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More flexibility for more innovation?

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More flexibility for more innovation?

Evidence from the Netherlands

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Abstract

Labor market flexibility continues to be one of economics, politics and society highly debated topic. In recent years, the impact of increased labor market flexibility on research and innovation has gained more and more attention. Previous studies have shown, depending on the measurement of flexibility as well as on the data that both positive and negative influences can be found. However, the financial flexibility in terms of wage rigidities has hardly been explored empirically. With the use of a unique dataset combining comprehensive information from both employers and employees we can accomplish variables not only to numerical and functional, but also to financial wage flexibility. In a panel probit model, we show that the influences of most of the indicators of wage flexibility are positive and vary by type of innovation. While the variables of wage bargaining has a higher impact on process innovations, information about specific wage levels, however, affects in particular the development of new products. The same applies to a separate consideration of wage bargaining levels. Aspects of numerical and functional labor market flexibility, in contrast, act negative on all types of innovation. Thereby, part time employees affect particularly processes, while flexible employment contracts have a stronger influence on product innovations. It seems that new products depend more on employment status and the resulting motivation of the employees.

Keywords: Labor market flexibility, innovation, wages, collective bargaining

1. Introduction

Globalization with the associated increasing international competition and the rapid technological change cause both economic and social changes that require greater adaptability and mobility of businesses and employees. In addition, the demographic change challenges the labor market of many countries. For these reasons, it is required to adapt the institutions of the labor market to the more flexible requirements, in order to solve the problem of unemployment and to ensure continued efficient labor market. Therefore, many labor market economists call for a greater labor market flexibility, especially after the sharp rise in unemployment in Europe in the 70s and 80s.[1] In addition, a lot of studies followed, which imply a positive impact of increased flexibility in the labor market on growth and productivity.[2] The impact of labor market flexibility on economic aspects has been discussed for a long time. This relates to influences on employment, growth, profits or productivity.[3] The theoretical approaches differ depending on the subject and the precise measurement of labor flexibility. There are many different hypotheses, and numerous studies for its empirical verification.[4]

However, possible negative repercussions of increased labor market flexibility should also be considered. A company's success always depends on the motivation of its employees. Particularly cost intensive projects require the willingness of employees, to bear the risk of a company. At the same time, the call for a greater security, especially since the crisis, continues to grow. This is also reflected in the new concept of `flexicurity'.[5]

Exactly this trade-off between flexibility and security as a working motivation concerns the generation of innovations. In recent years, the interest in potential impacts of labor market flexibility on research and innovation has increased. Innovation is considered as a driving force for productivity, competitiveness and growth.[6] The emergence of an innovation is understood as a complex process, influenced by various actors in both technical and social perspective. In this way, the national and regional environment, including its political frameworks, the supply of labor and knowledge and its specific economic structure affects the generation of innovations.[7] To support research and innovation, it is therefore necessary to know possible

1 See e.g. Brodsky (1994), OECD (1994) or Siebert (1997).
2 Nicoletti and Scarpetta (2003).
3 For a survey of theoretical approaches see Towers (1992) or Solow (1998).
4 A review of labor market flexibility, its definitions and implications can be found in e.g. Solow (1998), Beatson (1995) or Salvanes (1997).
5 Wilthagen and Tros (2004).
6 See e.g. Aghion and Howitt (1998).
7 See e.g. Braczyk et al. (2004) or Edquist and McKelvey (2000).

influential factors in order to develop targeted policy measures. The importance of research and innovation in Europe is underlined by the Lisbon Strategy of the European Commission. Against this background and given the financial crisis and its impact on employment and growth, research with regard to the concrete implementation of different types of innovation has regained its importance.

Some studies on this subject already exist, even though the data is not always on a sufficient company level.[8] Additionally, financial flexibility has hardly been explored empirically in previous investigations.[9] Pooling three datasets from the Netherlands, we obtained several measures of financial flexibility. Together with data on numerical and functional flexibility, we can therefore characterize labor market flexibility much more extensive.

In chapter 2, we give a definition of labor market flexibility and show briefly the incidence and development of its elements. The following chapter 3 introduces possible effects of labor market flexibility on innovation and provides a short survey of previous studies. Due to the lack of research, we focus on financial flexibility and present some hypotheses about possible impacts. The available data is summarized in chapter 4. After a description of the empirical model in chapter 5, its results are presented in the subsequent chapter 6. Finally, chapter 7 summarizes some conclusions.

8 See Freeman (2005) or Zhou et al. (2011). Studies with data on company level e.g. Arvanitis (2005), Michie and Sheehan (2003) or Kleinknecht et al. (2006).

9 Zhou et al. (2011): p. 3. Approaches of wage flexibility can be found in Sanchez and Toharia (2000).

2. Labor market flexibility

Labor market flexibility can be defined as the capacity of the labor market to adapt quickly to changes in economy or society. But what exactly includes the term labor market flexibility? The most commonly used definition is given by Atkinson (1985). He divides labor market flexibility as a function of corporate strategy in three different groups, the numerical, functional and financial. In addition, external and internal aspects of flexibility can be distinguished.

External numerical flexibility refers to the mobility of employees between different companies by cancelations and new entries. Thereby, it illustrates the extent to which the number of employees can be adapted quickly to economic requirements. Options of external numerical flexibility are the increase of flexible employment contracts as part-time or temporary employment. These forms of employment facilitate terminations and recruitments of associates and thus allow an easier adjustment to the number of employees to economic changes. Internal numerical flexibility refers to the ability of companies to adjust the working hours of their employed workers. It can affect daily, weekly or annual working time as well as seasonal arrangements or short-time work.

Functional flexibility describes how a company can use its employees for different tasks. It may be increased through continued training of employees so that multi-skilled workers are applicable to different fields of work. In addition, an external solution is possible through outsourcing or temporary employment.

Financial flexibility can be defined as the flexibility of wages. This means that wages will not be negotiated collectively. In this way, wages represent the equilibrium supply and demand in the labor market. This results in a larger difference between the wages of individual employees.[10]

In Europe, part-time employment and temporary employment contracts are usually labeled as atypical work. In selected sectors and especially for certain groups of employees atypical work is now common practice.[11] Looking at the data from the OECD (2010), the share of temporary employment increased from 1994 to 2009 on average across all OECD countries. However, the results of the individual countries differ significantly. In most countries, women and especially young people aged 15-24 have more frequently a temporary employment contract.[12] A similar picture emerges for part-time contracts. The shares are also significantly higher for women, because they use part-time contracts frequently for re-entering the labor market.[13]

10 In addition to these definitions, there are other classifications, which are used for further explanations of labor market flexibility. For more information, see e.g. Beatson (1995), Klau and Mittelstädt (1986) or Blyton (1992).

11 This applies for e.g. women or low-skilled employees. Further information see e.g. Grip et al. (1997) or O'Reilly and Fagan (2002).

12 OECD (2010): p. 288.

13 OECD (2010): p. 286.

3. Labor market flexibility and innovation

In recent years, research about possible influences on innovation has become more important and many studies with data for Italy, Spain or the Netherlands have emerged.[14] Thereby, most of all studies focus on numerical and functional aspects of labor market flexibility. The possible impact of various measurements of financial flexibility, however, is studied very little.[15] This is mostly based on the lack of equivalent data.[16]

Theoretically, numerical and functional labor market flexibility can have both, negative and positive impacts on innovation. In general, a negative correlation between increased labor market flexibility and innovation is assumed. The main argument for this is based on the assumption that innovation is path dependent, i.e. the implementation of new processes or products depends on aspects of the social environment, company culture, earlier investments as well as accumulated previous knowledge.[17] Researchers such as Grant (1991) assume therefore that the capabilities of an organization cannot be completely exhausted using short-term, temporary and part-time employment contracts. Following Zhou et al. (2011), temporary employment contracts undermine the training investments of a company. The knowledge and the productivity of the employee are migrating to another company. In this way, a company can lose a competitive advantage. In addition, employees are only willing to take the risks of innovation, when they get a sense of security in their employment.[18]

On the other side, arguments for a positive relationship between flexible employment contracts and innovation can also be found.[19] Following the approaches of Kodama (1995) or Matusik and Hill (1998), not necessarily only internal resources are used for innovation. Instead, innovations depend much more on the effective utilization of technology and knowledge, even beyond internal capacity. So far, external capacities can be seen as complementary innovation input factors.[20] Especially in the case of open source projects, the use of external resources is crucial. In addition, Arvanitis (2005) argues that temporary employment contracts facilitate a better alignment on special demand. Flexible employment also allows a larger labor turnover, which introduces new knowledge and fresh ideas into a company.[21]In that way inefficient workers

14 E.g. Pieroni and Pompei (2007), Altuzarra and Serrano (2010) or Zhou et al. (2011). For an overall survey see e.g. Storey (2001).
15 This applies especially to the combination of numerical, functional and financial flexibility.
16 See e.g. Zhou et al. (2011): p. 3.
17 Pavitt (1991).
18 Storey et al. (2001): p. 1.
19 Storey et al. (2001): pp. 3–4.
20 Teece (1986): pp. 288–289.
21 Adams and Brock (2004).

can easier be replaced.[22] As Bassanini and Ernst (2002) or Scarpetta and Tressel (2004) emphasized, severe restrictions on cancellations may also limit the endeavor of generating labor-saving innovations. Finally, Ichniowski and Shaw (1995) think that permanent employees may be disinclined to change in form of innovation due to habit or so called lock-in effects.[23] In this respect, flexible working arrangements such as outsourcing, temporary or fixed-term contracts can fit exactly right for the innovation process.[24]

The different arguments are also reflected in varying results of previous empirical studies. Michie and Sheehan (2003) used a large number of indicators for numerical and functional flexibility as well as for labor turnover. Their results show a clearly negative influence of numerical flexibility measured by flexible and part-time employment contracts. Training and group work as indicators for functional flexibility, in contrast, have a positive effect on innovation. A summary of individual aspects to so-called human resource management (HRM) systems make clear that combinations of various flexibility measures also act differently.[25] An increased flexibility seems to have a positive effect up to a certain limit. Using the logarithm of the new products turnover per employee as dependent variable, Zhou et al. (2011) also show a positive impact of variables measuring internal functional flexibility. At the same time, temporary employment contract also seem to affect positively. The results of Pieroni and Pompei (2007) clarify a significantly negative influence of labor turnover on patent. A more qualitative evaluation approach is chosen by Storey et al. (2001). They show that the employees directly involved in the innovation process are much less affected by flexible working arrangements.[26] Temporary or fixed term contracts are used primarily for cost reduction. However, the companies that complete many of these flexible contracts prove to be highly innovative. Storey et al. (2001) suggest that flexible employees support the innovators. Therefore, they do not affect innovations directly, but rather reflect the innovation activities of a company.[27]

Most of all studies regarding innovation and labor market flexibility focus on numerical and functional aspects. Thereby, the financial flexibility has hardly been considered. What effects of an increased flexibility in terms of wages on innovations are possible? Following the neoclassical labor market theory, labor market flexibility depends strongly on the wages that play a crucial role for the adjustment of labor demand and supply towards equilibrium. They result from the marginal productivity of labor and lead to a balanced labor market. Following the neoclassic basic idea of optimization and equilibrium, involuntary unemployment is

22 Zhou et al. (2011): p. 4.
23 Although Zhou et al. (2011) argue that potential lock-in effects could be reduced by training and human resource policies. Further details can be found in Zhou et al. (2011): p. 4.
24 A survey of different theory approaches is given by Pieroni and Pompei (2007): pp. 326–329 or Zhou et al. (2011): pp. 3–6 .
25 Michie and Sheehan (2003): pp. 132–133 .
26 Storey et al. (2001): p. 9.
27 Storey et al. (2001): p. 11.

only possible by distortions such as excessive wages forced by trade unions.[28] For this reason, economists have often called to open rigid wages to reduce the unemployment.[29] However, Kleinknecht (1998) shows that decreasing wages with an associated increase in labor demand and decline in unemployment can also be attributed to a low labor productivity growth. This could lead to a low economic growth and in turn to reduced labor demand. From an innovation-economic perspective, a company with low labor costs has only a limited incentive to replace old by new capital.[30] In addition, a restriction of wage increases also leads to a prevention of creative destruction, the core of the Schumpeterian theory.[31] Due to the possibility of higher monopoly profits as a result of a successfully implemented innovation an innovating company has advantages over non-innovators in higher wage demands. Thus an innovator has a higher chance of survival. Following Schumpeter (1976), only strong and innovative companies will survive. By preventing wage increases, non-innovators receive additional benefits.[32]

However, also rapidly rising wages may reduce innovation incentives. According to current literature, a union acts like a tax on intangible capital returns to get a share of quasi rents. As Malcomson (1997) indicated unions in powerful negotiating positions could skim off potential gains from innovation. For this reason, usually a negative influence is assumed.[33] However, the negative impact of unionization seems to be non-linear. Following the theory of Haucap and Wey (2004), this so called hold-up problem is especially important in the case of bargaining at company level.[34] A flexible wage-bargaining system can therefore create incentives for innovation. This leads to the presumption that rigid wages in both directions can have negative influences. According to the theoretical considerations we can derive two hypotheses regarding the financial flexibility.

Hypothesis I

A high degree of financial flexibility measured by low wage rigidities has a positive influence on innovation.

However, the affect of wage levels does not seem to be unambiguous. Both low and high wages may have a beneficial in terms of innovation. Lower wages allow a company, to invest more financial resources in research and development, whereas higher wages can be viewed as an incentive for innovative effort. The direction of the effect depends ultimately on the cost and the target of the planned innovation.

28 A general introduction to the neoclassical labor market theory can be found in Kaufman and Hotchkiss (2006).
29 OECD (1994) or Kleinknecht (1998).
30 Kleinknecht (1998): p. 389 and Kleinknecht (1998): p. 391.
31 Schumpeter (1976).
32 See also Kleinknecht (1998): p. 388.
33 A survey of theoretical and empirical evidence of the relationship between unions and innovation can be found in Menezes-Filho and Van Reenen (2003).
34 For a survey see e.g. Malcomson (1997) or Altuzarra and Serrano (2010).

Hypothesis II

The impact of financial flexibility measured by wage levels differs depending on the type of innovation.

The data as well as the empirical model to test these hypotheses are described in the following chapters.

4. Data

The available dataset is a combination of various data of the Netherlands. On the one hand, we used two datasets from the Centraal Bureau voor de Statistiek (CBS), the central bureau of statistics of the Netherlands in The Hague. First, we use the innovation information provided by the Community Innovation Survey (CIS). The CIS dataset of the European Commission is an innovation survey with a standardized questionnaire for all participating European countries. In this way, it offers harmonized information on research and innovation such as personal and expenditure for R & D or incentives as well as barriers to innovate.

In addition, data of the Dutch income tax office are used. This employee's level dataset contains extensive information about employment contracts such as working hours, wages or special payments. Furthermore, data on the employees themselves such as gender or age are included. An ID number allows the assignment of employees to a company. The entry and exit data indicate the duration of employment of an individual employed in a specific company within a respective year. In addition, they illustrate the employment changes within an organization.[35] The variable CAO, assigned by the negotiating union, shows for each employee whether its salary was negotiated collectively. The number identifies a specific collective agreement, if one was completed. However, there is no information if this potential agreement was negotiated at company or at industry level.

To include this information in the analysis, we used the Dutch Collective Labour Agreements Database and Monitor (DUCADAM) of the Amsterdam Institute for Advanced Labour Studies (AIAS), an independent research institute of the University of Amsterdam. This data collection contains all collective labor agreements (CLAs) in the Netherlands, resulting from an extensive inquiry as well as a co-operation with the Federatie Nederlandse Vakbeweging (FNV), the Dutch Trade Union Confederation. In addition to the CAO number, the dataset also includes relevant company and negotiating variables, such as the level of the bargaining process.[36] The CAO number is used for matching the DUCADAM data with the wage dataset from the CBS. The overlap between both datasets is about 97 %. Aggregated on company level, we matched this dataset with the CIS data using the company's ID. In this way, information about research and innovation could be associated with labor market data. Due to the fact that the CIS record does not contain

35 Thereby, the entrance month is counted only if the employment has started not later than the 15th day of the month. On the other side, the leaving month is counted only if the employment has determined after the 15th day of the month.

36 Further information about the DUCADAM dataset can be found in Hartog et al. (1999). Details about the variables and their coding are given in Schreuder and Tijdens (2004).

information about the public sector, we excluded all observations of the public sector of the wage dataset. The coupled dataset contains data for every second year from 1998 until 2008. With approximately 9,000 surveyed companies per year, the whole dataset covers about 50,000 observations. Table 1 summarizes some descriptive statistics for a survey of the entire record.

Table 1: Descriptive statistics of the dataset

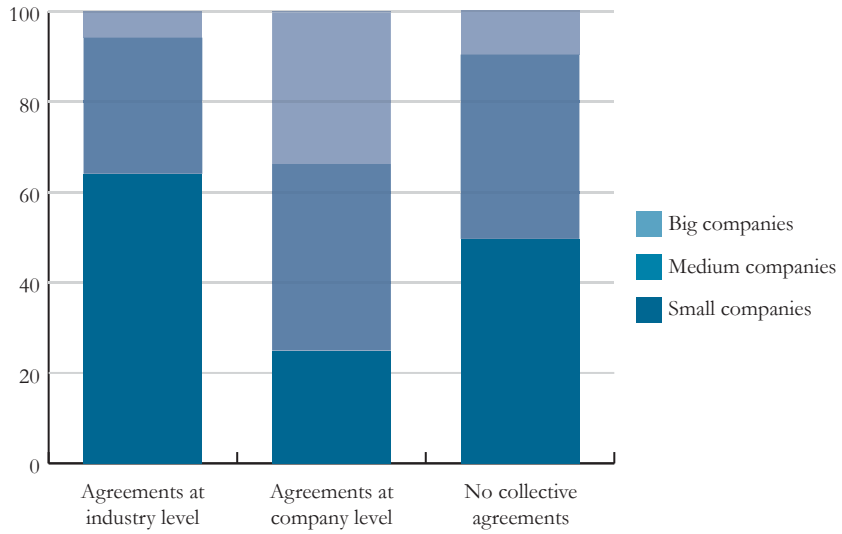
	All companies	Innovating companies
Innovation	36.59 %	
Process innovation	21.58 %	
Product innovation	27.79 %	
Manufacturing sectors	28.74 %	42.51 %
Service sectors	57.82 %	48.01 %
Service related sectors	13.44 %	94.90 %
Small sized companies (less than 50)	50.75 %	39.61 %
Medium sized companies (50-199)	39.07 %	44.06 %
Large sized companies (200 and more)	10.18 %	16.33 %
Researching companies	12.37 %	31.30 %
Share of part-time employees	36.42 %	30.06 %
Share of full-time employees	63.58 %	69.94 %
Share of employees with flexible contract	6.58 %	3.20 %
Share of employees with fixed contract	93.42 %	96.80 %
Share of employees with temporary contract	24.45 %	21.04 %
Share of employees with permanent contract	75.55 %	78.96 %
Collective wage bargaining at industry level	86.11 %	82.71 %
Collective wage bargaining at company level	6.12 %	9.58 %
No collective wage bargaining	7.77 %	7.70 %
Medium wage per employee	115.6391	85.662

Source: CBS, AIAS 1998-2008, own calculations

More than 36 % of the companies in the dataset are innovators. With nearly 28 %, product innovations are more frequent than process innovations. The data shows that more than 65 % of all companies belong to services or service-related sectors and only about 30 % to manufacturing industries. However, most of the innovating companies are manufacturing firms. The most frequently services are the rental as well as the wholesale sector. In the industry sectors, construction is the most frequently business field. Most of the companies are small with less than 50 employees. Only about 10 % are big companies with 200 or more employees. The company's size seems to be a crucial variable for innovation. About 60 % of all large companies have generated at least one successful innovation. Only about 12 % of all companies are doing research regularly. However, 95 % of them are successful innovators.

Most of the companies have a wage agreement at industry level. The share of agreements at company level is about 7 % and increasing over time. With more than 90 % the most of all firms pay a collectively bargained wage. Thereby, bargaining at industry level is especially important for small companies. Large companies with more than 200 employees, however, usually choose a negotiation at company level. This can be seen in Figure 1.

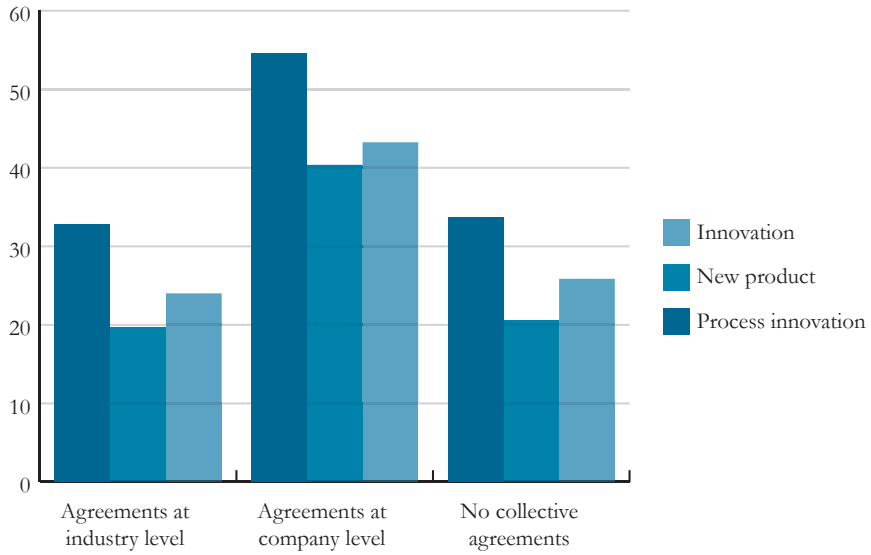
Figure 1: Share of big, medium and small sized companies in percent depending on the level of wage bargaining. Big companies have 200 or more employees, medium sized 50 or more and less than 200. Small companies have less than 50 employees



Deviations from 100 percent due to missing values
Source: CBS, ALAS 1998 - 2008, own calculations

At the same time, company level bargaining is of much higher importance for innovating companies. Following Figure 2, this is particularly true for new products, while bargaining at industry level is at least represented in process innovations.

Figure 2: Share of innovations, new products and new processes in percent depending on the level of wage bargaining



Deviations from 100 percent due to missing values
Source: CBS, ALAS 1998 - 2008, own calculations

The average wage per employed at companies with an innovation is significantly lower. About 60 % of employees of all companies are working on full-time, only less than 40 % on part-time. Most of all employees are working on a fixed contract. With an average of about 75 %, most employees have an indefinite contract. At least, more than 60 % of all companies give all of their employees a permanent working contract. The proportion is even higher in innovating companies.

5. Empirical Model

As the dependent variable, we first use the binary-coded variable INNNO for an innovation of a company. It can be interpreted as the probability of an innovation within the last three years. In a further step, we distinguish between product and process innovations using the variables PROCESS and PRODUCT. The CIS dataset uses the official definitions of the Oslo Manual of the European Commission. Therefore, an innovation is the implementation of a new or significantly improved product or process.[37] Due to the binary coding of the dependent variables, we use a panel probit model.[38]

According to the theoretical basis, we divide the explanatory variables into different flexibility classes. At first, we examine the financial flexibility. It is illustrated with the help of several variables and can be divided into two different groups. The first variables explain information about the bargaining process representing potential rigidity of wages. The grouped variable BARGAINLEV specifies the level of wage bargaining. The higher the value the more likely the transaction takes place at a decentralized level. The lowest value is the inflexible wage setting at the industry level. In contrast, a fully flexible wage setting system includes no common bargaining. According to our hypothesis I we expect a positive impact of the variable BRAGAINCOV on innovation. Following the model of Haucap and Wey (2004), the influence of the level of wage negotiations on the incentive to innovate is not linear.[39] To take into account for possible non-linearity, we use individual wage-setting levels in the regression in a further step. Using the most centralized collective agreements at industry level INDLEV as reference category, NOLEV identifies companies without any collective bargaining agreements, whereas COMPLEV stands for companies with a wage-setting at firm level. The variable BARGAINCOV indicates the percentage of employees in a company for whom the collectively agreed wage applies. This variable can have both positive and negative impacts. The greater the number of employees with collectively negotiated wage, the higher the lack of a company's flexibility. On the other hand, this leads to a decrease of transaction costs and the negotiation efforts. The second group of variables explaining financial flexibility describes the exact amount of wages. MEDWAGE is the monthly average wage per employee. As we already discussed before the effect can be both, positive and negative. Following

37 OECD (2005): p. 31.

38 Due to various observations without a change in the binary coded variables such as industry, group, research or collective agreements, we choose a random panel model. The topic lends itself to an analysis with time-series models. Nevertheless, we decided to use cross-section data over a certain time period. This allows us to append a panel model, which produces two main advantages. The CIS dataset contains panel data. This offers the advantage of excluding unobserved heterogeneity. In addition, we tried to maximize the comparability to previous studies, which also use panel models or at least pooled cross-section data. See e.g. Pieroni and Pompei (2007): p. 336, Giannetti and Madic (2007): p. 8 or Zhou et al. (2011): p. 7.

39 In their model Haucap and Wey show that coordinated bargaining at company level has the lowest incentives for cost reducing process innovations. However, centralized wage-setting has a positive influence. See Haucap and Wey (2004).

our hypothesis II, the coefficient will depend on the type of innovation. The wage also depends on age, experience, education and position. Wage differentials can therefore also act as a monetary incentive for an increasing work productivity and creativity. That is why we include the wage differentials within a company DIFFWAGE in the equation. We expect a positive relationship between DIFFWAGE and innovation.

Furthermore, we investigate the numerical and functional flexibility. Due to the fact that no information about training or further education can be found in the dataset, we put together internal and external components. PARTTIME is the proportion of part-time employees, while EMPLOYSTAT indicates the share of workers with a flexible employment status. In addition to temporary employees, these kinds of employment also include on-demand workers. The proportion of workers with a temporary employment contract is represented by the variable TEMPEMP. According to the results from the descriptive statistics, we expect a negative influence of the inserted measures of numerical and functional flexibility.

An additional measurement of changes in employment and thus of the flexibility of labor within a company is the labor turnover. An overall high labor turnover seems to indicate for a flexible adjustment of the number of employees.[40] The labor turnover is measured by two variables. LABIN gives the share of the employees who start working within a year in the company. LABOUT on the other hand measures the percentage of associates who leave the company within a year. The way of how the labor turnover might affect the incentives for innovation depends on the costs of employment as well as on use of human capital. On the one hand, looking for new staff generates additional costs. The exact amount of the costs is determined by factors such as the industry or the requirements of the vacancy. On the other hand, the longer an employee is employed in a company, the stronger its negotiating position and its possible capture of innovation rents.[41] In addition to the cost side, the human capital of the employees plays a crucial role for innovations. A company loses the human capital of its outgoing staff. However, new employees can bring in new ideas. Therefore, we expect a negative influence of LABOUT, while LABIN affect rather positive.

The control variables include at first the company's size SIZE, measured by the logarithmic number of employees. On the one hand, the size of a company illustrates possible economies of scale and better opportunities in the financial market.[42] On the other side, SIZE illustrates a higher accumulated human capital. For these reasons and according to current innovation research, a positive influence is expected.[43] The same applies to the logarithm of annual sales per employee TURN. Here we use the turnover of the

40 Further information about labor turnover can be found in Arnott and Stiglitz (1985).
41 Bassanini and Ernst (2002): p. 11.
42 Michie and Sheehan (2003): p. 130.
43 A survey can be found e.g. in Àcs and Audretsch (1987).

previous period, as it serves as financial resources available to invest in the implemented innovation. This further reduces potential simultaneity problems with the used innovation variables.[44] An innovation is based mostly on foregoing research. For this reason, we also control for existing research activities of a company using the binary coded variable RESEARCH, for which we expect a high positive value. The binary coded variable HEAD labels companies with headquarters in the Netherlands and is used here as a measure of activities in foreign markets. The variable GROUP is also binary-coded and refers to companies that are part of a corporate group. Belonging to a large group of companies, a company can benefit from research and knowledge of other group members. In addition, economies of scale can also be assumed in business groups. For these reasons, we expect a positive influence on this variable.[45]

The firm's age is an important factor and makes it therefore one of the most used control variables. Unfortunately, the dataset does not contain information about the age of a company. For this reason, we use the age of employees as a proxy.[46] The age of employees may also take on other control functions. Young employees, who are highly skilled and motivated, are mostly working in young companies. Thus, young employees might have an additional positive influence on the productivity of young companies.[47] One the other side, older employees have more experience on average. So far, a company also benefits of a mixture of young and old employees. To address these considerations, we include the share of employees older than 50 OLD and the variation of age within a company DIFFAGE into the equation. For the control of different factors for innovation activities of the manufacturing, we include the grouped variable SERVICE in the analysis to distinguish service and other sectors from manufacturing industries. In addition, the individual dummies SECTORS and YEARS for all industries and years are included.[48]

Table 2 summarizes both individual empirical regression models and describes the variables used in each case.

44 For example, similar dissolved by Michie and Sheehan (2003): pp. 129–130.

45 Using this variable, we also want to consider that the data of the CBS is collected at the level of operating units and not at the level of entire companies. For this reason, only a few large and very large observations are preserved in the record.

46 Following the results of Ouimet and Zarutskie (2011), the employee's age is strongly positively associated with the age of the company. See Ouimet and Zarutskie (2011): p. 1.

47 See Ouimet and Zarutskie (2011): p. 1.

48 Therefore, we also try to control for the different market structures of each industry. Information about the possible influences of market structure on innovation can be found in Àcs and Audretsch (1987) or Cohen and Levin (1989). Additional descriptive statistics with the averages of all included variables can be found in Table 5 in the appendix.

Table 2: Description of included variables and regression models

Variables		Description	Code	I	II
Dependent variables					
	INNOVATION	Business unit (BE) had a successful innovation	Binary	x	x
	PROCESS	BE had a successful process innovation	Binary	x	x
	PRODUCT	BE had a successful product innovation	Binary	x	x
Financial flexibility					
	BARGAINLEV	Degree of centralization of wage bargaining	Grouped 1-3	x	x
	BARGAINCOV	Share of employees with a collectively bargained wage	Percentage	x	x
	NOLEV	No collectively bargained wages	Binary		x
	COMPLEV	Collective bargaining at company level	Binary		x
	INDLEV	Collective bargaining at industry level	Binary		
	DIFFWAGE	Wage differential within a BE	Continuous	x	x
	MEDWAGE	Average monthly wage per employee within a BE	Continuous	x	x
Numerical, functional flexibility					
	PARTTIME	Share of part-time employees in BE	Percentage	x	x
	EMPLOYSTAT	Share of employees with flexible contract in BE	Percentage	x	x
	TEMPEMP	Share of employees with a temporary contract in BE	Percentage	x	x
Labor turnover					
	LABIN	Share of employees who entered the BE within a year	Percentage	x	x
	LABOUT	Share of employees who left the BE within a year	Percentage	x	x
Control variables					
	SIZE	Logarithm of the number of employees within a BE	Continuous	x	x
	TURN	Logarithm of the previous annual BE turnover	Continuous	x	x
	RESEARCH	BE is doing research	Binary	x	x
	HEAD	Headquarter of the BE is in the Netherlands	Binary	x	x
	GROUP	BE is part of a group of companies	Binary	x	x
	OLD	Share of employees older than 50 within a BE	Percentage	x	x
	DIFFAGE	Age differential within a BE	Continuous	x	x
	SERVICE	BE belongs to the service sectors	Binary	x	x
	SECTOR	Sectors dummies	Binary	x	x
	YEARS	Year dummies	Binary	x	x

6. Results

The results of the random panel probit regression for model I of Table 2. are presented in Table 3. The coefficients are sorted by both, the different types of flexibility as well as the types of innovation. The financial flexibility, measured by a number of wage data, seems to have an overall positive impact on the implementation of an innovation. This applies to both process and product innovations. However, on closer inspection of each variable, some significant differences between the two types of innovation can be found. Additionally, the effects of the two groups of variables to measure financial flexibility vary. Thus, the effects of variables for bargaining and commitment of wages are significantly higher for new processes, while the information about the actual wage levels seems to have a stronger influence on products.

Table 3: Results of the random panel probit regression, model I

Model I		Innovation	Process innovation	Product innovation
Financial flexibility	BARGAINLEV	.1239**	.1585***	.0784
		(.0479)	(.0452)	(.0510)
	BARGAINCOV	.1363	.2224**	-.0451
		(.1110)	(.1064)	(.1183)
	MEDWAGE	-4.13e^{-04}*	-1.51e^{-04}	-3.09e^{-04}
		(2.11e^{-04})	(2.23e^{-04})	(2.28e^{-04})
	DIFFWAGE	6.83e-$^{-05}$***	4.76e^{-05}***	6.02e^{-05}***
		(1.81e^{-05})	(1.64e^{-05})	(1.86e^{-05})
Numerical, functional flexibility	PARTTIME	-.3041***	-.1919**	-.1591
		(.0890)	(.0893)	(.0992)
	EMPLOYSTAT	-.1944*	-.0628	-.2798**
		(.1154)	(.1164)	(.1329)
	TEMPEMP	-.0780	-.0511	-.1741**
		(.0778)	(.0763)	(.0858)
Labor turnover	LABIN	.3940**	.3074**	.4901***
		(.1525)	(.1499)	(.1660)
	LABOUT	-.2983***	-.2547**	-.2066*
		(.1081)	(.1075)	(.1183)
Control variables	SIZE	.1949***	.1887***	.1627***
		(.0148)	(.0144)	(.0160)
	TURN	.0381***	.0429***	.0512***
		(.0117)	(.0116)	(.0129)
	SERVICE	-.3845***	-.2735***	-.2459***
		(.0748)	(.0753)	(.0810)
	RESEARCH	2.1337***	1.0747***	1.9472***
		(.0629)	(.0431)	(.0536)
	GROUP	.1103***	.0978***	.1690***
		(.0322)	(.0320)	(.0354)
	HOLLAND	-.1107	-.0244	.0023
		(.0715)	(.0642)	(.0720)
	OLD	-.6876***	-.6889***	-.5404***
		(.1582)	(.1580)	(.1748)
	DIFFAGE	-.0283***	-.0165*	-.0346***
		(.0093)	(.0093)	(.0104)
	CONSTANT	-.7851***	-1.4779***	-1.4058***
		.2786)	.2796)	(.3057)
	SECTORS	Yes	Yes	Yes
	YEARS	Yes	Yes	Yes
Statistics	N	16444		
	Pseudo-R^2	.81037	.81350	.83797
	Log-LL	-7762.3707	-7634.2526	-6632.5795

Source: CBS, AIAS 1996 – 2008, own calculations.
*Standard errors in parentheses. Significance levels: ***/**/* 1 %/5 %/10 %*

Considering new processes, the influence of the level of wage bargaining BARGAINLEV is the highest. The more a wage is set on a flexible level the higher the probability of a process innovation. Our hypothesis I can therefore be confirmed at least for process innovation innovations. However, the effect on products is only about half as big and not significant. The same applies to the bargaining coverage BARGCAOV within a company. A high proportion of employees within a company, who are affected by the wage agreements, has a significantly positive influence on new processes. In contrast, the effect on products is even slightly

negative and again not significant. The higher the average wage of a company, the lower the probability of an innovation. According to the results of the variable MEDWAGE, this statement applies to all types of innovation, whereas the impact on products is slightly higher. Only a slight but significant and positive influence on all types of innovation can be found in the variable DIFFWAGE. As suggested in advance, a high difference of all wages within a company can be understood as an incentive for innovation. However, the coefficient for new products is again slightly higher. Due to these differences between the two types of innovation, our second hypothesis can also be confirmed.

The variables of the numerical and functional labor market flexibility have a throughout negative influence, both on products and processes. Thereby, PARTTIME has a higher and more significant impact on processes. That means, the higher the share of employees working on part-time, the lower the probability of a successful process innovation. Variables for the length and the security of the employment contract, however, seem to have a much smaller influence on processes. Both, EMPLOYSTAT and TEMPEMP, have only a small and not significant influence. In contrast, the coefficients and the significance level of both variables are significantly higher in products. A low job security seems to be negatively correlated with the successful implementation of new products. This suggests a possible higher significance of the employee's working motivation towards the development of product innovations, while process innovations seem to depend rather on working hours.

The coefficients of the variables measuring the labor turnover show the expected directions. LABIN as the proportion of employees, who start working in a given year, has a high positive and significant influence on innovation. However, the coefficient is slightly smaller for processes. That means, that new products depend more on new entrants with new human capital and also new ideas. On the other hand, the probability of an innovation decreases significantly with LABOUT, the share of employees, who leave the company within a year. Again, the coefficients of the two types of innovation vary. The leave of employees has a greater negative impact on process innovations. Overall, the labor turnover affects all types of innovation positively. Due to the varying coefficients, the total effect of labor turnover is lower for processes.

The control variables show the expected positive effects of the variable firm size SIZE and the annual turnover per employee of the previous period TURN. According to a higher coefficient for product innovations, the development of new products seems to require higher investments. As presumed, the variable SERVICE is negative. That means that service sectors have a generally lower rate of innovation. Companies engaged in intensive research have a significantly higher probability of a successful innovation. Thereby, the

influence of RESEARCH on product innovations is again much higher. This means that the development of new products depends much more on research as new processes. The control variable HEAD is slightly negative in general for innovation, however, slightly positive for processes and products. In each case the coefficients are not significant. A company that is part of a group of companies has a positive impact on innovation. However, the degree of impact on new products of the variable GROUP is about twice as high as on the development of new processes. The share of employees older than 50 OLD, used as a proxy for company age, has a strong negative impact on the probability of an innovation, both on products as well as on processes. This corresponds to the results of most of the innovation research.[49] Also the variation of employee's age DIFFAGE has an overall negative, but only slight influence. The used control dummies for the included industries show a high probability for a process innovation in the energy sector, gas and water, while product innovations occur more frequently in the chemistry or the mechanical engineering industry. In contrast, both new processes and new products appear at least in the catering and the retail sector.[50]

A far-reaching analysis of wage flexibility is made in the further step. Now, the individual negotiation levels are inserted into the equation. NOLEV stands for no collectively negotiated wages, while COMPLEV identifies firms with wage negotiations at company level. The results can be found in Table 4**.** In comparison to centralized wage bargaining at the industry level, a positive influence on innovation of both no collective bargaining and wage setting at company level can be found. This applies to processes as well as for products. Thereby, NOLEV has the greatest positive impact. In addition, as stated above for the components of wage flexibility, the bargaining levels have a significantly higher influence on the development of processes than of products. However, the assumed non-linearity as stated by Haucap and Wey (2004) cannot be found in our estimations, which is consistent with our hypothesis I. Regarding process innovations, no collective bargaining has a much more positive influence compared to wage setting at industry level than collective agreements at company level. The same holds for product innovations, although the difference between both coefficients is only very small and the results for both are not significant.

Including the individual levels of negotiation changes the influence of the other variables of financial flexibility. However, the changes only affect the variables related to the wage bargaining process. The coefficient of BARGAINCOV decreases in all types of innovation. The impact on products is even more negative. In addition, the significance level decreases slightly. MEDWAGE remains the same, but with a

49 See e.g. Huergo and Jaumandreu (2004).

50 Regarding the variables used to measure the financial flexibility and their impact on innovation, also a reverse causality could be conceivable. For this reason, we calculated separate regression equations for each variable with innovation as an independent variable. In addition, we used the instrumental variable approach with lagged versions of each variable as instruments. The results did not change. Therefore, we assume that there are no biases.

slight decrease of significance. The influence of DIFFWAGE also remains unchanged positive and significant. The influence of the negotiation variables on new processes is still strongest. On the other hand, the variables relating to the actual wage level have fundamentally more impact on new products, so that our hypothesis II is further confirmed. This suggests that not the actual wage level but the binding nature of wage bargaining as well as the level of coverage within a company have a particularly strong impact on a company's new processes.

Table 4: Results of the random panel probit panel regression, model II

Model II		Innovation	Process innovation	Product innovation
Wage flexibility	NOLEV	.1842 (.1281)	.2871** (.1246)	.1100 (.1409)
	COMPLEV	.1589** (.0669)	.1727*** (.0608)	.1005 (.0686)
	BARGAINCOV	.0757 (.1374)	.1938 (.1341)	-.0897 (.1503)
	MEDWAGE	$-4.15e^{-04}$** ($2.11e^{-04}$)	$-1.52e^{-04}$ ($2.23e^{-04}$)	$-3.11e^{-04}$ ($2.29e^{-04}$)
	DIFFWAGE	$6.72e^{-05}$*** ($1.81e^{-05}$)	$4.71e^{-05}$*** ($1.64e^{-05}$)	$5.94e^{-05}$*** ($1.87e^{-05}$)
Numerical, functional flexibility	PARTTIME	-.3034*** (.0890)	-.1918** (.0893)	-.1588 (.0992)
	EMPLOYSTAT	-.1925* (.1154)	-.0620 (.1164)	-.2783** (.1330)
	TEMPEMP	-.0788 (.0778)	-.0516 (.0763)	-.1750** (.0858)
Labor turnover	LABIN	.3927*** (.1525)	.3068** (.1499)	.4890*** (.1660)
	LABOUT	-.2978*** (.1080)	-.2542** (.1075)	-.2066* (.1183)
Control variables	SIZE	.1939*** (.0148)	.1882*** (.0145)	.1620*** (.0161)
	TURN	.0377*** (.0117)	.0427*** (.0116)	.0509*** (.0129)
	SERVICE	-.3850*** (.0747)	-.2737*** (.0753)	-.2463*** (.0810)
	RESEARCH	2.1326*** (.0629)	1.0743*** (.0431)	1.9466*** (.0536)
	GROUP	.1096*** (.0322)	.0975*** (.0320)	.1686*** (.0354)
	HOLLAND	-.1098 (.0715)	-.0241 (.0642)	.0029 (.0720)
	OLD	-.6939*** (.1584)	-.6921*** (.1582)	-.5452*** (.1751)
	DIFFAGE	-.0281*** (.0093)	-.0164* (.0093)	-.0345*** (.0104)
	CONSTANT	-.7197** (.2919)	-1.4468*** (.2933)	-1.3575*** (.3217)
	SECTORS	Yes	Yes	Yes
	YEARS	Yes	Yes	Yes
Statistics	N	16444		
	Pseudo-R^2	.810378	.813503	.837974
	Log-LL	-7762.0902	-7634.1916	-6632.4634

Source: CBS, AIAS 1996 – 2008, own calculations.
*Standard errors in parentheses. Significance levels: ***/**/* 1 %/5 %/10 %*

The influence of the variables to measure numerical and functional flexibility remains the same. It is still true that the influence of PARTTIME is significantly higher for new processes, while both EMPLOYSTAT and TEMPEMP have a significantly higher influence on new products. That means part-time workers have a negative impact on innovations, especially on new and cost-saving production methods. The impact of easy cancelable working contracts, however, is only very slightly negative and not significant on new processes. In contrast, these contracts have a very negative effect on new products based on extensive research and reliable staff. Regarding the variables of labor turnover, again, everything remains the same. Following the coefficient of LABIN, new workers are particularly important for new products. Disposals measured by LABOUT have a more negative influence on new processes. Overall, however, the fluctuation is not as critical for new processes as for new products.

Also the control variables do not change. The SIZE impacts positive, while the age variables OLD and SDAGE, used as proxies for the firm's age, affect rather negative. The variable TURN is still more important for products that seem require greater investments. The same applies to the variable group. Corporations usually have greater economies of scale, more money available and better conditions in the financial market. In addition, they benefit from more cumulative human capital and opportunities for cooperation and knowledge spillovers. Research also seems to be much more important for products than for processes.

At last, the results of the regressions show that innovations are most likely in large, regular industrial firms that conduct research on a regular basis and whose employees are mostly younger than 50 years old. Regarding the flexibility variables, new processes are likely at companies with a low employment change and more full-time workers, who choose for the largest share of their employees a more decentralized wage setting. Companies with product innovations on the other hand are characterized by a high proportion of employees with a fixed and permanent contract with a lower wage level as well as by a high number of new entries.

7. Conclusions

At least, we could find out that financial flexibility as a part of labor market flexibility indeed has an impact on the probability to innovate. However, the effects differ depending on the type of innovation. First of all, the variables used to measure financial flexibility can be divided into two groups. One group contains information about the actual wage levels in a company. The effects of these variables are almost the same for both processes and products, whereas the coefficients for products are a little bit higher. Thereby, a higher wage differential within a company has a positive impact, while a higher average wage affects rather negative. The other group of variables of financial flexibility considers the wage bargaining process as well as the number of employees with a collectively negotiated wage within a company. These variables differ with respect to height and direction of their influences as well as in relation to the significance level. Regarding process innovations, the impact of a more flexible wage bargaining is positive and significant. This is also true for the individual wage setting levels NOLEV and COMPLEV. Moreover, a high bargaining coverage within a company also encourages process innovation. In contrast, the bargaining level has only a slightly positive and not significant influence on the development of new products. The bargaining coverage even affects negatively, but the coefficient is again not significant. Finally, there is a significant influence on financial flexibility, but the overall effect depends strongly on the type of innovation. The impact on process innovation seems to be considerably larger. Additionally, the individual variables used to measure financial flexibility affect very differently. Insofar, the strength of the effect depends on both the type of innovation as well as the precise measurement of financial flexibility.

Basically, the financial flexibility refers particularly to the cost side of a company. Process innovations, which are mostly targeted on a cost reduction and an associated increase in productivity, therefore deal precisely with this cost side. Thus, the more flexible the financial statements of a company, the easier it seems to implement a successful cost-reducing process innovation. Thereby, the actual wage level appears to have no particularly strong influence. It's more about the opportunity to change these ongoing labor costs. The same applies looking at the numerical and functional aspects of labor market flexibility. Part-time has a significantly negative influence on the probability of a process innovation. This coefficient is even higher and more significant than for products. But the variables about the working contract are not that much important for processes than for products. A flexible and non-permanent contract reduces only slightly and not significantly the incentives to develop a process innovation. That means, a more flexible contract

termination as well as a more flexible wage setting is an important point for cost-reducing and productivity enhancing processes. On the other side, the development of new products seems to depend much more on the contract form and its impacts on the motivation of all employees. A product innovation usually needs more financial resources and involves therefore a higher risk for the company as well as for its employees. This is also reflected in the coefficients of the control variables TURN ad RESEARCH in our regression results Table 3 and Table 4. A product innovation requires more research as well as more prior investments than a process innovation. To make its employees able to take this risk, a company has to give them an incentive. Thereby, a full-time contract does not seem to have a big impact. The coefficient in our results is not significant. But the incentive seems to be much more about labor security. The negative impact of a flexible employment status on a product innovation is more than four times higher than for a process innovation. The same holds for non-permanent contracts. They reduce the probability of a new product more than three times more than they reduce the incentive for new processes. An additional incentive could be the wage differential. As stated above, the wage bargaining process do not have a huge impact on the development of product innovations. But the variables of financial flexibility regarding the actual wage levels affect much more. The higher the wage differential of all employees within a company, the higher seems to be the probability of a new product. Hence, the wage differential could also be an incentive for an employee to make its contribution to the development of a new product.[51] But what implications can be conclusively drawn from an innovation economic perspective? Promoting a more flexible wage setting at company level or at least no collective bargaining in combination with more flexible working contracts could support an easier development of process innovations. In addition, the level of wage negotiation should involve most of all employees within a company. A stabilization of the individual wage bargaining levels that are already weakened by possible opening clauses should therefore be encouraged.[52]

On the other side, supporting working contracts that could increase the labor security and therefore also the incentives to take the higher risk of a product innovation can enhance the probabilities to develop new products. At least, it seems like the need of more flexibility to be more innovative depends strongly on the type of innovation. While processes seem to require a more financial flexibility regarding the wage-setting processes, the development of new products, in contrast, seems to need higher incentives and ask therefore

51 We are trying to make a clear distinction between process and product innovation. We know that, in some cases, a process innovation follows a product innovation, especially in the case of a drastic creation of an entirely new product with an associated new market. A successful creation of a new product can sometimes force the development of a corresponding new production method. However, drastic product innovations are rare and just an exception. In addition, most of the process innovations in our data are clearly related to the cost side of a company. For this reason, we assume a more cost-driven way of thinking in the development of new processes.

52 See also Haucap and Wey (2004).

for a higher labor security. Thus, it seems like process innovations require for more and product innovations for less flexibility and more stability.

The creation of an innovation-friendly environment promotes both the domestic and especially the international competitiveness. However, reverse effects of innovation in turn on employment should also be considered. Although a cost-efficient production and a resulting increase in productivity should be encouraged, process innovations mostly have a negative impact on the labor demand of a company. In the long run, process innovations are usually classified as labor saving. Effective production methods allow more and more the replacement of labor by capital.[53] For this reason, the conditions for both types of innovation should be considered.

53 More information can be found in Edquist et al. (2001).

Appendix

Table 5: Averages of all variables included in the regression models

Variables		Innovation		Process innovation		Product innovation	
		Yes	No	Yes	No	Yes	No
Financial flexibility							
	BARGAINLEV	.2499	.1996	.2535	.2023	.2604	.2015
	NOLEV	.0770	.0791	.0713	.0785	.0795	.0779
	COMPLEV	.0958	.0414	.1108	.0454	.1014	.0457
	INDLEV	.8271	.8795	.8178	.8761	.8191	.8764
	BARGAINCOV	.6125	.6744	.6522	.6601	.5999	.6738
	MEDWAGE	85.662	131.340	73.050	125.007	86.7309	124.990
	DIFFWAGE	1334.022	1106.393	1348.396	1136.733	1369.232	1118.227
Numerical, functional flexibility							
	PARTTIME	.3006	.3908	.2938	.3752	.2903	.3830
	EMPLOYSTSAT	.0320	.0632	.0324	.0575	.0283	.0606
	TEMPEMP	.2104	.2447	.2060	.2385	.2075	.2413
Labor turnover							
	LABIN	.1783577	.2095017	.1754669	.204915	.1760757	.2065577
	LABOUT	.1944554	.2372936	.190432	.230545	.1894199	.2339379
Control variables							
	SIZE	4.212538	3.549829	4.35449	3.623401	4.2419	3.616357
	TURN	5.030475	4.799961	5.072833	4.832042	5.036728	4.824658
	SERVICE	1.66979	1.948782	1.602193	1.9044	1.629225	1.927407
	RESEARCH	.3129728	.0092058	.3510856	.0563193	.378779	.0207072
	GROUP	.6584875	.5148215	.6671053	.5354923	.6746049	.5251275
	HOLLAND	.9418824	.9731351	.931652	.9675706	.9384877	.9698819
	OLD	.1891	.1964	.1895	.1952	.1884	.1957
	DIFFAGE	10.603	11.105	10.627	11.022	10.523	11.077

Source: CBS, AIAS 1998-2008, own calculations

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AIAS provides both teaching and research. On the teaching side it offers a Masters in Comparative Labour and Organisation Studies and one in Human Resource Management. In addition, it organizes special courses in co-operation with other organisations such as the Netherlands Centre for Social Innovation (NCSI), the Netherlands Institute for Small and Medium-sized Companies (MKB-Nederland), the National Centre for Industrial Relations 'De Burcht', the National Institute for Co-determination (GBIO), and the Netherlands Institute of International Relations 'Clingendael'. AIAS has an extensive research program (2004-2008) on Institutions, Inequalities and Internationalisation, building on the research performed by its member scholars. Current research themes effectively include:

- Wage formation, social policy and industrial relations
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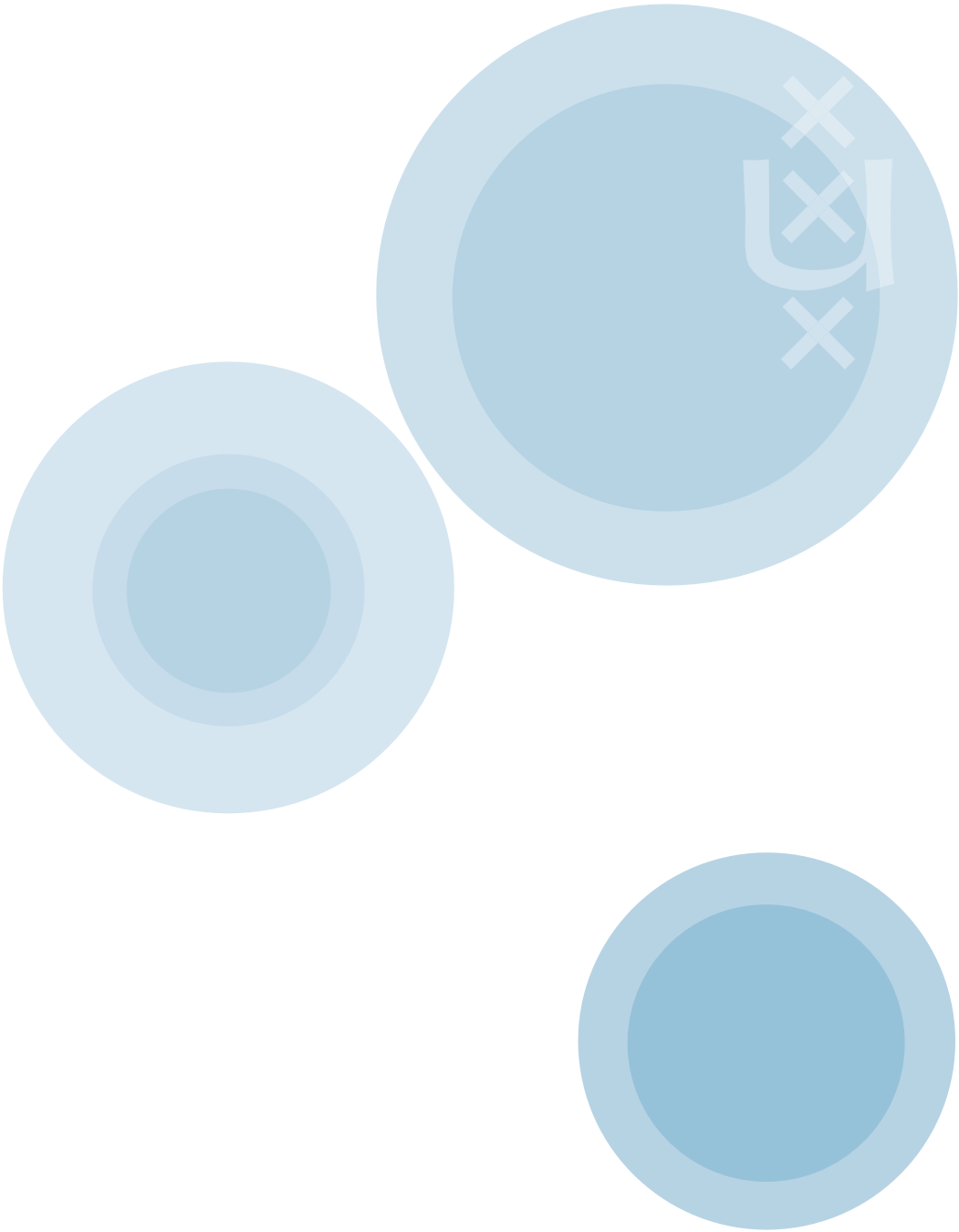
- The distribution of responsibility between the state and the market in social security
- The wage-indicator and world-wide comparison of employment conditions
- The projects of the LoWER network



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