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PRODUCT MARKET INTEGRATION
AND EUROPEAN LABOUR MARKETS

Torben M. Andersen
Niels Haldrup
Jan Rose Sørensen

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Torben M. Andersen[*], Niels Haldrup[**] and Jan Rose Sørensen[***][§]

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Abstract

European labour markets are in a state of flux due to the changing market situation induced by international integration. This process affects wage formation through more fierce product market competition and increased mobility of jobs. This development is by some observers taken to enforce labour market flexibility, while it for others signals an erosion of social standards and in turn possibly the welfare society. Since labour is not very mobile in Europe, the effects of international integration on labour markets is mostly indirect via product market integration. We review the channels through which product market integration affects labour markets and perform an empirical analysis of the convergence and interdependencies in wage formation among EU-countries. We find that integration is changing labour market structures and inducing wage convergences as well as stronger wage interdependencies, but it is a gradual process. Moreover, the present study does neither support that international integration will lead to a "race to the bottom" and rapidly erode domestic labour markets standards nor that it will relieve politicians of the need to consider labour market reforms to improve labour market performance.

Keywords: Integration, market power, wage convergence
Jel: F12, J31

[*]   Department of Economics, University of Aarhus, EPRU and CEPR
[**]   Department of Economics, University of Aarhus
[***] Department of Economics, University of Aarhus

1. Introduction

The implications of European integration for labour markets are of wide concern. To some this is seen as a process where market forces put labour market rigidities under strain. Governments and unions will eventually be forced to adopt so as to make European labour markets more flexible and thereby pave the way for higher employment and growth. To others this is seen as a threat to social relations and the possibility of maintaining a welfare society. One concern is that integration will undermine the social balance where employees supply labour peace in exchange for generous wages and social security systems (see e.g. Rodrik, 1997).

Ample casual evidence indicates that European labour markets are in a state of flux. Most visible has been the rapid convergence in nominal wage increases following the low inflation policy adopted in most European countries. Trade unions seem to have accepted this move more swiftly than could be expected, presumably because they have realized that the costs of excessive wage claims have increased due to intensified competition within Europe (see eg Fajertag, 1998a,b). Pressure from unions and left-wing parties for a social dimension in Europe can also be interpreted as reflecting that the "domestic power" has evaporated and that coordinated actions across Europe are needed to protect social standards (see Fajertag, 1998a,b).

The emergence of a "European wage norm" is reflected most strongly in The European Commission's strive for a European Wage Policy (CEC, 1998) which not only addresses the issues of maintaining nominal wage increases in accordance with the monetary policy objective of price stability but also the need for flexibility in wage setting. The stronger pressure to have wage increases in conformity with wage developments elsewhere in Europe has led to direct initiatives in two countries. Sweden has introduced a new wage model - "The Europe Norm" - stressing that average unit labour costs ought not in the long run to increase faster in Sweden than in the rest of the EU countries (see Hähnel, 1998). Belgium has introduced a law on "preventive safeguarding of competitiveness and the promotion of employment for 1997-98", which stipulates that nominal wage increases are not allowed to exceed a maximum defined as a weighted average of the expected pay increases in the most important trading partners - Germany, France and the Netherlands (see Fajertag, 1998 and Delcroix et al 1998).

There is also direct evidence showing that labour market relations are changing. One obvious channel arises because unions may lose power because the mobility of firms increases with international integration. This is exemplified by the Renault case where the plant in Vilvoorde, Belgium was closed at the same time as the plant in Valladolid, Spain was expanded. This shows how the power of firms is enhanced when they have a possibility of relocating production across borders. The decision was taken against the background of general excess capacity in the industry and the possibility of obtaining support form the regional EU funds. Trade union reactions to the relocation were aggressive partly because the closure was unanticipated (no advance warning in conflict with rules) and partly because of the globalisation aspect. It is particularly interesting to note that workers across countries organized actions against the company (Kuhlman, 1998).

These developments have also induced unions to strive for explicit cooperation across countries. The Belgian "wage norm" thus prompted trade unions from Belgium, Germany, Luxembourg and the Netherlands to meet. National confederations and major sectorial unions (including metal, construction, and private and public services) are striving for harmonisation of bargaining policies and exchange of information (Fajertag, 1999). As a specific example the European Metalworkers' Federation

follows a strategy of defining a framework for collective bargaining which sets minimum standards and rules as well as quantitative objectives for negotiations to be followed in national negotiations. There have also been taken initiatives to avoid that working time becomes a subject for European competition.

The aim of this paper is to take a closer look at the role integration may play for European labour markets. Europe is interesting because the process of integration has proceeded over several decades and it has recently been reinforced by among other things the creation of the Single European Market. The establishment of the European Monetary Union is of course another important step in this process. A premise for this study is that financial markets by now are tightly integrated, and that labour mobility between European countries is not likely to play a major role for overall labour market developments in a foreseeable future (Pedersen, 1996). Accordingly, labour markets are primarily affected indirectly via the effects increased international integration have for product markets. With more intensified competition in product markets it is likely that the power in national/local labour markets may evaporate and the labour markets will by necessity come to perform on more competitive terms. While most European workers need not fear that their wage will be determined in Beijing, they may fear that it will be determined in Athens. The possibility of factor price equalization seems thus a much more likely possibility within Europe which is not only formally fairly well integrated but also fairly homogeneous in terms of factor supplies[1], technology etc. In the limit one might thus conjecture that the integration process effectively will leave only one European labour market in which there is no choice but to follow the general wage development.

Despite the theoretical appeal of the factor price equalization theorem, it rests on strong assumptions of which some are strongly at odds with the European situation, primarily, the assumption that both product and labour markets are characterized by perfect competition. The implications of international integration when markets are non-competitive are not trivial especially since some reasons for international trade (like non-convex technologies) prevent markets from being perfectly competitive. The paper thus starts out in section 2 by reviewing theoretical insights on how product market integration affects labour markets when both markets are characterized by some form of imperfect competition. Section 3 presents evidence on wage developments and trade relationships in the EU. The empirical analyses aim at identifying the extent to which an effect of international integration on wage formation can already be identified, that is, are there any clear indications that the process of integration which has developed over the last decades have had any clear effects on wage formation. International integration is a process with a long duration and where the full effects of changes in the past have not yet fully materialized, the empirical evidence aims at evaluating the strength and speed at which these effects show up in labour markets. Section 3 presents evidence showing that increasing trade induces stronger wage comovements across countries while section 4 goes deeper into analysing how wage interdependencies have evolved. Finally, section 5 offers some speculative considerations on the policy implications.

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[1] European countries may be affected differently by changes in inter- and intra-industrial trade. The former being of more relevance for southern European countries and the latter for the other countries. For a discussion of how trade with emerging economies affect Europe see Bean et.al. (1998). For general surveys on how international integration affect unskilled and skilled groups in the labour market see e.g. Freeman (1995) and Slaughter and Swagel (1997).

2. How does product market integration affect the labour market?

In a setting with imperfect competition, it is not necessarily straightforward how increased product market integration affects labour market. This is brought out in a recent theoretical literature exploring the interrelation between product market integration and labour markets. As a prelude to the subsequent overview of the main channels through which product market integration affects labour markets, it is useful to consider a simple model within which some of this discussion can be structured.

Consider a single trade union which supplies workers to two different kinds of firms. One kind of firms produce goods for which there is no foreign competition (i.e. non-traded goods). The other kind of firms produce goods in competition with foreign firms (i.e. traded goods). Labour demand by firms producing non-traded goods is given as

$$L^N = L^N\left(w, Z^N\right) \tag{1}$$

where w is the domestic wage rate, and Z^N is a vector of variables affecting demand for non-traded goods. Labour demand from firms producing traded goods is given as

$$L^T = L^T\left(w, \tilde{w}, Z^T\right) \tag{2}$$

where $\tilde{w}$ is the foreign wage rate which may be interpreted as a weighted average of wages in countries which supply goods in competition with domestic firms. Z^T is a vector of variables affecting demand for traded goods. Total labour demand is given as the sum of L^N and L^T (i.e. $L=L^N+L^T$).

The trade union is assumed to maximize total income gain of trade union members which gives rise to the following objective function:[2]

$$U = L\left(w - \overline{w}\right) \tag{3}$$

where $\overline{w}$ is the alternative wage for trade union members (for instance unemployment benefits). For simplicity we assume that the trade union unilaterally sets the wage rate (i.e. we apply the monopoly union model, see e.g. Oswald, 1985)[3]. By maximizing (3) with respect to w, we get the standard result

$$w = \left(\frac{\varepsilon}{\varepsilon - 1}\right)\overline{w} \tag{4}$$

The wage rate is given as a mark up on the alternative wage, and the mark up is decreasing in the labour demand elasticity (i.e. $\varepsilon = -\frac{\partial L}{\partial w}\frac{w}{L}$). By using (1) and (2), the labour demand elasticity may be written as

$$\varepsilon = \left(1 - a^T\right)\varepsilon^N + a^T\varepsilon^T, \quad a^T = \frac{L^T}{L^T + L^N} \tag{5}$$

i.e. it is a weighted average of the elasticity of labour demand for firms producing non-traded goods (i.e. $\varepsilon^N = -\frac{\partial L^N}{\partial w}\frac{w}{L^N}$) and the elasticity of labour demand for firms producing traded goods (i.e. $\varepsilon^T = -\frac{\partial L^T}{\partial w}\frac{w}{L^T}$). The weights are given by the shares of labour employed in the two kind of firms. Since both domestic and foreign firms supply to the market for tradeables, it is a reasonable hypothesis that $\varepsilon^T > \varepsilon^N$.

This leads to the obvious conclusion that the more integrated the economy is in international product markets (the higher a^T), the lower the wage rate. While this

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[2] To simplify we disregard effects of taxes. The interplay between tax structure, product market integration and wages has not yet been analysed in the literature.
[3] An alternative would be to assume wage bargaining and to apply the Nash bargaining solution (see e.g. McDonald and Solow, 1981, and Nickell and Andrews, 1983), but the results would be similar to what we get in the more simple monopoly union model.

elasticity effect is an important effect, it does not fully capture the interactions which arise when economies integrate.

To see this, let us broadly interpret product market integration as a reduction in costs associated with international trade. These costs may take on many forms such as transport costs, tariffs, taxes, costs associated with border control, information costs about foreign markets, and costs of product approval in foreign markets[4]. It is useful to divide these different costs into two qualitatively different kinds, namely fixed costs or start up costs associated with exporting and variable costs which are more or less proportional to the level of export. As discussed below, reductions in these two kinds of costs may have qualitatively different implications for wages. In the following subsection, we discuss the specific channels through which product market integration affects labour markets.

2.1. Lower export costs without market entry

To see that product market integration does not have straightforward and trivial effects on labour markets, consider first the effects of lower export costs for a given distribution of goods between traded and non-traded, i.e. there is no market entry effect. Naylor (1998) finds - for the special case $a^T=0$ - that a decrease in variable export costs gives rise to a higher wage rate. For a given wage rate, a reduction in transport costs leads to higher employment because the variable costs of producing export goods decrease. This in turn implies that the elasticity of labour demand, ε^T decreases, and the trade union responds by increasing the wage rate. In other words, a decrease in the transport costs give rise to a higher labour demand, and the trade union converts some of this increase in labour demand into a higher wage rate. A critical assumption for this result is that the labour demand function is linear.

2.2. Lower export cost and market entry

Allowing for market entry may change the abovementioned result critically. Lower export costs make it more attractive for firms to enter foreign markets (i.e. to start up exporting), and goods which used to be non-traded become traded goods. The implications of market entry can most easily be analysed by considering a reduction in fixed costs associated with exporting. Huizinga (1993) and Sørensen (1993) illustrate the implications of market entry by comparing autarchy to fully integrated markets which in the notation above amounts to comparing the case of $a^T=0$ and $a^T=1$. This can be interpreted as a reduction in fixed export costs from a level which totally prevents export to a level where all goods become traded. Since $\varepsilon^T>\varepsilon^N$, the wage rate unambiguously decreases. Andersen and Sørensen (1999) generalize this result to intermediate cases where $0<a^T<1$. They consider a model with linear demand functions, and they find the following closed form solution for the wage reaction function (i.e. the domestic wage as a function of the foreign wage):

$$w = b_0\overline{w} + b_1\left(a^T,t\right)q + b_2\left(a^T\right)\widetilde{w} \tag{6}$$

where b_0 is a parameter, q is labour productivity, t is variable export costs, $b_1(\cdot) > 0$ and $b_2(\cdot) > 0$ are functions. First, we see that for given trade costs, the wage rate chosen by the trade union is increasing in the alternative income ($\overline{w}$), labour productivity (q) and the foreign wage rate ($\widetilde{w}$)[5]. Since b_1 is decreasing in a^T, but b_2 is

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[4] Flam (1992) discusses some of the trade costs which may be saved by the creation of the internal market.

[5] Hence, wages are strategic complements. In our case where we consider manufacturing wages in different countries this also seems the most reasonable assumption, though, see also Padilla et al. (1996).

increasing in a^T, the effect on the domestic wage rate of a larger fraction (a^T) of the economy being affected by international trade is ambiguous. If the foreign wage is high the domestic wage may increase when markets become integrated, but a relatively low foreign wage implies a decrease in the domestic wage. In a symmetric model, where the foreign country is similar to the domestic country, Andersen and Sørensen find that an increase in a^T gives rise to an unambiguous decrease in the wage rate.

A particularly interesting finding is that b_2 is increasing in a^T. This implies that domestic wages become more sensitive to changes in foreign wages, and we should see wage convergence when integration implies that a larger fraction of the economy becomes affected by trade. Andersen and Sørensen also find that wages become more sensitive to changes in productivity if trade costs increase (i.e. b_1 is increasing in t), which generalises the result found in Naylor (1998) and discussed above.

We should note that the share of traded goods (a^T) may increase not only because fixed export costs decrease. A decrease in variable export costs (t) may also make it attractive to export goods which used to be non-traded. In this case, the effect on the wage rate will be a mixture of the effect found in Naylor (1998) and the effect of an increase in the share of traded goods discussed above. Hence, it will be ambiguous whether the wage rate increases or decreases.

2.3. Entry and exit of firms

In an integrated market area, it becomes less important where firms are situated. The market can be supplied by firms from any area/country within the integrated market area. Thus, there will be a tendency for entry of firms in areas where production costs are low, and vice versa in high cost areas. This implies that labour demand becomes more geographically mobile which in turn tends to make the long run labour demand elasticity higher. If the trade unions take this into account, it follows from (4) that wages decrease. This effect of product market integration has been demonstrated formally in Driffill and Ploeg (1995).

2.4. Foreign direct investments

The level of foreign direct investments is another channel through which the functioning of the labour market is affected. It is useful to distinguish between horizontal and vertical investments (see e.g. Markusen et al., 1996). By horizontal investments is understood that production is split between similar plants situated in different countries, whereas vertical investments is characterized by production being split up in separate stages which are placed in different countries. In the literature on trade unions and foreign direct investments, the main focus has been on horizontal investments (see Bughin and Vannini, 1995, Zhao, 1995,1998, Naylor and Santoni, 1997), and a general finding is that horizontal investments lead to wage moderation. The reason for this result is that horizontal investments give rise to a more elastic labour demand in a specific country, and as in (4) this tends to give rise to a lower wage. However, with respect to vertical investments, Skaksen and Sørensen (1999) show that the wage rate may increase. The reason being that the labour demand elasticity in the domestic country decreases due to domestic wage costs becoming relatively less important for the total costs of the firm.

While the level of foreign direct investments affects the labour market, it is less obvious how product market integration affects the level of foreign direct investments. The main motivation for horizontal investments is to avoid trade costs (see e.g. Markusen et al., 1996), whereas vertical investments serve to exploit differ-

ences in production costs within the limits set by trade costs. Hence, since product market integration is induced by a decrease in trade costs, we should expect horizontal investments to decrease and vertical investments to increase. However, another aspect of product market integration may be lower costs of setting up new plants in foreign countries which will tend to increase both kinds of foreign direct investments. Therefore, the net implications for wages are ambiguous[6].

2.5. The effective degree of centralisation

Labour market performance may depend critically on the degree of centralisation in wage formation (see Calmfors and Driffill, 1988). Due to various forms of externalities in wage setting, including price effects, unemployment benefits and taxation, the labour demand elasticity faced by trade unions tend to be relatively high when the degree of centralisation is either low or high. Whereas, for a middle range of the degree of centralisation, the labour demand elasticity is relatively low. The implication is a hump-shaped relation between wages (and thus employment) and the degree of centralisation. It is a straightforward implication that the degree of centralisation falls when goods markets integrate because a larger number of firms competing in the product market implies that the number of trade unions supplying labour to produce a certain type of good increases. This decrease in centralisation has an ambiguous effect on wages (see Danthine and Hunt, 1994, and Driffill and Ploeg, 1993). If the labour market before integration was relatively centralised, the decrease in the effective degree of centralisation gives rise to a higher wage, whereas if the labour market before integration was relatively decentralised, the decrease in centralisation gives rise to a lower wage. Integration may thus affect countries differently depending on the labour market institutions. Finally, it is worth mentioning that international integration may induce unions to cooperate across nations (cf the examples given in the introduction), and this will counter the effect on the degree of centralization (see Driffill and Ploeg, (1993)).

2.6. Endogenous productivity

More intensified competition may have effects for productivity and technical progress. Through "defensive innovations", it may thus be possible to maintain competitiveness at the initial cost level. The possibility that defensive innovations can be a response to competitive pressure may seem inconsistent with economic theory, "if such labour saving or cost reducing measures exist, why weren't they already implemented?".

First, productivity depends on effort which in turn is an endogenous variable. In the face of an intensified competitive pressure, unions may face a trade off between accepting wage cuts or increasing effort to maintain their jobs. They may choose the latter implying that overmanning may be reduced, production restructured or specialized and individual effort increased.

Second, product market integration may increase incentives for innovative activities since one reason for undertaking such activities is to obtain a competitive advantage. Increased international integration can in this way induce technical progress and thereby create some leeway in the adjustment process reducing the need for wage moderation[7].

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[6] After establishment of the internal market, foreign direct investments have been increasing indicating that the latter effect seems to dominate.

[7] There is some empirical evidence in favour of this hypothesis (see e.g. Sachs and Shatz, 1994, Lawrence and Slaughter, 1993, Leamer, 1994, and Neven and Wyploz, 1996).

Finally, and not least, tighter international integration makes the transfer of technological knowledge easier, both via improved information flows and through trade in capital goods. This tends to lead to technology convergence and therefore in turn wage convergence.

2.7. Institutions

Labour market performance depends not only on labour demand but on a variety of institutional factors, which may be critical to the effects of international integration. Therefore, it is also likely that institutions will have to adapt to the new situation. One obvious example is the tax system since integration makes the tax base for certain forms of taxation more mobile and thereby creates a need for tax reforms or adjustment of public expenditures. This and other institutional changes may affect the labour market, but it is in general impossible to say in what direction and with what strength.

Considering institutions from a political economy perspective may give some indications on the direction in which institutional changes may go. Intensified international competition may potentially worsen the unemployment problem in the absence of structural changes, and this may pave the way for structural reforms making the labour market more flexible (see e.g. Saint-Paul, 1996). There is also some tendency for the degree of unionization to decrease (see e.g. Neumann et al., 1991 and Wallerstein et al., 1997) for less strike activity (see Aligisakis,1997), for the degree of labour protection to be lowered (see e.g. Saint-Paul, 1996), and for a more active attitude in labour market policies shifting from passive measures to more active job creating measures (see e.g. Barrell and Genre, 1999). At least some of these changes may have been induced by international integration, and they all point to more flexible labour markets.

2.8. Conclusion

We have reviewed the channels through which product market integration affects labour markets. The implications for the level of wages and employment are in general ambiguous since they depend critically on the initial situation, the specific market structure and the degree of international integration[8]. However, the theoretical work points to two important implications. First, product market integration implies a tendency for wage convergence. Second, wage interdependencies are strengthened, i.e. we should expect wages in specific countries to become increasingly sensitive to foreign wages. In the following sections, we consider whether there is empirical evidence in support of these two hypotheses.

3. Trade and wages

We now turn to some empirical evidence on the importance of international integration as reflected in international trade and wage formation in the EU countries[9]. We use data for the manufacturing sector in order to focus on a sector where trade potentially plays a dominant role. Figure 1 starts out by showing the development in the cross-country average nominal wage growth and its standard deviation. The figure displays a more or less continuous decline in average nominal wage increases from

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[8] There are testable implications for the labour demand elasticity, but with our data set we have not been able to empirically identify labour demand elasticities.

[9] Due to lack of data, Luxemburg and Portugal are not included in our sample of countries. During the whole time span, we define EU countries to be: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Sweden and UK.

the mid 70s to the end of the 90s. This reflects the transition from a high inflation regime to a low inflation regime. What is more interesting for our purpose is that this development in nominal wage growth has been quite similar across EU countries, which is reflected by the fact that there has also been a tendency for the standard deviation of wage increases to decrease, especially from the mid 80s and onwards.

Figure 1 about here.

As a more direct measure of wage interdependencies among the EU countries, we may look at wages in the single countries relative to wages in the other EU countries. For each country figure 2 displays the development in the ratio between the hourly wage rate and a (country-specific) trade weighted wage for the remaining EU countries, where the foreign wages are all denominated in a common currency. In the sequel we refer to the trade-weighted wages as the "foreign wage" associated with a particular country. Hence, a ratio of one indicates identical nominal wages in the home country and the "foreign" country. For a majority of countries the wage ratios are not that far from unity, and more interestingly, there is a tendency for the ratios to converge towards one over the sample period. Germany, Denmark and Greece seem to be outliers, but for the other countries there is a clear tendency that for countries with a ratio above one, the ratio is decreasing over time and for countries with a ratio below one the ratio tends to increase. This convergence in relative wages is also reflected in the fact that the standard deviation of the ratios has been decreasing over the sample period[10].

Figure 2 about here.

Can these developments be related to international integration? To address this issue, it is natural to start by analysing how trade relations have developed. An important indicator for product market integration is the development in the level of international trade, and it is well known that this level has been increasing for most countries. This is also the case for EU countries as illustrated in figure 3. This figure shows the cross country average of EU manufacturing exports and imports as a share of value added. In other words, it shows the development in the level of EU countries' trade with other EU countries as well as with non-EU countries. It is striking that the total trade level has been more or less continuously increasing, and since the mid 90s the average value of export and import has been higher than the value added in the manufacturing sector[11].

Figure 3 about here.

Our focus of attention is mainly on product market integration within the EU. Figure 4 exhibits the development in the fraction of EU countries' trade with other EU countries. We note that more than 60% of EU countries trade is with other EU countries. This fraction has been weakly increasing during the data period, but more or less all the increase has taken place between 1981 and 1987, and it has been redressed after 1991. These shifts are closely related to the European business cycle and may thus reflect cyclical factors implying that trade shares are fairly constant despite the increase in the level of trade.

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[10] The mean of the ratios has also been converging a bit towards one (from 0.90 to 0.93).
[11] On top of that there has been an increasing level of FDI, see e.g. Barrell and Pain (1997).

Figure 4. about here.

In our discussion in section 2 of potential links between product market integration and the functioning of the labour market, we have focused on imperfectly competitive markets. International trade models applying imperfect competition usually focus on intra industrial trade (see e.g. Krugman, 1990). Inter industrial trade is probably much better explained by classical trade theories such as the Heckscher-Ohlin model. In figure 5, we report the Grubel-Lloyd index for intra EU trade, which measures the share of intra EU trade which is intra industrial. We see that since the beginning of the 80s, the largest share of intra EU trade is actually intra industrial, and this share has been increasing continuously during our sample period. It is interesting to observe that the major increases in intra industrial trade took place in the 1970s.

Figure 5. about here.

The evidence presented so far does not contradict the hypothesis that product market integration in EU has given rise to wage convergence during the time span of our data period. Trade interaction between EU countries has been increasing, especially intra industrial trade, and there has been a tendency towards a similar wage development in most EU countries. However, it would be more convincing with an explicit test of a link between trade and labour market convergence. To perform such a test we extend a method developed by Frankel and Rose (1998). Their method is developed to test whether trade gives rise to more or less correlated business cycles between countries, but we can of course pose a similar question related to wage increases: Does increased trade give rise to more or less correlated wage increases? The test is performed in the following way. First, we divide our data period into three sub-periods of equal length. Second, we find the correlations in wage increases in manufacturing (differences of the logarithm to wages) between each pair of countries in each of the three sub-periods. The correlation between wage increases in country i and j in subperiod τ is defined as

$$\rho_{ij\tau} = Corr\left(\Delta \ln w_{i\tau}, \Delta \ln w_{j\tau}\right) \tag{7}$$

Third, since the correlations by definition lie between -1 and 1, we make the following scaled logistic transformation in order to get an unrestricted variable to be used in the regression analysis performed below:

$$r_{ij\tau} = \ln\left(\frac{\frac{\rho_{ij\tau}+1}{2}}{1 - \frac{\rho_{ij\tau}+1}{2}}\right) \tag{8}$$

If $\rho_{ij\tau} \to -1$, then $r_{ij\tau} \to -\infty$, and if $\rho_{ij\tau} \to 1$, then $r_{ij\tau} \to \infty$ Fourth, we calculate the trade level between each pair of countries in each of the three sub-periods as

$$t_{ij\tau} = \frac{X_{ij\tau} + M_{ij\tau}}{X_{i.\tau} + X_{j.\tau} + M_{i.\tau} + M_{j.\tau}} \tag{9}$$

where $X_{ij\tau}$ is total export of manufactures from country i to country j during time span τ, $M_{ij\tau}$ is total import of manufactures to country i from country j, $X_{i.\tau}$ is total global export of manufactures from country i during time span τ. $M_{i.\tau}$ $X_{j.\tau}$, and $M_{j.\tau}$ are defined in a similar way. Finally, we run the following regression

$$r_{ij\tau} = \alpha_1 + \alpha_2 D_2 + \alpha_3 D_3 + \delta t_{ij\tau} + \varepsilon_{ij\tau} \tag{10}$$

where D_2 is a dummy variable for period 2, D_3 is a dummy variable for period 3[12], and $\varepsilon_{ij\tau}$ is a disturbance term. The parameter δ measures the effect of trade on wage interdependencies. By pooling the data for the three sub-periods, we get a total of 234 observations[13]. We run the above regression using nominal wages as well as real product wages; the results including various diagnostic statistics are reported in table 1.

Table 1. Wage correlation equation

	α_1	α_2	α_3	δ	R^2	Het1	Het2	Reset	JB
Nom. wages	2.88**	-2.13**	-0.29	15.63**	0.45	0.13	0.17	.37	.00
	(0.14)	(0.18)	(0.18)	(3.62)					
Real wages	0.14	0.32*	0.10	7.86*	0.05	0.89	0.98	.93	.70
	(0.12)	(0.15)	(0.15)	(2.99)					

Note. A "*" signifies significance at 5% level, "**" at 1% level. Numbers in parentheses are standard errors. Het1 and Het2 report p-values for Whites heteroscedasticity tests, whilst Reset and JB report p-values for functional form and the Jarque-Bera normality test.

Both the nominal and real wage specifications appear to be reasonably well specified although some problems occur with respect to normality for the model using nominal wage correlations. The fit measured by the coefficient of multiple correlation, R^2, is largest for the nominal specification and drops remarkably for the real specification. However, in both cases δ has the expected positive sign, and it is significantly different from zero[14]. Hence, we have identified an empirically significant link going from trade interaction to labour market interdependencies. This link also seems to be in accordance with the theoretical predictions based on section 2 as an increasing trade level between two countries implies more closely correlated wage increases, i.e. an increasing trade level implies convergence in wage increases.

4. Wage convergence
The evidence presented in section 3 indicates that international integration has induced wage convergence, cf figure 2. If this is correct, we should be able to find direct evidence that the wage interdependencies have increased across countries, that is, foreign wages should play a larger role for domestic wage setting, cf the discussion in section 2. This issue cannot be assessed by turning to standard time series wage models for the simple reason that they are built on the presumption that parameters are stable; an assumption which cannot be maintained if international integration induces a process which gradually changes economic structures.

Accordingly, we adopt an approach of estimating time varying parameter models where the parameters of the wage equations are considered to be generated according to a stochastic process (which is non-stationary). Because the parameters are allowed to evolve gradually over time an important aspect and a conceptually attractable implication of *convergence* can be captured empirically, i.e. the fact that parameter values at the beginning of the sample period can be rather different from

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[12] The inclusion of the dummy variables imply that we allow a difference in the level of wage correlations for the three sub periods.

[13] Due to lack of data Ireland is not included, and the time span only covers 1970 to 1994.

[14] As an alternative to the use of log-differenced wages to remove a trend component in wages, we also used the Hodrick-Prescott filter to detrend the data. These results appeared to be qualitatively similar to those reported above.

those at the end of the sample period. Modelling convergence without explicitly allowing for parameter variability by assuming constant parameters can be rather misleading because an intrinsic feature in assessing convergence empirically is that of gradual change in an on-going process. This characteristic cannot be captured through cointegration and common stochastic trends analysis where only convergence for a *full* period can be examined rather than the possible gradual movement towards increased convergence.

The econometric approach we pursue was initially suggested by Haldane and Hall (1991) and has been implemented in a number of empirical studies including Hall et al.(1992), Serletis and King (1997), and Holmes (1998), mainly on financial and exchange rate data. To our knowledge no empirical studies have been conducted using this technique focusing on labour market data.

To simplify the analysis we have decided to focus on rather simple time varying parameter models which capture the main features we have in mind. The models under consideration are of the general form:

$$y_t = \alpha + \gamma z_t + \beta_t x_t + u_t \tag{11}$$

$$\beta_t = \beta_{t-1} + v_t \tag{12}$$

where

$$\begin{pmatrix} u_t \\ v_t \end{pmatrix} \sim N\left(0, \begin{pmatrix} \sigma_u^2 & 0 \\ 0 & \sigma_v^2 \end{pmatrix}\right)$$

The series y_t will typically be a domestic real wage series whereas z_t and x_t are exogenous variables with fixed and time varying parameters, respectively. The z_t and x_t series considered empirically are the productivity series and trade-weighted foreign (real) wage series, respectively, cf below.

The time varying parameter model is well described in e.g. Harvey (1989) and Hamilton (1994) and it has been displayed above in so-called *state-space form*. Equation (11) is frequently referred to as the measurement equation whereas (12) is the transition-equation describing the evolution of the state variable β_t (i.e. the time varying parameter) over time. The model has been simplified by allowing only one parameter to vary at a time; this has been done in order not to introduce too much model variation given that only 29 observations are available for estimation. The model parameters can be estimated by maximum likelihood where the Kalman filter is used to generate the input in the prediction error decomposition of the likelihood function. This can be easily accomplished when the model is put in state-space form as above, see the aforementioned references for technical details. In order to start up the Kalman filter estimation an initial value β_0 was found by use of a diffuse prior (see above references) and based on this initial condition the Kalman filter was used to recursively extract the state variables conditional on information including time period *t-1*. Full sample information can be used to estimate the latent state variables by implementation of the so-called *smoothing* up-dating algorithm. Below these smoothed state variables are extracted to represent the time varying parameters.

There are a number of theoretical assumptions underlying the state space model (11)-(12). In particular, the right hand side variables are considered exogenous and the error terms are assumed to be *i.i.d.* Gaussian noise. It is likely that some of the estimated relations suffer from these requirements, but there is no clear guidance in the literature what to do if these sorts of misspecification occur. At least model modifications which at first sight may look trivial will complicate estimation and in practice become impossible to implement.

With these reservations, we follow the literature and hence obtain some sort of quasi-maximum likelihood estimates upon which the latent variables can be found. It is our hope that results can be produced which exhibit some common patterns in the European wage formation over the past three decades.

We consider models specified in terms of various measures of real wages. This is motivated partly by theoretical concerns and partly by the fact that a nominal specification is likely to pick up inflation convergence which does not necessarily imply that economies have been more tightly integrated[15]. The estimation equations are the following[16]:

$$\text{Model 1: } \ln W_t / P_t = \alpha + \beta_t \ln W_{tf} / P_t + u_t$$

$$\text{Model 2: } \ln W_t{}^{DM} / P_t = \alpha + \beta_t \ln W_{tf}{}^{DM} / P_{tf} + u_t$$

The basic model (Model 1) relates the domestic product real wage to the foreign product real wage defined in terms of domestic producer prices. The idea being that penetration by foreign firms into the domestic product market depends on this measure of profitability. Model 2 considers as an alternative the product real wage defined in terms of domestic product prices which is the conventional way of defining this variable[17,18], and which is a measure often used in comparative studies.

The above specifications are designed to reflect dynamic patterns in the wage-formation process of the home country, especially with respect to the dependency of the (trade-weighted) foreign wages. Increased (relative) convergence between wage settings in the home country and the foreign country is identified when β_t tends towards unity over time. Observe that β_t tending to one does not necessarily mean that the wage rates are converging in absolute terms because an intercept with a coefficient different from zero is allowed in the models[19].

In figures 6-9 the smoothed state variables (the time varying parameters) have been displayed for four different models together with a 95% confidence band[20].

The results for Model 1 reported in figure 6 (note the different scale of the figures) reveal that parameters have been varying over time rejecting parameter stability and thereby lending support to the approach taken here. Convergence from below is observed for Austria, Finland, Greece, Ireland and Spain and from above for Sweden, while for Denmark, Belgium, Germany, France, Italy, the Netherlands and the UK there is no major changes over the sample period. One notable finding is that countries in the periphery or newcomers to the European Union (Austria, Finland, Greece, Ireland and Spain) have experienced a rather large increase in the influence of

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[15] We have also estimated the model with nominal wages and find results close to those reported for model 1 here.

[16] We adapt a log-formulation to avoid normalization problems arising due to use of index-numbers, as well as to make the β-coefficients comparable across countries since they measure elasticities.

[17] This specification raises an index number problem since we have hourly pay in domestic currency but only a price index. To overcome this problem we transform wages to be comparable across countries by measuring them in DM in the base year 1992. Given the log-specification, any level differences in prices will be picked up by the constant term.

[18] International comparisons are often based on unit labour costs. For theoretical reasons this approach is problematic, because in the standard case of a Cobb-Douglas technology unit labour costs are independent of the wage level. We do not report results for unit labour costs, since we have been unable to construct consistent series for the sample period and the countries considered here.

[19] Note that this feature mimics the distinction between the absolute and the relative PPP-hypothesis.

[20] The models have been estimated using the Gauss programming language.

foreign wages, that is, European integration has had a clear effect on wage formation. For the UK we find that until the early 1980s it seems to be following a track divergent from the rest of the EU, but then subsequently this development has been reversed. A similar pattern can be observed for Ireland.

Convergence is even more apparent from estimation of Model 2 (see figure 7) which shows important structural changes for all countries which either from below or above approaches a unit elasticity of domestic product real wage to foreign product real wages. The case of countries like Denmark and Sweden where the coefficient to foreign wages approaches one from above can be interpreted as indicating that these countries due to imperfect international integration have been able to attain a high wage level, but the integration process has evaporated this situation. Note the significant change for Spain after EU membership in 1986.

The results of estimating the time-varying parameter models confirm that structural changes have taken place and that international interdependencies in wage formation have been strengthened. This convergence can be the direct result of changes in market structures and powers as discussed in section 2, but it is also possible that the effect may run indirectly via a more easy flow and transfer of information and technological knowledge. In the latter case wage convergence simply follows from the fact that international integration makes countries more similar. In an attempt to discriminate between these two interpretations of the finding of wage convergence we estimate Model 1 in a form where we control for productivity (q), cf model 3 and 4.

$$\text{Model 3: } \ln W_t / P_t = \alpha + \gamma \ln q_t + \beta_t \ln W_{tf} / P_t + u_t$$
$$\text{Model 4: } \ln W_t / P_t = \alpha + \gamma_t \ln q_t + \beta \ln W_{tf} / P_t + u_t$$

Observe that model 3 has β varying, and model 4 has γ varying.

Ideally we would like to allow simultaneously for time varying coefficients to both productivity and foreign wages. However, this has not been possible[21] and we therefore allow in model 3 the coefficient to foreign wages to vary and in model 4 the coefficient to productivity to vary. The model specifications allowing for both productivity and foreign wages can also be interpreted as an estimation of the theoretical wage model (6), discussed in section 2.2[22], according to which integration may affect the sensitivity of wages to productivity and foreign wages.

The results for Model 3 are displayed in figure 8 and show, as should be expected, that controlling for productivity in general lowers the coefficient values for foreign wages. Moreover we see that although there is some general tendency for the effect of foreign wages to increase over time, it is much muted relative to the findings for model 1 and 2. This suggests that wage convergence in Europe may to a larger extent be induced by productivity convergence rather than a market effect. The findings for Model 4 graphed in figure 9 do not, however, yield unequivocal support to this interpretation since there is a general tendency that the effect of productivity on wages is declining. Theory predicts that this should happen when markets get more integrated, cf section 2. Moreover, the results reported in table 3.1 identified a trade effect.

The bottom line of this is that the analysis confirms that there has been wage convergence in Europe, but leaves open whether international integration primarily

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[21] Attempts were made but the algoritm failed to converge.
[22] Under the plausible assumption that the replacement ratio is constant.

affects wage formation by inducing convergence in technology and thus productivity or by affecting market structures and powers.

Figure 6. about here
Figure 7. about here
Figure 8. about here
Figure 9. about here

5. Conclusion

International integration of product markets have implications for labour markets through various channels including more fierce product market competition and increased mobility of jobs. The evidence presented in the present paper yields support to the view that increased integration induces a more similar wage development and stronger wage interdependencies. This is an ongoing process which evolves gradually, changes the structures underlying wage formation, and will continue in the years to come.

The present situation is, however, far from the one predicted by the hypothesis of factor price equalization. First, while convergence implies that wages are following each other more closely across European countries, it does not imply that the levels are the same. There are still differences in the level of wages irrespective of how these are measured, but there is a tendency that wage differences become smaller. Second, wage convergence is not tantamount to elimination of market power or inflexibilities in labour markets.

From these findings we draw the following lessons for economic policy. The fear that the integration process will lead to major downward pressure on wages and, in turn, devaluations of social standards, is not supported by the empirical evidence. This may be taken to imply that there still is a role for a domestic labour market and social policy, but also that international integration cannot be counted on to automatically make labour markets more flexible. While it may take us some way in this direction, market power will still exist in product and labour markets. It is worth stressing that even though integration may enforce some adjustment of the wage formation process, this is not necessarily going to lead to a better employment performance. For countries with an initial disadvantaged competitive position jobs may be lost in the process where wage formation is put under pressure by the intensified competition induced by international integration.

While the empirical evidence documents that labour market performance changes over time, the evidence reported here on structural changes also confirms that the adjustment process is fairly slow. The changes will, therefore, not be abrupt and this leaves time for the needed structural labour market reforms, but it also creates a risk that politicians underestimate the need for policy initiatives.

6. Data Appendix

The countries included in the empirical study are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Sweden, and United Kingdom. Due to lack of data, Luxembourg and Portugal had to be excluded from the analysis. In most cases it was possible to construct data series for the full period 1970-1998 by splining various data sources.

A complete characterization of the database can be obtained from the authors upon request.

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Data for manufacturing wages (wages for time worked) are taken from *Svenska Arbetsgivare Föreningen* (SAF) jointly with *OECD, Economic Outlook Data* for the early years, 1970-1974.

Trade weights for the construction of "foreign wages" were extracted from the *OECD Bilateral Trade Database* 1998.

Producer prices were found from the ratio of value added in current and fixed (1990) prices. The sources were the *OECD STAN database for industrial analysis*, and *Main Economic Indicators*.

Productivity index (1992=100) series (output per hour in the manufacturing sector) for Belgium, Denmark, France, Germany, Italy, Netherlands, Sweden, and UK were extracted from *U.S. Department of Labor, Bureau of Labor Statistics, August 1999*.(See Paul Krugmans's homepage http://www.mit.edu/people/krugman/index.html). Data for Austria, Greece, Ireland, and Spain were calculated using data for average annual hours worked in manufacturing (also *U.S. Department of Labor, Bureau of Labor Statistics, August 1999)* jointly with data for value-added. The source of the Finland data was *OECD International Sectoral Database ISDB, 1998.*

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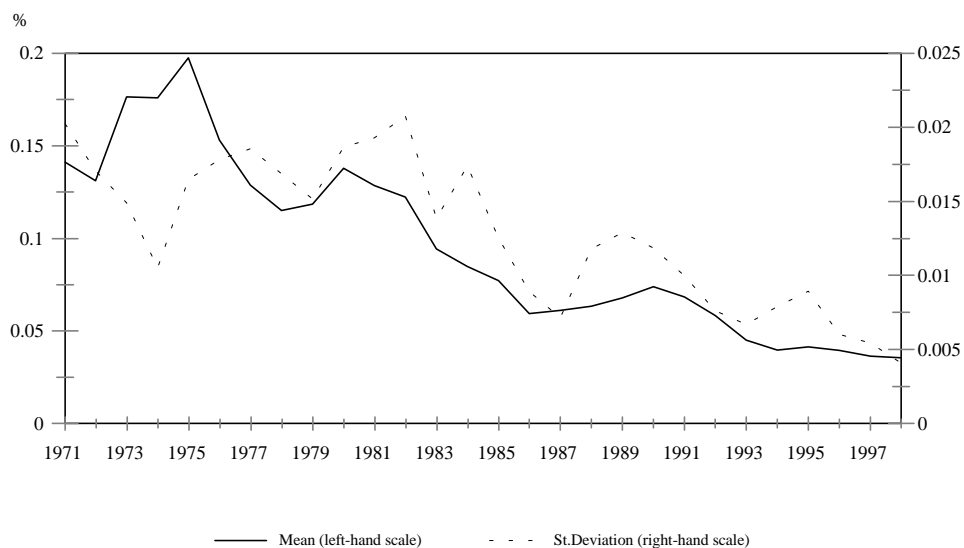Zhao, L., 1998, The Impact of Foreign Direct Investment on Wages and Employment, Oxford Economic Papers, 284-301.

Figure 1: Nominal wage growth , mean and standard deviations across EU countries.
Source: Own calculation based on Svenska Arbetsgivare Föreningen (SAF).
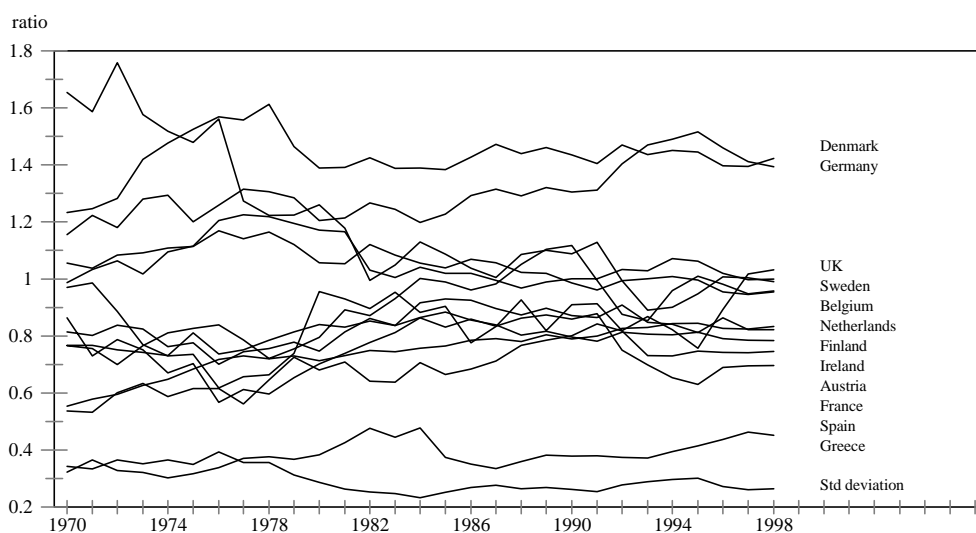
Figure 2. Ratio of domestic to foreign nominal wages. For each country the foreign
wage is constructed as the trade weighted wages of the remaining countries in the
sample. Wages are denominated in the same currency.
Source: Own calculations based on Svenska Arbetsgivare Föreningen (SAF) and the
OECD Bilateral Trade Database 1998.
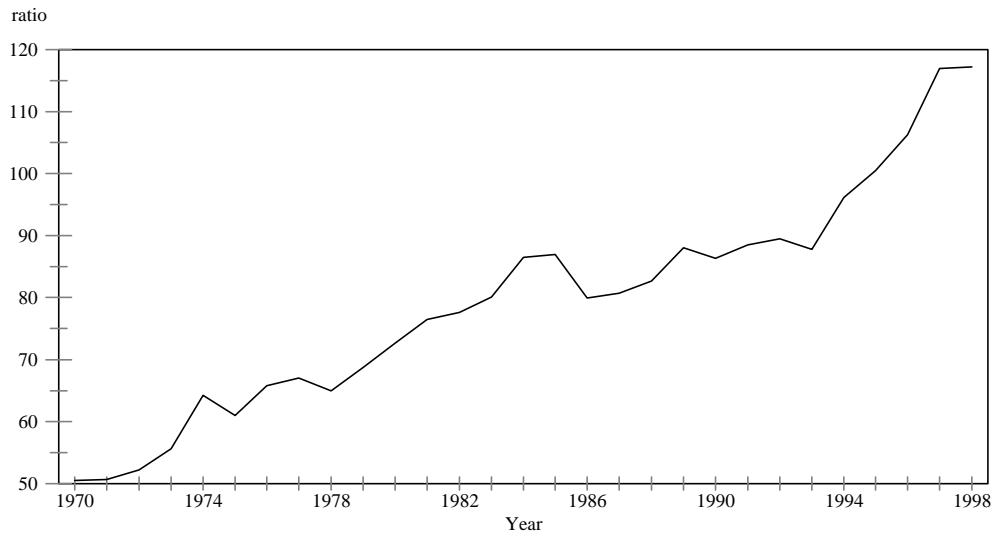
Figure 3: Total trade level. Cross-country average of EU countries manufacturing exports and imports as a share of value added.
Source: Own calculations based on OECD STAN Database 1998.

Figure 4: Trade between EU countries. The graphs show the fraction of EU countries' trade with other EU countries.
Source: Own calculations based on OED Bilateral Trade Database 1998.
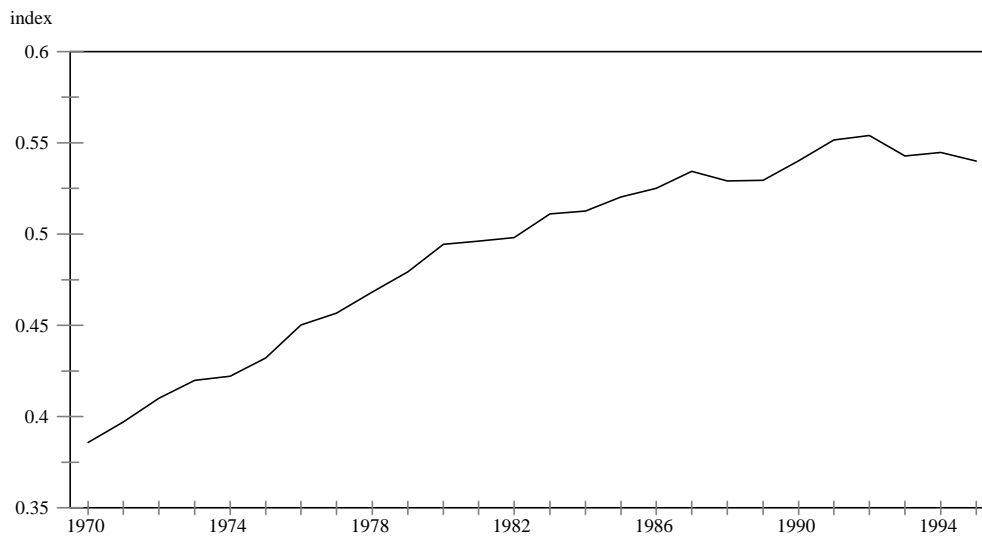
Figure 5: GL-index for intra EU trade
Source: Own calculations based on OECD Bilateral Trade Database, 1998.

Figures 6-9:
Product Market Integration and European Labour Markets

Torben M. Andersen, Niels Haldrup and Jan Rose Sørensen

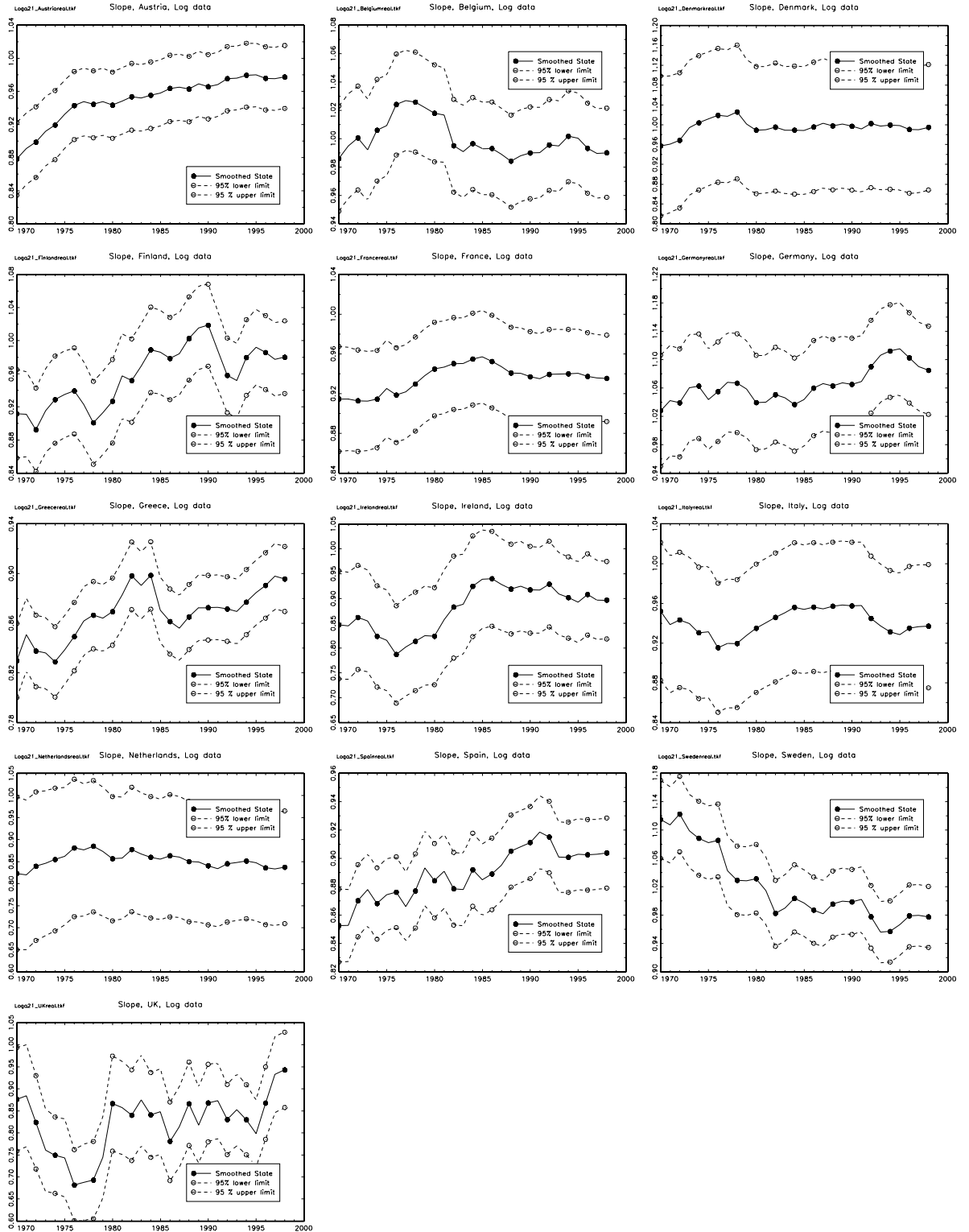Figure 6. Time varying β_t: $\ln W_t/P_t = \alpha + \beta_t \ln W_{tf}/P_t + u_t$

Figure 7. Time varying β_t : $\ln W_t^{DM}/P_t = \alpha + \beta_t \ln W_{tf}^{DM}/P_{tf} + u_t$
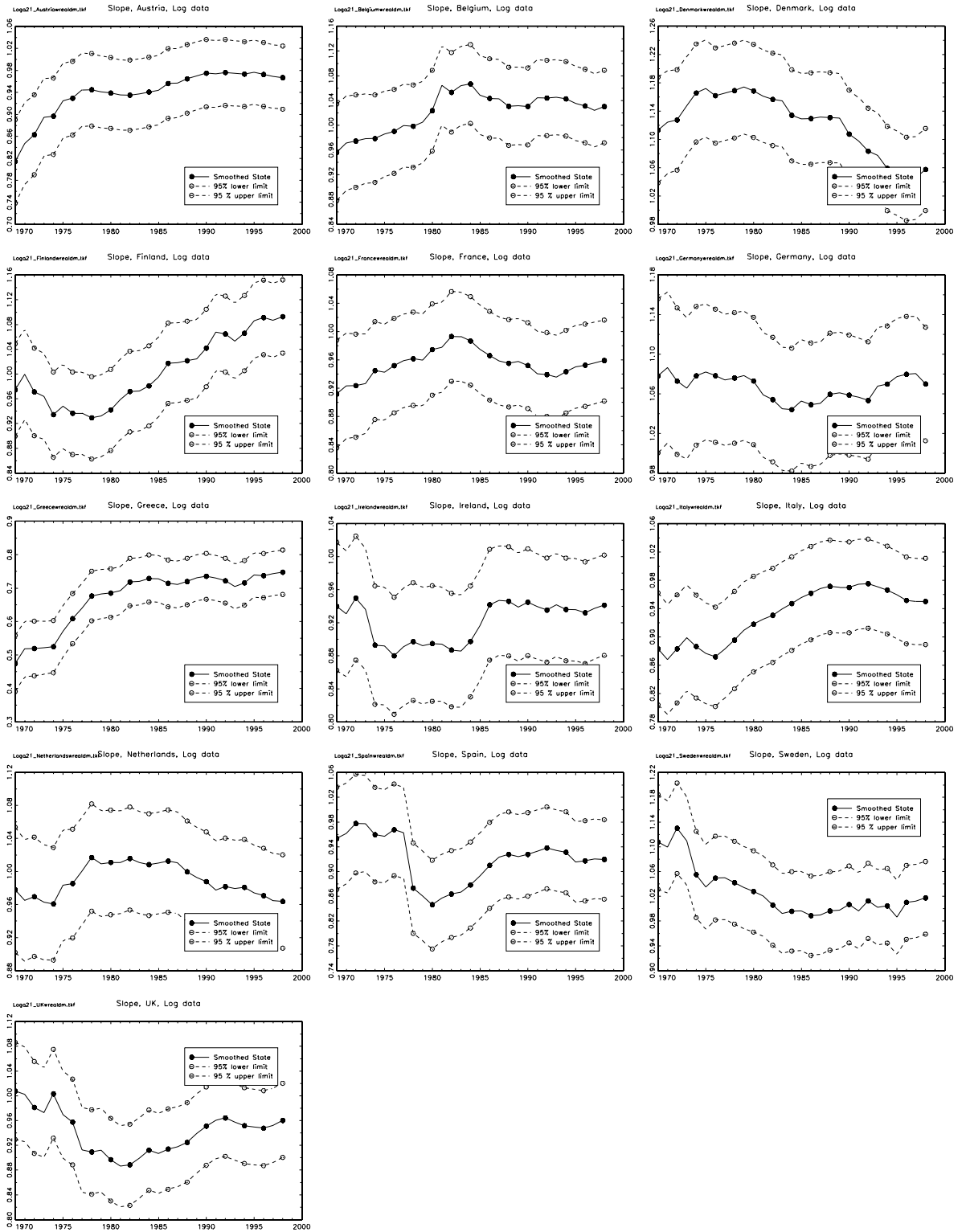

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Figure 8. Time varying $\beta_t : \ln W_t/P_t = \alpha + \gamma \ln q_t + \beta_t \ln W_{tf}/P_t + u_t$
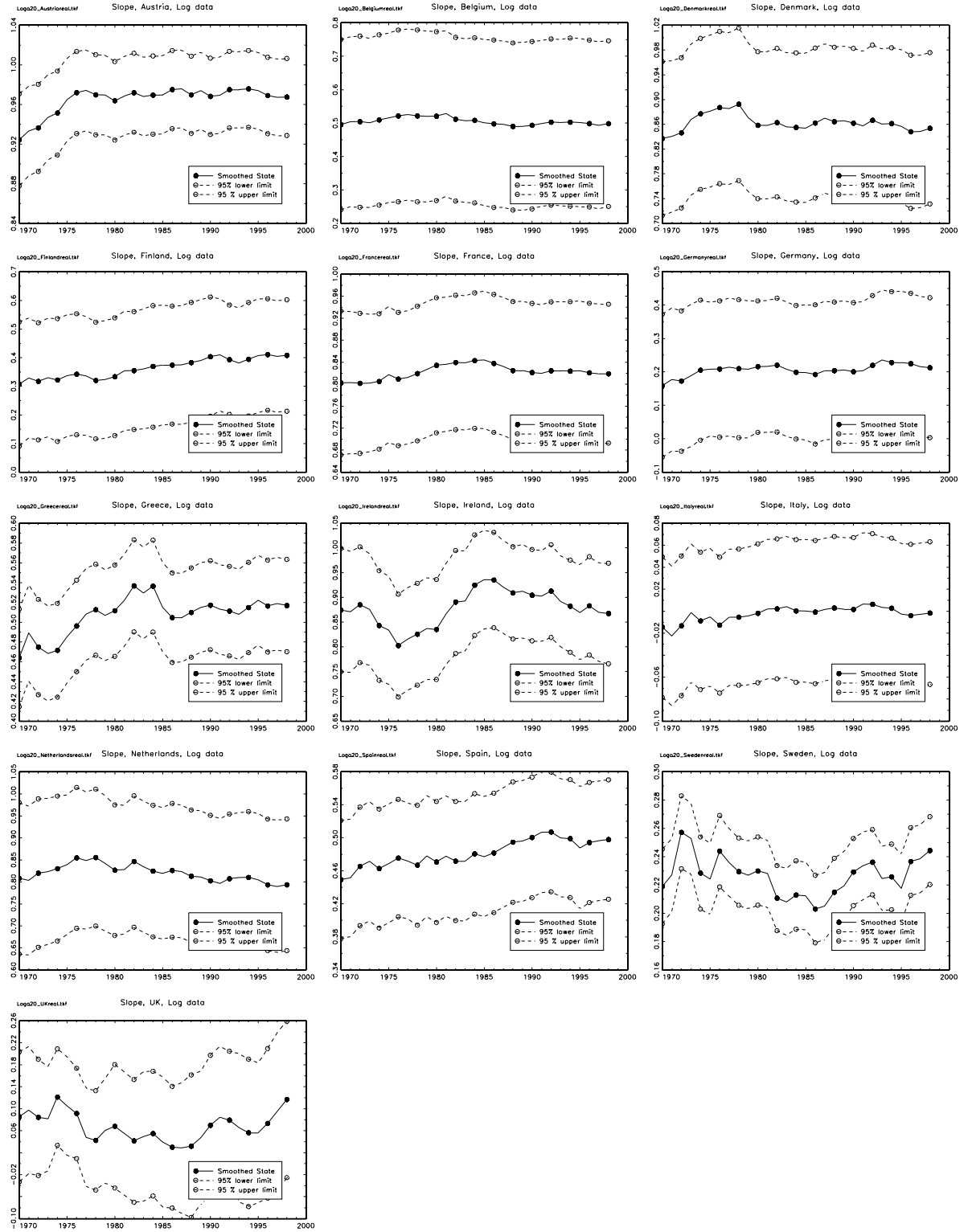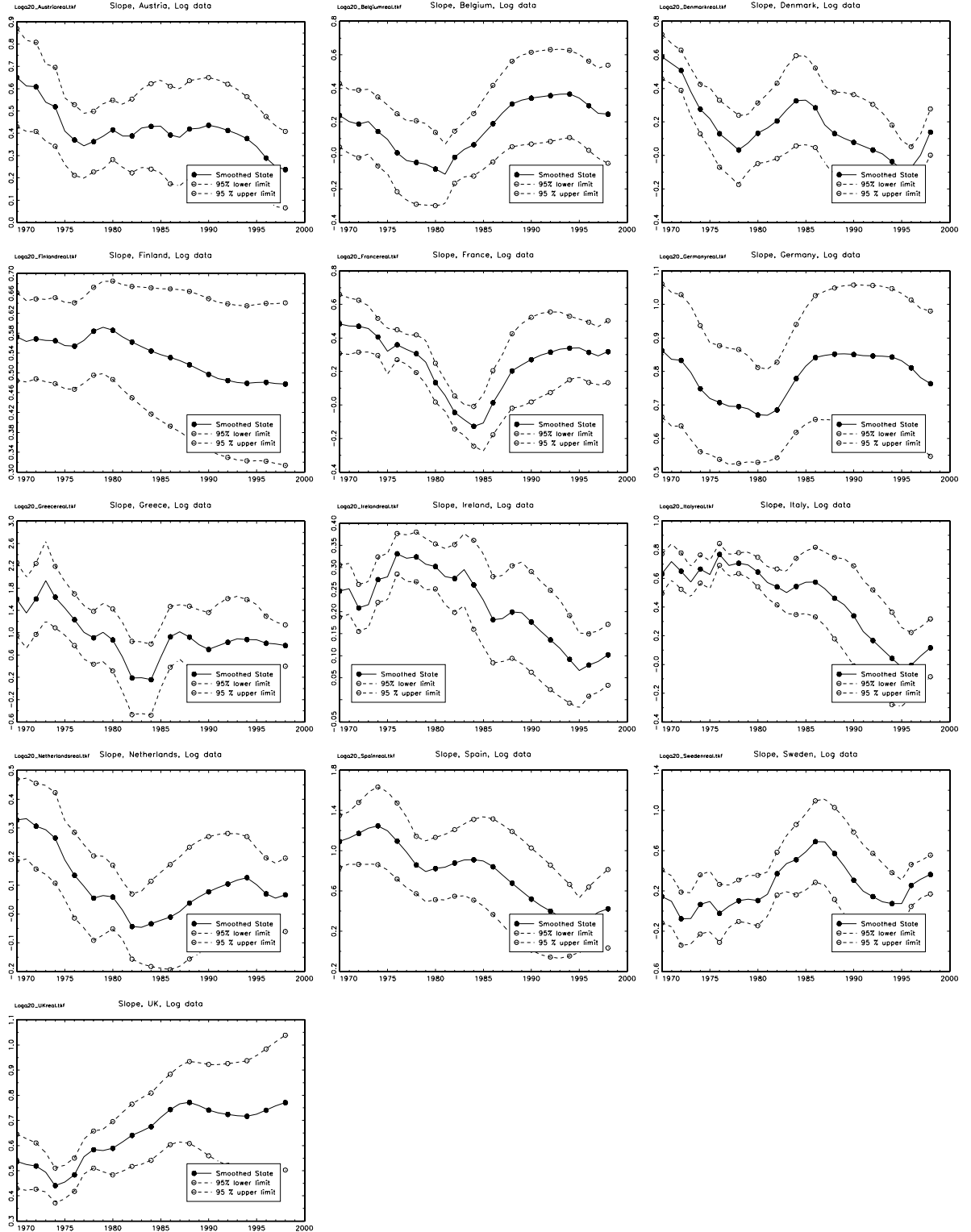
Figure 9. Time varying $\gamma_t : \ln W_t / P_t = \alpha + \gamma_t \ln q_t + \beta \ln W_{tf} / P_t + u_t$

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