BUDAPEST WORKING PAPERS ON THE LABOUR MARKET
BWP – 2009/8

Innovation and Rent Sharing in Corporate Wage Setting in Hungary

GÁBOR KŐRÖSI

INSTITUTE OF ECONOMICS, HUNGARIAN ACADEMY OF SCIENCES
DEPARTMENT OF HUMAN RESOURCES, CORVINUS UNIVERSITY OF BUDAPEST
BUDAPEST, 2009

Budapest Working Papers On The Labour Market
BWP – 2009/8

Institute of Economics, Hungarian Academy of Sciences
Department of Human Resources, Corvinus University of Budapest

Innovation and Rent Sharing in Corporate Wage Setting in Hungary

Author:

Author:
Gábor Kőrösi
senior research fellow
Institute of Economics Hungarian Academy of Sciences
E-mail: korosi@econ.core.hu

December 2009

ISBN 978 963 9796 87 4
ISSN 1785 3788

Innovation and Rent Sharing in Corporate Wage Setting in Hungary

Gábor Kőrösi

Abstract

Skill biased technical change arrived to Hungary with the transition to market economy. As Hungary integrated into the international economy, technical change progressed much faster in some sectors than in mature market economies. That lead to increasing skill premia, intensive rent sharing, and additional benefits for workers at innovative firms.

This paper analyses wage setting at Hungarian firms after the micro-economic restructuring and stabilisation period, in the years 1998-2006, with a special regard to wage determination at innovative firms. Wage setting is characterised by intensive rent-sharing. Premium at innovative firms varies with the way of measuring it, and also changes with the sector and over time.

JEL: J31, L10, O30, C23

Keywords: innovation, rent sharing, corporate wage setting

Innováció és hozamosztozkodás a vállalati bérmeghatározásban Magyarországon

Kőrösi Gábor

Összefoglaló

A tudásintenzív technikai átalakulás az átmenettel érte el Magyarországot. Az átmenet időszakában nálunk lényegesen gyorsabb volt a technikai fejlődés üteme, mint a fejlett piacgazdaságokban. Ez a képzettséghez kapcsolódó bérhozamok növekedéséhez és intenzív hozamosztozkodáshoz vezetett, aminek során az innovatív vállalatok dolgozói további juttatásokat is kaptak.

A tanulmány az 1998-2006-os időszak vállati bérezési gyakorlatát elemzi, és kiemelten vizsgálja azt, hogy az innovatív vállalatok bérezése mennyiben tér el az átlagtól. A vállalatok bérpolitikáját intenzív hozamosztozkodás jellemezte. Az innovatív vállalatoknál fizetett többletbér nagysága ágazatspecifikus, és időben is változik, valamint erősen függ attól is, milyen szinten, hogyan mérjük.

Tárgyszavak: innováció, hozamosztozkodás, vállalati bérmeghatározás

JEL: J31, L10, O30, C23

1. Introduction

Innovation may yield productivity gains and/or quality improvements in the output of a firm, leading to higher profits. However, a firm, engaged in research and development, needs employees able to work with new ideas, and adopt new methods. That requires special talents, and firms have to attract talented people with special incentives. These incentives may not only be higher wages: human resource management literature discusses other methods, like creating the right physical and social environment at the workplace. However, wage policy typically is one of the most important components of the package offered to innovative employees. Human resource management (HRM) literature discusses important details: how differences in incentive schemes should reflect the fact that research and development typically requires team effort, or that intellectual property may have different degree of vulnerability in different sectors.

Few people are able to innovate successfully. Those star performers, who can, frequently are offered special benefit packages. A small number of very talented persons can change the fortunes of the firm, and innovative firms obviously want to attract and keep such people. *Andersson, et al.* [2007], and [2008] borrow ideas from the HRM literature. Using a large linked employer–employee dataset they show, how highly skilled innovators can get very high rewards in competitive innovative sectors, like software engineering.

Innovative firms, however, do not only need stars. All employees need to be flexible enough when new procedures are introduced, and the company has to adjust to the novelty. That means that innovative firms need better quality labour, probably more highly skilled one than others. That also means that the average wage of a typical employee may well have to be higher at innovative firms.

When new technologies emerge, new skills may be needed, and those skills may be highly rewarded for a while. Several people studied the effect of computerization on the wage differentials. However, such effects, if exist, can only be short-term: as the new technology becomes part of the everyday operations, the extra benefit will fade away, *c.f., Entorf and Kramarz* [1997] and *Entorf et al.* [1999]. There always are new technologies demanding new skills. However, talented people can learn these skills, so innovative firms need well educated, talented people, who can flexibly adapt to new methods, techniques, and acquire the necessary expertise. There are relatively few such people, so the company will have to pay a premium for attracting and retaining them.

Rent sharing is an important ingredient of corporate wage policies. Companies frequently share their profits, or the returns to productivity improvements with their employees. It may help to align corporate and individual interests, giving incentives to efficiency enhancement.

Traditional labour market studies rarely find evidence of innovation related wage differentials among firms (*e.g., Bruinshoofd et al.* [2001]). The most important finding of the related labour market literature is that skill biased technical change increases within firm wage differentials as it leads to higher skill premium for the highly trained employees (*c.f., Machin* [2008]). That was also documented for Hungary by *Kertesi and Köllő* [2002] for the transition period. However, there is no sound theoretical foundation for expecting an ever increasing skill premium in corporate wage setting (*c.f., Card and DiNardo* [2002] vs. *Acemoglu* [2002]): it reflects the specific features of the innovation process in the past decades, and the shifts in the skill composition of labour demand and supply.[1] For example, *Naticchioni et al.* [2008] document declining skill premium in Italy in the past 15 years or so.

This study attempts to identify the effect of innovation on corporate wage setting on two levels. A linked employer-employee dataset is used for analysing corporate wage setting. However, characteristic features of the available data limit the scope of empirical analysis.

First, a standard dynamic firm-level wage model, based on rent sharing and efficiency wage hypotheses, is augmented with innovation indicators. This analysis, however, has to assume homogeneous labour, as the quality of labour can only be reliably measured for a relatively small number of large firms. Similarly to other studies, we find limited evidence of innovation premium in the overall wage setting of the firm.

Second, we measure innovation specific wage premium at the individual level, using an augmented human capital model. Unfortunately, this analysis has to be static due to the specific features of the dataset. However, the human capital model is augmented by firm, sector, and region specific variables, some also related to the research and development effort of the firm. Here we find substantial innovation related wage premium. However, this premium changes over time substantially. Initially, innovative firms, sectors paid higher wages to all employees. Since the late 1990's, however, innovation does not only influences inter-firm wage differences, but also intra-firm ones: we can only identify innovation premium for highly skilled employees in several innovative sectors. Employee level measurement also helps to identify the role of other factors, like wage dispersion, changes in the valuation of human capital.

The characteristic features of the dataset play important role in the empirical work. Section 2 discusses these data issues. Section 3 discusses hypotheses and the common

[1] *Brown and Campbell* [2002] couples a theoretical discussion of this issue with an extensive literature survey.

building blocks of the models. Section 4 presents results from the firm level analysis, while Section 5 discusses those at the individual level. Section 6 concludes.

2. Data

The paper uses a linked employer–employee dataset, with annual observations for the period 1992–2006 for Hungary, with additional information from an annual innovation survey since 1998.

The firm dimension is a panel, but employees are not identified over the years, thus the consecutive cross sections cannot be linked into a panel. Company information mostly consists of balance sheet data, supplemented with basic ownership, etc. information, also supplemented with regional and sectoral aggregates. The firm sample covers more than 50000 firms every year. It is strongly biased towards large firms; it covers roughly 90% of exports and value added, and well over 80% of employment. It covers all firms involved in research and development activities. However, employee information is only available for something like 15% of the firms in the sample, tilted towards large firms.

The corporate dataset does not differentiate labour: we only have total (full-time equivalent) employment and total wage bill, including premia. Thus an analysis based on this information has to assume homogenous labour.

The employee sample represents roughly 10% of the employees of these firms. The employee dataset consists of around 100000 observations annually: roughly 5% of corporate employment in Hungary. Employee information comes from the HR records stored at firms, thus it covers training, position, remuneration, etc., but it does not include family background and similar variables unknown to the firm.

The dataset details labour income by categories. As the corporate dataset consists of the total wage bill, here a comparable measure of wage was calculated: the benefit adjusted monthly wage, where one twelfth of annual premia were added to the monthly remuneration.

The innovation survey concentrated on research and development; all firms reporting research and development expenditures are covered. Innovation obviously is a much broader concept than R&D, however, other type of innovation activities are only available for a subset of firms, and unfortunately the common subset of the employee sample and the broader innovation survey sample is relatively small.

As the innovation data are only available for the 1998-2006 period, the sample for the empirical analysis starts with 1999, but the set of instrumental variables included observations from 1996.

The identification of R&D intensive sectors is based on the OECD classification: pharmaceuticals and high tech engineering. High-tech engineering consists of Aircraft and spacecraft; Office, accounting and computing machinery; Radio, TV and communications equipment; and Medical, precision and optical instruments sectors; *c.f., OECD* [2007], Appendix.

3. Assumptions and model specification

Several factors may influence corporate wage setting. Obviously, their importance is an empirical issue. This paper starts with a general specification incorporating most of these assumptions, thus their relative importance can be assessed.

The key assumption of our analysis is that companies share yields of productivity gains, or profits with their employees (*c.f., Katz and Summers* [1989]). *Rent sharing* may be the result of bargaining with monopolistic (unionised) labour. However, companies may not yield to insider power unwillingly: rent sharing may be part of their profit maximisign strategy as an incentive to increase productivity.

Rent sharing is frequently explained by changes in profitability, *e.g., Arai* [2003]. However, this paper rather follows the tradition of sharing the yield of productivity improvements, as those are more directly linked to innovative effort. *Nickell and Wadhani* [1990], in a seminal paper on British corporate wage determination, developed a dynamic adjustment model, where firms share the yields of productivity gains with their employees. Trade unions routinely refer to productivity growth in wage negotiations, so that is a more obvious channel of rent sharing. Productivity is measured by labour productivity (per employee value added).[2]

Nickell et al. [1994] extended the previous model, incorporating the effect of variables describing the intensity of product market competition and market position of the firm into the wage equation. They demonstrated that the favourable market position also was subject to a similar bargaining, and market power had a positive impact on wages in Britain. This positive impact also depended on firm size: trade unions were stronger at large firms, and thus, they have a stronger bargaining power against the management. Dominant firms were less likely to use unemployment pressure for limiting wage growth, thus making the wage curve effect conditional on firm size. Other studies also found that market structure and competitive pressure (*e.g.,* import penetration), or exposure to

[2] Productivity measurement is a complex issue. A quality adjusted total factor productivity measure would be also be possible. However, that is not the measure used at bargaining. Besides, labour productivity gave better, more stable empirical results.

foreign product markets may influence wage setting behaviour, *e.g., Abowd and Lemieux* [1993], or *Kramarz* [2003].[3]

Successful innovators can increase productivity and raise the quality of products and services, which enables them to charge higher prices. If the company is willing to share these yields with employees, higher and faster improving productivity may result in higher average wages at innovative firms. Wages may also be influenced by the need of hiring better, more talented and more flexible employees. These unobserved quality differences may increase 'normal' returns to human capital at innovative firms. That is especially true at firms involved in research and development (*c.f., Allen* [2001], *Andersson et al.* [2007] and [2008]). However, innovative firms also have to offer additional benefits as an incentive to dedicated work.

This paper uses an R&D activity indicator for measuring innovation effect. However, research and development, innovation are complex processes, which may influence wage setting in several ways. Benefits may be linked to some output measures, thus innovation effect may interact with productivity improvement: that is, innovative firms may share rents with their employees differently, than the average firm.

Obviously, in most cases only a relatively small fraction of employees play an important role in research and development. These people typically are highly trained professionals with very high human capital. The innovation premium may thus be strongly linked to the education premium. However, firms involved in research and development may want to spread benefits more widely, to create a positive environment.

Firms operating in sectors with strong research and development component frequently are multinationals. The location of research and development is decided at corporate headquarters. Innovation may come from the foreign branch of the firm, but it may still influence wage setting at the whole corporation. Thus, innovation premium is also measured at sectoral level at the manufacturing sectors with research and development intensive activity. A wage premium in these sectors may just be a spill-over effect of innovative firms, but it is likely that many firms in these sectors transfer innovation from other, foreign subsidiaries. This sectoral effect may not be uniform in all innovative sectors: pharmaceutical firms may protect intellectual property better with pattents than engineering enterprises, thus the innovation effect may be different in these sectors.

The inter-relationship of rent sharing and innovation premium is the main subject of our empirical analysis. However, there are several other factors studied in the literature which may also strongly influence corporate wage setting.

[3] It is interesting to note that they estimated opposite effect of foreign market exposure on wages: while *Abowd and Lemieux* [1993] found a positive, *Kramarz* [2003] a negative effect. The two models were substantially different: Kramarz could also take into account individual human capital endowments. It may just be a selection effect: firms under strong competitive pressure may have to employ better labour.

Larger firms are more likely to share rents and employ efficiency wage strategies. Firm size is usually measured by the number of employees. (*Bayard and Troske* [1999])

It is not always optimal to fully adjust wages to the actual prices and production decisions. Strong arguments support the *efficiency wages* hypothesis (*c.f., Akerlof* [1982] and *Akerlof and Yellen* [1986]) that adjustment is partial and slow. Thus, wage setting is a dynamic process.

Production decisions also depend on wages and on quality of labour. Basically employment and wage are jointly determined by the use of other productive inputs, and all depend on the actual demand for the products and services of the firm, given market prices. All these inter-related variables have to be treated endogenously.

A well-known and robust result of Hungarian labour market studies is that the type of ownership plays an important role in wage differentials at employee level, which cannot be attributed to standard explanatory variables of the human capital model. *Kertesi and Köllő* [2002] also showed that ownership structure changed the effect of other factors determining individual wages: while wages were strongly influenced by firm size at foreign-owned companies, productivity differences were more important at domestic firms. Foreign-owned companies paid relatively larger wage premium in low-wage sectors; thus, sectoral wages are less dispersed at foreign-owned employees than at domestic ones. They attributed a substantial part of ownership related sectoral wage differences to this relative advantage of low-wage sectors. *Earle and Telegdy* [2008] attribute some of these differentials to selection effect, but they still find substantial wage premium at foreign-owned firms.

Ownership-related differences were also observed in some other transition economies.[4] For example, *Dobbelaere* [2001] showed that foreign-owned firms paid higher wages in Bulgaria, but those wages were independent of the efficiency, thus, they did not share rents with their employees. Wages at state-owned enterprises, on the other hand, were strongly linked to productivity. However, foreign-owned firms seem to have different wage setting strategies in different transitional economies. *Damijan and Kostevc* [2002] analysed whether foreign investment had a positive effect on wage catch-up in transition economies. Their main result was heterogeneity: while they found a strong positive impact for Bulgaria and Hungary, the relationship was reversed in Estonia and Romania, and FDI had no significant effect on wages in Slovenia.

Several empirical papers, written on corporate wage setting in Poland found that the very intensive rent sharing was not independent of the ownership structure of the firms. (*Christev and Fitzroy* [2002] and *Bedi and Cieslik* [2002]) That sort of interaction is also tested for Hungary.

[4] The wage effect of foreign ownership is not transtion specific, *e.g., Aitken et al.* [1996] found persistent foreign owner wage premium for Mexico, Venezuela and USA, although with different characteristic features.

Regional wage differences are large and persistent in Hungary. The *wage curve* hypothesis of *Blanchflower and Oswald* [1994] offers a plausible explanation for this regional dispersion of average wages. They suggest that differences in regional unemployment rates strongly influence wage setting in the corporate sector. *Kertesi and Köllő* [1997] showed the fast growing role of local unemployment in wage setting in the early 1990's. Regional unemployment exerted an increasingly negative effect on wages in the competitive sectors.

Our main hypothesis is that there was an intensive rent sharing in the Hungarian economy, which may also be related to innovation effort.

Our initial model specifications attempts to encompass all above assumptions and hypotheses in some form. Two separate models are analysed at two different levels: first a dynamic wage determination model is estimated at the company level, second an augmented human capital model is estimated at the individual level.

The corporation level model explains average real wage differentials (incl. all premia) among firms.

The estimated model (at firm level):

$$\ln(W) = f(\ln(W_{t-1}), \ln(Pr), \ln(Pr_{t-1}), Innov, \ln(Pr) \times Innov, X) + \varepsilon$$

where W denotes wages, Pr is labour productivity, $Innov$ is the indicator variable for research and development activity, and two sectoral variables for pharmaceuticals and high-tech engineering measure possible spillover effects from innovative neighbours and/or foreign branches of the firm. X includes employment, local unemployment ratio, ownership (foreign and private), export share in sales, competitive pressure variables (market share, sectoral concentration index, and import penetration), together with meaningful interactions and time fixed effects.

The intensive transition period was over by the late 1990's in Hungary. However, *Kőrösi* [2007] found substantial structural breaks over time in the Hungarian corporate wage setting behaviour for this sample period, especially around 2002. There also were substantial sectoral differences. Because of this observed heterogeneity, the model should be estimated for specific subsamples, as the pooled estimation may be misleading.

Many variables are individually and jointly insignificant. Many studies use individual (firm) fixed effects to account for possible bias for omitted variables. However, as the model has to be estimated for short samples because of the structural break, fixed effects are not feasible.

As output, employment and wage decisions are the consequences of the same optimization process at the firm, wage, employment, output, exports, productivity, and all related variables (for example, market share, or various interactions) were treated as endogenous variables, using the system-GMM estimator (*c.f., Blundell and Bond* [2000]).

Unfortunately, at employee level we only have a series of cross sections, thus static models are used. But we also have human capital variables. An augmented Mincerian model is estimated, where the above firm specific factors are taken into account.

$$\ln(W) = f(Ed, Ex, \ln(Pr), Innov, X) + \varepsilon$$

where W is the benefit adjusted monthly wage of the employee, Ed is educational attainment, measured with the type of final qualifications, Ex is experience, measured in years. The innovation measure is either the previous research and development indicator, or a differentiated measure, where future, new, and past innovations are also distinguished.[5] X also includes gender, indicator for type of location (town, capital), and interactions with human capital variables, on top of variables used in the corporation level model. Equations are estimated by OLS. (Productivity does not seem to be endogenous, the Hausman test is not significant, when using firm specific instruments.)

The key differences between the two levels of measurement are: first, labour has to be treated homogeneously in the firm level model, thus variations in the quality of the labour employed by various firms may show up as differences in rent sharing, or some other components related to the quality of labour; second, as firm level models are dynamic, and coefficients are basically estimated from differences (system-gmm estimates coefficients partly from the differenced equation and partly using differenced instruments), fixed effects are largely eliminated, but those fixed effects do influence the estimation of the static individual level model.

4. Results 1: Firm level

The wage equation is estimated for various subsamples: all firms, manufacturing, and the two research intensive sectors: engineering and chemical industry. Table 1 summarizes estimation results.[6] The sample period was 1998-2006, but the model estimated for the full sample is strongly affected by a structural break; the estimates for the 1998-2001 and 2003-2006 subperiods are significantly different from each other, and have better properties. When the model is estimated for all firms, or the manufacturing firms, the specification is rejected by the overidentification test. That most probably is due to the

[5] *Future* indicates that the firm had not been involved in previous activity before, but it conducts research in the next year. *New* indicates the first year of R&D activity. *Past* indicates that the firm innovated until the previous year, but it no longer does research. These variables proved irrelevant in the firm-level model.

[6] Legend to Table 1: Estimation is by (system-)gmm with heteroscedasticity consistent standard errors. Productivity, employment and R&D activity are endogenous. Additional controls include local unemployment, market structure variables, ownership, various interactions, and time dummies. Asterisks after the coefficients and test statistics indicate that the test is significant at 0.05 level ($*$) or at 0.01 level ($**$). Overidentification test is the Sargan test; A–B 2^{nd} autocorr is the Arellano and Bond test for serial correlation; the joint test is the significance test for all variables, except time dummies, omitted from the table (Wold test, χ^2; time dummies usually are significant at the 0.01 level); Chow test tests for a structural break by the joint significance of the dummy premultiplied variables (Wold test, χ^2).

sectoral heterogeneity in wage determination, especially in rent sharing. The Sargan test typically is insignificant for sectors.[7]

Rent sharing is the dominant driving force of wage determination. Dynamic adjustment is an important component of the model. Research and development activity plays a limited role in wage setting, if we measure it at the firm level. The direct effect is usually positive, but marginal, however, the spillover effect seems to be ambiguous. The interaction of productivity and innovation is never significant. However, when the equations are estimated without the innovation related variables, the coefficients for the productivity change significantly, which shows that innovation plays an important role at the firms: it not only influences corporate wage determination, productivity is even more strongly influenced by research activity.

Wage negotiations typically concentrate on changes instead of levels. For example, trade unions typically refer to productivity growth, and attempt to get proportional increases. However, the estimated dynamics is different, it cannot be converted to simple differences.

The estimated model includes 41 coefficients for various variables, interactions, plus the coefficients representing the time fixed effects. Time fixed effects almost always are significant—macroeconomic conditions changed a lot during this period—, but other variables, omitted from Table 1, usually are insignificant. The few significant coefficients seem to be randomly distributed; there is no variable which was significant in both subperiods in both sectors.[8] However, omitting all insignificant coefficients changed some significant values, so their effect is not negligible, although insignificant.[9]

I paid a special attention to foreign ownership. Foreign-owned firms pay much higher wages than their domestic competitors, and empirical studies of Hungarian wage differentials typically found substantial foreign owner premium. However, ownership did not play an important role in the estimated dynamic wage equations, neither on its own, nor when looking at its interactions with other variables. It appears that higher wages were consistent with the higher productivity of foreign-owned firms. I also tested ownership related structural break, as in Poland, for example, wage setting was different at domestic

[7] The equation was also estimated for other sectors, but research activity is rare in other sectors. As the focus of this paper is the inter-relationship of rent sharing and innovation, I concentrate on the sectors with substantial R&D.

[8] Given the large number of coefficients, some tests really should be significant—every twentieth on the average, when using the 0.05 level—even if the true value of the coefficient is 0.

[9] *Kertesi and Köllő* [1997] found significant wage curve effect before our sample period. Local unemployment also was significant in Polish wage equations. It is insignificant here, even though there are substantial regional wage differences in Hungary. However, the regional distribution of unemployment situation has been very stable since the mid-1990's. As wages already adjusted to differences in unemployment levels before our sample, these differences are already incorporated into lagged wages, and local unemployment does not seem to exert additional pressure on wages.

Table 1: Wage determination: dynamic equation at firm level

Variables	1998–2006	1998–2001	2003–2006
All firms			
log lagged wage	0.52 **	0.59 **	0.45 **
log of productivity	0.35 **	0.55 **	0.44 **
log of lagged prod.	-0.24 **	-0.34 **	-0.25 **
R&D activity	0.06 **	0.09 **	0.05 **
High-tech engineering	0.03	0.00	0.02
Pharmaceuticals	-0.08	-0.09	-0.11 *
log of employment	-0.10 **	0.01 *	-0.06 **
Joint test χ^2_{34}	192.4 **	53.5 *	22.0
Chow test χ^2_{41}	83.3 **		
Nob	430483	225819	152373
A–B 2^{nd} autocorr	3.83 **	-3.83 **	2.17 *
Overident. test	14751.4 **	9818.7 **	1828.1 **
Manufacturing			
log lagged wage	0.52 **	0.55 **	0.44 **
log of productivity	0.41 **	0.43 **	0.42 **
log of lagged prod.	-0.25 **	-0.25 **	-0.22 **
R&D activity	0.04 **	0.05	0.02 *
High-tech engineering	0.01	0.06 *	0.01
Pharmaceuticals	-0.05	0.09	-0.12 *
log of employment	-0.06 **	-0.04 **	-0.06 **
Joint test χ^2_{34}	52.3 *	34.6	25.3
Chow test χ^2_{41}	102.0 **		
Nob	95715	48930	34716
A–B 2^{nd} autocorr	1.23	-2.92 **	-0.32
Overident. test	439.0 **	254.1 **	166.5 **
Engineering			
log lagged wage	0.51 **	0.57 **	0.40 **
log of productivity	0.50 **	0.53 **	0.43 **
log of lagged prod.	-0.26 **	-0.28 **	-0.18 **
R&D activity	0.03 *	0.08	0.00
High-tech engineering	0.04 **	0.01	0.04 **
log of employment	-0.02	-0.01	-0.06 *
Joint test χ^2_{34}	65.0 **	14.4	48.0 *
Chow test χ^2_{40}	72.6 **		
Nob	32779	14863	13341
A–B 2^{nd} autocorr	2.04 *	-0.13	-0.30
Overident. test	1422.4 **	95.0 **	58.6 *
Chemical industry			
log lagged wage	0.52 **	0.46 **	0.47 **
log of productivity	0.33 **	0.41 **	0.27 **
log of lagged prod.	-0.20 **	-0.17 **	-0.20 **
R&D activity	0.04	0.03	0.04
Pharmaceuticals	-0.04	0.20	-0.15 **
log of employment	-0.05	0.02	-0.09 *
Joint test χ^2_{34}	22.3	24.6	15.2
Chow test χ^2_{40}	43.7 *		
Nob	8424	3762	3480
A–B 2^{nd} autocorr	0.34	-1.66	-0.33
Overident. test	84.6 **	56.3 *	17.7

and foreign firms, however, that also was insignificant in the sectoral estimates.[10] That probably reflects the much higher penetration of foreign investors into the Hungarian corporate sector: foreign-owned companies set the pace for all firms in the Hungarian economy, so domestic firms cannot have different remuneration policies.

5. Results 2: Employee level

The static individual level wage equations are estimated for each year separately. Two alternative results are presented, which only differ in measuring innovation effect: Table 2 summarizes the baseline results for the period 1998-2006; estimates presented in Table 3 only differ in treating changes in innovation activity: three additional variables measure, how the innovation strategy of the firm changes. Figures 1-4 also highlight some tendencies in Table 2.[11]

When estimating employee level static models, there are strong structural breaks among consecutive years. Interestingly, the sectoral structural breaks become much less important; they are insignificant in several years, and even if significant, sectoral estimates do not differ that much. Thus for these equations an annual pooled regression was estimated. Labour had to be assumed to be homogenous in the corporate level wage model. As the skill composition of labour varies strongly among sectors, this sort of heterogeneity obviously showed up as sectoral differences in wage determination.[12]

Several variables became significant in the static regressions, which were insignificant in the firm level dynamic model. First and foremost, foreign ownership becomes a very important variable in static regressions, explaining a substantial fraction of wage differentials.[13] Clearly, foreign firms pay higher wages mostly because the dynamic adjustment process plays a different role in domestic and foreign firms.

Employment, and local unemployment are also significant in these static regressions, although the wage curve effect is very unstable over time, and more importantly, over alternative specifications. That indicates that the omission of the dynamic adjustment really changes the characteristics of the wage model.

---

[10] This structural break is significant in the entire sample and in the manufacturing sector, but that most probably is due to a composition effect, as the share of foreign-owned firms varies over sectors, and there are substantial differences among sectors.

[11] Legend to Tables 2 and 3: Estimation is by OLS with heteroscedasticity consistent standard errors. Additional controls include market structure variables, location, and various interactions. Asterisks after the coefficients and test statistics indicate that the test is significant at 0.05 level (∗) or at 0.01 level (∗∗). The joint test is the test for all variables omitted from the table (Wold test, χ^2); Chow test tests for a structural break by the joint significance of the dummy premultiplied variables for the previous year (Wold test, χ^2).

[12] *Galizzi* [2005] discussed the effect of changes in the composition of labour.

[13] That is also true in static firm level wage models, although the coefficients are typically smaller in those equations.

Table 2: Wage determination: Static equation at employee level

Variable	1998	1999	2000	2001	2002	2003	2004	2005	2006
Gender	0.14 **	0.14 **	0.15 **	0.13 **	0.13 **	0.14 **	0.13 **	0.15 **	0.12 **
Experience	0.02 **	0.03 **	0.03 **	0.02 **	0.02 **	0.02 **	0.03 **	0.03 **	0.03 **
Exp^2	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **
Vocational	0.11 **	0.11 **	0.11 **	0.09 **	0.08 **	0.06 **	0.07 **	0.07 **	0.08 **
Secondary	0.37 **	0.36 **	0.30 **	0.29 **	0.30 **	0.29 **	0.29 **	0.29 **	0.31 **
Tertiary	0.93 **	0.93 **	0.83 **	0.81 **	0.84 **	0.80 **	0.81 **	0.82 **	0.85 **
Productivity (log)	0.21 **	0.21 **	0.25 **	0.20 **	0.18 **	0.17 **	0.21 **	0.18 **	0.21 **
R&D	0.14 **	0.13 **	0.18 **	0.20 **	0.12 **	0.17 **	0.22 **	0.13 **	0.10 **
R&D×Tertiary	-0.05 **	0.02	0.09 **	0.04 **	0.06 **	0.11 **	0.10 **	0.13 **	0.05 **
Pharmaceutical	-0.01	-0.02	-0.16 **	-0.08 **	-0.12 **	-0.13 **	-0.03	-0.01	0.09 **
Pharma×Tert.	0.01	0.02	0.07	0.02	0.08	0.02	0.02	0.00	0.02
High-tech engin	0.00	-0.04 **	0.06 **	0.05 **	-0.02 **	-0.08 **	-0.08 **	-0.07 **	-0.06 **
High-tech×Tert.	-0.08 *	-0.07 *	0.06 *	0.10 **	0.02	0.06 *	0.04	0.05	0.00
Foreign	0.21 **	0.25 **	0.30 **	0.29 **	0.26 **	0.29 **	0.29 **	0.31 **	0.29 **
Employment (log)	0.10 **	0.10 **	0.06 **	0.09 **	0.07 **	0.08 **	0.06 **	0.06 **	0.06 **
Local unemp.	-0.13 **	-0.08 **	-0.12 **	-0.20 **	-0.07 **	-0.08 **	0.03 *	-0.09 **	-0.01 *
Joint test χ^2_{43}	114.3 **	93.8 **	142.2 **	249.0 **	78.7 **	143.8 **	94.3 **	148.9 **	84.3 **
Chow test χ^2_{59}		2945.8 **	684.5 **	943.2 **	239.1 **	382.4 **	97.2 **	693.9 **	249.1 **
Nob	103581	104860	118091	119417	114996	124527	137569	139125	135801
R^2	0.46	0.46	0.46	0.48	0.48	0.47	0.48	0.48	0.49

Figure 1 Returns to education

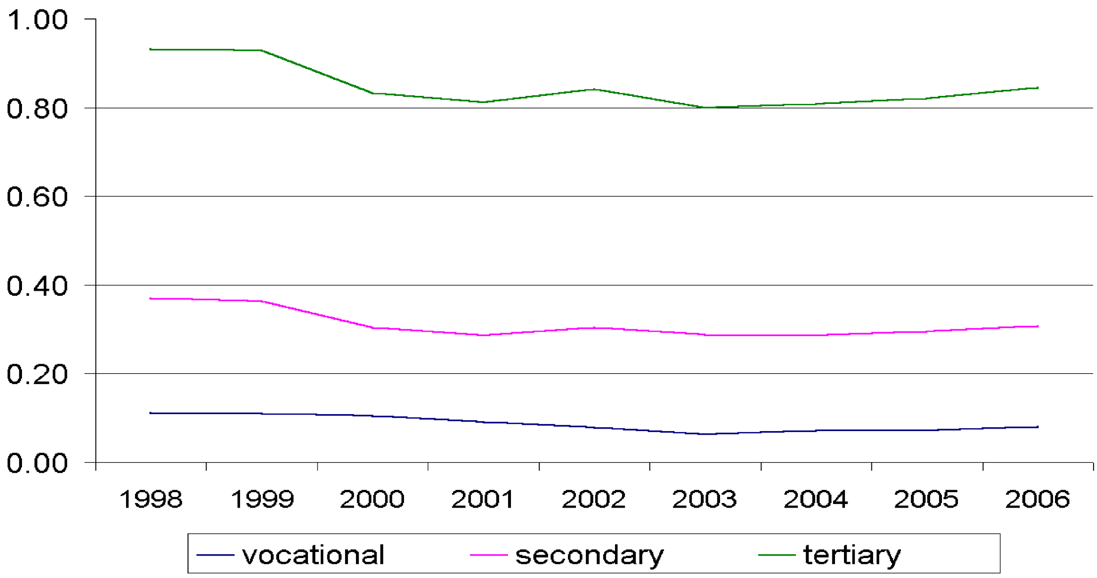
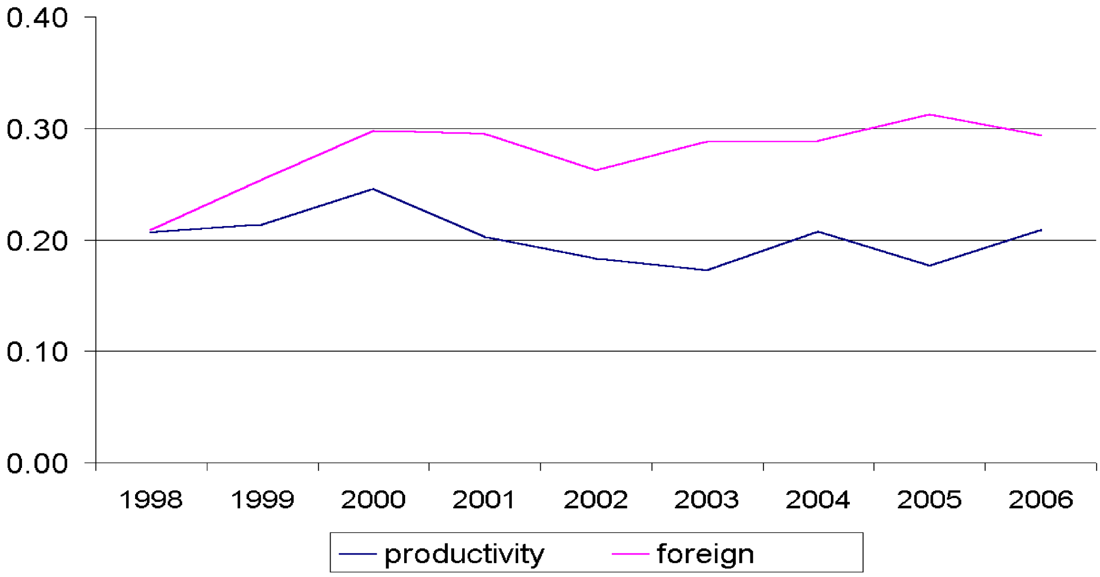


Figure 2 Foreign ownership premium and productivity elasticity



Fast skill-biased technical change resulted in very high returns to tertiary education. Several studies, including *Kertesi and Köllő* [2002] found that the gap increases ever since the late 1980's. However, our innovation augmented model qualifies that result. The returns to education did not change that much over time in these estimates. So the increasing skill premium may be due to a higher share of innovative firms, and a larger importance of innovation premia, which is mostly payed to highly skilled employees.

Estimated rent sharing is less intensive in the static model, part of the rent-sharing effect is clearly taken up by the ownership structure. Rent sharing is not directly related

Figure 3 Innovation premium

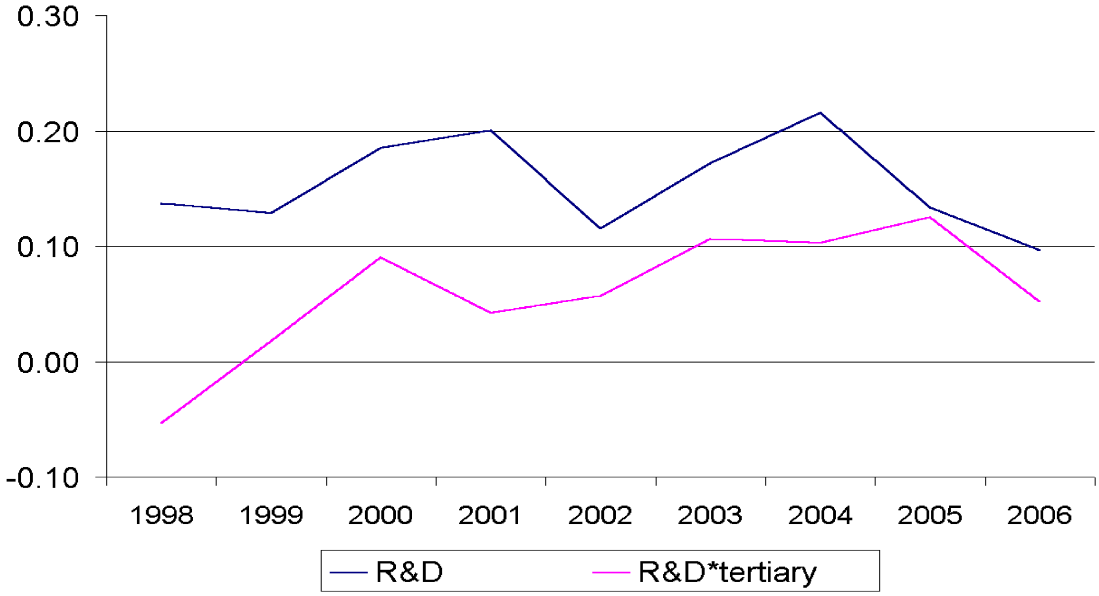
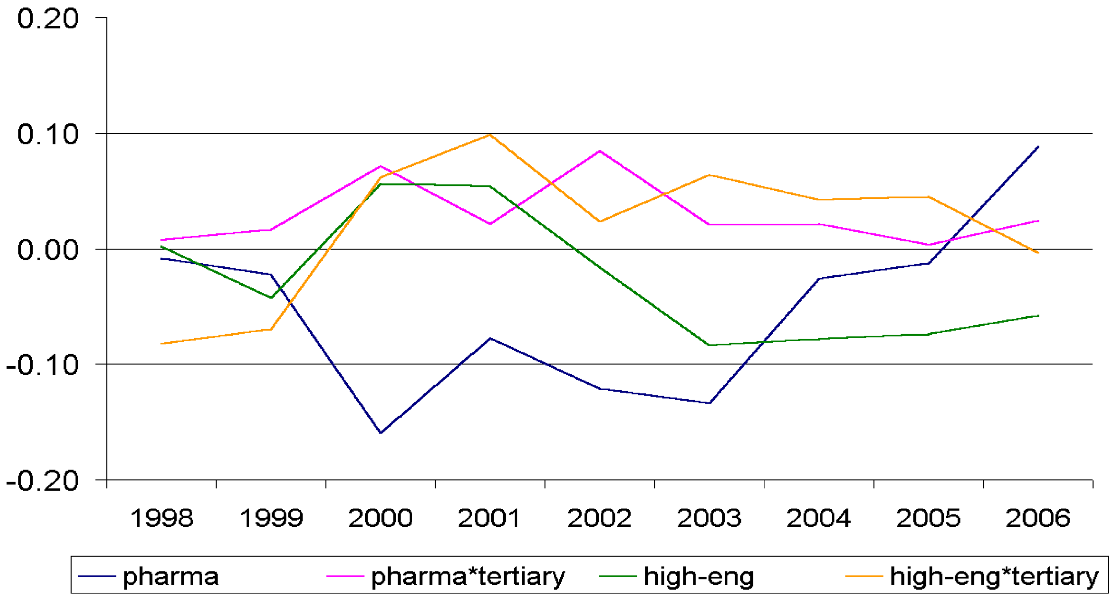


Figure 4 Pharmaceutical industry and high-tech engineering with R&D



to skills, but innovation premium is much bigger for highly educated people. Spill-over estimates are very sensitive to the inclusion of the innovation variable, and the pattern seems to shift from a general innovation premium at the beginning of the sample period to a skill specific innovation premium towards its end.

When looking at the effect of innovation dynamics, an interesting picture emerges (*c.f.*, Table 3). Firms starting research and development paid 5 to 15 percent extra premia in their first year of innovation effort until 2003 on top of the the regular premium

Table 3: Wage determination: Static equation at employee level

Variable	1999	2000	2001	2002	2003	2004	2005
Gender	0.13 **	0.14 **	0.13 **	0.12 **	0.14 **	0.13 **	0.14 **
Experience	0.03 **	0.03 **	0.02 **	0.02 **	0.02 **	0.03 **	0.02 **
Exp^2	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **
Vocational	0.12 **	0.11 **	0.09 **	0.08 **	0.06 **	0.07 **	0.07 **
Secondary	0.36 **	0.30 **	0.28 **	0.30 **	0.29 **	0.28 **	0.29 **
Tertiary	0.93 **	0.84 **	0.80 **	0.83 **	0.80 **	0.81 **	0.82 **
Productivity (log)	0.21 **	0.24 **	0.20 **	0.18 **	0.17 **	0.21 **	0.18 **
R&D	0.07 **	0.22 **	0.13 **	0.12 **	0.14 **	0.22 **	0.14 **
Future R&D	0.34 **	0.12 **	0.16 **	0.23 **	0.18 **	0.18 **	0.12 **
New R&D	0.15 **	0.16 **	0.07 **	0.05 **	0.08 **	-0.03 **	-0.02
Past R&D	0.30 **	0.14 **	0.34 **	-0.01	0.28 **	0.11 **	0.36 **
R&D×Tertiary	0.06 **	0.02	0.12 **	0.09 **	0.12 **	0.10 **	0.12 **
Pharmaceutical	0.03	-0.18 **	-0.02	-0.07 **	-0.15 **	-0.03	-0.02
Pharma×Tert.	-0.02	0.12 **	-0.03	0.09 *	0.01	0.02	-0.01
High-tech engin	-0.02 **	0.06 **	0.08 **	-0.07 **	-0.08 **	-0.09 **	-0.07 **
High-tech×Tert.	-0.07 *	0.07 *	0.09 **	0.03	0.06 *	0.05 *	0.05
Foreign	0.28 **	0.30 **	0.29 **	0.26 **	0.28 **	0.29 **	0.32 **
Employment (log)	0.09 **	0.06 **	0.09 **	0.07 **	0.08 **	0.07 **	0.06 **
Local unemp.	0.01	-0.15 **	-0.12 *	0.01 *	-0.05 **	0.02 *	-0.14 **
Joint test χ^2_{43}	84.3 **	151.4 **	193.2 **	82.2 **	129.1 **	89.4 **	141.4 **
Chow test χ^2_{62}		824.3 **	855.2 **	199.4 **	491.5 **	242.7 **	543.2 **
Nob	104661	118091	119417	114996	124527	137569	139125
R^2	0.48	0.47	0.48	0.49	0.47	0.48	0.49

paid by firms engaged in research and development activity. However, more importantly, firms preparing to start research activity increased wages substantially; before 2003 they paid higher premium than those already engaged in R&D activity. These firms, planning to innovate, had to attract workers able to do creative work, and obviously they offered high wages to them.[14] On the other hand, when a firm stops research and development, it still continues to pay higher wages; obviously, adjustment takes time, as wages, and also wage dynamics may be rather rigid downwards.

6 Conclusions

Rent sharing is much more intensive in Hungary than in developed market economies. Innovative firms pay an extra premium to their employees, especially to the highly skilled ones. Non-innovative 'neighbouring' firms may also have to offer somewhat higher wages, thus innovation premium may spill over to these firms, although that effect is very unstable and somewhat ambiguous. In a static model foreign-owned firms seem to pay hefty premia,

[14] Future R&D indicates that the firm starts R&D the year after. The next year is indicated by New R&D, when the firm actually started to innovate. Past R&D indicates that a former innovator is no longer engaged in research activity.

however that basically is the consequence of ignoring dynamics: it reflects the fact that multinationals are more innovative and dynamic.

Innovation has direct and indirect effects on wage determination. Firms with research and development activity increase productivity faster, thus they increase wages faster even with the same rent-sharing intensity. This effect may increase wage differentials even without a direct innovation premium. Innovative firms do pay significantly higher wages than those not involved in research and development; however, these higher wages are usually consistent with faster productivity growth, more dynamic development of the firm, thus when taking the dynamic adjustment process into account, that effect becomes difficult to measure. Another problem of firm level measurement of the innovation effect is that the innovation premium is unevenly distributed within firm: highly skilled employees get the most. As we cannot know the skill distribution from the company level data, that effect is poorly measured.

Table 4: Employment ratios of the population aged 25-62 by education, 1998 (%)

		Men			Women		
	Share of ISCED 0/1 & 2	All levels	ISCED 0/1 & 2	Diff-erence	All levels	ISCED 0/1 & 2	Diff-erence
Hungary	33	69.1	37.1	32	53.9	31.6	22.3
Poland	24	75.9	57.4	18.5	60.5	40.7	19.9
Comparators							
Austria	28	80.7	65.3	15.4	60.3	45.1	15.2
Finnland	28	76.2	61.6	10.9	69.8	57.8	12
Czechia	16	82.9	57.6	25.3	63.4	41.8	21.6
Comparators							
Danemark	20	84	69	15	73.2	55.7	17.5
Germany	19	76.9	62.5	14.4	59.7	40.4	19.3

Source: Education at a glance, OECD, Paris, 2000, Tables A2.1b and E1.1–E1.2.

However, the high rent sharing intensity is a curious fenomenon in Hungary. The usual explanation is that strong trade unions bargain with employers for the rent. Trade unions are very weak in the Hungarian corporate sector. The more plausible explanation is that relevant skills are rare in Hungary, and innovative and productive firms have to pay high wages just to attract and keep the few really able, properly skilled workers. Table 4 compares the employment probability of poorly educated people in Hungary to the same in some other small European countries. It is clear that there are more poorly educated people in Hungary than in the other countries, and their skills are much less useful: their employment chances are much worse than in the comparable economies. Thus, there is a clear skill shortage in Hungary, and innovative, productive firms have to compete for the few properly trained people. That explains why Hungarian firms are more willing to share rents with their employees than firms in most other economies, and why innovative firms pay relatively high innovation premium.

References

Abowd, J. and Lemieux, T. [1993]: The Effects of product market competition on collective bargaining agreements: the case of foreign competition in Canada; *Quarterly Journal of Economics*, Vol. 108, pp. 983-1014.

Abowd, J. M., Kramarz, F and Margolis, D. N. [1999]: High Wage Workers and High Wage Firms; *Econometrica*, Vol. 67, No. 2, pp. 251-333.

Acemoglu, D. [2002]: Technical Change, Inequality, and the Labor Market ; *Journal of Economic Literature*, Vol. 40, No. 1, pp. 7-72.

Aitken, B., Harrison, A. and Lipsey, R. [1996]: Wages and Foreign Ownership; *A Comparative Study of Mexico*, Venezuela and the United States; Journal of International Economics, Vol. 40, pp. 345-371.

Akerlof, G. A. [1982]: Labor Contracts as Partial Gift Exchange; *Quarterly Journal of Economics*, Vol. 97, No. 4, pp. 543-569.

Akerlof, G. A. and Yellen, J. L. (Eds.) [1986]: *Efficiency wage models of the labor market*; Cambridge University Press.

Allen, S. G. [2001]: Technology and the Wage Structure; *Journal of Labor Economics*, vol. 19, no. 2, pp. 440-483.

Andersson, F., Freedman, M., Haltiwanger, J., Lane J. and Shaw K. L. [2007]: *Reaching for the Stars: Who Pays for Talent in Innovative Industries?*; NBER, W12435

Andersson, F., Brown, C., Campbell, B., Chiang, H. and Park Y. [2008]: The Effect of HRM Practices and R&D Investment on Worker Productivity; *in: Bender*, S. at al. (Eds): The Analysis of Firms and Employees; University of Chicago Press, pp. 19-44.

Arai, M. [2003]: Wages, Profits, and Capital Intensity: Evidence from Matched Worker-Firm Data; *Journal of Labor Economics*, vol. 21, no. 3, pp. 593-618

Bayard, K. and Troske, K. [1999]: Examining the employer-size wage premium in the manufacturing, retail trade, and service industries using employer-employee matched data; *American and Economic Association Papers and Proceedings*, Vol. 89, No, 2, pp. 99-103.

Bedi, A. and Cieslik, A. [2002]: Wages and Wage Growth in Poland; *Economics of Transition*, Vol. 10, No. 1, pp. 1-27.

Bivens, J. [2006]: Wages, Profits, and Rent-Sharing in an Open Economy; *International Review of Applied Economics*, Vol. 20, No. 1, pp. 69-83.

Blanchard, O. and Katz L. [1999]: Wage Dynamics: Reconciling Theory and Evidence; *American Economic Review*, Papers and Proceedings, Vol. 89, No. 2.

Blanchflower, D. and Oswald, A. [1994]: *The Wage Curve*; MIT Press, Cambridge, MA, and London.

Blundell, R. and Bond S. [2000]: GMM estimation with persistent panel data: an application to production functions; *Econometric Reviews*, Vol. 19, No. 3, pp. 321-40.

Brown, C. and Campbell, B. A. [2002]: The Impact of Technological Change on Work and Wages; *Industrial Relations*, Vol. 41, No. 1, pp. 1-33.

Bruinshoofd, A., Hollauders, H. and Bas ter Weel [2001]: Knowledge Spillovers and Wage Inequality: An Empirical Analysis of Dutch Manufacturing; *Labour*, Vol. 15, No. 4, pp. 641-661.

Blanchflower, D., Oswald, A. and Garrett, M. [1990]: Insider Power in Wage Determination; *Economica*, Vol. 57, pp. 143-170.

Budd, J. Konings, J. and Slaughter, M. [2005]: Wages and International Rent Sharing in Multinational Firms; *The Review of Economics and Statistics*, Vol. 87, No. 1, pp. 73-84

Card, D. and DiNardo J. E. [2002]: Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles; *Journal of Labor Economics*, vol. 20, no. 4

Christev, A. and Fitzroy, F. [2002]: Employment and wage adjustment: insider-outsider control in a Polish privatisation panel study; *Journal of Comparative Economics*, Vol. 30, pp. 251-275.

Damijan, J. and Kostevc, C. [2002]: *The Impact of European Integration on Adjustment Pattern of Regional Wages in Transition Countries: Testing Competitive Economic Geography Models*; LICOS Discussion Paper 118.

Dobbelaere, S. [2001]: *Insider Power and Wage Determination in Bulgaria, An Econometric Investigation*; LICOS Discussion Paper 111.

Earle, J. S. and Telegdy, Á. [2008]: Ownership and Wages: Estimating Public-Private and Foreign-Domestic Differentials with LEED from Hungary, 1986 to 2003; *in: Bender*, S. at al. (Eds): The Analysis of Firms and Employees; University of Chicago Press, pp. 229-252.

Entorf, H. and Kramarz F. [1997]: Does unmeasured ability explain the higher wages of New Technology Workers?; *European Economic Review*, Vol. 41, pp. 1489-1509.

Entorf, H. Gollac, M. and Kramarz F. [1999]: New Technologies, Wages, and Worker Selection; *Journal of Labor Economics*, vol. 17, no. 3

Galizzi, M. [2005]: Wage Changes, Establishment Growth, and the Effect of Composition Bias; *Eastern Economic Journal*, Vol. 31, No. 2, pp. 165-184

Guadalupe, M. [2007]: Product Market Competition, Returns to Skill, and Wage Inequality; *Journal of Labor Economics*, vol. 25, no. 3

Hildreth, A. [1998]: Rent Sharing and Wages: Product Demand or Technology Driven Premia; *Economic Innovation and New Technology*, Vol. 5, pp. 199-226

Katz, L. F. and Summers, L. H. [1989]: Industry Rents: Evidence and Implications; *Brookings Papers on Economic Activity (Microeconomics)*, pp. 209-275.

Kertesi, G. and Köllő, J. [1997]: *The Birth of the 'Wage Curve' in Hungary 1985-95*; WDI working paper 104.

Kertesi, G. and Köllő, J. [2002]: Economic Transition and the Revaluation of Human Capital - Hungary, 1986-1999; *Research in Labor Economics*, Vol. 21, pp. 235-273.

Kőrösi, G. [2007]: Dynamics of Inter-firm Wage Differentials; *in: Fazekas (Ed): The Hungarian Labour Market 2006*, pp. 43-55.

Kramarz, F [2003]: *Wages and International Trade*; CEPR Discussion Paper No. 3936.

Machin, S. [2008]: An Appraisal of Economic Research on Changes in Wage Inequality; *Labour*, Vol. 22, Special issue, pp. 7-26.

Naticchioni, P., Ricci, A. and Rustichelli, E. [2008]: Wage Inequality, Employment Structure and Skill-biased Change in Italy; *Labour*, Vol. 22, Special issue, pp. 27-51.

Nickell, S., Vainoimaki, J. and Wadhwani, S. [1994]: Wages and Product Market Power; *Economica*, Vol. 61, pp. 457-473.

Nickell, S. and Wadhani, S. [1990]: Insider forces and wage determination; *The Economic Journal*, Vol. 100, No. 401, pp. 496-509.

Noorkôiv, R., Orazem, P.F., Puur, A., and M. Vodopivec [1998]: Employment and Wage Dynamics in Estonia, 1989-95; *Economics of Transition*, Vol. 6, No. 2, pp. 481-503.

OECD [2007]: *Science, Technology and Industry Scoreboard 2007*; OECD, Paris

Svejnar, J. [1999]: *Labor Markets in the Transitional Central and East European Economies*; in: Handbook of Labor Economics, Vol. 3b. O. Ashenfelter and D. Card, eds. Amsterdam: Elsevier Science, North-Holland, pp. 2809-2858.

Previous Issues of the Series

2008

Galasi Péter – Nagy Gyula: A munkanélküli-jövedelemtámogatások célzása Magyarországon 2004-ben. BWP 2008/1

Szilvia Hámori: Adult education in the European Union – with a focus on Hungary. BWP 2008/2

Galasi Péter: A felsőfokú végzettségű munkavállalók munkaerő-piaci helyzete és foglalkozásuk-iskolai végzettségük illeszkedése. BWP 2008/3

Anna Lovász: Competition and the Gender Wage Gap: New Evidence from Linked Employer-Employee Data in Hungary, 1986-2003. BWP 2008/4

Zsuzsa Blaskó: Does early maternal employment affect non-cognitive children outcomes? BWP 2008/5

Galasi Péter: A túl- és az alulképzés bérhozama 25 országban. BWP 2008/6

Galasi Péter - Nagy Gyula: Az aktív munkaerő-piaci programokba kerülés esélyei: képzés, bértámogatás, közhasznú munka. 2008/7

Galasi Péter: The effect of educational mismatch on wages for 25 countries. 2008/8

Gábor R. István: Életpálya-kereseti profilok és keresetingadozás. BWP 2008/9

2009

Istvan Gábor R.: Experience-earnings profile and earnings fluctuation: a missing piece in some labour market puzzles? BWP 2009/01

Anna Lovász – Mariann Rigó: Who Earns Their Keep? An Estimation of the Productivity-Wage Gap in Hungary 1986-2005. BWP 2009/02

Köllő János: Miért nem keresnek állást a magyar munkanélküliek? Hipotézisek az Európai Munkaerőfelvétel adatai alapján. BWP 2009/03

Bálint Mónika - Köllő János - Molnár György: Összefoglaló jelentés a KSH-ONYF adatfelvételről. BWP 2009/04

Gábor R. István: "Minimálbér-paradoxon" - versenyzői munkaerőpiacon? Egy gondolatkísérlet tanulságai. BWP 2009/05

Kertesi Gábor – Kézdi Gábor: Általános iskolai szegregáció Magyarországon az ezredforduló után. BWP 2009/06

Szilvia Hámori: Employment convergence of immigrants in the European Union. BWP 2009/07

A Budapesti Munkagazdaságtani Füzetek a Magyar Tudományos Akadémia Közgazdaságtudományi Intézetében működő Munkapiaci Kutatások valamint a Budapesti Corvinus Egyetem Emberi Erőforrások Tanszékének közös kiadványa.
A kiadványsorozat angol nyelvű füzetei "**Budapest Working Papers on the Labour Market**" címmel jelennek meg. A kötetek letölthetők az MTA Közgazdaságtudományi Intézet honlapjáról: **http://www.econ.core.hu**