ÖSTERREICHISCHES INSTITUT
FÜR WIRTSCHAFTSFORSCHUNG

WORKING PAPERS

Long-run Homogeneity of Labour Demand

Panel Evidence from OECD Countries

Franz R. Hahn

199/2003

Long-run Homogeneity of Labour Demand

Panel Evidence from OECD Countries

Franz R. Hahn

WIFO Working Papers, No. 199
March 2003

E-mail address: Franz.Hahn@wifo.ac.at
2003/060/W/0

Long-run Homogeneity of Labor Demand

Panel Evidence from OECD Countries

Franz R. Hahn
Austrian Institute of Economic Research
P.O.B. 91
A-1103 Vienna
Franz.Hahn@wifo.ac.at

Abstract

This paper is making an attempt to examine the long-run relationship between the key labor market parameters employment, aggregate output, real product wages and labor-augmenting technical progress for a sample of 21 OECD countries covering the period from 1970 to 2000. We apply a new panel error correction technique which allows us to constrain the long-run coefficients to be identical across the countries while letting the short-run coefficients which govern the dynamics, and the error variances differ freely, respectively. Thus, this estimation approach assumes that institutional and cultural differences, albeit causing short-term deviations of labor demand behavior across countries, leave the long-run structure of the labor markets unaffected. That is to say, the long-run equilibrium relationship between the key labor market variables is taken to be similar across the OECD economies. The empirical analysis shows that the long-run relationship between the key labor market parameters is equal across the OECD countries. However, adjustment speed of actual employment to the equilibrium is much higher in countries with flexible labor markets such as the U.S.A. and U.K. than in countries with rigid labor markets such as Germany and Austria.

JEL classification: C33, J2, J3, O3

Keywords: long-run employment, labor demand, labor market design, panel analysis

I am very grateful to Christa Magerl for excellent research assistance on this and related projects.

1. Introduction

Demand for labor is widely assumed to be governed by three key parameters: the adjustment speed of actual employment to the long-run equilibrium value, the real wage elasticity of labor demand, and the development of labor-augmenting technical progress.

This paper is aimed to check this proposition econometrically for 21 OECD economies over the period 1971 through 2000. To this end, we apply a dynamic panel estimation technique which allows for controlling for the quantitative impact of the institutional specifics of the labor market on labor demand behavior in these countries. In so doing, we also deal with the flip-side of this problem by asking whether there are any other differences in labor demand behavior in highly developed countries left to be explained. Theory suggests there aren't. This paper holds that theory is right.

The plan of the paper is as follows: Section 2 presents the estimation strategy. We apply a new panel error correction technique which allows us to constrain the long-run coefficients to be identical across groups while letting the short-run coefficients, which govern the dynamics, and the error variances differ freely, respectively. Thus, this estimation approach assumes that institutional and cultural differences, albeit causing short-term deviations of labor demand behavior across countries, leave the long-run structure of the labor markets unaffected. That is to say, the long-run equilibrium relationship between the key labor market variables is taken to be similar across the OECD economies. We check this homogeneity assumption by applying a Hausman test. Section 3 discusses the main findings of the empirical analysis. Section 4 concludes.

2. Demand for Labor – A Panel Error Correction Approach

We use the standard neoclassical optimization approach to derive the optimal labor demand function. Given a CES-production function, the long-run employment equation to be estimated thus has the following form:

$$\text{(1)} \qquad \ln L = \frac{1}{1+\rho} \ln(1-\alpha) - \frac{\rho}{1+\rho} \ln A + \ln Q - \frac{1}{1+\rho} \ln\left(\frac{W}{P}\right) - g\,t$$

where L stands for employment, ρ is the substitution parameter, α is the distribution parameter with $(1-\alpha)$ indicating the relative labor share in the product, A is the efficiency parameter, Q stands for aggregate output, $\frac{W}{P}$ for real product wages, and t is a time trend. The latter is expected to capture the labor-augmenting technical progress that is assumed to advance at a rate g.

To estimate the long-run employment equation (1) we apply the dynamic heterogeneous panel approach introduced by *Pesaran – Shin – Smith* (1999). This is supported by standard unit roots tests. For almost all OECD countries covered in the WIFO-OECD panel data set the Augmented Dickey-Fuller statistics suggest that the output, employment and real wage variables are $I(1)$. Aggregate output, as measured by real gross domestic product, employment, as measured by annual hours worked by employed persons and real product wages are based on estimates provided by the OECD and the University of Groningen, respectively. Implausible or poorly documented estimates of hours worked and of real product wages, respectively, have been replaced by own calculations. The calculation methods applied by WIFO are made available on request.

The econometric model used in the empirical analysis is an autoregressive distributed lag $ARDL$ model. Given data on time periods $t=1,2,3,...,T$, and groups $i=1,2,3,...,N$, the $ARDL(p,q,q,....,q)$ has the following general structure:

$$(1') \qquad y_{i,t} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta_{ij} x_{i,t-j} + \mu_i + \varepsilon_{i,t},$$

where $x_{i,t}$ is a $(k*1)$-vector of explanatory variables (regressors) for the group *i*, μ_i represent the fixed effects, λ_{ij} are the coefficients of the lagged dependent variables and δ_{ij} are $(k*1)$ coefficient vectors. The disturbances $\varepsilon_{i,t}$, $i=1,2,3,..., N$, $t=1,2,3,...,T$, are independently distributed across *i* and *t*, with zero means and variances $\sigma_i^2 > 0$.

Re-parameterization of (1') leads to the following error correction equation:

$$(2') \qquad \Delta y_{i,t} = \phi_i y_{i,t-1} + \beta_i x_{i,t} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*} \Delta x_{i,t-j} + \mu_i + \varepsilon_{i,t}$$

with $\phi_i = -(1 - \sum_{j=1}^{p} \lambda_{ij})$, $\beta_i = \sum_{j=0}^{q} \delta_{ij}$, $\lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{im}$, $j = 1, 2, 3, ..., p-1$,

and $\delta_{ij}^{*} = -\sum_{m=j+1}^{q} \delta_{im}$, $j=1,2,3,...,q-1$. Symbol Δ represents the first order difference operator.

An $ARDL(1,1,1)$ of equation (1) with no restrictions then has the following form:

$$(2) \qquad \ln L_{i,t} = \mu_i + g_i t + \delta_{10i} \ln Q_{i,t} + \delta_{11i} \ln Q_{i,t-1} + \delta_{20i} \ln\left(\frac{W}{P}\right)_{i,t} + \delta_{21i} \ln\left(\frac{W}{P}\right)_{i,t-1} + \lambda_i \ln L_{i,t-1} + \varepsilon_{it}.$$

The subscripts $i=1,2,3,...,21$ stand for 21 OECD countries, the subscripts $t=1971,1972,1973,...,2000$ for the years 1971 to 2000, μ_i represent the fixed effects due to the parameters α_i, A_i, and ρ_i, respectively, and $\delta_{i,j}$ are the coefficients of the explanatory variables and λ_i the coefficients of the lagged dependent variable.

The error correction equation of the dynamic model (2) is:

$$(3) \quad \Delta \ln L_{i,t} = \mu_i + \phi_i \left\{ \ln L_{i,t-1} - \theta_{1i} \ln Q_{i,t} - \theta_{2i} \ln\left(\frac{W}{P}\right)_{i,t} - \theta_{3i} t \right\} - \delta_{11i} \Delta \ln Q_{i,t} - \delta_{21i} \Delta \ln\left(\frac{W}{P}\right)_{i,t} + \varepsilon_{i,t}$$

where the error correction term in parenthesis depicts the equilibrium relationship (1), $\phi_i = -(1-\lambda_i)$ denote the adjustment coefficients, θ_{ji}, $j = 1, 2, 3$ the long-run coefficients, where $\theta_{1i} = \frac{\delta_{10i} + \delta_{11i}}{1-\lambda_i}$, $\theta_{2i} = \frac{\delta_{20i} + \delta_{21i}}{1-\lambda_i}$, and $\theta_{3i} = \frac{g_i}{1-\lambda_i}$, and δ_{ki}, $k = 11, 21$, represent the short-run coefficients.

The following restrictions are imposed by theory: the existence of a long-run equilibrium relationship requires $\phi_i \neq 0$ (that is, $\phi_i < 0$ in case of error correction), and given a standard CES-production function $\theta_{1i} = 1$, and $\theta_{2i}, \theta_{3i} < 0$.

As discussed in Pesaran – Shin – Smith (1999), three econometric techniques seem to be suitable to estimate $ARDL$ models such as equation (2): Mean Group (MG), Pooled Mean Group (PMG) and Dynamic Fixed Effects (DFE). The standard pooled and aggregate estimators are not consistent in dynamic models, even for large N and T (see, for example, *Pesaran – Smith*, 1995).

With both T, the number of time series observations, and N, the number of groups, quite large, all three methods produce consistent estimates of the coefficients, though these estimates will be inefficient (and biased) when specific homogeneity assumptions hold. The MG estimator is consistent and imposes no restrictions at all, and thus provides a standard of comparison. Since the MG estimator does not pay attention to the fact that certain parameters may be homogenous across groups, averaging the coefficients over groups can lead to substantial efficiency losses. More importantly, MG can easily be affected adversely by outliers in the finite sample case. Traditional pooled estimators such as the DFE, however, assume the opposite by constraining the coefficients and the error variances to be the same across groups. Only the intercepts are allowed to differ from group to group. These estimators may cause substantial efficiency losses when only long-run homogeneity assumptions are valid.

In macroeconomic settings, it often is compelling to impose equality of the long-run slope coefficients and allow the short-run dynamics and error variances to differ across countries, respectively. This allows for a tailor-made dynamic specification for every country, e. g. the number of lags included. In so doing, cultural and institutional specifics of a country, which usually drive short-term dynamics, can be properly accounted for.

The PMG, as shown by *Pesaran – Shin – Smith* (1999), has the advantage over the DFE and the MG model in that the short-run dynamics (and the error variances) are allowed to differ freely while the long-run slope coefficients are assumed to be equal across groups. We argue that, given the subject matter (that is, estimating the long-run relationship between the key labor market parameters in the OECD economies), the PMG estimator is superior to the other two estimators (MG, DFE) for a very good reason: Due to similar levels of economic and technological development, but profound differences in institutional infrastructure and design, it can rightly be expected that the long-run equilibrium relationships between fundamental variables is similar across the OECD countries, with the speed of adjustment to the long-run equilibrium values differing freely country by country. Needless to state, that this is fully in line with standard labor economics.

Econometrically, we check the long-run homogeneity assumption by applying a Hausman type test, introduced by *Pesaran – Smith – Im* (1996). The lag order of the $ARDL$ model for each country covered is selected by the Schwarz Bayesian Criterion (SBC), subject to a maximum lag of three. Based on these SBC determined lag orders long-run homogeneity is imposed. The computations are carried out using a GAUSS program made available by M. H. Pesaran.

3. Estimation Results for 21 OECD Countries

The $ARDL$ determined by the SBC for the sample of 21 OECD countries are shown in Table 1.

Table 1: Orders of lags in the ARDL model selected by SBC

	Employment	Output	Real wages
USA	1	0	3
Canada	1	0	1
Japan	1	0	1
Australia	2	1	3
New Zealand	1	1	2
Austria	1	3	2
Belgium	1	1	1
Germany	2	3	3
France	3	1	2
Italy	1	0	0
United Kingdom	1	0	3
Netherlands	3	3	2
Norway	2	1	1
Sweden	0	2	2
Finland	1	3	3
Luxembourg	2	1	0
Ireland	2	0	1
Spain	2	0	3
Greece	0	2	2
Switzerland	1	3	1
Turkey	1	0	1

The lag orders are quite different across the countries, indicating that labor market institutions do matter. Interestingly, the U.S.A. and U.K. whose labor markets are widely considered to be the most flexible, share the same $ARDL(1,0,3)$, that is, one lag of employment, three lags of real wages, and current output.

Table 2 presents the estimates of the long-run coefficients of equation (3) based on the estimators PMG and MG. The long-run output elasticity is a little lower than 1 in case of MG, but greater than unity when PMG is used. The long-run real wage coefficients are both significantly negative and very similar (MG –0.68 and PMG –0.66). The joint Hausman test statistic of 1.44 indicates very strongly that the restriction of long-run homogeneity of all long-run coefficients cannot be rejected, that is to say, the difference between the MG and PMG estimates is not significant. This confirms that the long-run relationship between the key labor market parameters is equal across the OECD countries. The regressions based on the long-run homogeneity assumption explain over 60 percent of the change in the logarithm of annual hours worked by employed persons in all but six countries, whereas the results for Sweden, Greece and Turkey are extremely biased by outliers.

Table 2: Long-run Coefficients from Regressions in the Change of Employment in 21 OECD Countries

	Pooled Mean Group estimator	Mean Group estimator	Hausman test[1])
ln Q	1,143 ***	0,980 ***	1,08
	(0,038)	*(0,162)*	[0,30]
ln W/P	-0,663 ***	-0,680 ***	0,01
	(0,028)	*(0,205)*	[0,93]
Error correction coefficient ϕ	-0,337 ***	-0,523 ***	
	(0,068)	*(0,082)*	
Joint Hausman test[1])			1,44
			[0,49]

*** . . . Significant at the 1%-level, standard errors in parentheses. – [1]) Test for long-run slope homogeneity, with p-values in square brackets.

What differs substantially from country to country, however, is the adjustment speed to the equilibrium (Table 3). This does not come as a big surprise, for institutions are widely considered to be the main culprit for both labor market laxity and flexibility. The adjustment coefficients meet the requirement to be negative for all, but two countries (Belgium, Turkey), but for five more countries (Germany, Sweden, Finland, Greece, Switzerland) the coefficient is insignificant. This is mainly due to the poor employment and real wage data in these countries. However, the estimates show very clearly that the adjustment speed is much larger in countries with flexible labor markets such as the USA and UK (–0.71 and –0.42, respectively) than in countries with rigid labor markets such as Italy and Austria (–0.06, and –0.20, respectively). Our calculations also confirm the finding that the MG estimate suggests much faster adjustment than the PMG.

Table 3: Group-specific Estimates of the Adjustment Coefficients

	Error correction coefficients ϕ_i		Standard error
USA	-0,731	***	0,037
Canada	-0,554	***	0,049
Japan	-0,217	***	0,043
Australia	-0,714	***	0,108
New Zealand	-0,219	**	0,087
Austria	-0,199	**	0,080
Belgium	0,006		0,028
Germany	-0,168		0,168
France	-0,202	**	0,067
Italy	-0,059	**	0,025
United Kingdom	-0,417	***	0,058
Netherlands	-0,273	**	0,116
Norway	-0,160	**	0,041
Sweden	-1,000		...
Finland	-0,157		0,102
Luxembourg	-0,105	**	0,033
Ireland	-0,256	**	0,053
Spain	-0,609	***	0,071
Greece	-1,000		...
Switzerland	-0,049		0,076
Turkey	0,008		0,035

*** . . . Significant at the 1%-level, ** . . . significant at the 5%-level.

Due to the estimation technique applied our results differ substantially from the findings of other papers. *Hofer – Pichelmann* (2002), for example, estimate a labor demand function for the Euro area, similar in spirit to our approach. Using a standard aggregate time-series estimator they obtain an estimate of the average adjustment speed for the Euro area of –0.55. This is significantly higher than our finding of –0.34 for the sample of 21 OECD countries. Their result compares much better with our MG estimate of the average adjustment speed (–0.52). This may be an indication that their result is upward biased. Estimates of the real wage elasticity also differ. We obtain a long-run real wage coefficient of –0.66 for our sample of OECD countries, compared to –0.56 for the Euro area according to Hofer – Pichelmann's calculation. This also may be mainly due to the different estimators applied. A potential source of division also is the poor quality of the employment data in quite a number of countries covered (hours worked by employed persons in this paper, persons employed in the study of *Hofer – Pichelmann*, 2002).

However, in both studies the estimates of the labor-augmenting technical progress are quite similar. Our estimates are close to a 1 percent increase per year, those of *Hofer – Pichelmann* (2002) about 1.1 percent.

4. Final Remarks

This paper made an attempt to examine the long-run relationship between the key labor market parameters employment, aggregate output, real product wages and labor-augmenting technical progress for a sample of 21 OECD countries. We applied a new panel error correction technique which allows us to constrain the long-run coefficients to be identical across the countries while letting the short-run coefficients which govern the dynamics, and the error variances differ freely, respectively. In doing so, we were able to capture the differences in labor market design across the OECD economies. The empirical analysis shows that the adjustment speed of actual employment to the equilibrium differs substantially across the OECD countries. Adjustment speed is significantly higher in countries with flexible labor markets such as the U.S.A. and U.K. than in countries with rigid labor markets such as Germany and Austria. For example, adjustment speed in the U.S.A. is three times as high as in Austria. According to our calculation the long-run real wage elasticity of labor demand in highly developed countries is –0.66. As theory suggests long-run output elasticity of labor demand is close to unity. Employment, as measured by hours worked, declines approximately by a margin of 1 percent annually due to labor-augmenting technical progress.

References

Greene, W. H., Econometric Analysis, Prentice Hall, Englewood Cliffs, 2000.

Hofer, H., Pichelmann, K., „Beschäftigungs- und Lohnanpassungen auf dem Arbeitsmarkt des Euroraums – Ein Überblick"; OeNB, Berichte und Studien, 2002, (3), p. 99-114.

Lee, K. C., Pesaran, M. H., Pierse, R. G., "Testing for Aggregate Bias in Linear Models", Economic Journal, 1990, (100), p. 137-150.

Pesaran, M. H., Smith, P. R., "Estimating Long-run Relationships from Dynamic Heterogeneous Panels", Journal of Econometrics, 1995, (68), p. 79-113.

Pesaran, M. H., Pierse, R. G., Kumar, M. S., "Econometric Analysis of Aggregation in the Context of Linear Prediction Models", Econometrica, 1989, (57), p. 861-888.

Pesaran, M. H., Shin, Y., Smith, P. R., "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels", Journal of the American Statistical Association, 1999, (94), p. 621-634.

Pesaran, M. H., Smith, R. P., Im, K. S., "Dynamic Linear Models in Heterogeneous Panels", in Mátyás, L., Sevestre, P. (eds), The Econometrics of Panel Data: A Handbook of Theory with Applications, 2nd Revised Edition, Kluwer Academic Publishers, Dordrecht, 1996.

Medieninhaber (Verleger), Hersteller: Österreichisches Institut für Wirtschaftsforschung • Wien 3, Arsenal, Objekt 20 • A-1103 Wien, Postfach 91 • Tel. (43 1) 798 26 01-0 • Fax (43 1) 798 93 86 • http://www.wifo.ac.at/ • Verlags- und Herstellungsort: Wien

Verkaufspreis: EUR 8,00 • Download kostenlos:
http://titan.wsr.ac.at/wifosite/wifosite.get_abstract_type?p_language=1&pubid=23646&pub_language=-1