DOES PRODUCT MARKET INTEGRATION LEAD TO DECENRALISED WAGE BARGAINING INSTITUTIONS?

MICHELE SANTONI

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“Does product market integration lead to decentralised wage bargaining institutions?” *

Michele Santoni
(Università degli Studi di Milano)

Abstract. This paper studies the effects of product market integration on wage-bargaining institutions. It first shows evidence of a negative correlation between the level of wage bargaining and proxy measures of integration, such as the degree of openness and import penetration, for a macro-panel of 17 OECD countries over the 1975-2000 period. It then develops a theoretical model of an import-competing unionised Cournot-Nash oligopoly. The model shows that a reduction in trade barriers, by lowering the sharable surplus between home firms and labour when the final goods are substitutes, gives unions incentives to choose more decentralised wage-bargaining institutions. This industry-level mechanism, however, works in the opposite direction with either complements or two-way trade and homogeneous goods. In these cases, cutting trade barriers raises the sharable surplus and encourages domestic wage-setters to choose more centralised institutions.

Keywords: Endogenous wage bargaining institutions, Unionised oligopolies, Trade integration

JEL Classification Codes: F16, J51, L13.

Address for correspondence:
Michele Santoni
DEAS
Facoltà di Scienze Politiche
Università degli Studi di Milano
Via Conservatorio 7
20122 Milano (MI)
Italy

Email: Michele.Santoni@unimi.it

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1. Introduction

The 2005 Enlargement programme of the European Economic Area, by further reducing trade barriers among member countries, has increased the process of product market integration started with the Single Market Programme in 1993 (see also Baldwin, 2006, and Alesina et al., 2008, on the trade effects provoked by the adoption of the Euro). Several papers have analysed the effects of increased integration on wage formation and employment outcomes in unionised labour markets (see e.g. Munch and Skaksen, 2002, Andersen and Skaksen, 2007, and Andersen et al. 2000: 110-12, for an early survey). However, the relation between product market integration and wage bargaining institutions, which should influence economic performance in the longer run, has received relatively less attention in the literature (see e.g. Flanagan, 1999, Calmfors, 2001, Agell, 1999, 2002, and Bertola, 2008, for discussions). Moreover, the theoretical papers addressing this relation do not provide formal models of endogenous determination of the degree of centralisation in wage bargaining (see e.g. Driffl and van der Ploeg, 1993, 1995, and Danthine and Hunt, 1994). Finally, the existing empirical evidence based on macroeconomic cross-country data (see e.g. Agell, 1999, 2002) suggests that more open economies should be associated with more centralised wage bargaining institutions: by compressing the wage distribution, centralised institutions would better satisfy the workers’ demand for social insurance against wage risk, which is the stronger the more open an economy is. However, such an empirical evidence flies in the face of the conventional view that product market integration, provided that it intensifies product market competition, should make wage settlements more, not less sensitive to firm-specific conditions.

To assess the sign of the correlation between product market integration and the degree of centralisation in wage bargaining, this paper presents first an empirical test based on 1975-2000 yearly macroeconomic panel data for 17 OECD countries. The results show that the correlation is negative. Random effects order probit estimates show that increasing either the degree of openness or the degree of import penetration, which are interpreted as two-way and one-way trade proxy measures of integration, respectively, raises the probability of observing both low and intermediate levels of wage-bargaining centralisation, while lowering the probability of observing high levels. These results are robust when controlling for the potential endogeneity of these proxies. This evidence of a negative correlation at the macroeconomic level between centralisation and integration motivates the development of a theoretical model highlighting an industry-level mechanism, based on pro-competitive effects of integration, which is able to generate this outcome.
The theoretical model addresses the following issues: how and in which direction does an increase in product market integration, measured as a reduction in “trade” costs from an arbitrary level (as e.g. in Naylor, 1998, and Lommerud et al., 2003) influence the degree of centralisation in wage setting within a given country? To what extent does this depend on both the degree of substitutability between final goods and market structure, i.e. whether there is one-way or two-way trade, for a given initial distribution of wage bargaining power between firms and unions and centralisation costs? The model considers a domestic Cournot-Nash triopolistic industry operating under a linear demand curve and composed of two unionised domestic firms and one non-unionised foreign firm. Following Horn and Wolinsky (1988), there is a multi-stage sequential game: given initial trade costs, the two unions decide whether or not forming a coalition for wage bargaining, and similarly the two firms; given wage bargaining institutions, domestic firms and unions choose wages; finally, domestic and foreign firms compete in the product market. The baseline model assumes one-way trade and allows for different degrees of product differentiation.

In the case of substitutes (the ‘normal’ case with Cournot-Nash competition), the paper shows that, depending on the trade-off between the differential union utility gain from centralisation (which is related to the union bargaining power, degree of product substitutability and domestic product market rents) and the union fixed costs of forming a coalition, two wage bargaining regimes may arise in equilibrium: either fully decentralised bargaining (i.e. at the firm level) or union centralised bargaining (i.e. a centralised union bargaining with two uncoordinated firms). Product market integration makes the fully decentralised bargaining regime more likely to occur. By lowering domestic product market rents, integration makes it less credible (i.e. more costly in terms of lost employment) the central union’s commitment to higher wages resulting from its internalisation of employment externalities in wage setting. Hence, integration lowers union incentives to form a wage coalition when facing uncoordinated firms, while not reversing the firms’ incentives to decentralised bargaining, by allowing domestic firms to keep wages down at the bargaining table with their union, which is more valuable when the goods are substitutes and competition is tough.

1 Horn and Wolinsky (1988) study the merging incentives for unions and firms in a duopoly (see also Davidson, 1988, and Grandner, 2001) when the degree of product substitutability is allowed to vary. They find that unions (firms) have incentives to merge when the goods are substitutes (complements). However, they assume a symmetric distribution of bargaining power and do not address trade issues.

2 This is consistent with Danthine and Hunt’s (1994) finding, derived within a different non-strategic framework, that product market competition is a tougher discipline device for industry-level unions than for firm-level unions.
This industry-level mechanism encouraging wage decentralisation, however, is reversed with complements. In this case, unions are better off by staying separate, while firms prefer forming a coalition, other things given. As a consequence, either fully decentralised bargaining or firm centralised bargaining (i.e. a central employer association bargaining separately with two unions) occurs in equilibrium. Integration now pushes towards centralisation. The intuition is that, with complements, cutting trade costs means not only more import penetration, but also more market opportunities and rents for domestic producers, which raises the firms’ incentives to form a coalition when facing uncoordinated unions. A similar mechanism operates when considering two-way trade under the special case of homogeneous goods: product market integration gives more incentives to union centralisation, by raising both domestic wages and market rents.

Hence, the theoretical model suggests that product market integration has ambiguous effects on the degree of centralisation of wage bargaining institutions at the industry level, depending on the degree of product differentiation and market structure. Under one-way trade and substitutes, the results of the model are consistent both with the macroeconomic empirical evidence of this paper and with the view that integration should causes both more competition and (union) wage moderation (see e.g. Blanchard and Philippon, 2003), and the emergence of more decentralised bargaining institutions (see e.g. Katz, 1993) domestically, although the existing literature considers different mechanisms than those pointed out here.³

The paper is organised as follows. Section 2 presents empirical evidence on the correlation between integration and the level of wage bargaining. Section 3 presents the baseline model with one-way trade and exogenous wage bargaining institutions. Section 4 determines domestic institutions in Nash equilibrium and analyses the effects of product market integration. Section 5 extends the model to two-way trade with homogeneous goods. Section 6 concludes.

2. Are the bargaining level and product market integration negatively correlated?

³ Danthine and Hunt (1994: 536-37) note that integration increases the number of unionised firms competing in a given industry. Flanagan (1999: 1169-1170) argues that a firm’s benefits from wage flexibility increase with integration. Calmfors (2001: 17) argues that, as long as the degree of centralisation is negotiated between firms (favouring decentralisation) and unions, integration will improve the employer’s conflict payoffs in such a negotiation. Driffill and van der Ploeg (1993), on the contrary, show that a reduction in trade costs increases wage competition between unions in different countries and argue that this gives unions more incentives to go international to avoid it.
This section wants to assess empirically the sign of the correlation between product market integration and the bargaining level. Following the existing empirical literature, this section considers macroeconomic data. Earlier work by Agell (1999, 2002), using cross-country OLS estimates for a sample of 20 OECD countries, finds a positive correlation between the Calmfors and Driffill (1988) centralisation rank index and average 1980-1984 log openness. This section presents an alternative test using the bargaining level index (BL) computed by Golden, Lange and Wallerstein (2006) for 17 OECD countries over the 1950-2000 period, which allows us to exploit both the time series and the cross sectional variation in the data. This section starts with the following model specification: \( y_{it} = \beta'x_{it} + \lambda_t + \delta_i + v_{it} \), where \( \delta_i \) and \( \lambda_t \) are individual country and time specific effects, which are introduced in order to control, respectively, for country time-invariant fixed effects and for contemporaneous cross-country correlations (i.e. shocks common to all the countries in a given year, such as oil shocks); \( x_{it} \) is a vector of explanatory variables and \( v_{it} \) is the stochastic residual.

The dependent variable (y) is the index of the bargaining level (BL), ranging discretely from 1 (i.e. plant-level wage setting, which can be interpreted as full decentralisation) to 5 (i.e. central wage-setting with sanctions, which can be interpreted as full centralisation). The vector x consists of the following explanatory variables: the log degree of openness (LOPENK), designed as the sum of exports and imports over real GDP per capita, which is taken as a two-way trade proxy measure for the degree of product market integration; the log country population (LPOP) and the log real GDP per capita corrected for the terms of trade (LRGDPTT), which are used, respectively, as proxies for country size and economic development. All of these data are taken from the Penn World Tables, mark 6.2. Column 1 of Table 1 below presents the panel regression over the 1975-2000 period using the fixed-effects (within) estimator implemented by STATA 9.2. The panel is unbalanced since there are two missing values of the BL variable for Spain (1975-1976). In contrast with Agell’s results, Table 1 shows that higher openness is significantly and negatively correlated with the

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4 Agell (2002) finds that this result is robust to alternative measures of centralisation (i.e. union and firm coordination indexes), and of the degree of openness, controlling for country GDP per capita, country size and cultural homogeneity.

5 This is the BARGLEV2 variable of Golden, Lange and Wallerstein (2006). The dataset (version dated June 16, 2006) is available on line at: [http://www.shelley.polisci.ucla.edu/](http://www.shelley.polisci.ucla.edu/). The countries included in the sample are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the UK, and the US. Relatively to Agell (2002), there are no publicly available data for Ireland, New Zealand, and Portugal. The data for Spain cover the 1977-2000 period only.

6 This data set is available on line at: [http://pwt.econ.upenn.edu/](http://pwt.econ.upenn.edu/). In Appendix 1, Table A.1 reports the summary statistics of the variables used in this section.
bargaining level. Moreover, the bargaining level is negatively affected by country size and positively affected by the level of economic development.

Table 1. Centralisation of wage bargaining and product market integration: Fixed-effects estimates.

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>(1) Fixed –effects (within) regression for Bargaining Level BL</th>
<th>(2) Fixed-effects (within) IV regression First Stage for Instr-LOPENK</th>
<th>(3) Fixed-effects (within) IV regression for Bargaining Level BL</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOPENK</td>
<td>-1.424559*** (0.4508528)</td>
<td>0.9059352*** (0.1234822)</td>
<td>-4.517985*** (1.352024)</td>
</tr>
<tr>
<td>Instr-LOPENK</td>
<td>0.9059352*** (0.1234822)</td>
<td>0.823137** (0.0552279)</td>
<td>-0.9238752 (2.201538)</td>
</tr>
<tr>
<td>LPOP</td>
<td>-4.2194972*** (1.237156)</td>
<td>0.6823137*** (0.0552279)</td>
<td>0.450389*** (1.218283)</td>
</tr>
<tr>
<td>LRGDPITT</td>
<td>1.510288*** (0.5766815)</td>
<td>0.912835*** (0.0117949)</td>
<td>-0.807556*** (0.0304814)</td>
</tr>
<tr>
<td>TARIFF-INT</td>
<td>0.912835*** (0.0117949)</td>
<td>0.823137** (0.0552279)</td>
<td></td>
</tr>
<tr>
<td>LECTR</td>
<td>-0.807556*** (0.0304814)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time dummies</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>R²</td>
<td>0.3254</td>
<td>0.3916</td>
<td>0.0194</td>
</tr>
<tr>
<td>F –test (joint)</td>
<td>F(16, 396)=35.91 [0]</td>
<td>F(16,395)= 620.81 [0]</td>
<td></td>
</tr>
<tr>
<td>Wald-test (joint)</td>
<td>chi²(27) = 70.36 [0]</td>
<td></td>
<td>chi²(1)=0.842 [0.3588]</td>
</tr>
<tr>
<td>Sargan test</td>
<td></td>
<td></td>
<td>chi²(1)=0.842 [0.3588]</td>
</tr>
</tbody>
</table>

Notes: The regression includes 440 observations on 17 countries over the period 1975-2000 (unbalanced panel). F-test and Wald test that all the coefficients are equal to zero. Sargan test of overidentifying restrictions. Column 3 reports bootstrapped standard errors (500 replications). * p<0.10, ** p<0.05, *** p<0.01, where p is the marginal probability level. For variable descriptions and definitions see the Appendix 1.

One problem with these results is the potential endogeneity of the degree of openness: if this is the case, the degree of openness will be correlated with unobservables that affect the bargaining level, thus with the error term, leading to inconsistent estimates of the effect of LOPENK on BL. For example, different wage bargaining institutions may influence differently national firms’ incentives to undertake labour productivity enhancing investment, which in turn may affect the likelihood that firms will trade internationally, thus the country’s degree of openness. To address the endogeneity problem, the following instruments for the degree of openness are identified: an index of tariff barriers constructed for capturing freedom to trade internationally by the Fraser Institute (see Gwartney and Lawson, 2007), and covering the 1970-2007 period.

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7 On the relation between centralisation levels and firms’ incentives to innovation, see Haucap and Wey (2004). On the relation between firms’ productivity and their incentives to become international, see Helpman (2006: 592-595).
for several countries (TARIFF-INT). An index of domestic product market regulation, whose log value (LECTR) is used here, computed by Conway and Nicoletti (2006) over the 1975-2003 period for a number of non-manufacturing industries in several OECD countries. One would expect the TARIFF-INT variable to be positively correlated with the degree of openness (as a higher value for this index is associated with lower tariff barriers), and the LECTR variable to be negatively correlated with it (as a higher value for this index means more domestic regulation, thus less domestic competition). Column 2 in Table 1 above presents the results of the auxiliary regression generating INSTR-LOPENK. Column 3 shows the regression for BL with the endogeneous degree of openness. There is still a statistically significant negative effect of the log degree of openness on the bargaining level, although the estimated coefficient varies widely relatively to the results in column 1, as expected. The Sargan test for overidentifying restrictions cannot reject the null hypothesis that the equation is properly specified and the instrumental variables are uncorrelated with the error term, implying that the selected instruments are not weak.

The discrete and ordinal nature of the dependent variable bargaining level suggests us to support the previous empirical findings by estimating a random effects ordered probit model. To deal with the potential correlation of the explanatory variables (LOPENK, LPOP and LRGDPTT) with the unobserved country-specific time-invariant effects, the former are replaced with their deviations from the individual country

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8 This index varies between 1 and 10, with 1 indicating high tariff barriers and 10 none at all and is available on a five-year basis over the 1970-2000 period, see Gwartney and Lawson (2007). Here, the missing years have been interpolated. Griffith et al. (2007) use this index as a measure of border controls in estimating a firm’s domestic profitability.

9 This aggregate index varies on a scale between 0 (no regulation) and 6 (maximum regulation) and covers both seven non-manufacturing industries (gas, electricity, post, telecommunications, air transport, rail transport and road freight) and three main areas (public ownership of business sector firms, legal barriers restricting access to markets and other barriers to entry related to market or industry structure); Fiori et al. (2007) use it as a proxy for domestic regulation as well. Nicoletti et al. (2001, p. 181) use a legal index of product market regulation that includes the manufacturing sectors as a proxy measure for integration, but their index is computed for 1997 only.

10 Table 1 assumes that the residuals are homoskedastic and serially uncorrelated. If this is not the case, the estimates will be consistent but inefficient. However, it turns out that the statistical significance of the estimated coefficients is unaffected by bootstrapping the variance-covariance matrix of the estimator. (Column 3 reports the bootstrapped standard errors.) Moreover, Table 1 implicitly assumes data poolability, thus coefficient homogeneity. If this is not the case, it is well known that the pooled estimator will be inconsistent even asymptotically.

11 This model is built around a latent regression \( y^*_t = \beta' x_t + \lambda_t + \delta_i + v_{it} \), where \( y^*_t \) is an unobservable latent variable for the bargaining level, \( x_t \) is a vector of time-varying explanatory variables, \( \beta' \) is a vector of parameters, \( \delta_i \) is a country-specific time-invariant random effect and \( v_{it} \) are random variables independently and identically distributed over time. The stochastic components are assumed to be mutually independent and normally distributed with zero mean and constant variance. The researcher observes the bargaining level \( y \) on an ordinal scale from 1 to 5 such that \( y=1 \) if \( y^* \leq \text{cut1} \), \( y=2 \) if \( \text{cut1} < y^* \leq \text{cut2} \), \( y=3 \) if \( \text{cut2} < y^* \leq \text{cut3} \), \( y=4 \) if \( \text{cut3} < y^* \leq \text{cut4} \), \( y=5 \) if \( y^* > \text{cut4} \). The parameters and the unknown thresholds cut1 to cut4 are estimated by the maximum likelihood procedure implemented by STATA 9.2.
time-averaged sample means (DLOPENK, DLPOP, DLRGDPTT, where, say, DLOPENK=LOPENK-ALOPENK, with ALOPENK being the country mean), such that the country-specific random effects become uncorrelated with the transformed variables.\textsuperscript{12} Below, Table 2 reports the results, while Table 3 shows the estimated marginal effects of changes in the degree of openness on the predicted probability for each level of bargaining (i.e. BL=1, 2, 3, 4, 5). Tables 2 and 3 use import penetration panel data from the OECD (2006) as well rather than the degree of openness. Import penetration is defined as the value of imports of goods and services as a percentage of total domestic demand and is interpreted as a one-way trade proxy measure of the degree of product market integration.

### Table 2. Centralisation of wage bargaining and product market integration: Random effects ordered probit regressions for the Bargaining Level BL.

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>(1) Coefficient (standard errors)</th>
<th>(2) Coefficient (standard errors)</th>
<th>(3) Coefficient (standard errors)</th>
<th>(4) Coefficient (standard errors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLOPENK</td>
<td>-2.699538*** (0.8157793)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instr-LOPENK</td>
<td></td>
<td>-0.914858*** (0.0713371)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLIMPORTPenet</td>
<td></td>
<td></td>
<td>-3.335706*** (0.7691921)</td>
<td></td>
</tr>
<tr>
<td>Instr-LIMPORTPenet</td>
<td></td>
<td></td>
<td></td>
<td>-0.2215807* (0.1191645)</td>
</tr>
<tr>
<td>DLPOP</td>
<td>-9.910*** (2.222401)</td>
<td>-10.44688*** (2.085282)</td>
<td>-10.37597*** (2.193299)</td>
<td>-10.38318*** (2.142242)</td>
</tr>
<tr>
<td>DLRGDPTT</td>
<td>2.957574*** (1.089151)</td>
<td>1.209059</td>
<td>3.84069*** (1.114499)</td>
<td>0.5735783</td>
</tr>
<tr>
<td>Time dummies</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>cut1</td>
<td>-3.148043*** (0.284908)</td>
<td>-6.182283*** (0.4234241)</td>
<td>-1.80869*** (0.2651935)</td>
<td>-3.075172*** (0.4734213)</td>
</tr>
<tr>
<td>cut2</td>
<td>-1.94155*** (0.2510369)</td>
<td>-5.077506*** (0.3866464)</td>
<td>-0.5968884*** (0.2464669)</td>
<td>-2.212276*** (0.4670709)</td>
</tr>
<tr>
<td>cut3</td>
<td>0.2192547 (0.2311739)</td>
<td>-2.942163*** (0.3347105)</td>
<td>1.625151*** (0.2499621)</td>
<td>-0.2291594</td>
</tr>
<tr>
<td>cut4</td>
<td>1.107844*** (0.2348721)</td>
<td>-2.02472*** (0.3281127)</td>
<td>2.52158*** (0.2574731)</td>
<td>0.6863242</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-408.81854</td>
<td>-408.14998</td>
<td>-405.63184</td>
<td>-431.30899</td>
</tr>
<tr>
<td>Bound test</td>
<td>F(2, 397) = 16.75 [0]</td>
<td></td>
<td>F(2, 397) = 11.60 [0]</td>
<td></td>
</tr>
<tr>
<td>Kleibergen-Paap rank test</td>
<td>p value = 0.14</td>
<td></td>
<td>p value = 0.19</td>
<td></td>
</tr>
</tbody>
</table>

Notes: The regression includes 440 observations on 17 countries over the period 1975-2000 (unbalanced panel). LR test: Likelihood Ratio test that all the coefficients are equal to 0. Bound test of the joint significance of the selected instruments. Kleibergen-Paap rank test under the null hypothesis that the instruments identify the endogenous regressor.

* p<0.10, ** p<0.05, *** p<0.01, where p is the marginal probability level. For variable descriptions and definitions see the Appendix 1.

\textsuperscript{12} Namely, the latent regression becomes $y^*_{it} = \beta'(x_{it} - \bar{x}_i) + \lambda_t + (\delta_i + \beta'x_i) + v_{it}$. 

7
Table 3. Marginal effects of the degree of openness/import penetration on the predicted probabilities.

<table>
<thead>
<tr>
<th></th>
<th>Pr(BL=1)</th>
<th>Pr(BL=2)</th>
<th>Pr(BL=3)</th>
<th>Pr(BL=4)</th>
<th>Pr(BL=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(standard errors)</td>
<td>(standard errors)</td>
<td>(standard errors)</td>
<td>(standard errors)</td>
<td>(standard errors)</td>
</tr>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLOPENK</td>
<td>0.0106338* (0.00658)</td>
<td>0.1902645*** (0.0678)</td>
<td>0.8089374*** (0.25635)</td>
<td>-0.7183587*** (0.22423)</td>
<td>-0.513643*** (0.16142)</td>
</tr>
<tr>
<td>(2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instr-LOPENK</td>
<td>0.0089514** (0.00402)</td>
<td>0.0895545*** (0.0167)</td>
<td>0.2118802*** (0.03175)</td>
<td>-0.2963186*** (0.03088)</td>
<td>-0.1304762*** (0.01788)</td>
</tr>
<tr>
<td>(3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLIMPORTPenet</td>
<td>0.3595535*** (0.11257)</td>
<td>0.8659215*** (0.22311)</td>
<td>-1.329202*** (0.32497)</td>
<td>-1.807247*** (0.41385)</td>
<td>-0.0336077*** (0.01385)</td>
</tr>
<tr>
<td>(4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instr-LIMPORTPen</td>
<td>0.004887* (0.00297)</td>
<td>0.0219751* (0.01174)</td>
<td>0.0485052* (0.02811)</td>
<td>-0.0767116* (0.04084)</td>
<td>-0.0352916* (0.01951)</td>
</tr>
</tbody>
</table>

Note: Each cell shows the marginal effect of an increase in the log deviation of the degree of openness/import penetration from its mean on the predicted probability of observing a particular value of the dependent variable bargaining level BL for a country that has the sample average for LPOP and LRGDPTT. * p<0.10, ** p<0.05, *** p<0.01, where p is the marginal probability level.

It turns out that an increase in the degree of openness has a statistically significant and negative effect on the degree of wage centralisation. Increasing openness raises the predicted probability of BL=1 (i.e. full decentralisation) while lowering the probability of BL=5 (i.e. full centralisation) at the same time, as shown by the negative estimated coefficient for DLOPENK (see column 1 in Table 2). This result is robust when controlling for the potential endogeneity of openness. The Bound test does not reject the joint significance of the instruments TARIFF-INT and LECTR, hence the selected instruments are not weak (see column 2 in Table 2).\(^\text{13}\) Table 3 (see rows 1 and 2) shows that increasing the degree of openness both raises the probability of observing low (i.e. BL=1) and intermediate (BL=2 and BL=3) levels of centralisation and lowers the probability of observing high (BL=4 and BL=5) levels of centralisation. The results are similar when using import penetration rather than openness (see Table 2: columns 3 and 4; Table 3: rows 3 and 4).

The evidence of a negative correlation between the degree of centralisation and proxy measures of integration at the macroeconomic level in these data suggests us that market-based economic mechanisms pushing towards decentralisation, as argued by Danthine and Hunt (1994) and Calmfors (2001) among

\(^\text{13}\) This result is confirmed by the Kleibergen-Paap rank test for instrument validity reported in Table 2. This test cannot reject the null hypothesis that the matrix of reduced form coefficients for the endogenous regressor is rank 1 against the alternative of rank 2. Moreover, a test on the estimated threshold parameters cut1 to cut4 shows that they are statistically different, implying that the five ordered categories for BL are truly different. (These results and the auxiliary regressions for Table 2 are available on request from the author.)
others, are likely to dominate social insurance incentives to centralisation, as argued by Agell (1999, 2002).

The next section presents a theoretical model specifying the conditions under which higher product market integration can lead to more decentralised wage bargaining institution within a given industrial sector.

3. The model

In a home country, there is a typical Cournot-Nash industry composed of two unionised domestic firms and one non-unionised foreign firm. Firms produce goods, which can be either substitutes or complements, under constant marginal costs and face linear demand curves for their products. Home unions maximise rents from employment in excess of an exogenously fixed reservation wage. Home wages are determined through Nash bargaining, potentially occurring in four different bargaining regimes: full decentralisation (DD, i.e. firm-level negotiations); full centralisation (CC, i.e. two-union/two-firm industry level negotiation); union centralisation (CD, i.e. the two unions form a coalition that bargains separately and simultaneously with the two firms); firm centralisation (DC, i.e. the two firms form a coalition that bargains separately and simultaneously with the two unions). Following Flanagan’s (1999: 1170) argument that “relatively centralised bargaining structures appear to be associated with relatively high transactions costs”, the paper assumes that unions and firms face positive exogenous fixed costs of centralisation, H and G, respectively (see section 4 below for a discussion). The foreign firm’s marginal costs are exogenous and depend both on a foreign wage \( w^* \) (in terms of a domestic numéraire good, produced in a competitive sector) and on trade costs \( t \) (representing e.g. a tariff, transport and red-tape costs or other transactions costs) proportional to foreign output. Product market integration is interpreted as a reduction in trade costs \( t \). This and the next section assume that domestic firms do not export, thus imposing one-way trade. Section 5 extends the analysis to two-way trade in the special case of homogeneous goods.

The representative domestic consumer has quasi-linear preferences over \( X \), the Cournot-Nash good, and \( Y \), the numéraire good produced in a competitive sector:

\[
U(X,Y) = \alpha \left[ \sum_{i=1}^{2} x_i + x^* \right] - \frac{1}{2} \left[ \sum_{i=1}^{2} x_i^2 + (x^*)^2 + 2cx_1x_2 + 2dx^*(x_1 + x_2) \right] + Y
\]

\[ (1) \]

14 Based on Nickell and Layard’s taxonomy (see Boeri et al, 2001: Tab. 5.1), DD may represent countries such as the UK, CC the Nordic Countries, CD Spain, DC Switzerland. The theoretical literature on product market integration in unionised oligopolies typically assumes plant-level monopoly-union wage setting, see e.g. Naylor (1998) and Lommerud et al. (2003). Leahy and Montagna (2000) consider industrial monopoly unions as well.
where \(-1 < c \leq 1\) and \(-1 < d \leq 1\) represent, respectively, the degree of substitutability between the home goods \(x_i\), \(i=1, 2\), and between the foreign good \(x^*\) and the home goods \(x_i\). All the goods are substitutes (complements) for \(c>0\) and \(d>0\) (\(c<0\) and \(d<0\)). However, consumers potentially treat domestic and foreign goods differently: in particular, they treat the domestic goods as a composite commodity vis-à-vis the foreign good,\(^{15}\) but when comparing domestic goods they treat them as differentiated goods. Furthermore, it is assumed that \(|c| \geq |d|\) and that \(1 + c - d^2 > 0\): the foreign goods cannot be closer substitutes (complements) for the domestic goods than these are between them. Clearly, goods are homogeneous for \(c=d=1\). From equation (1), it follows that \(P_i = \alpha - x_i - cx_j - dx^*\), for \(i, j = 1, 2, i \neq j\) and \(P^* = \alpha - x^* - d(x_1 + x_2)\) are the linear inverse product demand curves.

Given the degree of product market integration, in stage 1 home firms and unions choose simultaneously and independently whether or not forming a wage coalition, thus determining the equilibrium bargaining regime. In stage 2, given the bargaining structure, wage negotiations occur in the domestic labour market. In stage 3, firms compete in the product market. The solution is derived under backward induction.

3.1 Stage 3: Cournot-Nash competition

Firms have symmetric linear-in-labour technologies, and the marginal product of labour is normalised to unity. The firms’ profit functions are: \(\Pi_i = (P_i - w_i)x_i\), for \(i=1, 2\), and \(\Pi^* = (P^* - w^* - t)x^*\); \(w_i\) are domestic wages, \(w^*\) are exogenous foreign wages, \(t\) are “trade” costs. Firms maximise profits by choosing output and employment, and by taking outputs of the rival firms and predetermined wages as given. This process yields upwards (downwards) sloping output best reply functions (not reported here) when the outputs are substitutes (complements) for \(c \geq d>0\) (\(0>d \geq c\)). Labour demand curves and indirect profits are, respectively:

\[
x_i^* = \left[ \frac{\alpha(2-c)(2-c)-(4-c^2)w_i+(2c-d^2)w_j+(w^*+t)(2-c)d}{2(2-c)(2+c-d^2)} \right]^{\frac{1}{2}};
\]

\[
x^* = \left[ \frac{\alpha(2-c)[2(1-d)+c]-(4-c^2)(w^*+t)+(2-c)d(w_1+w_2)}{2(2-c)(2+c-d^2)} \right]^{\frac{1}{2}}
\]

\[
\Pi_i = \left[ x_i \right]^{\frac{2}{2}}; \quad \Pi^* = \left[ x^* \right]^{\frac{2}{2}}
\]

\(^{15}\) This assumption allows us to generate symmetric equilibrium wages domestically, see below.
with i, j=1, 2 and i\neq j. For given wages, domestic firms’ indirect profits (total industry outputs) are an increasing (decreasing) function of trade costs t, as expected. For the foreign firm to be active in any regime, it is assumed that \( \alpha > \frac{(2 + c)(w_1 + w_2) - d(w_1 + w_2)}{2(1 - d) + c} \), where \( 2(1-d)+c>0 \) holds from previous restrictions.

### 3.2 Stage 2: wage setting

Domestic workers join the union at the firm level. The typical trade union maximises rents:\(^{16}\)

\[
U_i = (w_i - \tilde{w}) x_i
\]

\( \tilde{w} \) can be interpreted as the reservation wage level (e.g. the wage rate in the competitive sector; an unemployment benefit; the disutility of labour), which is taken as given by the unions. The wage is the outcome of a Nash bargaining occurring simultaneously within each firm, subject to the rules of the game that depend on the predetermined bargaining regime, see below. The parametric union bargaining power over wages is \( 0 \leq b \leq 1 \). For \( b = 0 \) the union has no bargaining power, for \( b = 1 \) it is a monopoly wage setter.

The following analysis assumes that the union bargaining power parameter \( b \) is the same across both firms and bargaining regimes, namely regime changes only affect the parties’ inside options, not the parameter \( b \).

(This assumption implies that the discount factors of the negotiators are unaffected by regime changes.)

### 3.2.1 Fully decentralised wage bargaining (DD)

Each domestic firm and union bargain simultaneously and separately over the wage rate, anticipating the effects of the wage decision on their labour demand curve (2), thus on the product market stage. The Nash solution to the wage problem is

\[
NA_{DD}^i = \left( \frac{\alpha}{\Pi_i} \right)^{1-b} \left( \frac{w_i - \tilde{w}}{x_i} \right)^b
\]

\( i=1, 2 \), where the relevant equations (2), the domestic labour demand curve, and (3), the domestic indirect profits must be substituted in. The inside options for both the union and the firm are set equal to zero in the

---

\(^{16}\) The assumption of union-rent maximisation allow us to make consistent welfare-based comparisons of union and firm utilities across bargaining regimes (see Lommerud et al., 2003, for a discussion). Efficient wage-employment negotiations are not analysed, in light of the scant empirical evidence supporting efficient bargaining at the firm level and, especially, at the industry level.
absence of any utility flow during a dispute. Each firm-union bargaining pair maximises the Nash product (5) by choice of the wage, taking as given the two rival firms’ marginal costs. Solving the model,17 yields the symmetric equilibrium wages, which are reported in Table 4 below. Table 4 shows that the domestic wage is a mark-up over the reservation wage $\bar{w}$. The mark-up is increasing in union bargaining power $b$ and proportional to a measure of product market rents $R_{om} = \alpha (2-d) + d(w^* + t) - 2\bar{w} > 0$, where $R_{om}$ can be interpreted as a measure of market size for domestic producers.18 Cutting trade costs $t$ lowers (raises) $R_{om}$ and induces wage moderation (wage hikes) when the domestic and foreign goods are substitutes (complements). Actually, cutting trade costs lowers (increases) the labour demand of the typical home firm at any given wage level and, because of linearity, the elasticity of labour demand rises (falls) at the initial optimal wage.19

3.2.2 Union centralised wage bargaining (CD)

A centralised union bargains simultaneously with each home firm. The union’s objective function when bargaining in firm $i$ is the sum of the union rents in both the firms. Following Horn and Wolinsky (1988: 452), assume that, in the case of a temporary negotiation breakdown in firm $i$, the firm $i$ earns zero profits, whereas the firm $j$ operates at the anticipated equilibrium output of this regime, or $x_{1,2}^{CD} (w_1^{CD}, w_2^{CD}; w^* + t)$, say. Moreover, assume that centralisation of bargaining activities implies a symmetric fixed cost $H \geq 0$ for each union (see section 4 below for a discussion): when negotiating with firm $i$, the centralised union’s inside option is the utility flow $V=[w_j^{CD} - \bar{w}] x_j^{CD} (w_j^{CD}; w_j^{CD}; w^* + t)$, which can be interpreted as strike funds.20 Each firm’s inside option is zero. The Nash programme becomes

17 Appendix 2 reports the relevant first-order conditions for the optimal wage in all the bargaining regimes, focussing on the special case of homogeneous goods.

18 This follows Rowthorn’s (1992) interpretation of the maximum level of domestic sales consistent with breaking even as a measure of market size. Here, the maximum level of domestic sales, given the output produced by the foreign firm is $(x_1 + x_2)_{\text{max}} = 2(\alpha - \bar{w} - d x^*) / (1 + c)$ where $x^* = \max \{[\alpha (1+c - 2d) + 2d\bar{w} - (1 + c)(w^* + t)] / 2(1 + c - d^2); 0 \}$ is the Cournot-Nash equilibrium output for the foreign firm when the domestic firms play $(x_1 + x_2)_{\text{MAX}}$.

19 This result is a feature of the one-way trade framework of this section, see section 5 below.

20 Alternatively, one could assume that firm $j$ operates at the anticipated duopoly equilibrium output resulting from its interaction with the foreign firm.
For the foreign firm to be active in any regime, assume:

\[ N^i_{CD} = \left[ \Pi_i \right]^{1-b} \left\{ \left[ w_i - w \right] + \left[ w_j - w \right] \right\} x_j - 2H - V \]  \tag{6} 

where the relevant equations for the labour demands (2) and indirect profits (3) must be substituted in; \( V \) is taken as given by the parties during the negotiation. Here, the union internalises the employment externality in wage setting, as it recognises the effect of the wage in the firm \( i \) on the employment level in the firm \( j \).

From equation (6), solving the FOCS yields the symmetric equilibrium wage, as shown in Table 4 below.

**Table 4. Market equilibrium under one-way trade.**

<table>
<thead>
<tr>
<th>FULLY DECENTRALISED DD REGIME</th>
<th>UNION CENTRALISED CD REGIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w_{i,DD} ) = ( w + \frac{b(2-c)}{2(4-d^2-b(2c-d^2))}R_{ow} )</td>
<td>( w_{i,CD} = w + \frac{b(2-c)}{2\left(4-d^2-b(2c-d^2)\right)}R_{ow} )</td>
</tr>
<tr>
<td>( x_{i,DD} = \frac{(4-d^2)(2-b)}{2(2+c-d^2)[2(4-d^2)-b(2c-d^2)]}R_{ow} )</td>
<td>( x_{i,CD} = \frac{(4-d^2)-b(2+c-d^2)}{2(2+c-d^2)[4-d^2-b(2c-d^2)]}R_{ow} )</td>
</tr>
<tr>
<td>( U_{i,DD} = \frac{b(2-b)(4-d^2)(2-c)}{2(2+c-d^2)[2(4-d^2)-b(2c-d^2)]}R_{ow}^2 )</td>
<td>( U_{i,CD} = \frac{b(2-c)[4-d^2-b(2+c-d^2)]}{4(2+c-d^2)[4-d^2-b(2c-d^2)]^2}R_{ow}^2 )</td>
</tr>
<tr>
<td>( \Pi_{i,DD} = \left[ x_{i,DD} \right]^2 )</td>
<td>( \Pi_{i,CD} = \left[ x_{i,CD} \right]^2 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FIRM CENTRALISED DC REGIME</th>
<th>FULLY CENTRALISED CC REGIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w_{i,DC} = w + \frac{b(2-c)}{4(2-c)+b(2c-d^2)}R_{ow} )</td>
<td>( w_{i,CC} = w + \frac{b}{4}R_{ow} )</td>
</tr>
<tr>
<td>( x_{i,DC} = \frac{2(2-b)(2-c)+b(2c-d^2)}{2(2+c-d^2)[4(2-c)+b(2c-d^2)]}R_{ow} )</td>
<td>( x_{i,CC} = \frac{(2-b)}{4(2+c-d^2)}R_{ow} )</td>
</tr>
<tr>
<td>( U_{i,DC} = \frac{b(2-c)[2(2-b)(2-c)+b(2c-d^2)]}{2(2+c-d^2)[4(2-c)+b(2c-d^2)]^2}R_{ow}^2 )</td>
<td>( U_{i,CC} = \frac{b(2-b)}{16(2+c-d^2)}R_{ow}^2 )</td>
</tr>
<tr>
<td>( \Pi_{i,DC} = \left[ x_{i,DC} \right]^2 )</td>
<td>( \Pi_{i,CC} = \left[ x_{i,CC} \right]^2 )</td>
</tr>
</tbody>
</table>

\( R_{ow} = \alpha(2-d) + d(w^* + t) - 2w > 0 \) for the foreign firm to be active in any regime, assume: \( \alpha > \frac{(2+c)(w^* + t) - d(w_1 + w_2)}{2(1-d) + c} \).

**Note:** Foreign outputs are not reported. For \( 0 < d < c \leq 1 \), the goods are substitutes.
3.2.3 Firm centralised wage bargaining (DC)

A central employer association bargains simultaneously with each firm-specific union. Assume that the employer organisation derives a utility flow equal to the profits in firm $j$ at the anticipated equilibrium output of this regime, $\hat{x}_2^{DC}(\hat{w}_1^{DC}, \hat{w}_2^{DC}; \hat{w}^* + t)$, say, implying the following inside option, $Z = \Pi_j^{DC} - 2G$. This may be interpreted as lock-out funds (see Davidson, 1988: 420-21), where $G \geq 0$ denotes the symmetric fixed costs paid by each firm for centralising their bargaining activity (see section 4 below for a discussion).

The unions’ inside option is zero. Using equations (2), (3) and (4) and maximising, for given $Z$,

$$N^{DC}_i = \left[ \frac{\hat{w}_i - \hat{w}}{x_i} \right]^{1-b} \left( \frac{\hat{\Pi}_j + \hat{\Pi}_j - 2G - Z}{\hat{\Pi}_j + \hat{\Pi}_j - 2G - Z} \right)^{1-b}$$

with respect to the wage, yields the symmetric equilibrium wage, as shown in Table 4 above. Here, the employers internalise the profit externality of the wage choice in the firm $i$ on the profits of the firm $j$.

3.2.4 Fully centralised wage bargaining (CC)

A central employers’ association and a centralised union bargain simultaneously in the two firms. This implies inside options $Z = -2G$ and $V = -2H$, respectively. Thus, the optimal wage maximises

$$N^{CC}_j = \left[ \frac{\hat{w}_j - \hat{w}}{x_j} \right]^{1-b} \left( \frac{\hat{\Pi}_j + \hat{\Pi}_j - 2G - Z}{\hat{\Pi}_j + \hat{\Pi}_j - 2G - Z} \right)^{1-b}$$

The symmetric equilibrium wage is reported in Table 4 above. The internalisation of employment and profit externalities by unions and firms, respectively, make now the unions stronger (weaker) at the bargaining table, when the goods are substitutes (complements). Table 4 also shows the equilibrium values for domestic outputs, union’s utility and firm’s profits in the various regimes. These are obtained by direct substitution.

4. Stage 1: Endogenous wage bargaining institutions

Following the literature on coalition formation in oligopolistic markets (see e.g. Bloch, 2002, for a survey), assume that unions and firms can form a single coalition as regards wage determination (a wage coalition henceforth), namely a centralised union or a centralised employer association. Each union announces simultaneously whether or not it wants to join the centralised union, given the firms’ simultaneous decision.
of whether or not joining a centralised employer association. Inside a wage coalition, the unions, say, take into account of the total union rents when bargaining over wages with firms, and similarly the firms take into account of the total firm profits if they constitute an employer association. Then, stage-two equilibrium total union rents and profits are equally divided inside each coalition. Hence, Table 4 above shows the gross payoffs for each individual union and firm in each bargaining regime.

Assume now that each organisational form (i.e. centralised vs. decentralised organisation) is associated with non-negative fixed organisational costs and that these costs are higher in a wage coalition.\(^{21}\) By normalising organisational costs of decentralised organisations to zero, assume that each union and firm face symmetric exogenous fixed costs \(H \geq 0\) and \(G \geq 0\), respectively, of forming and staying in a coalition. These may be interpreted as higher transactions costs (e.g. decision-making costs), administrative costs (e.g. the cost of hiring new lawyers and accountants), costs related to union recognition laws and employment protection legislation, or opportunity costs related to internal organisational reasons that would favour decentralisation over centralisation. \(H\) and \(G\) are both measured in terms of the numéraire. Assuming that centralisation is associated with higher transactions costs than decentralisation is consistent with Flanagan’s (1999: 1170) macroeconomic view of wage bargaining institutions. Moreover, industrial relations evidence shows that, although merging usually allows unions to avoid coalition costs and achieve economies of scale, it often leads to duplication of personnel and higher decision-making costs (see e.g. Campling and Michelson, 1997), which can lead to higher organisational costs on balance.

A sub-game perfect Nash equilibrium bargaining regime is a strategy profile (the strategy set for each agent being joining or not the relevant coalition) such that no agent has an incentive to deviate unilaterally, given the strategy choice of the others. This of course implies that the decision by, say, a union to form a coalition will depend on whether or not firms decide to forming one in turn. A wage coalition is stable if the utility each agent obtains by joining the coalition, net of centralisation costs, is larger than the utility it gets by not joining it, other things given.\(^{22}\) This implies the following:

---

\(^{21}\) Similarly, the literature on the international fragmentation of production assumes that fixed organisational costs vary with the organisational form depending on a firm’s ownership structure and location, see e.g. Helpman (2006).

\(^{22}\) This can also be interpreted as follows. Assume that the two unions (firms) choose simultaneously whether to remain centralised or decentralised, given their expectations of what firms (unions) will do. If they have both common expectations on whether firms (unions) will form a wage coalition and veto power (e.g. one union alone cannot form a wage coalition), the payoff matrix depends on the variables described in Proposition 1, see Appendix 3.
Proposition 1. Equilibrium wage bargaining regimes. For a given common degree of product market integration $t$ and non-negative centralisation costs $H$ for unions and $G$ for firms:

i) if the goods are substitutes, $c>d>0$, decentralisation is a dominant strategy for firms. Depending on the parameter combination $(b, c, d, H, R_{ow}(\alpha, d, t, w^*, \bar{w}))$ each union will choose either centralisation or decentralisation. As a result, two possible (unique) sub-game perfect Nash equilibrium regimes may occur: either CD or DD. CC and DC are never equilibrium regimes of the game.

ii) if the goods are complements, $-c<-d<0$, decentralisation is a dominant strategy for unions. Depending on the parameter combination $(b, c, d, H, R_{ow}(\alpha, d, t, w^*, \bar{w}))$, firms will either choose centralisation or decentralisation. As a result, two possible (unique) sub-game perfect Nash equilibrium regimes may occur: either DC or DD. CC and CD are never equilibrium regimes of the game.

Proof. Directly from Table 4 and the definition of a sub-game perfect Nash equilibrium bargaining regime: see the Appendix 3 for details.

Proposition (1) basically confirms the results derived in a closed-economy unionised duopoly model by Horn and Wolinsky (1988, Propositions 1 and 2) under the assumption of symmetric wage bargaining power ($b=1/2$ here). In the absence of centralisation costs, when the goods are substitutes (complements) the union (firm) dominant strategy is to form a wage coalition, while firms (unions) prefer decentralisation. In the presence of centralisation costs, however, there is a trade-off between these costs and the utility gains from centralisation. If, for example, the latter gains fall, it is more likely that unions (firms) will remain decentralised when the goods are substitutes (complements). Moreover, there is a role here for union bargaining power $b$: it can be shown that the unions’ (firms’) incentives to centralisation with substitutes (complements) are stronger for intermediate values of union power, whereas they are reduced when the union is either weak (i.e. $b\rightarrow0$) or strong (i.e. $b\rightarrow1$, see the Appendix 3 for details).

How are these results affected by product market integration? From Table 4 (see also the Appendix 3), both the firms' incentives to centralisation with complements and the union’s incentives to centralisation with substitutes are affected by trade costs through the effects that these have on $R_{ow}$, the product market rents potentially accruing to domestic producers. Cutting trade costs has the effect of lowering domestic rents when the goods are substitutes, since competition becomes tougher in this case, but it raises domestic rents...
when the goods are complements, because more imports of complementary goods increase market opportunities for domestic producers as well. This suggests the following:

**Proposition 2. Product market integration and the wage bargaining regime under one-way trade.**

Product market integration has an ambiguous effect on the degree of centralisation of wage bargaining institutions, depending on whether the goods are substitutes or complements. When the goods are substitutes (complements), cutting trade costs raises the incentives towards decentralisation for unions (centralisation for firms), while not reversing the incentives to decentralisation for firms (decentralisation for unions). As a result, integration raises the likelihood that the fully decentralised wage bargaining regime DD (the firm centralised wage bargaining regime DC), is the unique dominant strategy sub-game perfect Nash equilibrium.

*Proof.* See the Appendix 3.

5. **Two-way trade with homogeneous goods**

To what extent do the results of the previous section depend on assuming one-way trade? We know from Naylor (1999) that in a “reciprocal dumping” model of a unionised international Cournot-Nash oligopoly with homogeneous goods cutting trade costs can enlarge export opportunities for home firms, opening up the possibility of an increase in total labour demand and thus, with a linear demand curve, of home wages. In a similar framework, Lommerud et al. (2003) show that a domestic unionised firm, anticipating such wage increase, may choose to move its plants in a non-unionised foreign country, from which to serve both the home and foreign markets. Both papers assume that wages are set at the firm-level by monopoly unions. This section builds on these papers to verify how two-way trade affects the relation between product market integration and wage bargaining institutions. As in Lommerud et al. (2003), this section considers trade liberalisation between one unionised and one non-unionised country under symmetric linear product demand curves. Similarly to Naylor (1999), it assumes that home firms can serve the foreign market through exports only and that the goods are homogeneous. This latter assumption simplifies the analysis, although it restricts the comparison with one-way trade to the case of substitutes. Finally, to make such a comparison transparent, this section maintains the previous assumptions (i.e. two unionised home firms compete à la Cournot-Nash with a non-unionised foreign firm; the domestic reservation wage exceeds the foreign wage). The sequence of events does not change: at stage 1, home unions and firms choose wage bargaining institutions; at stage 2,
unions and firms set wages, given the bargaining regime; at stage 3, there is product market competition. However, stage 3 now differs. If we assume symmetric preferences between countries (by setting \(c=d=1\) in equation 1 above), each firm now faces a distinct linear product demand curve in the domestic and foreign countries, namely: 

\[ P_i = \alpha - x_i - x_j - x^* \quad \text{and} \quad P_{i}^{*} = \alpha - z_i - z_j - z^* , \quad i \neq j , \quad i = 1 , 2 \] for home firms; 

\[ P_k = \alpha - x^* - x_1 - x_2 , \quad \text{and} \quad P_{k}^{*} = \alpha - z^* - z_1 - z_2 \] for the foreign firm, where \(Z=z_1+ z_2 +z^*\) are the outputs in the foreign country. At stage 3, the home and foreign firms choose the outputs by maximising: 

\[ \Pi_i = (P_i - w_i)x_i + (P_i^* - w_i - t)z_i , \quad i = 1 , 2 \quad \text{and} \quad \Pi^* = (P_k - w^* - t)x^* + (P_k^* - w^*)z^* \]

respectively, where \(t\) represents the common trade costs. Labour demands under two-way trade turn out to be: 

\[
\hat{Y}_i = \frac{\alpha + w^* + t - 3w_i + w_j}{4} + \frac{\alpha + w_i - 3(w_i + t) + w_j + t}{4} = \frac{(\alpha - t/2) - 3w_i + w^* + w_j}{2} 
\]

\[
\hat{Y}^* = \frac{\alpha - 3(w^* + t) + w_1 + w_2}{4} + \frac{\alpha - 3w^* + (w_1 + w_2 + 2t)}{4} = \frac{(\alpha - t/2) - 3w^* + w_1 + w_2}{2} 
\]

Equation (9) assumes that all the firms are active in both the domestic and foreign markets under each bargaining regime, in which case labour demands are a decreasing function of trade costs. Hence, integration would shift out labour demand curves, which with linearity would lead to higher domestic wages. At stage 2 of the game, there is wage bargaining for given institutions: the derivation of stage 2 is presented in the Appendix 4. Table 5 below shows the corresponding domestic equilibrium wages, outputs, union’s utility and profits. Note that the payoffs of domestic producers depend now on measures of domestic product market rents under both two-way trade, \(R_{TW}=[\alpha-t/2] + w^* - 2\bar{w} \), and one-way trade, \(R=\alpha+w^*+t-2\bar{w} \).

At stage 1 of the game, the unions and firms compare the payoffs in the various regime vis-à-vis the centralisation costs. Similarly to the one-way trade case with substitutes, it turns out that the firms choose decentralisation as a dominant strategy, whereas the unions choose either centralisation or decentralisation

\[23\] For this to be the case, it is sufficient that \(z_i>0\), or \(\alpha>3w_i+2t-w^*\).

\[24\] As shown in the Appendix 4, the equilibrium wages of Table 5 are a linear approximation of the first-order conditions under the hypothesis that the trade costs \(t\) are ‘sufficiently small’.

\[25\] \(R\) is the maximum level of domestic sales at home consistent with breaking even, when the foreign firm plays Cournot-Nash; the corresponding amount in the foreign market is \((z_i+z_j)_{max}=\alpha+w^*+2(\bar{w}+t)\). Summing up gives \(2R_{TW}\).
depending on the parameter combination \((b, H, R_{TW}(a, t, w^*, \bar{w}))\), which implies that either CD or DD is the equilibrium regime. However, the effects of product market integration are now different, as shown in

**Proposition 3. Product market integration and the wage bargaining regime under two-way trade.**

Under two-way trade with homogeneous goods, product market integration raises the unions’ incentives to centralisation, while not reversing the firms’ incentives to decentralisation. As a result, integration makes it more likely that the union centralised wage bargaining regime CD is the unique dominant strategy sub game perfect Nash equilibrium.

**Proof:** See the Appendix 5.

**Table 5. Market equilibrium under two-way trade and homogeneous goods.**

<table>
<thead>
<tr>
<th>FULLY DECENTRALISED DD REGIME</th>
<th>UNION CENTRALISED CD REGIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>(w_{iT}) DD = (w^+ \left[ \frac{b}{12 - 7b} \right] R_{TW})</td>
<td>(w_{iT}) CD = (w^+ \left[ \frac{b}{2(3 - b)} \right] R_{TW})</td>
</tr>
<tr>
<td>(^\wedge x_{iT}) DD = ( \left[ \frac{R(12 - 9b) + 2b(R - R_{TW})}{4(12 - 7b)} \right] )</td>
<td>(^\wedge x_{iT}) CD = ( \left[ \frac{(3 - b)R + b(R - R_{TW})}{4(3 - b)} \right] )</td>
</tr>
<tr>
<td>(^\wedge U_{iT}) DD = ( \left[ \frac{3(4 - 3b)b}{4(12 - 7b)^2} \right] R_{TW}^2 )</td>
<td>(^\wedge U_{iT}) CD = ( \left[ \frac{b(3 - 2b)}{4(3 - b)^2} \right] R_{TW}^2 )</td>
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<tr>
<td>(^\wedge \Pi_{iT}) DD = ( \left[ \left(^\wedge x_{iT}\right) DD \right]^2 + \left[^\wedge z_{iT} DD \right]^2 )</td>
<td>(^\wedge \Pi_{iT}) CD = ( \left[ \left(^\wedge x_{iT}\right) CD \right]^2 + \left[^\wedge z_{iT} CD \right]^2 )</td>
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<table>
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<th>FIRM CENTRALISED DC REGIME</th>
<th>FULLY CENTRALISED CC REGIME</th>
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<tr>
<td>(w_{iT}) DC = (w^+ \left[ \frac{b}{4 + b} \right] R_{TW})</td>
<td>(w_{iT}) CC = (w^+ \left[ \frac{b}{4} \right] R_{TW})</td>
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<tr>
<td>(^\wedge x_{iT}) DC = ( \left[ \frac{(4 - b)R + 2b(R - R_{TW})}{4(4 + b)} \right] )</td>
<td>(^\wedge x_{iT}) CC = ( \left[ \frac{(2 - b)R + b(R - R_{TW})}{8} \right] )</td>
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<td>(^\wedge U_{iT}) DC = ( \left[ \frac{b(4 - b)}{2(4 + b)^2} \right] R_{TW}^2 )</td>
<td>(^\wedge U_{iT}) CC = ( \left[ \frac{b(2 - b)}{16} \right] R_{TW}^2 )</td>
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<tr>
<td>(^\wedge \Pi_{iT}) DC = ( \left[ \left(^\wedge x_{iT}\right) DC \right]^2 + \left[^\wedge z_{iT} DC \right]^2 )</td>
<td>(^\wedge \Pi_{iT}) CC = ( \left[ \left(^\wedge x_{iT}\right) CC \right]^2 + \left[^\wedge z_{iT} CC \right]^2 )</td>
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\[R = \alpha + w^* + t - 2\bar{w} \geq R_{TW} = a - \frac{t}{2} + w^* - 2\bar{w} > 0\]

\[Z_{iT} = x_{iT} - \frac{3}{4}t, \quad \hat{Y}_{iT} = 2x_{iT} - \frac{3}{4}t\]

**Note:** Foreign outputs are not reported.

For each firm to be active in each market, assume that \(^\wedge x_{iT} > \frac{3}{4}t\), or \(\alpha > 3w_1 + 2t - w_j - w^*\)
Under two-way trade, domestic product market rents $R_{TW}$ become a decreasing function of $t$: cutting $t$ increases the export market opportunities of domestic firms, which outweighs the loss of rents in the home market due to the increased import penetration. As a result, domestic producers observe that the sharable surplus is enlarged by integration. As long as domestic wages increase with integration as well, the unions have more incentives to form a coalition, other things given. Thus, in this case, integration should be associated with a tendency towards centralisation of wage bargaining institutions within the industry.

Propositions 2 and 3 have been derived by assuming that the fixed centralisation costs $G$ and $H$ do not change after integration. However, integration may be associated with “exogenous” pressures increasing the costs of centralisation for both unions and firms (e.g. new union recognition laws making coordination more costly; reorganization of working activities, with flattening of hierarchies and multi-tasking, increasing the benefit of flexibility for firms, see Boeri et al., 2001: 118). In this case, other things given, decentralisation is more likely to become a dominant strategy for domestic producers. Conversely, if, as Agell (1999, 2002) argues, integration, by increasing external risks, raises the unions’ incentives to choose centralised bargaining as a social insurance device, this may be interpreted here as a reduction in centralisation costs $H$. As a result, despite integration CD could remain the equilibrium regime under one-way trade with substitutes, with no measurable effects on the degree of centralisation.

Finally, how would the model’s predictions change if we were to relax the assumption of exogenous trade costs? A general analysis is beyond the scope of this paper, but a temptative answer can be given using the simplest model with one-way trade and homogenous goods. Fisher and Wright (1999) consider a monopoly union framework with decentralised wage setting and homogeneous goods, and study the positive and welfare effects of reducing trade costs from their optimal value to zero. Optimal tariffs are derived by maximising a utilitarian social welfare function (including tariff revenue) in the typical industry. Their paper allows for both unilateral and bilateral trade agreements, such that optimal tariffs are regime specific. In the case of unilateral agreements, Fisher and Wright (1999: 813) show that a unionised country is always worse off by liberalising trade with a country where the labour market is competitive. Their result would remain valid in our framework with one-way trade, homogeneous goods and exogenous foreign wages, conditional on the bargaining regime. However, two further implications would be present. First, because optimal tariffs

26 Details are available from the author on request.
would be larger under wage centralisation, trade liberalisation would provoke a stronger bias away from centralisation than in the exogenous trade cost case. Second, as long as unilateral trade liberalisation provokes decentralisation of wage negotiations, liberalisation may be welfare improving, provided that centralisation costs are sufficiently high and the social planner sees them as real resources taken away from social welfare. Hence, because it saves on centralisation costs, liberalisation-induced decentralisation of wage bargaining institutions can become a welfare-improving substitute for labour market reforms.

6. Conclusions

This paper has considered the effects of product market integration on the degree of centralisation of wage bargaining institutions. It has first presented evidence of a negative correlation between integration and centralisation based on 1975-2000 yearly macroeconomic data for 17 OECD countries. Random effects order probit estimates have shown that either higher openness or higher import penetration raises the probability of observing both low and intermediate levels of centralisation, while lowering the probability of observing high levels. These results have motivated the development of a partial equilibrium model of an import-competing unionised Cournot-Nash triopoly that is able to generate, under some conditions, the negative correlation suggested by the evidence. The model has shown that cutting trade barriers raises the likelihood of observing firm-level (industry-level) wage negotiations, when the final goods are substitutes (complements), as long as more integration generates higher (lower) sharable domestic surplus. Under two-way trade and homogenous goods, however, more integration is predicted to favour industry-level, not firm-level negotiations. Although the comparison between the evidence and the predictions of the theoretical model is not univocal, the findings of this paper suggest that more integration is likely to be associated with more decentralisation, and that product market incentives can be an important explanation for this result to occur.
References


Appendices
Appendix 1. Data sources and definitions

Bargaining level (BL). Definition: bargaining level at which wages are determined using the coding

1= for plant level wage-setting
2= for industry-level wage setting without sanctions
3= for industry-level wage setting with sanctions
4=for central wage-setting without sanctions
5=for central wage-setting with sanctions

The index for bargaining level assigns a score of one, two, three, four and five to each country for each year. Sanctions refer to legally enforceable sanctions against industrial conflicts or situations in which lower levels do not have access to strike funds without authorization from above (including situations in which strike funds do not exist). The data are available for 1950-2000 and cover 17 OECD countries; data are missing for 1950-1976 for Spain, and for all the years for Ireland, New Zealand and Portugal. Source: index BARGLEV2 from Golden, M., Lange, P. and Wallerstein M. (2006).


Domestic product market regulation (ETCR). Definition: OECD aggregate index of regulatory restrictions to product market competition in energy, transport and communication. The ETCR aggregate indicator measures restrictions in seven industries: electricity, gas, air passenger transport, rail transport, road freight, postal services and telecommunications. The indicator is increasing in the degree of restrictions to private ownership and competition. The data are yearly over the 1975-2003 period and cover 21 OECD countries. Source: Conway and Nicoletti (2006).


Import Penetration (IMPORTPenet). Definition: Import penetration ratio defined as the ratio between the value of imports as a percentage of total domestic demand. Source: OECD (2006).


Tariff (TARIFF-INT). Definition. This is an index of the unweighted average tariff rate constructed by Fraser Institute from various sources. It varies between 1 and 10, where 1 indicates very high tariffs and 10 indicates none at all. The data were collected every 5 years over the period 1970-2000 and cover 141 countries. Source: Gwartney and Lawson (2007). Data adjustments: Intermediate years are interpolated.

<table>
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<th>Mean</th>
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<tr>
<td>Tariffs (TARIFF-INT)</td>
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<td>0.5663163</td>
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</table>

Note: For sources and definitions see the Appendix 1.
Appendix 2. Derivation of equilibrium wages under one-way trade with homogeneous goods

Appendix 2 derives explicitly the First Order Conditions for equilibrium wages under one-way trade with homogenous goods (thus setting $c=d=1$). In the $DD$ regime, from equation (5), the two FOCs are

$$b \hat{\Pi}_i \left[ \frac{1}{4} \left[ a - 3w_i + w_j + w^* + t \right] \frac{\partial \hat{\Pi}_i}{\partial w_i} + \frac{3}{4} \left( w_i - \hat{w} \right) \frac{\partial w_i}{\hat{w}_i} \right] + (1-b) \left[ \left( w_i - \hat{w} \right) \frac{\hat{\Pi}_i}{\partial \hat{w}_i} \right] = 0 \quad (A.2.1)$$

The first Left-Hand Side term is the union’s net marginal benefit of a wage increase, with the standard trade-off between wage increments and employment losses. The second LHS term is the firm’s net marginal cost of a wage increase, which includes the cost of losing market shares when output competition is tough (i.e. when the outputs are strategic substitutes). Equation (A.2.1) defines implicitly the firm-union pairs’ wage best-reply functions: as wages are strategic complements here, these would be linear and upwards sloping in wage space. Solving (A.2.1), yields symmetric equilibrium wages (see Table 4 above for $c=d=1$).

In the $CD$ regime, from equation (6), the solution to the two FOCs for the wage is

$$b \hat{\Pi}_i \left[ \frac{1}{4} \left[ a - 3w_i + w_j + w^* + t \right] \frac{\partial \hat{\Pi}_i}{\partial w_i} + \frac{3}{4} \left( w_i - \hat{w} \right) \frac{\partial w_i}{\hat{w}_i} \right] + (1-b) \left[ \left( w_i - \hat{w} \right) \frac{\hat{\Pi}_i}{\partial \hat{w}_i} \right] = 0 \quad (A.2.2)$$

Because the outputs are strategic substitutes, increasing the firm’s $i$ wages raises the firm’s $j$ labour demand: the union’s net marginal benefit from a higher wage becomes now larger than under DD. Centralisation, by internalising the employment externality of higher wages in a firm, allows the union to precommit itself credibly to a tougher stance at the bargaining table. Hence, equilibrium wages are larger than under DD (see Table 4).

In the $DC$ regime, from equation (7), the solution to the two FOCs for the wage is

$$b \hat{\Pi}_i \left[ \frac{1}{4} \left[ a - 3w_i + w_j + w^* + t \right] \frac{\partial \hat{\Pi}_i}{\partial w_i} + \frac{3}{4} \left( w_i - \hat{w} \right) \frac{\partial w_i}{\hat{w}_i} \right] + (1-b) \left[ \left( w_i - \hat{w} \right) \frac{\hat{\Pi}_i}{\partial \hat{w}_i} \right] = 0 \quad (A.2.3)$$

Both the union’s net marginal benefit of higher wages and the firm’s net marginal cost of higher wages fall relative to previous regimes. The latter result occurs because, with strategic substitutability in the output game, internalising the positive effect of the wage increase in the firm $i$ on the outputs, thus on the profits, of the firm $j$ makes the firm $i$ weaker at the bargaining table.

In the $CC$ regime, solving equation (8) yields the following two FOCs
The internalisation of employment and profit externalities by unions and firms, respectively, make now unions stronger at the bargaining table, given that the goods are strategic substitutes (see Table 4).

Appendix 3. Proof of Propositions 1 and 2

Proof of Proposition 1. Consider the strategy choice of the typical firm: given that the unions are decentralised, from Table 4 the firm’s net gain from centralisation is:

$$\delta(b, c, d, G, R_{ow}) = \Pi_j - \Pi_j - G = \left[2c - d^2\right]^*$$

with $R_{ow} = \alpha(2 - d) + d(w^* + t) - 2w > 0$. For $G \geq 0$, $0 < b < 1$, $-1 < c \leq 1$, $-1 < d \leq 1$, $|c| > |d|$, the sign of equation (A.3.1) cannot be determined a priori, because it depends on the sign of the term $-(2c-d^2)$. If the goods are substitutes (complements) $c > d > 0$ ($-c < d < 0$), and (A.3.1) is negatively (ambiguously) signed: each firm has never an incentive (has a potential incentive) to form a wage coalition. Intuitively, when competition is tough under strategic substitutability, domestic firms can obtain lower wages if they bargain separately with their own unions rather than jointly. With complements, however, whether or not the firm will actually join in a coalition will depend on the comparison between the difference in operating profits and the fixed centralisation costs $G > 0$. Clearly, other things given, the higher is the market size $R_{ow}$ and the lower are the centralisation costs $G$ the more likely is that firms will form a coalition. The union bargaining power parameter $b$ and the degree of product complementarity $c$ and $d$ affect non-linearly the difference in operating profits, thus the firm’s choice. For example, for given values of $c$ and $d$, and other things given, the firm’s incentives to centralisation are larger for intermediate values of the union bargaining power: when union power is small (i.e. $b \to 0$), wages are already low and the incentive to form a coalition to keep them lower is reduced. Similarly, when union power is large (i.e. $b \to 1$), the firm has a limited ability to influence wage determination anyway.

Given that the unions are centralised, the firms’ net gain from centralisation are, from Table 4:
\[ \varepsilon(b, c, d, G, R_{ow}) = \prod_{CC} - \prod_{CD} - G = -\left[2c - d^2\right] \tag{A.3.2} \]

\[ b(1-b) \left\{ \frac{4\left[(4 - d^2) - b(2c - d^2)\right] - b\left[4 - d^2 - b(2c - d^2) + 2(2 - c)\right]}{[2 + c - d^2 \left[4 - d^2 - b(2c - d^2)\right]^2} \right\} \left(R_{ow}\right)^2 - G? \]

With substitutes, c>d>0, equation (A.3.2) always takes on negative values: the firms will never form a coalition. This, together with equation (A.3.1) establishes that decentralisation is a dominant strategy for firms with substitutes. With complements, (A.3.2) can take on a positive sign: however, as shown below, in this case it is a dominant strategy for unions to remain decentralised, thus this case is no further discussed.

Turning to the typical union, the union’s net gain from centralisation, given that the firms are decentralised, is, from Table 4:

\[ \Phi(b, c, d, H, R_{ow}) = \prod_{CD} - \prod_{DD} = \left[2c - d^2\right] \left\{ \frac{b^2(2 - c)\left[1 - b\left(4 - d^2\right) - b(2c - d^2)\right] + b^2(2 - c)(2c - d^2)}{d\left[2 + c - d^2 \left[4 - d^2 - b(2c - d^2)\right]^2\right]} \right\} \left(R_{ow}\right)^2 - H? \]

If the goods are complements (c<0<d<0), the previous expression is negatively signed and unions have no incentives to join a wage coalition. If the goods are substitutes (c>d>0), each union has a potential preference to centralisation as the difference in variable utility under CD and DD is positive. The final choice depends on the comparison between the union gross gains from centralisation and the corresponding cost H>0. In turn, centralisation gains depend on market size R_{ow} (i.e. the higher market size is the higher is the union incentive to forming a coalition, other things given), on the degree of product differentiation c and d, and on the union bargaining power b, where the latter affects the union’s incentives non linearly. For example, when the goods are homogeneous, c=d=1, (A.3.3) becomes \[ \phi = \frac{b^2\left[18 - 2b + 4b^2\right]}{8(3-b)^2(6-b)^2}\left[\alpha + w + t - 2w\right]^2 - H. \]

It can be shown that this expression for \( \phi \) is hump-shaped in union power b (peaking at b=4/5): other things given, a “very strong” union (i.e. b→1) gains less than a “strong” union (i.e. b→4/5) from a coalition. This is because a very strong union under CD sets too high wages than under DD, imposing a too large employment cost (a too large loss in the domestic firms’ market share), which lowers the gross gains from centralisation.

Turning to the union’s incentive to centralisation when the firms are in a coalition, from Table 4 they are:

\[ \rho(b, c, d, H, R_{ow}) = \prod_{CC} - \prod_{DC} = \left[2c - d^2\right] \left\{ \frac{8(2-c)(1-b) + b(2-b)(2c - d^2)}{\left(2 + c - d^2\right)\left[4(2 - c) + b(2c - d^2)\right]^2} \right\} \left(R_{ow}\right)^2 - H \tag{A.3.4} \]
Equation (A.3.4) is negatively signed for \(-c<-d<0\): together with (A.3.3) this establishes that decentralisation is a dominant strategy for the unions with complements. Equation (A.3.4) can take on a positive sign with substitutes: however, centralisation is not an equilibrium strategy for the firms and this case is no further considered. Summing up, equations (A.3.1) to (A.3.4) imply that with substitutes (complements), two unique sub-game perfect Nash equilibria bargaining regimes may occur: either CD or DD (either DC or DD). QED.

Proof of Proposition 2. From Table 4 and equations (A.3.1) and (A.3.3), it turns out that the union’s utility differential (the firm’s profit differential) are proportional to \(R_{ow}^2\) and that \(R_{ow}^2\) is increasing (decreasing) in the value of the trade cost \(t\) when the goods are substitutes (complements). Integration, by cutting \(t\), lowers (raises) the union’s (firm’s) gross gains from centralisation, other things given. Moreover, although integration lowers the firm’s (union’s) incentives to decentralisation with substitutes (complements), from (A.3.2) and (A.3.4) this remains the firm’s (union’s) dominant strategy. This establishes Proposition 2. QED.

Appendix 4. Derivation of equilibrium wages under two-way trade with homogeneous goods

Under two-way trade, the typical domestic firm’s gross payoff is \(\hat{\Pi}_i = \left( x_i - \frac{w}{2} \right)^2 + \left( z_i \right)^2\), whereas the typical union’s payoff is \(\hat{U}_i = \left( w_i - \frac{\hat{w}}{2} \right) Y_i\), where \(x_i\), \(z_i\) and \(Y_i = x_i + z_i\) are given by equation (9) in the main text.

In the DD regime, inside options are equal to zero. The FOCs for the optimal wage are:

\[
\begin{align*}
\frac{b}{x_i + z_i + (w_i - \frac{w}{2}) \left( \frac{\partial x_i}{\partial w_i} + \frac{\partial z_i}{\partial w_i} \right) + 2(1-b) \left( \frac{\hat{U}_i}{\hat{\Pi}_i} \right) \left[ x_i \frac{\partial x_i}{\partial w_i} + z_i \frac{\partial z_i}{\partial w_i} \right]} = 0 \tag{A.4.1}
\end{align*}
\]

Evaluating (A.4.1) in symmetric equilibrium with \(w_i=w_j\) and \(\partial x_j/\partial w_i=\partial z_j/\partial w_i\), the second LHS term turns out to be proportional to: \(A = (x_i + z_i)^2 = 4x_i \left( x_i - \frac{3}{4} t \right)^2 + \frac{9}{16} t^2 \approx 2\), if trade costs \(t\) are ‘sufficiently small’ (e.g., if \(t<0.09\) in numéraire terms). Then, solving (A.4.1), yields the optimal wage reported in Table 5.

In the CD regime, the firm’s inside option is zero, while the union’s net payoff is \(\hat{U}_i + \hat{U}_j - 2H - V\), where, similarly to the one-way trade case, \(V=U_{j^{CD}} - 2H\) is its inside option. The FOCs for the wage are:

\[
\begin{align*}
\frac{b}{x_i + z_i + (w_j - \frac{w}{2}) \left( \frac{\partial x_i}{\partial w_i} + \frac{\partial z_i}{\partial w_i} \right) + (w_j - \frac{w}{2}) \left( \frac{\partial x_j}{\partial w_i} + \frac{\partial z_j}{\partial w_i} \right) + 2(1-b) \left( \frac{\hat{U}_j}{\hat{\Pi}_i} \right) \left[ x_i \frac{\partial x_i}{\partial w_i} + z_i \frac{\partial z_i}{\partial w_i} \right]} = 0 \tag{A.4.2}
\end{align*}
\]

In symmetric equilibrium, \(w_i=w_j\), \(\partial x_j/\partial w_i=\partial z_j/\partial w_i\), and \(\hat{U}_i = \hat{U}_j = \hat{U}_j^{CD}\): the second LHS term of (A.4.2) is again proportional to \(A\approx 2\) for a ‘sufficiently small’ \(t\), similarly to the DD case. Solving (A.4.2) yields \(w_i^{CD}\).
In the DC regime, the union’s inside option is zero, while the firm’s net payoff is \( \hat{\Pi}_i + \hat{\Pi}_j - 2G - Z \)
where, similarly to the one-way trade case, \( Z = \hat{\Pi}_j^{DC} - 2G \) is its inside option. The FOCs for the wage are:

\[
b \left[ x_i + z_i + \left( w_i - w \right) \left( \frac{\partial x_i}{\partial w_i} + \frac{\partial z_i}{\partial w_i} \right) \right] + 2(1-b) \left[ x_j \frac{\partial x_j}{\partial w_j} + z_j \frac{\partial z_j}{\partial w_j} + x_j \frac{\partial x_j}{\partial w_j} + z_j \frac{\partial z_j}{\partial w_j} \right] \left[ \frac{U_i}{\Pi_i + \Pi_j - 2G - Z} \right] = 0 \quad (A.4.3)
\]

In symmetric equilibrium, \( w_i = w_j, x_i = x_j, z_i = z_j \), \( \partial x_i / \partial w_i = \partial z_i / \partial w_i, \partial x_j / \partial w_i = \partial z_j / \partial w_i \) and \( \hat{\Pi}_i = \hat{\Pi}_j = \hat{\Pi}_j^{DC} \): the second LHS term of (A.4.3) is proportional to \( A \approx 2 \) for a ‘sufficiently small’ \( t \). Solving (A.4.3) yields \( w_i^{DC} \).

Finally, in the CC regime the firm’s net payoff is \( \hat{\Pi}_i + \hat{\Pi}_j - 2G - Z \), with \( V = -2H \), while the union’s net payoff is \( \hat{U}_i + \hat{U}_j - 2H - V \), with \( V = -2H \). The FOCs for the wage are:

\[
b \left[ x_i + z_i + \left( w_i - w \right) \left( \frac{\partial x_i}{\partial w_i} + \frac{\partial z_i}{\partial w_i} \right) \right] + 2(1-b) \left[ x_j \frac{\partial x_j}{\partial w_j} + z_j \frac{\partial z_j}{\partial w_j} + x_j \frac{\partial x_j}{\partial w_j} + z_j \frac{\partial z_j}{\partial w_j} \right] \left[ \frac{\hat{U}_i + \hat{U}_j - 2H - V}{\hat{\Pi}_i + \hat{\Pi}_j - 2G - Z} \right] = 0 \quad (A.4.4)
\]

In symmetric equilibrium, \( w_i = w_j, x_i = x_j, z_i = z_j \), the second LHS term of (A.4.3) is proportional to \( A \approx 2 \) for “sufficiently small” \( t \). Solving (A.4.4) yields \( w_i^{CC} \).

**Appendix 5. Proof of Proposition 3**

By using the payoffs of Table 5, it turns out that:

\[
U^{CD} - U^{DD} - H = \frac{\left( 1-b \right) \left( 216 - 54b \right) \left( 1-b \right) + 27b^2 }{ (12 - 7b)^2 (3-b)^2 } b \left( R_{TW} \right)^2 < 0 \quad (A.5.1)
\]

\[
U^{CC} - U^{DC} - H = \frac{6 \left( 1-b \right) + 2-b^2 }{16 \left( 4+b \right)^2 } b^2 \left( R_{TW} \right)^2 < 0
\]

\[
\Pi^{DC} - \Pi^{DD} - G = \frac{4 \left( x^{DD} + x^{CD} \right) - 3t }{2 \left( 3-b \right) } - G < 0, \quad x^{DC} - x^{DD} = -b \left[ 16 \left( 1-b \right) R_{TW} + b R_{OW} \right] < 0
\]

\[
\Pi^{CC} - \Pi^{CD} - G = \frac{4 \left( x^{CC} + x^{CD} \right) - 3t }{2 \left( 3-b \right) } - G < 0, \quad x^{CC} - x^{CD} = -b \left[ 3 \left( 1-b \right) R_{TW} + 2 b R_{OW} \right] < 0
\]

where the restrictions \( x^{DC} + x^{DD} > (3/4)t \) and \( x^{CC} + x^{CD} > (3/4)t \) are needed if all the firms are active in their foreign market. From (A.5.1) and the definition of a sub-game perfect Nash equilibrium regime, it follows that either CD or DD occur in equilibrium. The union’s incentives to centralisation are increasing in \( R_{TW} \), but \( \partial R_{TW} / \partial t < 0 \): cutting trade cost \( t \) raises the union’s incentives to centralisation. This establishes Proposition 3.

QED.