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Jobless Growth: the Impact of Structural Changes

SUMMARY: In the past three decades, jobless growth has been indicating a significant change in the structure of employment. Economic growth is continuous and ongoing; however, the organisation of work, production and structural impacts result in new systems, which in turn decrease employment in the long run. Can the impact of structural changes be observed as a result of the 2008 economic crisis? In my study, using the example of the United States, I will illustrate, with the help of empirical data, the main economic processes which contribute to the sustainment of jobless growth. My research analyses the 2001–2014 period in a quarterly breakdown, using 19 variables. For the sake of easier analysis, I organised the variables into principal components, examined the pre-crisis and post-crisis medians of the artificial variables, and then applied the multivariate regression model, which made it clear that in the United States, structural factors have considerable impact on the development of the employment level and economic growth.

KEYWORDS: jobless growth, structural impact, employment
JEL CODES: E24, E60, J30

*I*n 2015, I published an overview in the *Public Finance Quarterly* on jobless growth, a problem affecting the United States (Martus, 2015). At the time, I presented the factors underlying jobless growth; however, I did not examine the phenomenon using statistical data. The objective of this study – as a continuation of my earlier article – is to support, by means of statistical data, the existence of structural impacts in the United States resulting from the 2008 crisis. Numerous studies (Rajan, 2010; Groshen − Potter, 2003) argue that the fact that the recovery of employment is lengthy after a recession can be traced back to structural causes. Naturally, structural factors cannot explain all employment-related problems, as the fact that a structural change

comes about in the US can be attributed to several factors (monetary decisions[1], *just-in-time* systems[2], etc.). But it is increasingly clear that most causes develop to become structural in nature, thereby also generating structural problems. In this study, after a brief review of the relevant literature, I will present a few processes typical of the economy, concerning which it will become clear that changes no longer last a short period of time, but rather represent a longer process. I will continue by presenting the empirical study conducted on the basis of the review of the literature. In the analysis, I will be seeking to answer which variables exhibit significant differences in terms of the pre-crisis and the post-crisis years. This will help me to answer whether structural change can be observed as a result of the crisis. Instead of years, I have

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broken down my observations into quarters but as a result, the initially 37 variables used in the study were reduced to 19. As jobless growth can only be characterised by multiple variables, among which correlation is very high, I will first transform the 19 variables remaining in the research into artificial variables using principal component analysis. In order to analyse the data obtained during the principal component analysis, I conducted a nonparametric test which compares the medians of my artificial variables. After this, I identified the causative relationships between the created principal components and jobless growth using regression analysis.

WHY STRUCTURAL?

Jobless growth refers to the realisation of economic growth that is not accompanied by the creation of jobs. In the post-recession recovery period, the number of jobs only reaches pre-crisis levels with great difficulty. The relevant literature refers to this as *jobless growth* and *jobless recovery*. This phenomenon can be observed during times of crisis, and among developed countries it represents a grave problem primarily in the United States. Developing countries are also affected, we need only take a look at the economic data of India or Sub-Saharan Africa in recent years (Jha, 2002). The true problem is that the co-movement of these two factors (employment and GDP growth) diverges for increasingly longer periods (Bivens, 2011), and thinking in short-term solutions is no longer sufficient. Both the recovery period and the employment level have changed. According to 2008 labour market data, in the worst-performing quarter the net balance of jobs was –750,000 in the US (Magas, 2011).
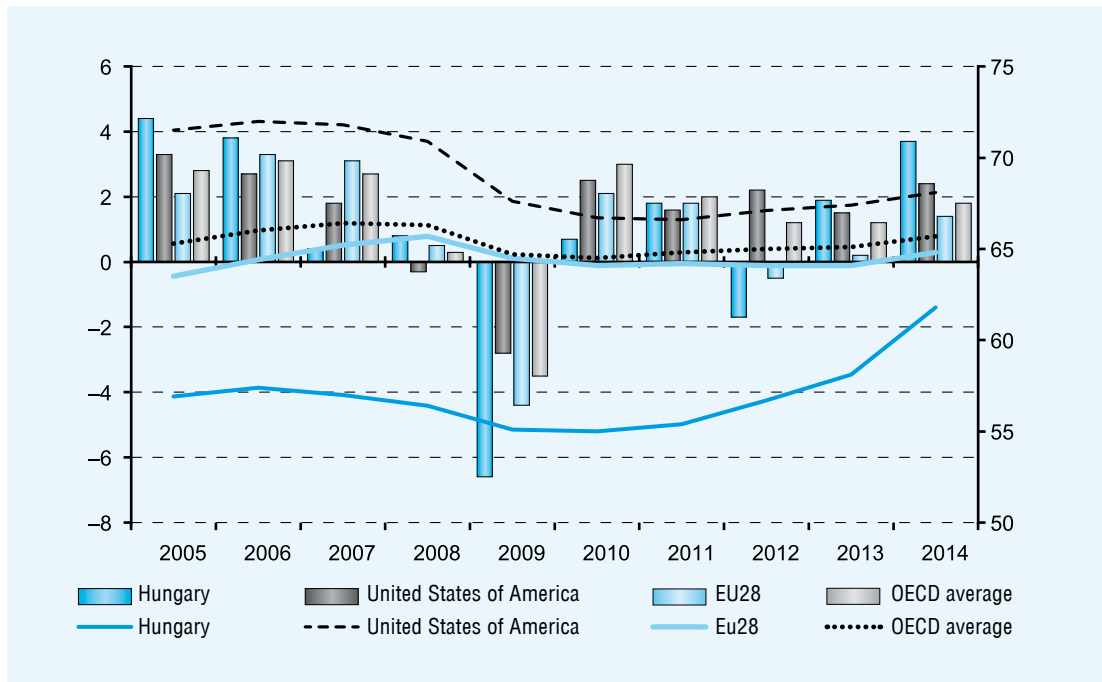
The appearance and impact of jobless growth could be characterised as cyclical before the 2001 recession, in other words, it only appeared when the recessions had ended. Today, however, multiple structural changes define this phenomenon and as a result, the problem will itself also become structural in nature. From the perspective of Hungary and the Member States of the European Union, the process is all the more important because looking at 2005–2014 data, we can see that the overall employment level is below that of the United States (*see Figure 1*), while the focal point of jobless growth is the US. Although GDP growth decelerated during the crisis and in subsequent years in the US, there were no substantial fluctuations and growth has been stable compared to the GDP growth of other country groups and Hungary. Though the study primarily focuses on the phenomenon of jobless growth in the United States, on the basis of the results it would be expedient to draw conclusions concerning the countries of the European Union as it is clear that the US is still doing better in terms of employment than Europe. This of course does not mean that jobless growth should feature in European economic policy programmes as an objective, but rather that through the example of the US, we have the opportunity to examine which factors reduce employment, and to attempt to avoid these by avoiding jobless growth. In this chapter of my study, I will provide an overview of the relevant literature on the characteristics of jobless growth.

The recovery of employment and output is also shown in *Table 1*, which presents data from the National Bureau of Economic Research. The first lines (months to turn around) present the number of months needed to shift from decrease to increase, while the second lines (months to trough level, the level directly preceding the crisis) indicate the number of months required to reach the employment level preceding the crisis. The term 'half-life' indicates the months needed to recreate half

Figure 1

THE CHANGE OF THE EMPLOYMENT RATE (%, RIGHT AXIS) AND GDP GROWTH (%, LEFT AXIS) BETWEEN 2005–2014

Hungary   United States of America   EU28   OECD average
Hungary   United States of America   Eu28   OECD average

Source: author's own editing based on OECD (2016)

Table 1

TIME NEEDED TO RETURN TO PRE-CRISIS LEVELS (MONTHS)

	1970	1975	1982	1991	2001	2009
Employment						
Months to turn around	6	4	2	17	23	23
Months to trough level	16	10	4	31	55	NA
Half-life	27	23	10	38	NA	NA
Output						
Months to turn around	0	0	0	0	0	0
Months to trough level	0	0	0	0	0	0
Half-life	7	10	5	9	3	15

Source: Jaimovich – Siu (2012, p. 7)

of the jobs terminated during the crisis. The table indicates that the drop in employment data generates a structural decrease. In 1991, as many as 17 months were needed for employment not to drop, while in 2001 and 2003 the number of such months increased to 23. Even more time is needed to achieve the level measured during the crisis.

But what are the possible reasons behind these periods becoming longer? According to *Groshen* and *Potter* (2003), the answer is to be found in the increased scale of structural changes. Following the 2001 crisis, permanent layoffs dominated as opposed to temporary layoffs, and job relocation from one industry to another was also typical (Aghion − Howitt, 2009; Peraltva − Alva, 2011; Bernanke, 2003; Rajan, 2010). In their study, Groshen and Potter (2003) showed that in periods after recessions workers did not find new jobs at the same companies or even in the same industries, in other words there was no rehiring. As creating new jobs takes longer than having an old position filled, not to mention the fact that it also entails greater risk, employment also takes longer to recover. While cyclical effects can be reversed and they adapt to changes in demand, in the case of structural impacts companies or industries relocate workers as well as capital into other industries, or even other countries. In the case of cyclical job losses, we are talking about temporary layoffs, whereas in the case of the structurally unemployed there is a permanent layoff; employment ceases entirely and a change of industry occurs. As far as structural changes are concerned, a long period of time is required until new jobs are created. In the case of temporary layoffs, the employer and the employee adapt to the drop in demand, in other words, the employment relationship is only terminated temporarily. The employment relationship is restored when economic conditions improve, and until then

the employer may help employees receive unemployment benefits.

According to Groshen and Potter (2003), increased structural change has three main causes.

❶ The structural decline observed might be a reaction to the sudden overexpansion/ growth of an industry. For instance, industries that attracted too much investment during a technological boom may have to "pay it back" later by reducing their workforce. There were substantial investments in the high-tech and telecommunications industries, which facilitated innovations that were able to operate without a human workforce.

❷ Monetary and fiscal policy helps reduce cyclical swings in employment.[3]

❸ Innovations in firm management often lead to structural change, for instance the introduction of lean production.[4]

Jaimovich and *Siu* (2012) argue that the polarisation of jobs is one of the fundamental reasons for jobless recovery (*JR*). Job polarisation refers to the increasing concentration of employment in the highest- and lowest-wage occupations, as jobs in middle-skill occupations disappear[5]. According to the authors, the past 25–30 years have seen polarisation and *jobless recovery* in the US *(see Figure 2)*. The polarisation in occupations is a result of routine-based technological change as technology replaces the workforce. The two phenomena are linked to one another. The authors' findings (Jaimovich − Siu, 2012):

❶ the disappearance of routine occupations can be linked to the past three recessions,

❷ the polarisation of jobs plays an important role in the development of jobless recovery,

❸ the drop in aggregate per capita employment[6] occurs in medium-skill routine jobs,

❹ jobless recovery can only be observed in disappearing, medium-skill jobs (no JR is observed in high and low-skill jobs),

❺ JR was not present before the polarisation

Figure 2

PERCENTAGE CHANGE IN EMPLOYMENT SHARES
BY OCCUPATION GROUPS
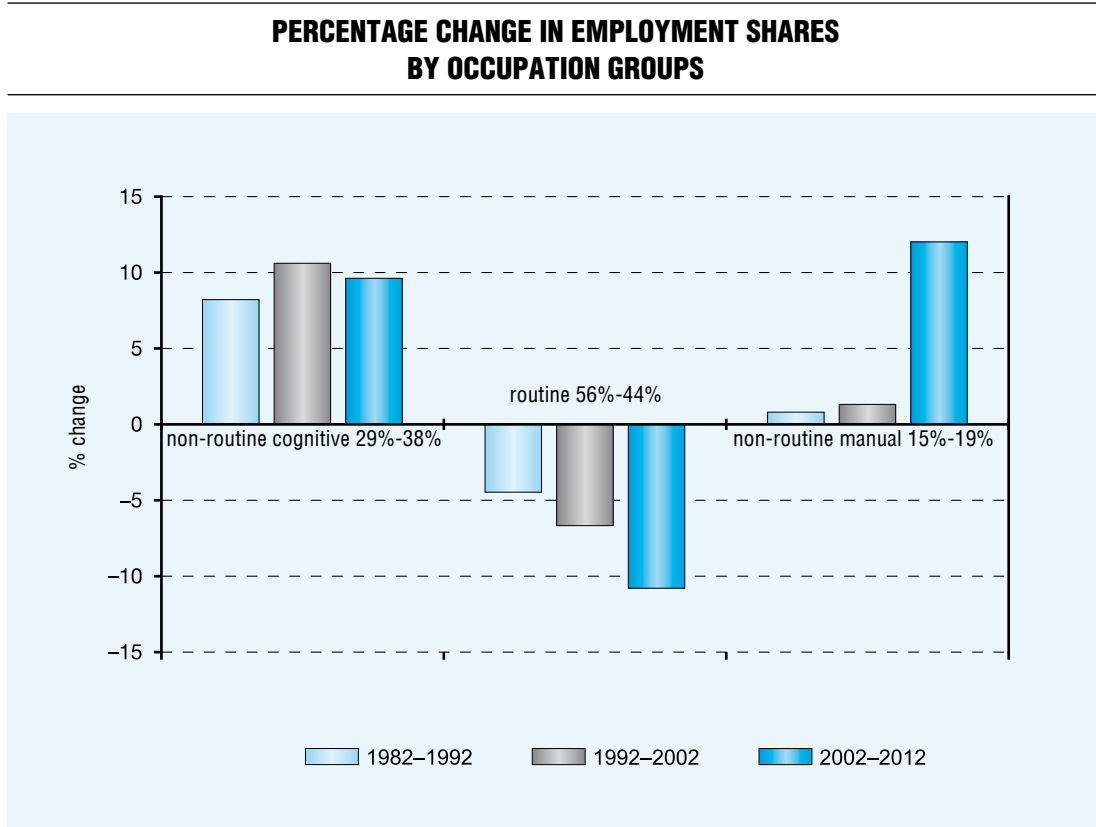
Source: Jaimovich – Siu (2012, p. 8)

of occupations (i.e. prior to the past 25–30 years).

Other structural causes include the changes in technological processes (Botos, 2012; Radnóti, 2003; Aronowitz − Difazio, 2010; Christensen − Bever, 2014) and related effects such as *offshoring* and *outsourcing*. In the 2000s some US companies decided that they would relocate part of their operations to lower-income countries, which is referred to as offshoring. This is what happened for example when the US relocated a part of its car industry to Mexico; parts of its computer and software production to India; and some financial institutions to the Caribbean region. There are of course some *offshoring* cases where firms relocate operations to foreign affiliates they own and control. In contrast, *outsourcing* refers to

the contracting out of activities not closely related to production, in other words such activities are performed by another company. The direct results of *offshoring* and *outsourcing* are a drop in the number of jobs and a decline in the creation of new jobs. This is well supported by facts as well: for example, by 2003 *offshoring* activity contributed to a drop in US output and the termination of jobs (Schultze, 2004). Though output per one worker (productivity) increased sharply, employment dropped. According to *Schultze* (2004), this is the true cause of jobless recovery. When companies outsource part of their operation, it returns to the country as import. In the following chapter, I will present the structural changes observed in employment based on the study by Groshen and Potter (2003).

Comparison of the structural change in employment of OECD countries and the US
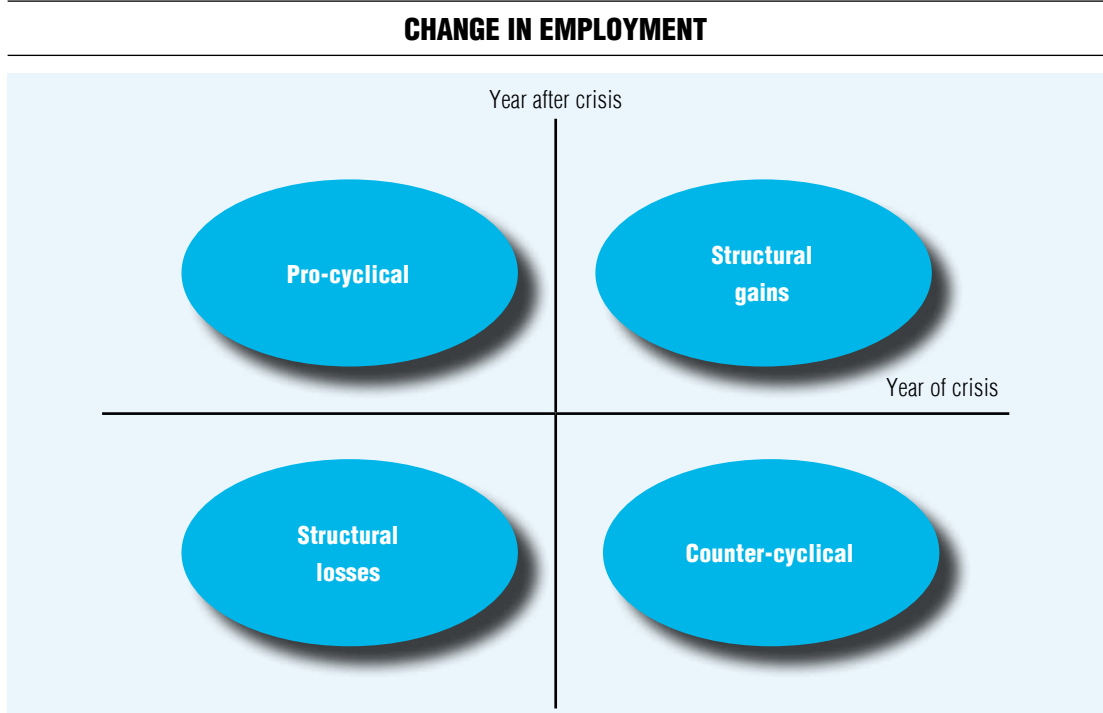
During my statistical data analysis, I rely heavily on the work of Groshen and Potter (2003), and draw my conclusions based on the creation of groups defined by them. In their study, the authors examine how employment changed during the recession and the subsequent year (over a period of 12 months) in the United States in 1980 and 2001. Based on these, they created four groups to represent the change in employment: the first group is structural loss, the second is pro-cyclical flow, the third is counter-cyclical flow, while the fourth is structural gains (*see Figure 3*). The authors' results show that when a drop was observed in the year of the crisis and this decline was still existent in the year after, this is interpreted as structural loss (of jobs) (first quarter). Based on Groshen and Potter (2003), in my study I will treat trends longer than one year as structural. In contrast, in regions where employment dropped both during the crisis and the period after the crisis, this is termed as structural loss (of jobs). In the case of pro-cyclical employment, a drop in employment is observed in the year of the crisis; however, the employment level in the various sectors increases after the crisis. In the case of counter-cyclical processes, the employment level increases in the year of the crisis, but drops in the year following the crisis (in essence, it seems as if the crisis increases the employment level).

Taking the grouping shown in Figure 3 as a basis, during my research I analyse which sectors are characterised by structural job losses in European OECD countries and the United States. During my analysis, I follow the method used by Groshen and Potter (2003), aware of the fact that the impact of various economic processes is not felt for the duration of a single calendar year. The sector-level employment data needed for my analysis was culled from the OECD (2016) database, while the precise dates concerning crises peaks was determined using the FED St. Louis (2016) database. I examined two crises: the crisis of 2001 and that of 2008. The reason for this was that I wanted to examine what changes the past two crises brought about in OECD countries in terms of the various sectors. Firstly, I examined the averages of European OECD countries during the 2001 recession. The recession peaked in the first quarter of 2001; therefore, I examined the year 2001 (*X* axis) from the perspective of the change in employment, and 2002, the year after the crisis (*Y* axis). The size of the spheres indicates the distribution of employment among the various sectors. *Figure 4* shows that the distribution sector had the most employed persons (hospitality, transport, etc.) in European OECD countries. Employment in this sector in 2001 dropped compared to 2000, just as it dropped in 2002 compared to 2001. This means that in the short run, the market was unable to recall all of the employed persons back to the sector, and this indicates a structural change. The second largest sector is education. Here, a drop was observed during the crisis; however, in 2002 the number of employed started to increase once again. This may be due to the fact that in education, universities only employ guest lecturers for certain semesters, and that there was no great technological change in this sector and investment into human capital and the use of live labour is still required. It is clearly visible that the number of employed in agriculture is low, with the sector employing only 5.41 per cent within the total number of employed persons. Employment is even lower in the real estate sector, and in the financial-insurance market and the information and communication technology market.[7]
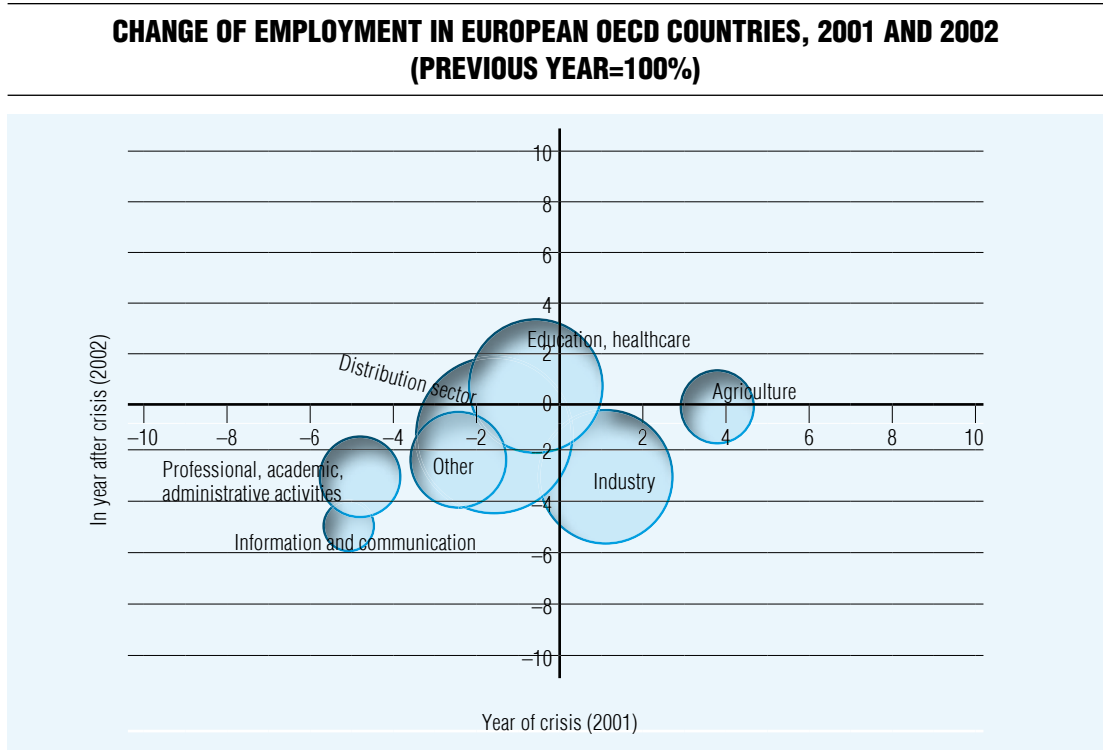
Even though the ratio of workers in the information and communication technology sector comes as no surprise (given that the transition to this sector is just beginning), it is

CHANGE IN EMPLOYMENT

Source: author's own editing

CHANGE OF EMPLOYMENT IN EUROPEAN OECD COUNTRIES, 2001 AND 2002 (PREVIOUS YEAR=100%)

Source: author's own editing based on OECD (2016) data

all the more surprising that this represents the lowest point in the structural area. This could be explained by the fact that there is constant change in the sector, new technologies are developed continuously, and as such is difficult to keep up with the changing environment.

In the United States, it was again the distribution sector that employed the most people in the labour market (24.9 per cent) *(see Figure 5)*. While in European countries the number of employed persons during these periods dropped, growth was observed in the US. The other largest employment sector is again education, only slightly behind the distribution sector (24.8 per cent). There were no structural changes here, as even though employment dropped in the year of the crisis, an increase was observed in the year after.

Agriculture and industry were the lowest employment sectors and, as we can see, agriculture exhibited growth during the crisis and in the year after as well, which means that this sector created jobs structurally. The US industry shows an interesting picture as it progresses in a counter-cyclical direction: the number of employed increased during the crisis, but dropped in 2002. This may have been on account of the fact that investments in industry increased due to low interest rates, but these changes stimulated and encouraged the use of technology.

Employment structure across sectors changed during the crisis of 2008 (*see Figure 6*). The crisis peaked in the last quarter of 2007, and as such the year of the crisis represents 2008 changes, while the year after presents 2009 changes.

The distribution and education sectors remain the largest employers in European OECD countries, but we can observe that the majority of sectors underwent structural changes as most sectors are found in the lower left area of the figure. It is readily apparent that the construction sector suffered a sharp decrease. The ICT is found in the pro-cyclical area, i.e. the number of employed dropped during the crisis, but then started increasing.

In the US, the real estate sector was the only one that underwent a pro-cyclical change, though the ratio of employed is low (1.8 per cent) (*see Figure 7*). The agriculture sector exhibited counter-cyclical change, and exhibited large-scale growth following the crisis. All the other sectors covered by the analysis underwent a structural change. The distribution sector is still the largest employer; however, decrease in this sector can be considered structural. Industry, which also employs a large number of workers, has lost a high number of employees, as has the financial and insurance sector along with the ICT. This change can be explained with the marked appearance of investments into machinery.

Examining the years of the crisis, the figures reveal that structural changes are increasingly powerful. These changes may be termed as structural, as in most sectors the employment level was unable to recover, produce further decrease, in other words, the problem is deepening.

Groshen and Potter (2003) found that while in the mid–1970s and at the beginning of the 1980s, half of changes in jobs were cyclical and the other half structural in nature, in the 1990s this ratio was 43 to 57 per cent, and in 2001 21 to 79 per cent (*see Figure 8*). During my research, I came to the conclusion that during the crises of 2001 and 2008, structural changes became significant in terms of employment, which represents a problem, because something new must be created in an uncertain environment, which in turn takes much time.

The problem is, therefore, quite obvious. The ratio of cyclical and structural impacts in employment has changed. The increasing proportion of negative economic processes covers a lengthy period, thereby generating other problems: the outsourcing decisions
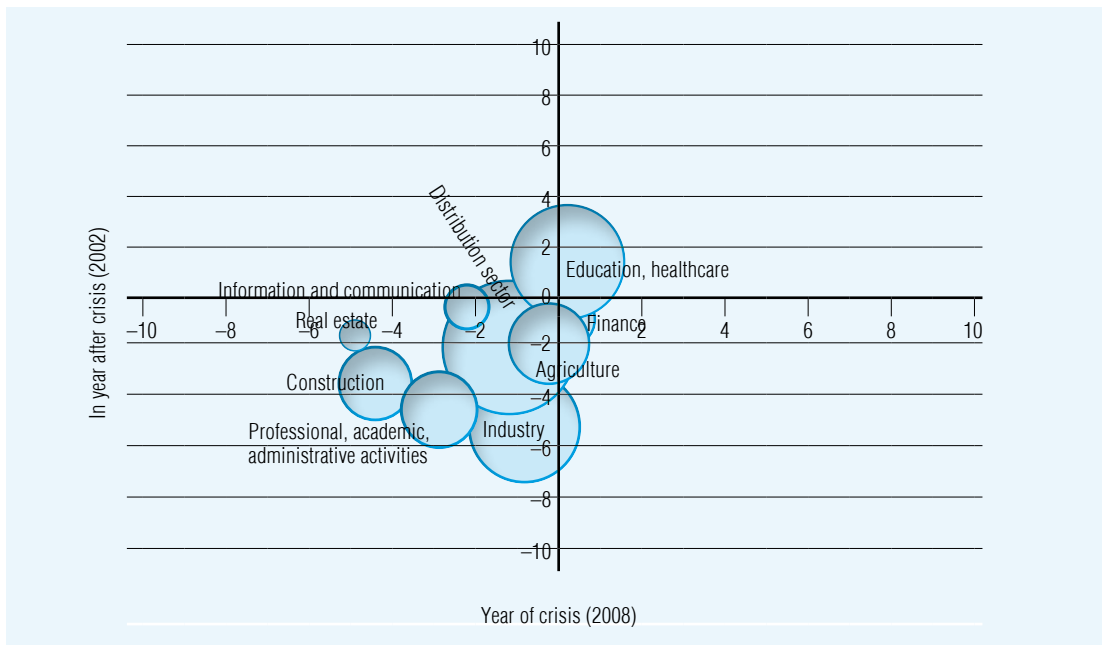
Figure 5

CHANGE OF EMPLOYMENT IN THE UNITED STATES, 2001 AND 2002
(PREVIOUS YEAR=100%)
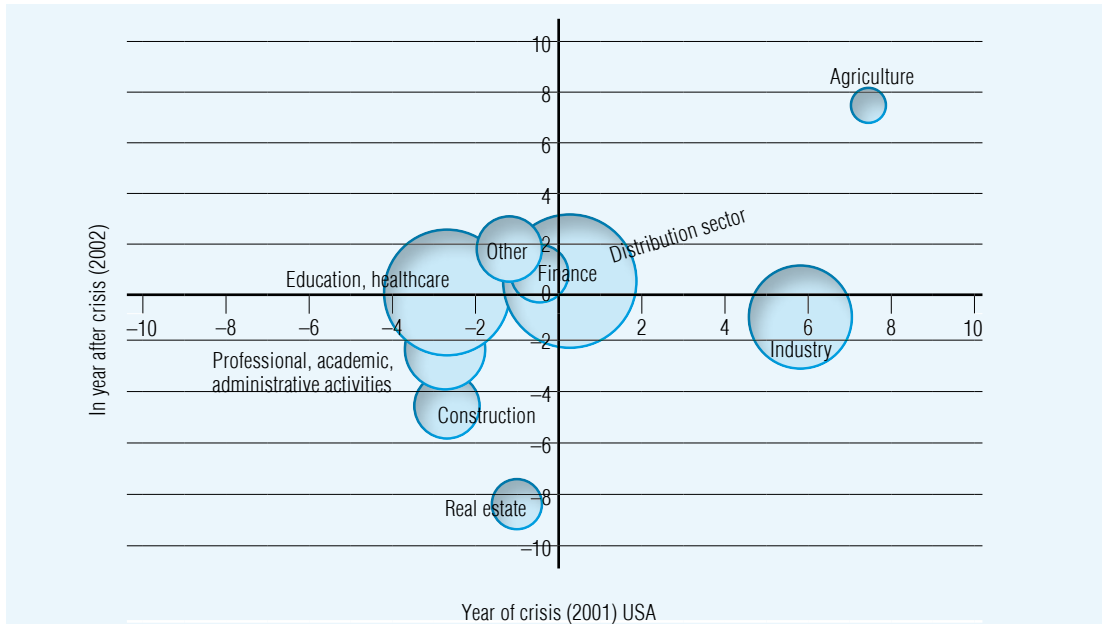
Source: author's own editing based on OECD (2016) data
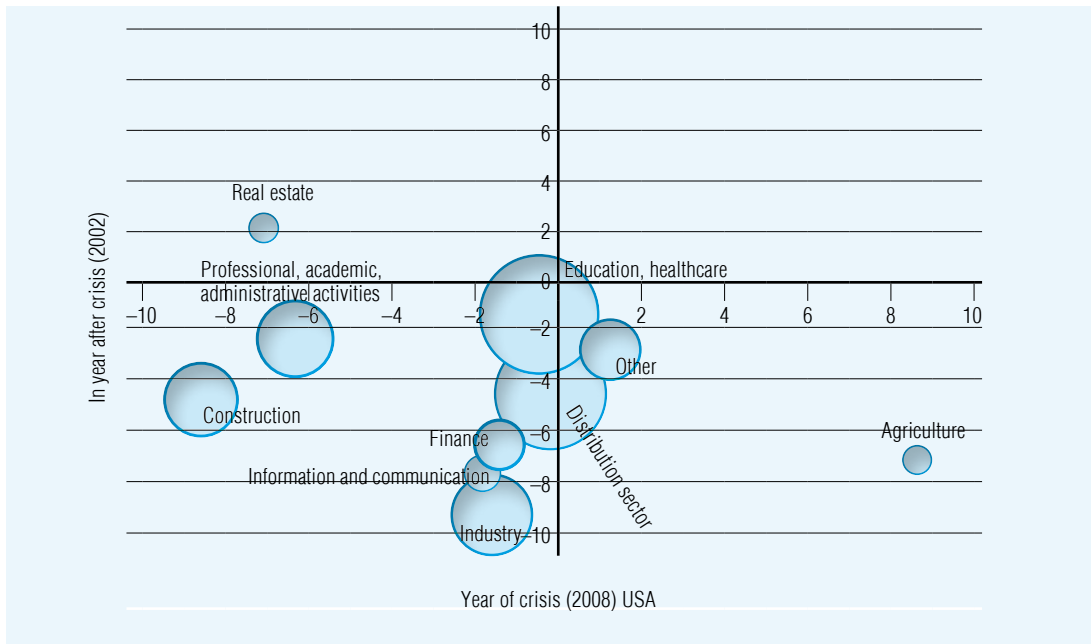
Figure 6

CHANGE OF EMPLOYMENT IN OECD COUNTRIES, 2008 AND 2009
(PREVIOUS YEAR=100%)

Source: author's own editing based on OECD (2016) data

Figure 7

CHANGE OF EMPLOYMENT IN THE UNITED STATES, 2008 AND 2009
(PREVIOUS YEAR=100%)

Source: author's own editing based on OECD (2016) data

of companies that are more favourable from a taxation and wage perspective, but which eliminate jobs; or the decrease in wages which in turn reduces consumption and investment.

In the following section of my study, narrowing my analysis exclusively to the US, I seek to answer which factors of the causes listed underwent significant change following the economic crisis of 2008, and which had the greatest impact on employment and growth data.

EMPIRICAL RESULTS: EXAMINATION OF THE UNITED STATES

Jobless growth can be traced back to numerous structural causes (Martus, 2015; Rajan, 2010; Waxell, 2011). During my empirical study, I researched whether based on the relevant

literature any factors exist that as a result of the crisis did not show significantly different values compared to pre-crisis levels, and also sought to find out which factors impacted the change of employment and growth the most.

Indicators covered by the analysis

The United States has been constantly struggling with the problem of jobless growth. By the time the employment level started to rise again following the 2001 crisis, the economic crisis of 2008 again set back the growth rate as far as employment was concerned, indeed reducing this growth rate, which then stagnated and only started to increase slowly.

I attempted to cover as many variables in the study as possible, but my efforts were hindered by the availability of certain data.

Figure 8

DISTRIBUTION OF STRUCTURAL AND CYCLICAL CHANGES, IN 1975, 1981, 1991, AND 2001
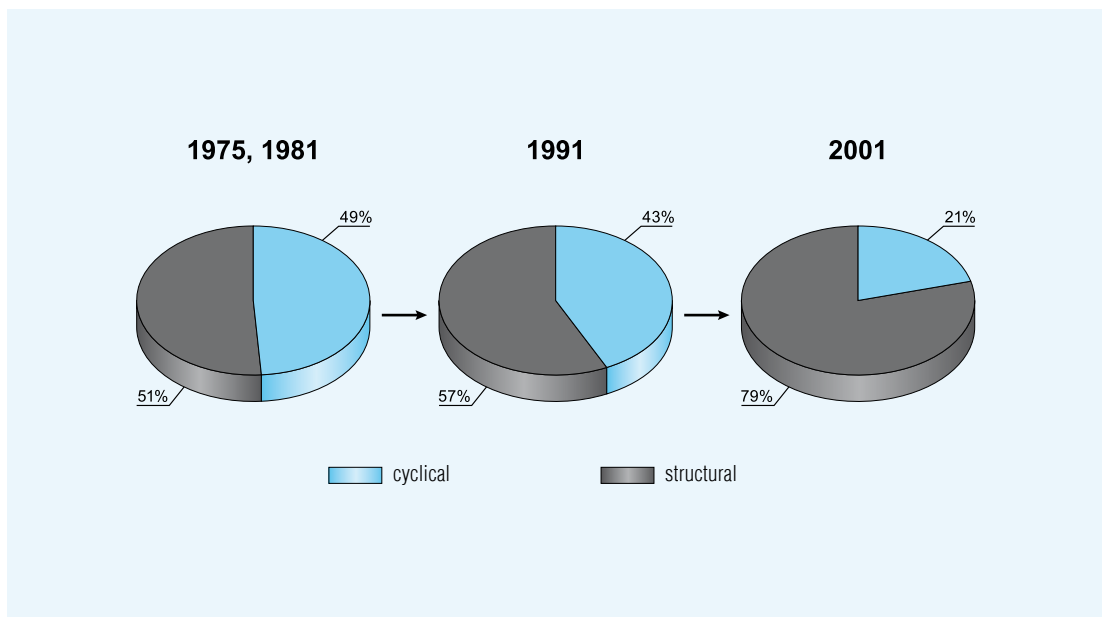
Source: author's own editing

Initially, I identified 37 indicators for my examination of the problem. During the identification of indicators, I relied heavily on the works of *Aronowitz − DiFazio* (2010), *Bernanke* (2003), *Bettio − Rosenberg* (1999), *Bivens* (2011), *Botos* (2012), *Corsi* (2009), *Daly* (2013), *Ernst − Viegelahn* (2014), *Farkas* (2011), Krugman (2012), *Mulligan* (2012), *Rajan* (2010), *Shimer* (2012) and *Schreft − Singh* (2003). In spite of this, regarding the appearance of *just-in-time* systems on the labour market, none of the indicators seemed suitable to cover this concept in its entirety. Of the literature dealing with *offshoring* and *outsourcing*, I relied on *Schultze* (2004) and *McIvor et al.* (2008); however, the availability of data was again limited. I culled the statistical data from various databases and reports (databases and reports from the International Labour Organisation, The World Bank Reserve Economic Data, the Bureau of Labor Statistics and the Organisation of Economic

Co-operation and Development), from the literature used for the theoretical section and from the policyuncertainty.com website. The main problem was that most data is available at an annual level, and that the data series include numerous new indicators which are not available for the years before 2001 (such as the indicator measuring labour cost).

The data best covered the 2001–2012 period, which is a relatively short period in terms of the analysis, as it only represents two recessions (2001 and 2008); and we cannot fully review the most recent crisis and the period following it either. As this analysis only represents a small sample, I collected the data in a quarterly breakdown, but this resulted in the reduction of the number of variables, with only 19 variables remaining in the final analysis. The quarterly breakdown is also justified because I am examining economic changes the impacts of which can also be observed in a shorter time horizon.

Methodological background

Based on the analysis of the relevant literature, I created three large groups (variables related to labour and the organisation of work; structural variables and production variables). The aim of my research is to examine structural changes in the US in respect of the 2008 crisis. To this end, I first organised the variables into principal components in order to capture the main areas of structural changes. The principal component analysis was needed because the number of indicators was too high and a strong correlation was observed between them. My objective, therefore, is to create artificial indices as a linear combination of standardised variables, in order to filter out subsequently which effects changed and how compared to their pre-crisis state. *Armstrong* and *Soelberg* (1968) applied principal component analysis in their study, examining 50 employers based on 20 indicators. *Hui* and *Kwan* (1994) also conducted principal component analysis when they examined the capital markets of 7 countries in a quarterly breakdown for the period between 1980 and 1987. After the creation of artificial indices, I conducted a nonparametric test in order to examine whether a significant difference can be observed in terms of structural changes in the period before the crisis and the period following the crisis.

Principal component analysis is a special factor analysis enabling multiple variables to be converted into a few principal components. When creating the principal component, it should be taken into account that our variables must correlate with one another, which can be examined using the Kaiser−Meyer−Olkin (KMO) test (Ketskeméty−Izsó, 2005; Sajtos−Mitev, 2007). If the value of correlation is high, i.e. there is a strong link between the two variables, the variables are suitable for the principal component analysis. During my

research, this criterion was met. Literature is not consistent on the acceptance of the KMO test value, with some stating that the test value cannot be accepted below 0.5 (Ketskeméty − Izsó 2005). During principal component selection, the variables converted into a principal component must be interpretable with one another, which is why during the analysis we also rotate our variables, which produces data that is simpler and easier to interpret (Sajtos − Mitev, 2007). My analysis of principal component weight is based on the correlation between the variable and the principal component in the given case.

As previously indicated, my analysis covers indicators starting from 2001, and I gathered data up until the end of 2014 in a quarterly breakdown. As a result, I obtained 55 periods, which constitute my observation units. Thereby the sample complied with the requirements for a "large sample". The data culled from the databases are featured in a quarterly breakdown, and in most cases show changes compared to the first quarter of 2001 (the peak of the crisis).

The groups set up on the basis of relevant literature have different principal components. This is also illustrated by the fact that when organising the indicators into principal components, the variables did not create a single group, but rather two groups in general. When running the test, I organised the variables within a given group into separate principal components, obtaining a total of five principal components *(see Table 2)*. The objective of this procedure is to reduce data quantity in the principal component analysis, by achieving the largest possible variance ratio using the lowest number of principal components possible (Sajtos − Mitev, 2007).

In order to compare the mean of the principal components of the two samples (pre-crisis period and post-crisis period), a two-sample *T*-test may be used. In order to

use the *T*-test, however, the conditions of application must be verified. The achievement of normal distribution is indispensable to running the test. The normality of the sample can be established using the *p*-values of the Shapiro–Wilk test; however, this condition of application in our case was not fulfilled and thus we were unable to use the *T*-test in our research. Another method to examine averages is the use of nonparametric tests, where running a two-sample test is also possible, except that in this case we are testing medians and not means. Testing medians is more expedient in the current study as means are sensitive to outlier values.

The results of principal components

After running the principal component analysis presented in Chapter 3.2, a KMO value of 0.88 was obtained, which means that the principal component would be suitable for application. The model's explanatory power proved to be good (86 per cent), and it converted the variables into four

Table 2

CHARACTERISTICS OF PRINCIPAL COMPONENTS

Dimension	Principal component	Indicator	KMO	Explained variance ratio
Factors influencing production	Economic policy	CPI	0.61	79.86
		Personal consumption expenditures price index		
		State and local taxes on goods and imports		
		Consumer confidence index		
		Interest rate		
	Uncertainty	VIX index		
		Business confidence index		
		Economic policy uncertainty index		
Structural impacts	Capital market	FDI (assets)	0.78	84.78
		R+D (investment)		
		Federal government expenditures		
		Imports of products and services		
		Private pension funds		
	Opportunity	New jobs		
		Change of net export		
Labour market factors	Labour market	Labour cost index	0.76	83.12
		Part-time employment		
		Median weekly income in full-time employment		
		Average length of unemployment		
		Hourly minimum wage		

Source: author's own editing

principal components. During the procedure, attention should also be paid to the analyst's responsibility which plays a role in the automatic procedure. The analysis generated variable groups that cannot be interpreted as a joint principal component. Consequently, I ran the principal components on the basis of the groups created based on the relevant literature, with the results shown in *Table 2*.

The first principal component was named economic policy, and may best be classified among causes related to production. The related variables depend on economic policy decisions. The Fed's policy interest rate is an instrument of monetary policy, taxes are instruments of fiscal policy, and private pension funds along with labour costs also depend on the results of economic policy decisions. The second principal component group, among processes determining production, is uncertainty. VIX refers to the volatility index, which increases as a result of uncertainties, thereby making the economy vulnerable. The changes of the consumer and business confidence indices also play an obvious role in this group. If the value of the index is lower, negative effects are created in the area of the region's vulnerability, as for instance consumption and the number of investments may drop (which in the case of the US is one of the instruments of economic policy). The principal components determining production together comply with the KMO criterion, as their value is 0.61 and the variables comprising them explain the total variance of the original variable to 79.86 per cent.

The third principal component refers to the capital market. This includes export, import, FDI as well as research and development. These variables depend greatly on external relations as the US needs to stimulate foreign investments, which it can also achieve by increasing government consumption. With the help of external re-

lations, research and development can also become more intense. The fourth principal component was clearly to be opportunity. This principal component contains only two variables: new jobs and export. The two are closely linked as by increasing export, the number of new jobs can also increase, which in turn can promote economic growth. The KMO value of the two principal components is 0.78, and the two artificial variables explain 84.78 per cent of the total variance of the original variables.

The fifth principal component can be classified as one of the characteristics of the labour market. If we take indicators as a basis, we can see that numerous variables are linked to wages, which greatly influence consumption and its volume. The hourly minimum wage determines consumption volumes, as does the rate of inflation as well as personal and federal expenditures. Part-time employment can feature in this group, because if part-time employment increases, as a second job it will generate more income for the population, which can be spent on consumption.

It is clear on the basis of both the relevant literature and the data that the classification of principal components is no easy task as a given component can belong to multiple dimensions. Numerous authors (Schultze, 2004; Rajan, 2010; Groshen and Potter, 2003; Jaimovich – Siu, 2012) consider structural problems to be the gravest among the problems of the US economy. The impact of structural changes has apparently become permanent in the past 20 years, which can be seen during recessions and the periods following recessions. Increasingly frequent crises and increasingly difficult recoveries are observed on account of structural changes. After the creation of principal components, the nonparametric test is easier to conduct, where group medians are compared in the pre-crisis and post crisis periods.

Median testing

When running the nonparametric tests, different medians were characteristic of each principal component in respect of the two periods *(see Table 3)*.

Based on the nonparametric test, there are significant differences in group medians for all five principal components. It is very clear that the medians of the artificial variables created exhibit significant growth, with the exception of the principal component of opportunity *(see Figure 9)*. The trends of median changes are caused by the joint effect of the various indicators. Following the crisis, the Fed decided to pursue an investment stimulating policy through a zero interest rate policy and quantitative easing. As a result, the number of investments increased, and FDI stimulation was successful. R+D also increased on account of the stimulation of investment. Export volumes and the number of new jobs dropped, whereas import increased. The consumer price index, along with government and personal expenditures, increased as a result of quantitative easing. The rate of part-time employment also increased in the period following the crisis as many workers had low income, and the number of unemployed who were only able to find part-time jobs also

increased sharply. Interest rates in economic policy dropped, showing near zero values. In spite of this, the labour cost index, taxes, the average duration of unemployment and the number of private pension funds all increased. Pension funds clearly increased because people are afraid of future uncertainties, and therefore would rather opt for savings. Uncertainty increased on the sides of both the consumers and business players, and so did economic uncertainty on account of the unpredictability of the economic situation. It should not be forgotten, however, that some variables could have been featured in multiple principal components, which means that certain variables are closely linked to one another.

This analysis, however, does not answer what the actual relationship is between the principal components created and jobless growth, which is something I will be elaborating on in the next chapter.

Multivariate linear regression

Regression analysis is a multivariate statistical procedure, where the correlations between two or more metric variables are examined. In the case of regression, we can examine the causative
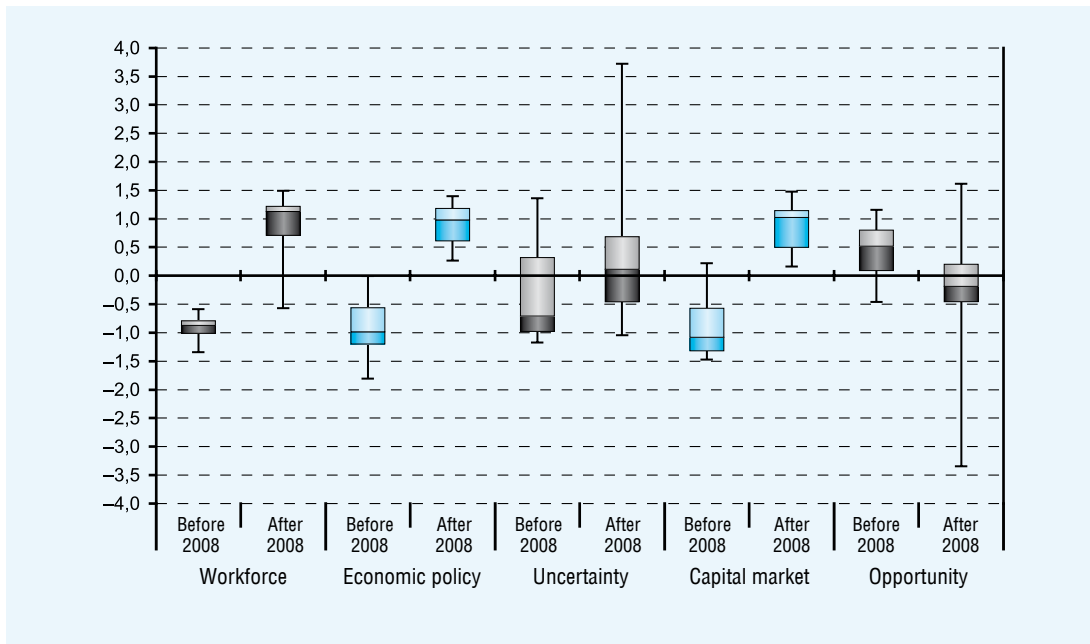
Table 3

RESULTS OF THE NONPARAMETRIC TEST

Principal component	p-value	Median	
		before 2008	after 2008
Economic policy	<0.001	−0.98	0.98
Uncertainty	0.043	−0.71	0.11
Capital market	<0.001	−1.08	1.02
Opportunity	0.005	0.52	−0.19
Labour market	<0.001	−0.87	1.13

Source: author's own editing

BOX PLOT FOR PRINCIPAL COMPONENT MEDIANS SEPARATELY FOR THE PRE-2008 AND POST-2008 PERIODS

Source: author's own editing

relationship between the independent and dependent variable. This method of analysis is widely used and is encountered in numerous areas, for example in the study by *Gábor et al.* (2012) on the effectiveness and costs of monetary sterilisation in China. In relation to employment, *Canales* (2014) also analysed the effects of minimum wages using regression, while *Shuttleworth* and *Lloyd* (2005) analysed employment by examining average travel-to-work distances. *Behar* and *Mok* (2013) used regression analysis to analyse the employment levels in the public and private sectors.

My model for jobless growth is as follows:

JG= pc (workforce; economic policy; uncertainty; capital market; opportunity)

In the model *JG*, as the target variable, represents jobless growth. I created a principal component using the employment rate and GDP growth, which allows me to capture the phenomenon by means of a single variable. My explanatory variables represent my principal components.

For the analysis, the multicollinearity between the principal components must first be examined. To show multicollinearity, the VIF indicator is used, the value of which cannot exceed 5, otherwise there is strong multicollinearity between the explanatory variables (Kovács, 2008). The economic policy principal component is not featured in the regression analysis of jobless growth, because our group of variables showed strong multicollinearity with this artificial variable. The Durbin–Watson test shows primary autocorrelation, which in this case came to (1.212; 1.622), and was sufficiently low. I did not apply delays in the model.

The results concerning regression are shown in *Table 4*. In the period prior to

2008, there is strong (R=0.97) and significant (p-value: 0.01<0.05) relationship between jobless growth and the group of explanatory variables. The differences of jobless growth before 2008 can be explained to 94.1 per cent with the groups of explanatory variables (R^2=94.1), while the remaining 5.9 per cent can be explained with other factors not taken into account, and coincidence. Before 2008 all four artificial variables should be featured in the model, as there is a causative relationship between the various principal components and my target variable (jobless growth) (p-values <0.05). In the case of partial correlation, we examine whether in the case of the fixed workforce, the relationship between jobless growth and the other factors is medium or strong. If we examine structural impacts, we can observe that in this case there is a strong, positive relationship between jobless growth and structural factors (capital market), in other words, if the structural artificial variable increases, then GDP increases but employment drops. In 2008 and the subsequent period, we only feature four artificial variables in the linear regression model as there is no causative relationship between the principal component of opportunity and my target variable (p=0.47).

In the case of standardised variables, we can see which of the five principal components I examined had the greatest impact on jobless growth. The standardised variables provide assistance in comparing artificial variables. These clearly indicate that before 2008, structural changes (capital market) had the greatest influence on jobless growth, as it did after 2008, but then the impact of structural changes on jobless growth increased to a greater extent compared to the other variables. The model's explanatory power shows that the differences of jobless growth prior to 2008 and in 2008 are explained by my explanatory variables to 94 per cent and 97 per cent respectively.

SUMMARY

Jobless growth represents a serious problem as after the most recent crisis, employment in the

Table 4

REGRESSION PARAMETERS

Period examined	Principal components	Standardised parameter	*P-value*	Partial correlation	The model's explanatory power	Model's *p*-value
before 2008	constant		0.07		0.94	<0.001
	workforce	0.25	0	0.56		
	uncertainty	−0.33	0	−0.7		
	capital market	0.52	0	0.85		
	opportunity	0.19	0.01	0.53		
2008 and after 2008	constant		0.02		0.97	<0.001
	workforce	0.29	0	0.75		
	uncertainty	−0.18	0	−0.61		
	capital market	0.67	0	0.88		
	opportunity	−0.04	0.47	−0.15		

Source: author's own editing

various sectors dropped drastically. The drop in the number of jobs in certain industries is not just temporary, but rather represents a permanent loss of jobs. At the same time, while employment drops, GDP continues to increase, and this relationship between the two variables has numerous causes. Using statistical data, I examined whether the components (principal components) of the phenomenon of jobless growth were significantly different before the crisis and after the crisis. The results clearly show that external relations were significantly different from the pre-crisis level, which is a positive development as a high amount of R+D is generated and there is a high inflow of FDI. Significant growth is also observed in the consumption principal component, which also indicates a positive change as it increases GDP. Even though consumption increased, this failed to sufficiently contribute to a rise in employment. The change of economic policy also supported GDP growth rather than employment, because as this effect increases, so does labour cost because there is a positive relationship between the artificial variable and labour costs in the US.

As seen in the results, post-crisis growth in the principal components created was both decisive and favourable from the perspective of GDP growth. However, three variables that would allow for the characterisation of employment (labour cost, the duration of unemployment, and the ratio of part-time employed persons) are changing unfavourably, in other words, are becoming structural problems, since just because something increases GDP, it does not necessarily favour employment. Jobless growth, therefore, is a grave problem, one that is increasingly becoming structural in nature. The solution is not an easy one as significant changes have occurred in the employment structure, something which also represents the structural process of the phenomenon. According to data from the FRED St. Louis database, the US has still not returned to employment levels recorded prior to 2001 (among employed persons in the 15−74 year old age group), which may give rise to serious concern.

Consequently, the permanence of jobless growth is arguably the most impacted by structural factors. In addition, factors related to the organisation of work and production also play a substantial role, but it is difficult to draw a clear line between the processes, as the factors are inter-related and shape one another. Based on the data, we have seen that certain principal components were lower before the crisis, but started to increase afterwards, with the exception of new jobs and exports. The economic and social processes examined had a positive impact on economic growth, yet jobless growth was still generated as they had the opposite effect on employment.

NOTES

[1] For more details on the relationship of monetary policy and employment, see for instance Gorodnichenko – Shapiro, 2007; Blanchard, 2005; Mishkin, 2007

[2] See for instance Rajan, 2010; Schreft − Singh, 2003

[3] See Gorodnichenko – Shapiro, 2007; Blanchard, 2005; Mishkin, 2007

[4] Lean production means the elimination of all forms of wastefulness (reduction of costs, the best possible satisfaction of customer needs) (Losonci, 2010).

[5] Occupations can be distinguished as cognitive versus manual, and routine versus non-routine (Jaimovich − Siu, 2012). Non-routine cognitive occupations include managerial, professional and

technical workers (such as PR managers, financial analysts, computer programmers and economists). Routine cognitive occupations can be those in sales, and office and administrative support (secretaries, travel agents). Routine manual occupations are "blue collar" jobs, such as machine operators, dressmakers, assemblers, etc. Non-routine manual occupations are maintenance, gardening, waiter, etc. jobs. According to the authors, these occupations correspond to rankings in the occupational income distribution. Routine occupations make up one group (including both manual and cognitive), and these represent middle-skill occupation groups; while non-routine cognitive occupations represent high-skill occupations and non-routine manual occupations low-skill and low-wage occupations. Jaimovich and Siu (2012) examined the distribution of these job types for the period between 1967 and December 2013. The ratio of both non-routine occupational groups grew over the years, while routine employment displayed a decrease. Overall, it can be said that in the routine employment groups, employment was never able to recover from the past three recessions (neither in the short-term, nor in the medium and long-term). These occupations are disappearing.

[6] All individuals aged over 16 years that do not participate in education, divided by the number of the population.

[7] The financial and insurance sector or the real estate sector is not shown in the figure. In the year of the crisis, the number of employed in the financial sector increased by 0.11 per cent and by 0.95 per cent in the subsequent year. The sector accounts for 2.86 per cent of employed. In contrast, the real estate sector dropped by 0.29 per cent in the year of the crisis, but produced a growth in the subsequent year (0.66 per cent). 1.14 per cent of the total number of employed persons work in the real estate market.

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