler, 2010) and thus their ability to abide during crises.

Still, when measuring economic resilience, time should be measured in moments; pre-shock, shock and post-shock for as Martin (2012) claims, "It may be that those compensating, self-correcting adjustments take a while to have effect, but the assumption nevertheless is that the economy will sooner or later return to its pre-shock equilibrium state". Unlike Martin's (2012) claims, resilience in this context also refers to the ability to respond to opportunities during a crisis period and adapt.

As such a system that is locked in to resist against a solid and continuous stress would be more conservative and internally focused than others. This makes the system much more sensitive to external shocks and disturbances (Foster, 2007; Mancini, Salvati, Sateriano, Mancino, & Ferrara, 2012). Bruneau et al. (2003) state that resilience is "the ability of the system to reduce the chances of a shock, to absorb a shock if it occurs (abrupt reduction of performance) and to recover quickly after a shock". Thus a resilient system will show:

- Reduced failure probabilities.
- Reduced consequences from failures, in terms of lives lost, damage, and negative economic and social consequences. (The power of a system to resist against any disturbance without having any damage or failure)
- Reduced time for recovery (The ability to realize problems and failures and address them, either by rectifying, fixing or altering them, and to do so with speed.)

Hill et al. (2008) claim: “Regional economies can be thrown off their growth paths through (a) structural change resulting from global or domestic competition, from changes in the region’s competitive advantage for various products, and/or from changes in consumer demand for products the region produces, or b) other external shocks (a natural disaster, closure of a military base, movement of an important firm out of the area, etc.)”

Heavily deindustrialized regions may suffer from economic crises more. According to Martin (2012), “Destruction of large sections of the region’s industrial base may have negative multiplier effects on other local sectors of activity, such as supporting suppliers and business services. It may also reduce the region’s employment and associated incomes that local purchasing power is seriously reduced with additional knock-on effects on a whole range of consumer services”.

Resilience capacity of a system depends on the system’s pre-shock existing situation. Industrial variety, re-orientating skills and technologies build up a systems resilience capacity. These often come through time in a successful economy. When these are balanced, alongside a large industrial portfolio (industrial diversification) a region will be more economically resistant when compared to an industrially specialized region. Considering different industrial activities have different business structures and different markets, diversified economies have a greater ability to resist against external shock (Boschma, 2014; Christopherson et al., 2010; Martin, 2012).

Boschma (2014) states that a resilient region should create its own opportunities or new combinations to increase its resilience through diversification into new growth paths. He claims the main factor to achieve is to have a diversified economy because of the limited ability of specialized economies. In addition, attempts of specialized economies to become more diversified might incur difficulties due to their existing industrial structure. However, it is also a resilience capacity to be adaptive to new forms. In addition, he mentioned that diversified economies consist of different elements and they are built from the combination of those elements. It is highly possible once a system is diversified to adjust to a new combination and to adapt to new formalities, resulting in them being increasingly resilient.

On the other hand, highly specialized economies are more vulnerable to disturbance, since having only one type of business structure and one type of external/internal market naturally creates more dependence. Surprisingly, specialized service industries have more resilience than manufacturing and construction industries. Being independent in a stable location brings more resilience than geographically reliant industry (Martin, 2012).

It is clear in the resilience literature that there is a positive relation between sectorial diversity and strong economic resilience. Questions still remain, however, regarding the resilience of a industrially specialized region, which creates direct or indirect connections, strong sectorial linkages and needs diverse resources, during and after a period of crisis?

Global Automotive Industry

As stated before, diversified economies build the strongest resilience, resulting in specialized regions becoming less common. This is because of the economic structures' motions after repeated crises. The automotive industry is a major sector since it is a combination of output from different sectors, thus a crisis relating directly to this one sector could, and would, impact several sectors. Conversely, being in the middle of sectorial linkages also gives it great potential to provide technological development and information spill over through a diversified economy, despite its highly specialized production structures. The automotive industry has direct and indirect connection to textile, rubber and plastic products, machinery, chemical and chemical products, electrical equipment, electronic, and metal production sectors and is therefore incredibly diverse. The result is that any industry in this matrix affected in any way would create a knock on effect upon the whole network of industries, and the effect of that would depend upon the resilience of not only each individual sector, but also the robustness of the collective network (the entire automotive industry).

The automotive industry is a prime example of this, for types of production in this industry have changed over the last century more than once. Gereffi (1994) assumed that network based production became common in post-Fordist period, which depends on horizontal linkages that allow no property relationships, and yet allow independent firms and multi-national partnerships without any boundaries. On the other hand, the Fordist period depended on close geographical proximity, vertical hierarchical relationships. In addition, they claimed that outcomes of post-Fordist period encouraged big companies to choose their location independent from distance but on expanses, which encouraged multi-national companies and flexible structures.

The Globalization of world economies brought with it new forms of organization affecting competitiveness and economic policies. The automotive industry is in the top five biggest industries globally. With huge networks of global production systems a WTO report based on data from 2010 placed it just behind the fuel and chemical industries (WTO, 2011). Therefore, the automotive industry could be categorized as a "production network" whose interconnected nodes and links extend spatiality across national boundaries and in doing so integrate parts of disparate national and sub-national territories".

Although the number of spare parts producers was much higher, in the beginning of 1980 there were 85 independent major passenger automotive assembly companies around the world. This number decreased to 20 in the year of 2000. The main reason of shrinking numbers of automotive producers is mergers and acquisitions. In addition, those major passenger automotive producers became a minority although they could sustain their production. USA (9,9%), European Union members (Germany 9,3%, Spain 4,0% and France 3,7%) and Japan (12,3%) occupy 50% of global market (OICA, 2014a).

The costs of productions are converging and companies are investing in countries where they can optimize their expenditure due to keep their competitive advantages. In addition, companies choose different countries for different parts that have different production techniques and substances. The result is that every single part of a vehicle may be produced in different country and assembled in yet another one. In the automotive industry there are many firms such as automotive manufacturer

companies (assembly and integrated production), original parts manufacturers, spare parts manufacturers, supplier industry firms that do subcontractor production, raw material manufacturers, distributors, vehicle and parts dealers and transporters. The automotive sector production chain consists of a large number of activities from design to distribution, and many firms from raw materials manufacturers to distributor firms creating a vast amount of employment. 8 million people are employed in this production chain, and 50 million people have a position in supplier industries. China is the biggest employer with 1.6 million workers and the USA follows with 954,000. Germany has 773,217, Russia 755,000 and Japan 725,000 workers. These five biggest production pools have over 4.8 million workers; 57% of world's automotive production workers (OICA, 2014b).

Methodology and Data

This research focuses upon how a region which has a specialized industry that creates direct or indirect connections, strong sectorial linkages and needs diversified inputs of resources, would act against an external disturbance at a time that a crisis has been identified. For this reason, examining the regional resilience of automotive specialized regions is an excellent example of a specialized industry with a diversified supply background. First of all, automotive specialized regions in Europe and Turkey had to be determined. Location quotient and basic sector employment (part of economic base theories), which is a tool to analyze basic sectors in an economy, were used to define the automotive specialized regions. Shift share analysis identified automotive specialized regions' performance during a crisis period. These analyses show the regional performance to identify their resilience. It is important to measure their performance to define their achievement. One of the important elements of shift-share is to give ideas about national economic effects on sector, sectorial trends within the country, and the competitive capacity. The components of the analysis, especially regional shift, give the expected shifting trends in the regions. Regional shift does not explain the reasons of regional factors, which build resilience but it allows the comparing of the regions resilience. However, only measuring regions' performance is not enough to identify their resilience and resilient factors: countries that have different economic and development policies have different development paths and will therefore respond differently to external shocks. In addition, because of different development policies and paths countries, and even regions within countries could perform differently.

For location quotient basic sector and shift-share analysis, 2010 employment number of C29 - Manufacture of motor vehicles, trailers and semi-trailers as the current data has been analyzed. "C29 - Manufacture of motor vehicles, trailers and semi-trailers employment numbers 2006-2010" have been taken from Eurostat⁴. For having a comparison for the trends of motor vehicle manufacturing and manufacturing, a second shift-share analysis has been applied with "C Manufacturing" data. The reason for a secondary shift-share with manufacturing data is to describe the general effect of a regional background upon the manufacturing industry. This way it is possible to understand the average industrial portfolio within the region despite fast and slow growing industries. Although both sectors are related and have strong ties, the drivers

⁴ 2008 and 2009 C29 employment numbers for FR10 (Ile de France) are not given, therefore they have not been added to shift-share analysis.

and barriers are different; therefore the response of the sectors against the external shocks would be different.

Location quotient technique

The Location Quotient Technique is the most commonly utilized economic base analysis method. This technique compares the local economy to a reference economy (most of the time this is a national economy), in the process attempting to identify specializations in the local economy. The location quotient technique is based on a calculated ratio between the local economy and the economy of some reference unit.

Calculation

To calculate any location quotient the following formula is applied. In this formula, regional economy is compared to the national economy. To allocate employment to the basic and non-basic sectors, location quotients are calculated for each industry. The location quotient provides evidence for the existence of basic employment in a given industry.

The formula for computing location quotients can be written as:

$$LQ = (E_{ir} / E_r) / (E_{in} / E_n)$$

Where:

$$\begin{aligned} E_{ir} &= \text{Local employment in industry } i \\ E_r &= \text{Total local employment} \\ E_{in} &= \text{Reference area employment in industry } i \\ E_n &= \text{Total reference area employment} \end{aligned}$$

Only three general outcomes are possible when calculating location quotients. In location quotient "1.0" is main value.

$LQ \leq 1.0$ - Non-Basic Industry: When LQ that is less than zero local employment is less or equal than national level for a given industry. Therefore, that industry is not sufficient for local demand for a given good or service.

$LQ > 1.0$ - Basic Industry: LQ that is greater than zero provides evidence of basic employment for a given industry. When an LQ is bigger than 1.0, the analysis addresses the economies which have greater local employment than national level in a specific sector. These additional employments create a surplus in the region and must be exported. According to the LQ, this makes them Basic sector employment.

Basic sector employment

Although location quotient is a basic, common and reliable analysis method, it does not mean that it will always show the precise results. Because of the assumptions of the Location Quotient approach, a second formula must be applied to determine the number of Basic sector employment when the LQ is greater than 1.0 (Dinc, 2002). By using the same notation the equation for Basic Sector can be derived as:

$$BS_{ir} = (E_{ir} / E_{in} - E_r / E_n) * E_{in}$$

Where:

$$E_{ir} = \text{Local employment in industry } i$$

Er = Total local employment
Ein = Reference area employment in industry i
En = Total reference area employment

It can also be defined as the employment multiplier that estimates local basic sector employment impacts and allows analysts to project non-basic sector job creation given an increase in basic sector employment. The Base Multiplier can provide insight as to how many non-basic jobs are created by one basic job.

Shift-share analysis

Shift-share analysis is an analysis tool, which is used in regional science and politics as well as in urban studies. It determines the regional growth or decline proportion in three different components. The analysis helps to identify growth patterns of industries where a regional economy has competitive advantages over the larger economy. It also identifies the effect of national growth trends and the shift of industry (Dinc, 2002; Esteban-Marquillas et al., 1972).

In this research, employment data have been taken into the account and examined in three components.

National growth share: This factor describes as if the nation as a whole is experiencing the same employment growth, if the same growth trend could occur in every region, and examines first the national growth share in the regions and employment change increase or decrease.

Industry mix effect: This second component is the change in a local industry that would be attributed to the growth or decline of the industry. However, this component isolates the fact that not all the industries grow the same. It represents the contribution from a specific industry to national level changes the numbers of employment in a region.

Regional shift: this component measures the change in a particular industry in the region due to the difference between the industry's local growth/decline rate and the industry's reference area growth rate. It also indicates growth/decline in industries due to the local area's competitive position in any given industry. It is generally observed that some regions and some industries grow faster than others, even during periods of growth. This is usually attributed to some local comparative advantage such as natural resources, linked industries, or favorable local labor situations. The regional share component can help identifying a local area's economic strengths and point to industries that enjoy local comparative advantage. It cannot, however, identify what the actual comparative advantage is (Barff & Prentice III, 1988; Dinc, 2002; Elburz & Gezici, 2012).

Calculation

As stated above, the shift-share analysis divides the change in local economy into three components. The employment numbers have been used as the variable to examine the economic change in the region.

The formulas for computing three different shift share components can be written as:
$$e_{i,t} = e_{i,t-1} + (NS_i + IM_i + RS_i)$$

$$\Delta e_i \equiv e_{i,t} - e_{i,t-1} \equiv NS_i + IM_i + RS_i$$

$$\text{National Share } NS_i \equiv e_{i,t-1} (E_t / E_{t-1} - 1)$$

$$\text{Industrial Mix } IM_i \equiv e_{i,t-1} (E_{i,t} / E_{i,t-1} - E_t / E_{t-1} - 1)$$

$$\text{Regional Share } RS_i \equiv e_{i,t-1} (e_{i,t} / e_{i,t-1} - E_{i,t} / E_{i,t-1})$$

e_i = regional employment in i th sector

E_i = national employment in i th sector

E = national total employment

$t-1$ = initial year of period

t = finish year of period

E = regional total employment

It is assumed that the base year is identical in all of the above variables.

When the shift-share analysis is inadequate to explain resilience, some variables are vital to define the background of it. These indicators are essential elements for resilience.

Table 1: Explanatory Variables for Resilience

Gross Value Added	GVA per person is calculated as the simple ratio of the economic activity in a region divided by the number of people living in a region, while productivity is defined as the ratio of GVA divided by the labor input used to create it (OECD, 2001; Oguz & Knight, 2010).
Research & Development Innovation	Research and development (R&D) represents one of the determinants to the innovation process and is defined by the OECD (2006) as 'creative work to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to create new applications' (Porter, 2003).
Education	High-skilled workers, who would work and produce advance production, are useful resource as human capital to labor market for high-tech sectors rather than low-tech sectors (World-Bank, 2014).
Personal costs	Personnel costs include taxes and employees' social security contributions retained by the unit as well as the employer's compulsory and voluntary social contributions (OECD, 2001). Many pension schemes are based on wage levels and dynamics. Firms pay wages to employees usually depending on working time and/or on results.
Working time	Period of time that an individual spends at paid a occupation. Working time may vary from person to person often depending on location, culture, and lifestyle choice, and the profitability of the individual's livelihood; but most of the time is related to the cost of living (OECD, 2014).
Unemployment	Apart from its financial and social effects on personal life, long-term unemployment negatively affects social cohesion and, ultimately, may hinder economic growth. Long-term unemployment in developing countries triggers employment increment in sub-contractor companies (OECD, 2011).

Finally, the most critical element of resilience capacity is diversification in the economy. Diversified economies tend to adapt to external shocks more easily (Boschma, 2014; Martin, 2012; Martin & Sunley, 2013). In addition, Porter (2003) claims that higher specialized regions have less innovative powers. He claims lower concentration has a positive relation with worker wages. Hirshman-Herfindahl index is a measuring tool to analyze specialization of the economy. To calculate diversification, it is a common measure to inverse of a Hirshman-Herfindahl index.

$$DI_j \equiv 1 / \Delta_i (E_{ij} / E_j)^2$$

E_{ij} = the employment of sector i from the region j

E_j = the total employment of the region j .

The Herfindahl index of spatial concentration is a measure of absolute concentration. If economic activity in the city under consideration is fully concentrated in a sector, the equation gives $DI = 1$, and this index increases as activities in this city become more diverse (Duranton & Puga, 2000). The results will show the trend of the regions; either the regions stand specialized or tend to change their industrial structure for diversifying in order to increase their adaptive capacity.

Analysis and Results

As the results of location quotient and basic sector employment analysis with merged 2010 EU data, 20 highest resulted regions lie beyond the confidence level (95%) according to standard deviation (std. dev.). The regions which have higher than a 1.00 LQ score (figure 1) and higher than 64.63 in basic sector employment analysis (figure 2), have been defined as the significant threshold to define automotive industry specialized regions.

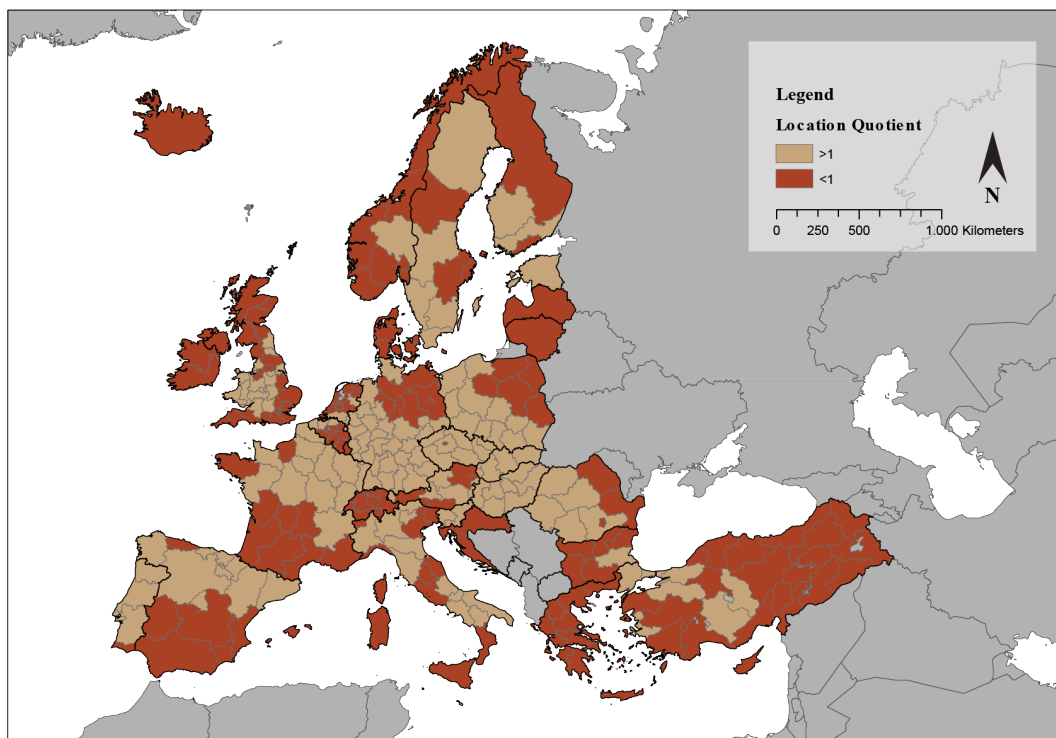


Figure 1: Location Quotient Results Based on Automotive Industry Employment

The findings have been proved that the German automotive industry sector has employment far beyond any other regions. Location quotient analysis shows agglomeration effect in the middle and middle-east of Europe. This effect creates a corridor from south Germany through the Czech Republic, Hungary and Romania. It is seen that some small agglomeration areas occurs through this corridor; in north Spain, middle Italy and northwest Turkey (figure 2). In addition, Basic Sector results

approve findings after location quotient analyses but they don't show any agglomeration corridor along middle Europe. Rather proving production corridors, it shows automotive industry poles. Results match through south Germany, Hungary, Czech Republic northwest Turkey and north Spain.

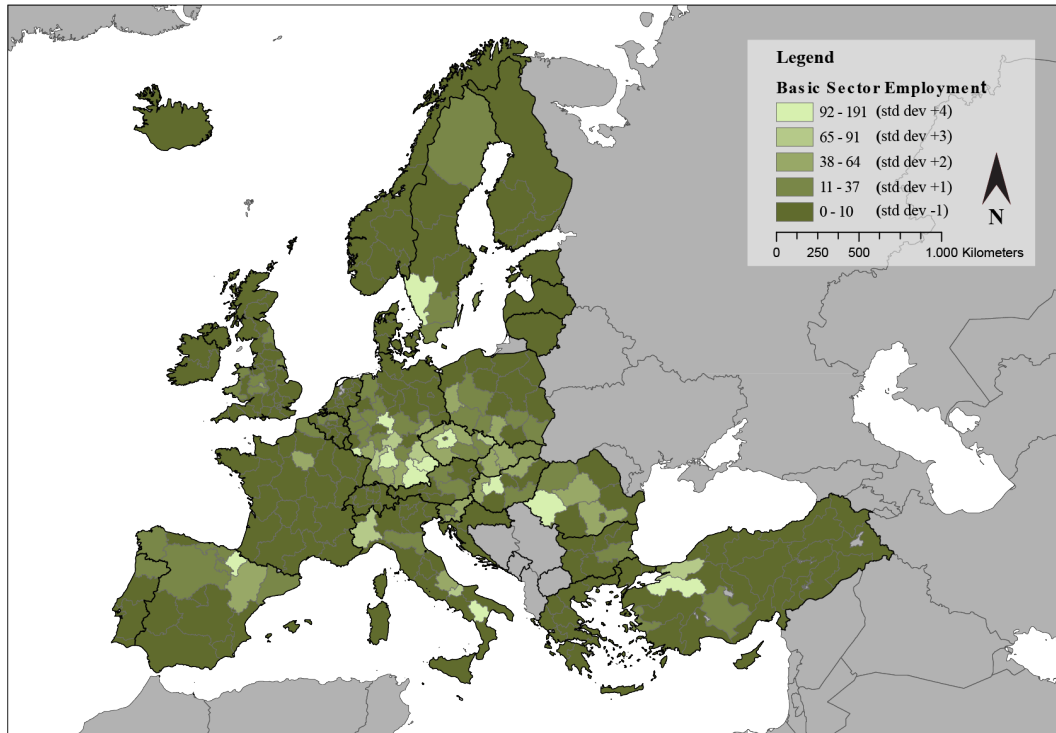


Figure 2: Basic Sector Employment Results Based on Automotive Industry Employment

Nine regions in Germany specialize on the automotive industry based on basic sector employment analysis. Significantly in south Germany the regions of Stuttgart, Nierbayern, Saarland, Oberbayern, Kassel, Karlsruhe, Oberpfalz, Chemnitz, Unterfranken, host major automotive manufacturers like BMW, Mercedes-Benz, Audi and Opel. Not only do these manufacturers have headquarters and big factories in Germany, they also play a role in global markets, making these companies important international players. On the other hand, France does not have the same characteristics as Germany. The location of automotive companies headquarters in different regions like in Germany does not occur in France. Two of big three French automotive companies, Citroen and Renault, are located in the region of Ile de France, the French capital. While they have their headquarters in Ile de France, they also have major factories around the world (Table 2).

Table 2: Location Quotient and Basic Sector Employment Results

Region	LQ	BS
FR10	7,91	64,79
ITC1	8,03	65,95
TR42	8,06	66,15
ITF2	8,69	72,12
DE26	8,99	74,91
DE23	9,43	79,00
DE12	9,98	84,18
CZ08	10,74	91,29
SE23	10,90	92,80
DE73	11,27	96,26
DE21	11,71	100,37
DEC0	11,82	101,41
TR41	11,84	101,64
ITF5	12,27	105,64
ES22	12,51	107,86
HU21	14,51	126,65
RO42	15,36	134,60
DE22	17,66	156,20
CZ02	18,16	160,91
DE11	21,44	191,61

Moreover, Italian major automotive manufacturer Fiat has some Italian and non-Italian minor automotive manufacturers and suppliers. According to Fiat's headquarters; the Italian automotive industry is located in north Italy and south Italy: Basilicata, Piemonte and Molise. In addition, Stredni Cechy, Czech Republic, is hosts the biggest Czech automotive company Skoda. Although Skoda belongs to Volkswagen Group, Skoda was established in Mlada Boleslav, Czech Republic, and is one of oldest companies that produces automotives. Moravskoslezsko also has the automotive supplier industry in Czech Republic. On the contrary, other regions, Comunidad Foral de Navarra, Spain, Közép-Dunántúl, Hungary, Bursa and Kocaeli, Turkey, Vest, Romania, do not have any special automotive companies. Although these regions have low innovation, they have high export numbers. In addition, these regions produce automotive and supply materials for big automotive companies from Europe and Asia (Welfens, 2012).

Shift-Share Analysis

Shift-share analysis has been calculated according to regions national data of employment change in the automotive industry to predict the performance of automotive specialized regions in European Union and Turkey developing.(Table 3).

The regions of Spain, Hungary, Romania and Italy have negative national growth rate during the analysis period. In addition, these regions' industrial mix components are positive, which means they have growing automotive industry during the analysis period except Spanish region ES22. However, most of the regions have a slow growing automotive industry sector during the analysis period. German regions do not show same pattern.

Table 3: 2006-2010 shift-share results of automotive-industry-specialized regions

Region	National Share	Industrial Mix	Regional Shift	Total Shift
CZ02	369	2.009	-5.504	-3.127
CZ08	-9	254	5.565	5.810
DE11	5.848	3.495	-18.468	-9.125
DE12	1.583	1.133	1.688	4.404
DE21	3.511	2.040	-7.895	-2.344
DE22	1.294	1.053	1.061	3.409
DE23	587	628	1.250	2.465
DE26	685	604	1.570	2.858
DE73	904	600	-2.828	-1.324
DEC0	906	756	-6.765	-5.102
ES22	-11.871	10.711	1.504	344
FR10	1.227	-22.648	109.827	88.406
HU21	-951	7.546	647	7.242
ITC1	-167	-26.078	12.842	-13.403
ITF2	11	-1.068	1.668	611
ITF5	-44	-3.169	3.470	257
RO42	-108	-336	25.121	24.677
SE23	594	-10.833	-2.301	-12.539
TR41	3.920	-2.811	14.944	16.053
TR42	3.015	-1.740	-339	937

In addition, FR10 (in the center of Europe), RO42 and TR41 (developing countries and cheaper work force than European Union level), and ITC1 (producing for significant brands, which have high market share) have regional competitive advantages among all other regions.

The results of national shift show the same pattern in table 4, during crisis national effect on regional automotive industry shows negative employment. This decrease does not sustain during and after the crisis period in Turkey. Spanish region ES22 and Hungarian region HU21 both have negative national shares during analysis period. Italian regions and Czech regions also have a negative national shift after the crisis period although rest of the regions do have positive national share after crisis. This is a sum of and indicator of national policies in different countries. Turkey and Germany are affected least according to the national shift numbers.

Table 4: 2006-2010 National Shift results of automotive-industry-specialized regions

Region	2006-2007	2007-2008	2008-2009	2009-2010
CZ02	745	648	-646	-378
CZ08	232	243	-303	-180
DE11	3.219	2.062	-337	905
DE12	859	560	-115	278
DE21	1.921	1.252	-201	539
DE22	697	458	-83	223
DE23	318	199	-43	113
DE26	363	246	-45	121
DE73	490	323	-57	148
DEC0	495	313	-61	159
ES22	377	-11.227	-782	-238
FR10	No Data	No Data	No Data	No Data
HU21	-34	-252	-659	-6
ITC1	651	473	-939	-352
ITF2	27	20	-13	-22
ITF5	77	57	-125	-52
RO42	10	86	-276	72
SE23	1.086	402	-998	105
TR41	514	808	134	2.464
TR42	470	622	93	1.831

In table 5 the Industrial Mix component of shift-share analysis can be seen. With the end of the crisis the automotive industry sector starts to grow again in the regions specialized for it, although Turkish regions TR41 and TR42, and Swedish region Västsverige (SE23) keep suffering from slow growth. In addition, the automobile industry has actually grown faster after the economic crisis. Although it has fast growing rate after the crisis, the growth numbers do not compensate for the decrease during the crisis period. This might be the result of a fast growing service sector in Europe. Another possibility of this result might be the fact of the decentralization of the industry from Europe. These two factors are related and the fast growing automotive industry specialized regions in Europe are focusing on the design, administrative and managerial functions of the automotive industry.

Table 5: 2006-2010 Industrial Mix results of automotive-industry-specialized regions

Region	2006-2007	2007-2008	2008-2009	2009-2010
CZ02	2.149	3.747	-5.002	1.115
CZ08	668	1.404	-2.348	530
DE11	-3.618	-3.565	-6.717	17.394
DE12	-966	-969	-2.284	5.351
DE21	-2.159	-2.164	-4.007	10.370
DE22	-784	-791	-1.651	4.279
DE23	-357	-344	-853	2.182
DE26	-408	-425	-892	2.328
DE73	-551	-558	-1.137	2.846
DEC0	-556	-541	-1.209	3.063
ES22	-593	11.961	-527	-130
FR10	No Data	No Data	No Data	No Data
HU21	2.860	8.065	-3.821	442
ITC1	1.401	-24.752	-1.607	-1.121
ITF2	58	-1.033	-22	-71
ITF5	166	-2.954	-215	-166
RO42	213	-1.919	-970	2.340
SE23	-1.360	-1.287	-4.976	-3.210
TR41	984	104	-3.710	-188
TR42	900	80	-2.579	-140

The results of Regional Shift can be seen in table 6. First of all, Turkish region TR 41 (Bursa), Romanian region RO42 (Vest) and French region FR10 (Ile de France) have the highest competitive advantages. Romanian region RO42 managed to maintain its competitive advantage throughout the crisis period. Although Turkish regions TR 41 (Bursa) and TR42 (Kocaeli) have positive Regional Shift just before the crisis, they did not keep it. The Italian regions' regional shift decreases before and after the crisis. German regions have an unsteady pattern throughout the crisis. Half of them (DE11, DE21, DE73 and DEC0) lose their competitive advantages in the automotive industry before the crisis. Recovery period for German regions means incremental increase of competitive advantages and they are least affected regions from the crisis. Czech region CZ02 and Spanish region ES22 have an unstable regional shift until the fourth period. During and after the crisis period these two regions could not recover their competitiveness as before the crisis period.

Table 6: 2006-2010 Regional Shift results of automotive-industry-specialized regions

Region	2006-2007	2007-2008	2008-2009	2009-2010
CZ02	-3.434	-3.149	2.441	-1.362
CZ08	1.523	2.774	1.381	-115
DE11	-1.242	-15.997	1.009	-2.238
DE12	402	4.874	-3.836	248
DE21	860	-11.163	563	1.846
DE22	538	-317	270	569
DE23	-438	2.565	-74	-803
DE26	854	-74	272	517
DE73	435	-771	-555	-1.937
DEC0	-475	1.387	-329	-7.348
ES22	-39	-345	1.352	536
FR10	No Data	No Data	No Data	No Data
HU21	2.961	-2.481	592	-425
ITC1	-843	18.385	-5.527	827
ITF2	2	-926	2.531	61
ITF5	-52	3.044	34	445
RO42	784	14.372	6.124	3.841
SE23	-2.131	487	1.119	-1.776
TR41	7.300	2.757	-408	5.296
TR42	966	-1.074	1.580	-1.811

Comparing the employment change of the manufacturing industry and automotive industry shows the sectorial structure in the automotive industry specialized regions clearly (table 7). The automotive industry forms 18% of the manufacturing industry in these regions. Between 2006 and 2010 total employment change in the manufacturing industry is 9%, however, total employment change in the automotive industry is 15%.

Table 7: Employment Change Between 2006-2010 in Manufacturing and Automotive Industry

	Manufacturing Industry		Automotive Industry	
CZ02	-20.690	-13%	-3.127	-8%
CZ08	-3.807	-3%	5.810	46%
DE11	34.041	7%	-9.125	-6%
DE12	21.564	8%	4.404	11%
DE21	30.119	9%	-2.344	-3%
DE22	19.610	17%	3.409	10%
DE23	22.490	20%	2.465	16%
DE26	21.519	17%	2.858	16%
DE73	13.906	14%	-1.324	-6%
DEC0	8.218	9%	-5.102	-22%
ES22	-9.880	-14%	344	3%
FR10	338.552	63%	88.406	164%
HU21	-6.860	-6%	7.242	49%
ITC1	-68.057	-15%	-13.403	-21%
ITF2	-1.806	-10%	611	23%
ITF5	-2.490	-9%	257	3%
RO42	-37.789	-20%	24.677	137%
SE23	-35.736	-19%	-12.539	-27%
TR41	15.735	6%	16.053	52%
TR42	30.561	17%	937	3%
Total	369.200	9%	110.509	15%

The 2006-2010 shift-share comparison between the automotive and total manufacturing industry highlights that the total manufacturing industry is a fast growing industry while automotive is the opposite (table 8). However, it represents a generalized picture of the industry, and the manufacturing industry naturally has both fast and slow growing components. On the other hand, regional shift components have a negative effect upon the manufacturing industry while having a huge positive effect upon the automobile industry. French region FR10 is once more an exception. The regional shift component in FR10 has a high influence on both the manufacturing and automotive industry.

Table 8: 2006-2010 Shift-Share Components Comparison Between Manufacturing and Automotive

	National Shift		Industrial Mix				Regional Share					
	Manufacturing	Automotive	Manufacturing	Automotive	Manufacturing	Automotive	Manufacturing	Automotive				
CZ02	1.547	-7%	-20.690	-13%	-20.672	100%	2.009	-64%	-1.565	8%	-5.504	176%
CZ08	1.250	-33%	-3.807	-3%	-20.450	537%	254	4%	15.392	-404%	5.565	96%
DE11	19.303	57%	34.041	7%	50.062	147%	3.495	-38%	-35.323	-104%	-18.468	202%
DE12	10.474	49%	21.564	8%	27.098	126%	1.133	26%	-16.008	-74%	1.688	38%
DE21	12.949	43%	30.119	9%	32.358	107%	2.040	-87%	-15.188	-50%	-7.895	337%
DE22	4.511	23%	19.610	17%	11.952	61%	1.053	31%	3.147	16%	1.061	31%
DE23	4.468	20%	22.490	20%	12.473	55%	628	25%	5.548	25%	1.250	51%
DE26	5.048	23%	21.519	17%	13.765	64%	604	21%	2.706	13%	1.570	55%
DE73	3.809	27%	13.906	14%	9.976	72%	600	-45%	121	1%	-2.828	214%
DEC0	2.607	32%	8.218	9%	-5.856	-71%	756	-15%	11.467	140%	-6.765	133%
ES22	-69.571	704%	-9.880	-14%	52.577	-532%	10.711	3114%	7.114	-72%	1.504	437%
FR10	12.156	4%	338.552	63%	-84.495	-25%	-22.648	-26%	410.891	121%	109.827	124%
HU21	-5.218	76%	-6.860	-6%	-5.073	74%	7.546	104%	3.431	-50%	647	9%
ITC1	-1.681	2%	-68.057	-15%	-53.495	79%	-26.078	195%	-12.881	19%	12.842	-96%
ITF2	-31	2%	-1.806	-10%	-1.849	102%	-1.068	-175%	74	-4%	1.668	273%
ITF5	-126	5%	-2.490	-9%	-3.460	139%	-3.169	-1233%	1.095	-44%	3.470	1350%
RO42	-253	1%	-37.789	-20%	-54.255	144%	-336	-1%	16.719	-44%	25.121	102%
SE23	2.512	-7%	-35.736	-19%	-35.634	100%	-10.833	86%	-2.614	7%	-2.301	18%
TR41	26.714	170%	15.735	6%	-12.156	-77%	-2.811	-18%	1.178	7%	14.944	93%
TR42	20.912	68%	30.561	17%	-8.226	-27%	-1.740	-186%	17.875	58%	-339	-36%

When the sectorial structure has been analyzed through the results of the Inverse Hirshman-Herfindahl index, which represents the diversification index of whole economy, regions choose to get diversified up to 7% in average. Some automotive industry specialized regions, TR41 and HU21 that have high positive employment change in automobile industry, keep their sectorial structure similar (table 9). German regions are especially prone to diversification in their sectorial structure, displaying that the growth of the country does not spread through regions equally, regardless of whether the national economy is strong or regional economies diversified. The main factor is that regions have different characteristics. In addition, FR10, French capital, has the highest Inverse Hirshman-Herfindahl score and also increases its diversity more.

Table 9: Inverse Hirshman-Herfindahl index of automotive-industry-specialized regions between 2006-2010

Region/Time	2006	2010	Change
CZ02	3,805	4,318	13%
CZ08	4,514	4,27	-5%
DE11	3,532	4,114	16%
DE12	3,868	4,578	18%
DE21	4,29	5,04	17%
DE22	3,826	4,274	12%
DE23	3,847	4,265	11%
DE26	3,8	4,166	10%
DE73	4,318	4,833	12%
DEC0	4,117	4,421	7%
ES22	4,204	4,805	14%
FR10	4,742	5,162	9%
HU21	3,948	4,138	5%
ITC1	4,424	4,167	-6%
ITF2	4,928	4,366	-11%
ITF5	5,362	4,551	-15%
RO42	3,952	4,336	10%
SE23	4,627	5,264	14%
TR41	3,177	3,312	4%
TR42	3,674	3,737	2%

Shift-share analyses for automotive specialized industry regions showed their performances; however, it is not adequate to explain resilience. In literature to explain the background of resilience performance some indicators have been used. These indicators create the basis of the economic structure, and therefore are essential elements for resilience. In order to identify the background of shift-share results, the values of explanatory variables (Gross Value Added, innovation, diversification, tertiary education, long-term unemployment and personal cost per hour) have been normalized according to their data years under each variable. The normalized values have been summed to create an index, although they do not have a special weight in the equation. The results have been shown in the table 10.

Table 10: Normalized and Summed Explanatory Variables

	2006	2007	2008	2009	2010
CZ02	1,39	1,37	1,39	1,00	1,11
CZ08	1,62	1,80	1,65	1,34	1,44
DE11	3,79	4,01	3,45	3,33	3,20
DE12	3,80	3,85	3,56	3,07	3,43
DE21	4,14	4,21	3,87	3,76	3,47
DE22	2,37	2,59	2,20	2,06	2,19
DE23	2,88	3,33	2,83	2,85	3,02
DE26	2,89	2,67	2,18	2,46	2,45
DE73	2,42	2,53	2,24	2,13	1,93
DEC0	2,97	2,98	2,39	2,58	2,69
ES22	2,24	2,29	2,07	2,10	2,31
FR10	5,68	5,50	5,47	5,56	5,56
HU21	1,62	1,71	1,72	1,74	1,74
ITC1	2,51	2,41	2,39	2,16	1,99
ITF2	2,09	2,07	1,95	2,03	1,98
ITF5	1,46	1,58	1,48	1,39	1,41
RO42	0,43	0,61	0,68	0,63	0,57
SE23	3,49	3,60	3,12	2,83	2,56
TR41	0,38	0,24	0,43	0,45	0,39
TR42	0,61	0,65	0,54	0,49	0,34

These results have been compared with the shift-share results. Turkish regions TR41, TR42 and Romanian region RO42 have the lowest scores after this calculation. French capital FR10 has the highest scores in each year. In addition, TR41 and RO42 have highest second and third employment; however, FR10 has the highest. This can be explained with that Turkey and Romania are developing counties and have different character than other developed EU countries such as France. However, FR10's metropolitan dynamics make it a special example among all other regions.

Conclusion

This research focuses on the automotive industry specialized regions to show how a specialized region on a sector, which has large amounts of connection to different industries, would act during a crisis period in terms of resilience. In addition, the performance of those economies during the shock period is vital. To calculate it, shift-share analysis is a relatively simple and useful tool, so long as employment numbers of the regions are taken into account as is common usage in literature.

It is important when dealing with one region to take into account global network chains; dealing exclusively with European Union members and Turkey (as has been done here) gives just a simplified example of the conditions of the automotive industry. Investigating global production chains all around the world would show, with much more clarity, the effects upon the automotive industry during a crisis period. The automotive industry in different countries should not be examined as disparate and individual.

In addition, a dynamic shift-share analysis gives the regions' annual performance during crisis. As mentioned before, resilience is a time-based notion; therefore it is significant to clarify performance over time to see the regional trends. As a benefit of annual results of shift-share analysis, it is easy to interpret the year of the crisis; there is a significant decrease in the employment numbers. On the other hand, a shift-share analysis does not give the background information of regions' resilience capacity. To explain the reasons of regions economic resilience, some further indicators must be examined.

In literature, resilience has been related to the region's economic diversification and innovation. Diversified economies have the possibility to have relations with different sectors. Therefore, if an industry-based crisis would occur, the economy would keep continuing its other production networks. A specialized economy would not have the same possibility. However, while specialized economies are not diversified, specialized regions could also include diversification with related sectors. Another important indicator is innovation. Inventing and producing something new would bring the economy extra added value. In addition, innovation capacity is related to a region's high-skilled employment, this factor increases the know-how capacity, it is a tacit knowledge and difficult to transfer, hence the regions, which have this capacity, would learn from past event and adjust themselves for the future.

As mentioned before diversification of economies and their innovation capacities play very significant roles in literature. The results of shift-share analyses show that the regions with diversified industrial structure and high innovation have positive performances. However, less diversified economies and low innovation capacity regions showed better performance. Some of those regions have long working hours; some of them have low long-term employment numbers and low personal costs. Nonetheless, it is difficult to know which indicator has a more important role in building resilience.

Moreover, the decentralizing effect of the crisis pushed the automotive industry to the peripheral areas of Europe. What were once the biggest automotive production regions of Europe have more diversified economies right now. The competitive capacity of the Eastern European region takes more investment to build more assembly plants. Turkey is still a major investment attraction. At this point regional policies are the key factors in attracting new industrial investments. Decentralized industry flow would enable the ability to sustain. Turkey and Eastern European countries could be a new automotive production center within the Europe. However, becoming more specialized on a sector without the necessary innovative ability and added value, it would be hard to overcome a future crisis for Turkey.

Finally, the performance in this research of Turkish regions, gives a brief overview about what would occur during a future crisis period. Although they performed well and have not been affected by a global crisis, the inspected indicators show there is high risk of not showing the same performance for too long. In general, Turkish regions show the opposite economic structure of European regions. It is based more on human power to keep the competitive advantage, hence long working hours, low personal costs, low R&D employment ratio and low long-term unemployment that focus more upon quantitative production rather than qualitative production, which relies instead upon high innovation and added value.

In a nutshell, resilience will become more important in the future as crises could occur more frequently and with a bigger radius due to increased global connectivity. Countries and regions have to learn lessons from previous crises and produce new development policies to improve their weaknesses. Although some main indicators have been highlighted in the literature, a common resilience index must be generated, and it must show the weights of the indicators that are significant in the building of resilience.

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