SESO
STUDIECENTRUM VOOR ECONOMISCH EN SOCIAAL ONDERZOEK

VAKGROEP PUBLIEKE ECONOMIE

Labour economics or industrial economics? Analysing gross job creation and destruction in the theory of oligopoly

Jozef KONINGS[1]

Report 94/295

January 1994

[1] *I wish to thank Bruno De Borger, Stefan Késenne, Reinout Koopmans and Paul Walsh for helpful comments and discussions. All errors are mine.*

Universitaire Faculteiten St.-Ignatius
Prinsstraat 13 - B 2000 Antwerpen
D/1994/1169/01

Abstract

This paper analyses spillovers from the product market to the labour market to explain simultaneous creation and destruction of jobs even within narrowly defined homogenous goods sectors. The main result of the paper can be summarised as follows: Gross job creation and gross job destruction will be larger, the tougher the degree of price competition firms face. We provide evidence that support our framework of thought. It is suggested that modern labour economics should make more explicit use of modern I.O. theory.

JEL Classification: J5

Key words: Toughness of Price Competition, Job Creation, Job Destruction

I. Introduction

This paper is motivated by recent empirical evidence on gross job creation and destruction indicating that at all phases of the business cycle and even within narrowly defined sectors, there exists simultaneous creation and destruction of jobs (Davis and Haltiwanger 1990, 1992 for the U.S., Boeri and Cramer, 1992 for Germany, Contini and Revelli, 1993 for Italy and Konings, 1993 for the U.K.). This empirical literature questions seriously a lot of the existing theory in labour economics. A large class of models assumes homogeneous behaviour of firms within the same sector, assuming away idiosyncratic shocks to firm-level employment. Labour demand is usually analysed by assuming a "representative firm" and is concerned with corresponding wage elasticities. However, the firm's response to exogenous wage shocks might be different depending on several factors, like the nature of the shock (a positive viz. a negative one), strategic interaction with other firms, etc.. The results on job creation and job destruction indicate that firms do behave in a very heterogeneous way unlike the main working assumption of homogenous firm behaviour.

Gross job flows are related to net flows in the following way,

(1) ΔE = Entry + Expansions - Exit - Contractions,

Net employment growth (ΔE) is the sum of the employment flows stemming from biological change of firms (entry and exit) on the one hand and the expansion and contraction of existing firms on the other. It is exactly the right hand side in equation (1) which is at the core of the theory in industrial organisation. A large body of the research in I.O. is concerned with the evolution of the size distribution of firms and the process of firm expansion and contraction. It is argued that the forces behind the process of firm and industry evolution is one of learning (Jovanovic, 1982). Firms are endowed with a certain efficiency level which is a random draw of a known distribution. It is only over time that firms find out about their efficiency level and this leads to heterogeneous firm behaviour regarding employment growth.

In this paper we do not pursue this route further, rather we want to show the importance of the integration of the theories developped in the Industrial Organisations literature with Labour Economics[2]. While it is difficult to generate simultaneous job creation and job destruction in typical labour demand models, we show that it is a natural result if we model strategic interactions between firms. By doing this we suggest that there exists a relationship between the *degree of price competition* firms face and the amount of gross job creation and destruction within one sector. We also provide preliminary empirical results encouraging the approach we suggest.

Section 2 provides the basic theoretical framework. Section 3 analyses labour demand in the extreme of weak price competition, while section 4 analyses the other extreme of tough price competition.

---

[2]Examples in the literature using Industrial Organisation to analyse labour market problems are Dowrick, 1989 and Konings and Walsh, 1993.

II. Basic Framework

In this section we introduce two examples which reflect a more general result. Under oligopoly the equilibrium price a firm faces can vary from the monopoly price to the competitive price level. The two examples we work with must be viewed as "building blocks", rather than real life situations. We use homogeneous Cournot competition as a building block to model weak price competition on the one hand, and on the other hand we use homogeneous Bertrand competition as a building block to model very tough price competition. If our result holds for these two extreme cases we assume it will hold for any degree of price competition which lies inbetween these two examples (see Sutton, 1991).

We assume that the wage is determined exogenously in order to keep the labour market as simple as possible in our model such that we can focus on the importance of the product market in the demand for labour. Two firms produce a homogeneous product with one factor of production, labour (L). Firm 1 produces X and earns a payoff π, while firm 2 produces Y and earns a payoff π^*. Both firms have the same technology, with diminishing marginal productivity of labour and face a conventional inverse demand function for their product. We write the payoff functions for firm 1 and 2 respectively as the following:

(1) $$\pi = P(X,Y)X - WL$$

(2) $$\pi^* = P(X,Y)Y - W^*L^*$$

Where W is the per unit wage cost of workers in firm 1 and W^* is the per unit cost of workers in firm 2.

III. Labour Demand under Weak Price Competition

In this section we use the model described above to analyse labour demand and fluctuations in labour demand in the extreme of weak price competition. In other words we assume Cournot Oligopoly.

Both firms move simultaneously and unilaterally. Firm 1 chooses L to maximise π, given W, holding L^* constant. Firm 2 chooses L^* to maximise π^*, given W^*, holding L constant. We first analyse employment setting in firm 1 by writing down its first order conditions for profit maximisation.

(3) $$\pi_L = P(1 + 1/\eta)F' - W = 0$$
$$\Rightarrow L = R(L^*)$$

where η stands for the price elasticity of demand and R(.) stands for the optimal response function of firm 1.

Similarly for firm 2,

(4) $$\pi^*_{L^*} = P(1 + 1/\eta^*)F^{*\prime} - W^* = 0$$
$$\Rightarrow L^* = R^*(L)$$

Thus in both firms employment is set where the marginal revenue product of labour, which is conditional on L, is equal to the per unit wage. The conditions are expressed as optimal response functions, R and R^*, in equation (3) and (4). The following implies uniqueness and stability of the Nash equilibrium in employment setting.

(5) $$D \equiv \pi_{LL}.\pi^*_{L^*L^*} - \pi_{LL^*}.\pi^*_{L^*L} \quad > 0$$

Where $\pi_{LL^*} = \pi^*_{L^*L} < 0$.

Solving (3) and (4) simultaneously we obtain the optimal employment in firm 1 and firm 2 as a function of the exogenous variables, W and W^*, or

(6) $$L^0 = \rho^1(W,W^*)$$

(7) $$L^{*0} = \rho^2(W,W^*)$$

Note that employment demand not only depends on the firms own wage, but also on the wage paid in the other firm. This is a very common result for an industrial econmist, not for a labour economist. Taking a total differential of (3) and (4) and by applying Cramer's rule we obtain the comparative static effects of a change in resp. W and W^* on the optimal employment levels in firm 1 and 2, yielding the expected signs, or

$$\rho^1_1 = \pi^*_{L^*L^*} / D < 0,$$

$$\rho^1_2 = \pi^*_{L^*L} / D > 0,$$

$$\rho^2_1 = \pi_{LL^*} / D > 0,$$

$$\rho^2_2 = \pi_{LL} / D < 0.$$

These comparative statics effects may be interpreted as idiosyncratic shocks on the wage. An exogenous increase in the wage in firm 1, holding the wage in firm 2 constant and is therefore specific to firm 1, leads to a decrease of employment in firm 1 (job destruction) and to a lesser extent an increase of employment in firm 2 (job creation). Figure 1 illustrates the effect of an idiosyncratic shock to the wage in firm 1. We start from a symmetric equilibrium, where $X_0 = Y_0$, implying $L_0 = L^*_0$. Employment is set where the *conditional* marginal revenue product of labour is equal to the firm's wage level. We call this the *conditional* marginal revenue product, since it depends on a *given* employment level in the other firm. An idiosyncratic shock in firm 1, pushing up the wage in firm 1 from W_0 to W_1 and leads to a fall of employment in firm 1 (job destruction) and to a lesser extent to an increase of employment in firm 2 (job creation). Note in figure 1 that the *conditional* demand for labour demand for firm 2 shifts out in response to a fall in employment in firm 1. This results in a shift in the conditional demand function of firm 1 further in.The reason for this is because employment demand in one firm is *conditional* on employment in the other firm and hence employment in the other firm becomes a shift factor. We summarise these results as the following,

Result 1: *Under oligopoly, even with homogenous products, there is simultaneous job creation and destruction within one sector in response to idiosyncratic shocks.*

Result 2: *Under oligopoly, the labour demand curve in firm i will shift in response to (i) a change in the wage in firm i, (ii) a change in the wage in firm j.*

IV. Labour Demand Under Strong Price Competition

In this section we investigate how results 1 and 2 change or don't change when we assume the limit of tough price competition, Bertrand competition. In this case the strategies of both firms can be described as follows:

Firm 1 sets a price, P, to maximise profits, π, given the exogenous wage, W and holding P^* constant. Firm 2 sets a price, P^*, to maximise profits, π^*, given its exogenous wage W^*, and holding P constant. They play simultaneously and non-cooperative, and have no capacity constraints. Assuming symmetry in costs, $W = W^*$, then it is easy to show, by proof of contradiction, that the unique Nash Equilibrium for this game is characterised by the following:

$$(8) \qquad P = P^* = W = W^*$$

This result is standard for the Bertrand Model (see e.g. Tirole, 1989). Analysing the comparative static effects of a change in W (W^*) is equivalent to analysing the effects of idiosyncratic shocks. The smallest exogenous increase in the wage of firm 1 will ensure that firm 2 enjoys the entire market, while firm 1 will exit, because then $P^* = W^* < W = P$. In other words in this case job destruction and job creation are maximised. Thus, in the limit of tough price competition, results 1 and 2 still hold.

We can summarise sections III and IV in the following propositions,

Proposition 1: *In the presence of idiosyncratic shocks there exists simultaneous creation and destruction of jobs even within homogenous goods industries. This holds independent of the degree of price competition in the product market.*

Proposition 2: *Job creation and job destruction will be weaker, the weaker the degree of price competition firms face.*

V. Empirical Results

In this section we test the importance of the product market in the process of job creation and job destruction, and thus look for evidence supporting our barebone model of the previous sections. The dataset consists of approximately 1000 U.K. manufacturing firms drawn from the EXSTAT/DATASTREAM company accounts over the period 1972-1986. This sample is a representative one for the U.K. manufacturing sector, although the correlation bewteen employment growth in the sample and employment growth in the manufacturing population weakens after 1982. This is due to the companies act of 1982, implying that firms were no longer required to report "home" or domestic employees. As a consequence the sample size drops significantly after 1982. For this reason we shall look at correlations up to 1982. More details can be found in Konings (1993).

Gross job creation in sector j is defined as follows

(9) $$pos_{jt} = \Sigma_{i \in I} g_{it}(x_{it}/X_{jt}), \text{ for all } g_{it}>0$$

where X_{jt} stands for sector size j at time t, I stands for the set of all firms in sector j at time t and g_{it} is the growth rate in firm i and x_{it} stands for the size of firm i at time t. The gross job destruction rate in sector j at time t is then defined as

(10) $$neg_{jt} = \Sigma_{i \in I} |g_{it}|(x_{it}/X_{jt}), \text{ for all } g_{it}<0$$

Gross job reallocation in sector j at time t is then simply the sum of the gross job creation and gross job destruction rate or

(11) $$gross_{jt} = pos_{jt} + neg_{jt}$$

To compare gross job flows with net flows we define net employment growth in sector j at time t as the difference between the job creation and job destruction rate or

(12) $$net_{jt} = pos_{jt} - neg_{jt}$$

Table 1 shows the size weighted average gross job creation, destruction and reallocation rate for different manufacturing sectors. It is clear that there exists simultaneous creation and destruction of jobs even within narrowly defined sectors. This comfirms proposition 1 above.

To test proposition 2 we have to proxy the degree of price competition. To do this we assume that the analysis is short term. In this case we can proxy the "toughness of price competition" by the 5-firm concentration ratio. A high concentration ratio would reflect weak price competition, while a low concentration ratio would reflect tough price competition. A long term analysis would involve modelling entry in a two stage game, stage one captures the entry decision, while stage 2 the price competition stage. In the theory set out above, we restricted the analyses only to the second stage. Concentration ration as a proxy for price competition in the long run would be less appealing since in that case concentration is endogenously determined.

As a first raw test, we computed the median concetration ratio for each year. At the aggregate level, there exists a clear negative correlation between concentration and gross job reallocation. The pearson correlation coefficient is -0.53, if this is only computed up to 1982, the pearson correlation coefficient is even -0.63. We also computed the spearman rank correlations at the industry level. Table 2 summarises them. There exists a clear negative rank correlation between gross job reallocation, creation and destruction on the one hand and concentration on the other. This correlation is even stronger if we restrict our sample until 1982.

Finally, we regressed the industry gross job reallocation rate on industry concentration and other industry characteristics, like import penetration, industry sales, union density and R&D intensity. These are standard industry characteristics, which might capture different aspects of the degree of price competition as set out in the theory. We also included a set of time dummies to control for common aggregate shocks. The estimation methododogy we used, is robust regression. The main reason to use this is to control for outliers. Since we are merely searching for raw correlations, rather than trying to estimate a structural model or a demand equation, it is important to control for these outliers, which potentially bias the main correlation between the variables. The procedure of robust regression exists in first performing an initial screening based on Cook's distance > 1 to eliminate outliers prior to calculating starting values. The next step performs Huber iterations followed by biweight iterations, as suggested by Li (1985). Table 3 reports the results. The first column simply regresses the gross job reallocation rate on industry concentration and time dummies. There is a strong and negative correlation bewteen the two. The second column also includes the other industry characteristics already mentioned. Import penetration captures an exogenous increase in competition from abroad and is positively related to the gross job reallocation rate. R&D relaxed price competition and as expected, has a negative effect on gross job reallocation, although the coefficient is not significant at conventional levels. An increase in industry sales captures an increase in demand and is negatively correlated with gross job reallocation. Finally, union density is negatively correlated, but not significant.

VI. Conclusion and Summary

The aim of this paper was to make the bridge between Industrial Organisation and Labour Economics and to provide a "barebone" theoretical framework. We did this to find explanations for the observed pattern of gross job flows in the U.K. and elsewhere, although the I.O. approach could be applied to numerous other problems in labour economics. The traditional theory in labour economics, assumes homogeneous firm behaviour or a representative firm and can therefore not explain simultaneous job creation and job destruction.

We have shown that as soon as we take into account strategic interactions between firms, it is very easy to obtain simultaneous job creation and destruction within one sector. Our main result is that there exists a relationship between the *degree of price competition* and the *amount of job creation and destruction* at the industry level. The weaker the degree of price competition the lower the gross job reallocation rate is. We tested this proposition using U.K. data and found evidence in favour of our theory.

Perhaps a neater way of testing the theory is to compare industry gross job flows between different countries. The same industries in different countries should reflect the same technology and therefore the same degree of price competition (unless there is government intervention). Therefore, there should be a positive correlation between the different industries over all countries regarding the of gross job reallocation. However, the current research on gross job flows is still in its childhood. Of crucial importance is access to good micro-level data, however a lot of European countries still do not allow researchers access to them. Hopefully this will soon change.

Table 1: Gross job flows for 2-digit industries

2-digit name	pos	neg	net	gross
Brick and Rooftiles	0.024	0.039	-0.015	0.064
Building Materials	0.021	0.041	-0.020	0.063
Cement and Concrete	0.019	0.027	-0.008	0.047
Paint	0.022	0.045	-0.023	0.067
Electricals	0.013	0.038	-0.025	0.051
Cold formed fastening	0.062	0.045	0.017	0.107
Founders & Stampers	0.022	0.051	-0.029	0.073
Industrial Plant	0.025	0.039	-0.014	0.065
Mechanical Handling	0.029	0.040	-0.011	0.069
Pumps and Valves	0.019	0.043	-0.024	0.062
Steel and Chemical Plant	0.043	0.046	-0.003	0.089
Wires and Rope	0.011	0.063	-0.052	0.074
Misc.Mechanical Engineering	0.016	0.054	-0.038	0.070
Machine Tools	0.025	0.053	-0.028	0.079
Misc.Engineering Contractors	0.027	0.067	-0.040	0.095
Instruments	0.012	0.045	-0.033	0.057
Metallurgy	0.028	0.041	-0.013	0.070
Special Steels	0.003	0.080	-0.076	0.083
Misc. Metal Forming	0.011	0.046	-0.035	0.058
Radio and T.V.	0.044	0.027	0.017	0.071
Floor Covering	0.013	0.054	-0.041	0.068
Furniture and Bedding	0.060	0.035	0.025	0.096
Household appliances	0.033	0.067	-0.034	0.101
Cutlery	0.034	0.044	-0.010	0.078
Motor Components	0.016	0.052	-0.036	0.068
Motor Distributors	0.008	0.079	-0.071	0.088
Breweries	0.028	0.014	0.014	0.043
Wines and Spirits	0.027	0.034	-0.007	0.062
General Food Mnfg.	0.013	0.039	-0.026	0.052
Milling and Flour	0.056	0.031	0.025	0.087
Newspapers & Periodicals	0.015	0.048	-0.033	0.063
Publishing & Printing	0.020	0.050	-0.030	0.070
Packaging and Paper	0.024	0.040	-0.016	0.065
Clothing	0.036	.0420	-0.006	0.078
Cotton and Synthetic	0.001	0.066	-0.065	0.067
Wool	0.028	0.059	-0.031	0.087
Misc. Textiles	0.011	0.071	-0.060	0.083
Tobacco	0.066	0.058	0.008	0.125
Footwear	0.028	0.024	0.004	0.052
Toys and Games	0.065	0.088	-0.023	0.150
Plastics and Rubbers	0.032	0.052	-0.020	0.085
Pharmaceuticals	0.015	0.034	-0.019	0.049
General Chemicals	0.010	0.053	-0.043	0.063

Note: The figures refer to 14-year size weighted averages.

Table 2: Spearman Rank Correlations between concentration and y at Industry Level

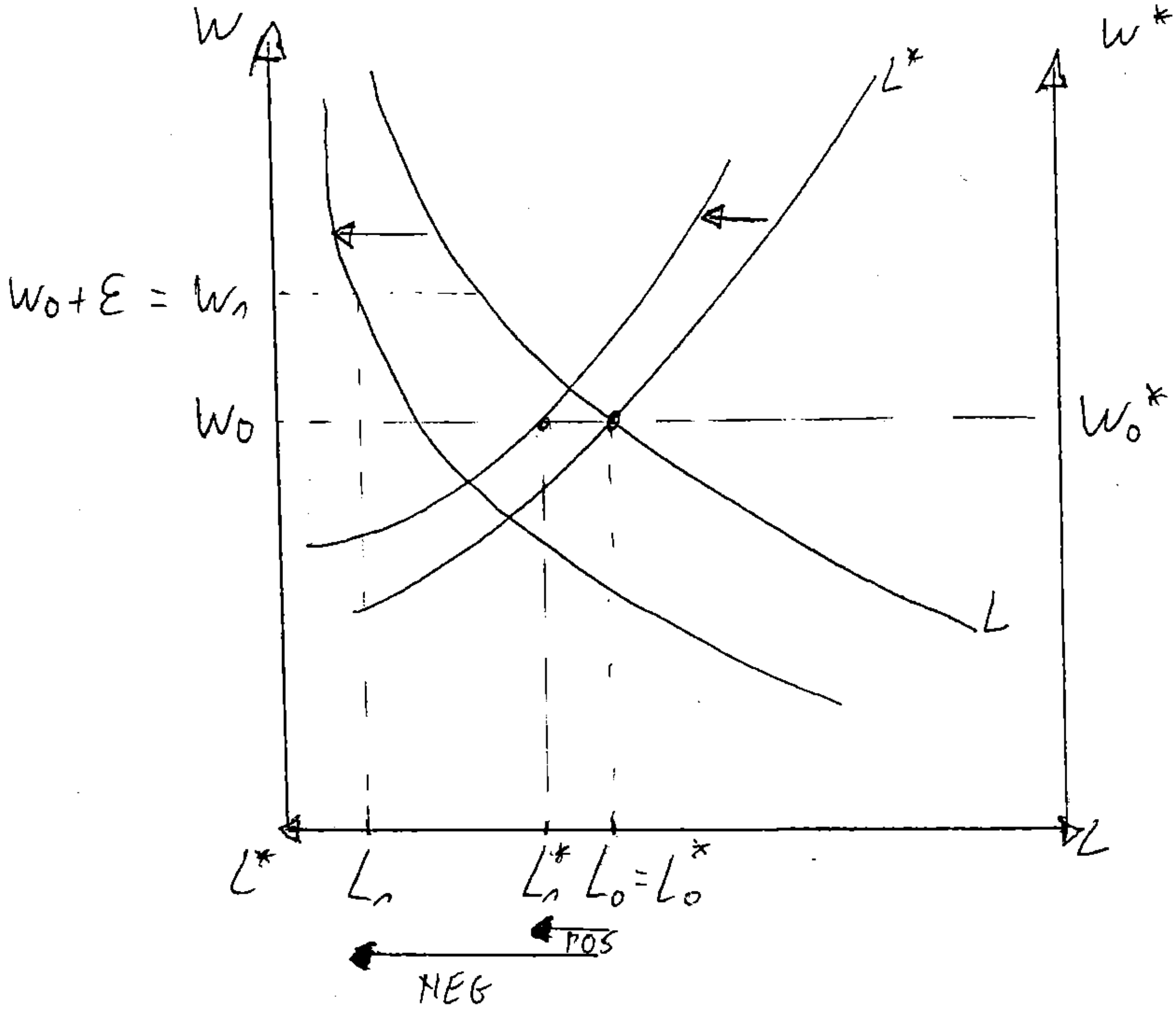
y	entire sample	up to 1982
gross	-0.14	-0.21
pos	-0.046	-0.132
neg	-0.14	-0.11

Table 3: Robust Regression Results
Dependent Variable: Gross Job Reallocation Rate

	(1)	(2)
concentration	0.038	-0.033
	(-4.49)	(-3.86)
import penetration	_	0.0003
		(2.42)
R&D	_	-0.0009
		(-1.03)
industry sales	_	-7.98e-07
		(-1.879)
union density	_	-0.016
		(-1.086)
N	380	380
F(.,.)	22.86(10,369)	17.99(14,365)

Notes: t-statistic in brackets, time dummies included.

Figure 1



References

Boeri, Tito and Cramer, Ulrich (1992). "Why Are Establishments So Heterogeneous? An Analysis of Gross Job Reallocation in Germany." Unpublished.

Contini, Bruno and Revelli, Ricardo (1993). "Job Creation and Labour Mobility: The Vacancy-Chain Model and Some Empirical Findings", R&P Working Paper No. 8/RP Torino.

Davis and Haltiwanger (1990). "Gross Job Creation and Destruction: Microeconomic Evidence and Macroeconomic Implications". *NBER Macro Economic Annual*, 5, pp 123-168.

_________________(1992)."Gross Job Creation, Gross Job Destruction and Employment Reallocation", *Quarterly Journal of Economics*, August, 3, pp. 819-863.

Dowrick, Steve (1989). "Union-Oligopoly Bargaining". *The Economic Journal*, Vol. 99, pp. 1123-1142.

Jovanovic, Boyan (1982). "Selection and Evolution of Industry". *Econometrica*, 50, pp. 649-670.

Konings, Jozef (1993)."Job Creation and Job Destruction in the U.K. Manufacturing Sector". *Centre for Economic Performance Discusssion Paper 176, London School of Economics.*

Konings, Jozef and Walsh, Patrick (1993). "Evidence of Efficiency Wage Payments in U.K. Firm Level Panel Data". *The Economic Journal*, forthcoming May 1994.

Li, G. (1985). "Robust Regression". *Exploring Data Tables, Trends, and Shapes*, ed. D.C. Hoaglin, F., et al., New York: John Wiley & Sons.

Sutton, John (1991). *"Sunk Costs and Market Structure"*, MIT Press.

Tirole, Jean (1989).*"Industrial Organisation"*, MIT Press.

LIJST VAN RECENTE SESO-RAPPORTEN

SCHROYEN F., The comparative statics of tax evasion with elastic labour supply - Can we really say anything about the reactions of a tax evader ?, November 1992, 62 blz. **(92/280)**

COPPIETERS P. & A. HUFKENS, The role of the service sectors within the changing economic structure, December 1992, 23 blz. **(92/281)**

COPPIETERS P., DE BORGER B. & A. HUFKENS, Productivity growth measurement in the Belgian banking sector 1985-1989, December 1992, 26 blz. **(92/282)**

VAN GOMPEL J., Stabilization with wage indexation and exchange rate flexibility -a survey of the literature-, January 1993, 47 blz. **(93/283)**

NONNEMAN W., De kosten van instellingen van hoger onderwijs buiten de universiteit, januàri 1993, 33 blz. **(93/284)**

HEYLEN F., VAN POECK A. & J. VAN GOMPEL, Real versus nominal convergence - national labour markets and the European integration process, April 1993, 42 blz. **(93/285)**

KESENNE S., The unemployment impact of a basic income, May 1993, 25 blz. **(93/286)**

CORTENS I. en W. NONNEMAN, Is het onderwijs meer dan een filter ?, juni 1993, 31 blz. **(93/287)**

VAN TRIER W., James Meade and his "social dividends" - An intriguing chapter in the history of an idea, July 1993, 34 blz. **(93/288)**

HEYLEN F., The theory and evidence of unemployment persistence - A review of the literature, August 1993, 41 blz. **(93/289)**

YZEWYN D., Input-outputanalyse en toeristische impactmeting - een verkennende toepassing voor Vlaanderen, augustus 1993, 70 blz. **(93/290)**

HEYLEN F. en A. VAN POECK, Government preferences and equilibrium inflation - a simple test of the Barro-Gordon Model, August 1993, 24 blz. **(93/291)**

VAN POECK A., Belgian banks under stress - the effects of deregulation and financial innovation on the performance of the Belgian credit institutions, September 1993, 32 blz. **(93/292)**

VAN GOMPEL J., Unemployment and monetary integration - on the relevance of wage formation characteristics in a target zone regime versus an irrevocably-fixed exchange rate regime, November 1993, 22 blz. **(93/293)**

BORGHERS E., Automatic ARMA identification for a large number of time series, December 1993, 42 blz. **(93/294)**