

# Labour Market Institutions and Structural Reforms: A Source for Business Cycle Synchronization?

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**Abstract** We focus on the influence of institutional variables on business cycle synchronization for 20 OECD countries from 1979 to 2003. More precisely, this paper derives measures for similarity of institutions and structural reforms, and investigates direct and delayed reform effects on synchronization by applying robustness tests to a panel data framework with bilateral data. Our findings indicate an instantaneous relationship between both similarity of institutions as well as common structural reforms and business cycle correlation.

*Keywords:* Business cycle synchronization, Labor Market Institutions, Structural reforms

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## 1. Introduction

Business cycle synchronization has been a frequently discussed topic in economics over the last decade, predominantly in the context of currency areas. Synchronized business cycles are an important prerequisite for the well-functioning of an optimal currency area. A common monetary policy, as it exists in a currency union, reduces the member countries' flexibility to react to shocks. If members of a currency area are in different business cycle positions, shocks require different economic reactions making it challenging to find an appropriate monetary policy adjustment for all members. Similar to this, candidate countries with less synchronized cycles could boost their chances of admittance to the currency union by bringing their idiosyncratic cycle in line with the currency area cycle. However, it is rather unclear which economic or political adjustments, especially concerning labour market regulation, result in higher synchronization, and which design the adjustments should exhibit. Therefore, a better understanding of the determinants of business cycle synchronization and their exact functioning has become a main goal for politicians of both members of the European Monetary Union and aspirants for a membership since its advent in 1999.

Starting with Frankel and Rose (1998), who first examined the relation between trade intensity and business cycle synchronization, there has been a growing literature on the determinants of business cycle convergence over the last decade. Factors like bilateral trade intensity, explained in more detail by e.g. Frankel and Rose (1998), and Gruben et al. (2002), or the degree of specialization as pointed out by e.g. Imbs (2004), and García Herrero and Ruiz (2008) are quite evident transmission channels and have been detected as significant determinants in various studies for different specifications and frameworks. Similarity in fiscal policy, although not analyzed as comprehensively as trade and specialization, appears to be important for a stronger co-movement of output gaps. Some more explanation on this relation can be found in, for example, Inklaar et al. (2008) or Darvas et al. (2007).

Similarity of labor market institutions has recently gained importance in empirical analyses, mainly due to the availability of better data. Although studies on this topic predominantly deal with the impact of labor market structures on employment or economic growth, institutional settings are also likely to play an important role for the degree of business cycle synchronization. The impact of the wage bargaining system on a country's macroeconomic performance is stressed, for instance, by Calmfors and Driffill (1988) or Flanagan (1999). Under a highly centralized or coordinated wage setting regime, unions know about the macroeconomic consequences if they take advantage of their market power, and will therefore refrain from excessive wage claims. Zanetti (2009) investigate the direct link between the bargaining power of workers and macroeconomic fluctuations and detects a dampening impact of high bargaining power on the cyclical variation. Additionally, in a recent study Rumler and Scharler

(2011) empirically investigate the influence of labor market institutions on macroeconomic volatility. They found that the employees' bargaining power is particularly linked to the fluctuations of business cycles. Furthermore, Andolfatto (1996) argues that the workers' and firms' search behavior has an impact on aggregate fluctuations, while Veracierto (2008) points to the considerable effects of firing costs on the business cycle. Accordingly, factors shaping both the search behavior of workers and firms as well as the wage setting should be considered as drivers of macroeconomic fluctuations.

These examples emphasize the relevance of labor market institutions for the movement of the business cycle. Consequently, if institutional frameworks differ across countries, reactions to common shocks do as well, all other things equal. Hence, we generally assume that distinct institutional settings are linked to differing cycles, while similar settings should foster a stronger co-movement.

Our study extends the existing literature in several ways. We use an augmented set of structural indicators of institutional arrangements and implement a measure for the similarity of structural reforms concerning these institutions. Thus, the impact of both institutional conditions and reforms are examined. Since reforms will need some time to materialize, we also include lagged values of the reform measures. There are strong theoretical implications about the impact of similar labor market structures on synchronization. Nevertheless, it is unclear which institutional factors indeed affect the co-movement of business cycles. Thus, we analyze empirically whether the theoretical assumptions can be confirmed, and which institutions matter. In order to receive reliable results, an approach to test robustness is applied. In doing so, we examine the robustness of the effect of a variable by repeatedly estimating its coefficient with a changing information set.

The study is organized as follows. Chapter 2 presents theoretical considerations and empirical evidence on the determinants of business cycle synchronization, while chapter 3 gives a short overview of the dataset. Chapter 4 explains the underlying empirical methodology including the different robustness tests. The estimation results are presented in chapter 5, while chapter 6 summarizes the findings and concludes.

## **2. Theory and Empirical Evidence**

From a theoretical point of view, business cycles are the consequence of common and idiosyncratic shocks hitting a country. Business cycle synchronization for any set of countries is mainly driven by factors which influence a country's shock absorption and propagation mechanisms, thus determining the resilience to macroeconomic shocks. Typically, variables like trade intensity, the similarity of sectoral structures, fiscal or monetary policy are assumed to influence the synchronization of business cycles since these factors likely affect either the absorption or the propagation of shocks. While the mentioned factors have been extensively analyzed in empirical studies, the role of labor market institutions is still unclear. In this chapter, we confine attention to the theoretical arguments why labor market institutions may influence business cycle synchronization, and report earlier empirical findings on this topic. Furthermore, theoretical and empirical aspects concerning variables which have already been identified as determinants of business cycle synchronization are presented. These variables are essential for our empirical analysis, since we include them as control variables.

### **2.1 Labor Market Institutions**

Labor market institutions can affect the business cycle in various ways. Factors like the workers' bargaining power, employment protection legislation or the unemployment compensation determine how shocks influence a country's economic output. Central to this is the firms' reaction to shocks in terms of wage and labor force adjustments. Blanchard and Giavazzi (2003) show that institutions which provide workers with a high bargaining power are responsible for an inflexible labor market since wage adjustments are more difficult to implement. This issue has been tested and confirmed empirically by Nunziata (2005) who highlights that institutional rigidities like high labor taxation, generous unemployment benefits or strict employment protection are significantly linked to high average wage levels, indicating the limited room for firms to lower wages when facing a negative shock. Thus, the effects of shocks which, for example, increase a firm's production costs cannot be appropriately compensated via wage adjustments. This inflexibility could give rise to price increases and a fall in aggregate demand. However, a highly coordinated wage bargaining decreases the wage

pressure on the firms since unions take the macroeconomic consequences of high wage claims into account. Hence, the degree of coordination should be taken into account when analyzing the effects of high bargaining power on synchronization.

Besides, institutions may have an impact on output fluctuations through their effect on the matching process. A high degree of employment protection lowers a firm's flexibility to respond to changes in aggregate demand. Ljungqvist (2001) argues that unproductive workers (who would be laid off without employment protection) remain in a firm. Particularly during an economic downturn, the pressure of high firing costs forces firms to forego workforce adjustments as a reaction to, for example, a capacity under-utilization. The additional wage payments to unproductive workers reduce the firms' room to manoeuvre and result in lower investments and higher prices. Moreover, following the argumentation of Boeri and Garibaldi (2007), less workers are hired in an economic upswing since firms include potential firing costs in their hiring decision, leading to an inefficient and unproductive allocation of labor.

The amount of unemployment compensation may also affect the business cycle. Nickell and Layard (1999) show that a high spending on unemployment compensation reduces the job search intensity of the unemployed and, hence, labor supply. In this case, firms may not find enough productive workers during an upswing or after a positive economic shock. Nevertheless, a certain amount of unemployment compensation payment increases the probability that an unemployed finds a productive job, as pointed out by Arpaia and Mourre (2005). Without this transfer payment the unemployed would accept the first job offer which may be an unproductive match. However, this neglects the worker's opportunity to search on-the-job. Hence, the negative effect of a low unemployment compensation on the worker productivity is difficult to quantify.

Overall, we assume that all institutional factors which influence the wage bargaining or the search and matching process, indirectly impact on the business cycle. Accordingly, the workers' bargaining power, unemployment benefits, labor taxes and the employment protection legislation are expected to affect business cycle convergence.

These considerations have the following implications for business cycle synchronization: If countries have different labor market institutions, a common shock will lead to distinct economic consequences, resulting in diverging business cycles. In the same vein, the shock absorption and propagation mechanisms of two economies will be similar if they have comparable institutional arrangements. Nevertheless, common labor market structures may also lead to diverging cycles caused by asymmetric shocks, especially in the presence of highly inflexible labor market structures. High regulations concerning, for example, employment protection may impede appropriate industry-specific or country-wide reactions to a shock. Asymmetric shocks or different industry structures in the presence of common shocks may then result in different output fluctuations. Furthermore, institutional reforms are aimed to raise the economic flexibility and thereby a country's resilience to idiosyncratic or asymmetric shocks. In a monetary union this could compensate the inflexibility of the individual economies caused by e.g. a common monetary policy through a strengthened idiosyncratic shock absorption mechanism. Generally, we expect that similar reforms lead to higher synchronization. However, this can only be true, if both countries' reforms are competition-enhancing, thus raising the countries' ability to cushion shocks. In contrast, regulative reforms should decrease the countries' resilience to idiosyncratic or asymmetric shocks, consequently lowering the degree of synchronization.

Theoretically, the effects of similar labor market structures and reforms depend on whether idiosyncratic or common shocks prevail, as well as whether the reforms which are carried out are regulative or competition-promoting. Empirical results on this connection are scarcely available since only few studies concentrate on analyzing the impact of institutional arrangements in the labor market on business cycle synchronization, while reforms have not been analyzed in this context up until now. Böwer and Guillemineau (2006) use the employment protection legislation and the union density as proxies for labor market flexibility and apply an extreme-bounds analysis in a cross-section framework. Similar to this, Artis and Claeys (2007) build their study upon a panel data set with the employment protection legislation, the union density, the benefit replacement ratio and the tax wedge as indicators for labor market flexibility. None of the studies find a robust and significant effect of labor market structures on business cycle co-movement. Both studies use the absolute differences of

the indicator values to account for differences in the institutional structures of two countries, but they do not consider institutional reforms. Furthermore, we take advantage of a larger set of institutional indicators and use a more systematic empirical approach to explain synchronization.

While the role of labor market institutions for the degree of synchronization is still an open question, there is an extensive literature which has dealt with the identification of the determinants of synchronization. The factors which we describe in the following are taken as control variables for our empirical analysis.

## 2.2 Control Variables

Basically, trade is assumed to be the main transmission channel for business cycles and a key factor for higher co-movement. If, for example, the trade intensity between two countries is high, an idiosyncratic shock affecting the first country likely spills over to the trading partner, thus, influencing the countries' business cycles in a similar way. This will happen, if the trade intensity is mainly driven by intra-industry trade. However, theory predicts that higher trade intensity also leads to an increased industrial specialization, resulting in a larger fraction of inter-industry trade. Then, industry-specific shocks will not affect both countries in the same way, resulting in diverging business cycles. Obviously, the theoretical effects of trade intensity on synchronization are ambiguous. In contrast to that, empirical studies find a positive relationship between a high trade intensity and similar business cycles. According to Frankel and Rose (1998), the overall effect of trade on business cycle synchronization is strong. These findings are supported by subsequent studies of Gruben et al. (2002), Calderón et al. (2007) and Imbs (2004). Compared to the results of Frankel and Rose (1998), however, their conclusions point to somewhat lower effects of trade, but still support the view that trade intensity has a positive impact on business cycle synchronization. Abbott et al. (2008) also detect a positive trade effect on business cycle co-movement, but argue that the positive impact of higher trade intensity is predominantly limited to European countries. The studies of Baxter and Kouparitsas (2005) and Böwer and Guillemineau (2006) find that trade is robustly connected with business cycle synchronization and thus confirm the view of Frankel and Rose (1998).

Fiscal policy may contribute to business cycle correlations as well. Fiscal divergence can be the result of the reaction to idiosyncratic shocks which helps to keep together the business cycles. In this case, fiscal policy works as an instrument of flexibility to increase an economy's resilience against idiosyncratic or asymmetric shocks. But fiscal convergence may also foster synchronization if common shocks are absorbed in a similar way by countries with a common fiscal policy. Although the fiscal policy mechanism is theoretically conflicting, Darvas et al. (2007) provide empirical support of a positive impact of complementary fiscal policies on synchronization in a panel of OECD countries. In a similar vein, Akin (2007) finds that similarity in bilateral fiscal policies fosters output synchronization. Overall, the recent literature suggests that similarity in fiscal policies has a positive effect on business cycle synchronization.

Similar to trade intensity, the theoretical considerations do not help to get a clear picture about the role of a comparable sectoral structure. If two countries exhibit a similar sectoral structure, shocks will affect both economies in a similar manner, while highly specialized industries in the presence of common shocks cause business cycle divergence. If idiosyncratic shocks prevail, the effect of a common sectoral structure on synchronization highly depends on whether these shocks spill over. Shocks which finally have an impact on both countries result in higher synchronization, while little shock spill-overs lead to diverging business cycles. Empirically, convergence of business cycles is more likely to arise between countries that have similar production structures. Otto et al. (2001) find that similar industry structures are positively correlated with output co-movement. However, the results are not statistically significant. Likewise, both Baxter and Kouparitsas (2005) and Böwer and Guillemineau (2006) conclude that structural similarity goes in line with convergence, although the outcome is weak. Furthermore, Imbs (2004) and García Herrero and Ruiz (2008) find clear evidence that similar production structures tend to promote the synchronization of cycles.

Even the effects of a common monetary policy on synchronization are not clear-cut. On the one hand, it contributes to more similar output fluctuations by bringing into line the monetary policy reactions of different countries facing the same shock. Furthermore, a common monetary policy promotes the trade

intensity inside a currency area by reducing the barriers to trade. However, it is unclear whether inter-industry or intra-industry trade will gain importance. As already mentioned, the trade characteristic determines the impact on synchronization. Additionally, countries lose a mean of flexibility to react to idiosyncratic or asymmetric shocks by submitting to a common monetary policy, thus, the effect on synchronization cannot easily be predicted. Empirical studies on this relationship deliver contrary results. While Baxter and Kouparitsas (2005) as well as Clark and van Wincoop (2001) do not consider a currency union as relevant for the determination of business cycle synchronization, Frankel and Rose (2002) report a significantly positive effect of a common currency for the similarity of business cycles. They conclude that a common monetary policy promotes the trade intensity inside a currency area without observing a trade intensity decline with nonmembers.

### 3. Data

The analysis of synchronization between countries has to be based on the construction of country pairs in order to capture differences between countries. We use an unbalanced panel that covers 20 OECD countries, and makes a total of 190 country pairs. Such a panel estimation requires a common time frame that conforms to the smallest available period. Furthermore, developing a measure for business cycle synchronization calls for the construction of periods of more than one year. Following the existing literature, periods of five years length are specified. Therefore, we define that our time frame ranges from 1979 to 2003, since this is the least common period in terms of data availability. The underlying data structure consists of five periods of five years each starting in 1979, such that the first period covers the years from 1979 to 1983, while the second period goes from 1984 to 1988, and so on. The following variables are included in our empirical analysis. The endogenous variable is represented by the Hodrick-Prescott (HP)-filtered industrial production index (*IIP*) correlations over 5-year periods.<sup>1</sup> Bilateral measures for institutional similarity and the similarity of institutional reforms are the variables of interest. Overall, we apply 9 indicators which cover four different policy fields of the labor market. More specifically, one indicator for employment protection (EP), the first year benefits (FYUB) and the overall benefits (OUB) for the unemployment benefit system, the union density (UD), the bargaining coordination (BCO), and the bargaining centralization (BCE) for the bargaining system, and the employment tax rate (TX1), the direct tax rate (TX2) and the indirect tax rate (TX3) for the tax system are considered. For the principal components estimation, we construct the first principal component based on the particular indicators of each group. In the following, the measures for institutional similarity will be denoted as 'distance', while the bilateral reform indicators are called 'direction'.

Measures for trade intensity, similarity of fiscal and monetary policy and the sectoral structure serve as control variables. For all explaining variables, we calculate the 5-year averages of the bilateral measures to get variables which fit to the panel structure. All further technical details and explanations concerning data sources and the construction of variables can be found in Appendix 1.

### 4. Econometric Methodology

The theoretical implications of section 2.1 entail that all institutional factors affecting the wage setting and the search and matching process can determine the degree of business cycle synchronization between two countries. However, several indicators of institutions measuring different fields of labor market rigidities are available and the researcher is left without knowing which ones are important and which ones are not. For example, wage rigidity might be the consequence of strong unions, but could also be influenced by a low bargaining coordination. Thus, both factors representing the bargaining system can matter for the degree of synchronization, but do not necessarily have to. Including all indicators in the empirical model would both lead to a severe loss of degrees of freedom and multicollinearity, resulting in biased and unreliable coefficient estimates. Therefore, a systematic approach is necessary to identify those factors which are in fact connected to the degree of business cycle synchronization.

First, we reduce the number of available institutional indicators by constructing the first principal component for each institutional category for which more than one indicator is available, i.e. the bargaining system, the unemployment benefit system, and the tax system. Thus, the joint estimation of

each institutional category together with the control variables can be conducted in a single regression. Nevertheless, the estimation of the principal component of, for instance, the employment, the direct and the indirect tax rate gives no information on which of the different taxes matter. Hence, we apply a specific type of robustness test that enables the estimation of particular sub-indicators of an institutional category.

We now direct attention to the econometric methodology. The equation for the principal components estimation is the following panel regression model in vector form:

$$Y = \alpha + \beta X + PC_{dis}\xi_{dis} + PC_{dir}\xi_{dir} + \lambda + u. \quad (1)$$

We specify a fixed effects model to control for time- and country-specific effects  $\lambda$  and  $\alpha$ .  $Y$  represents the contemporaneous correlations of a country-pair's business cycles for each time period taken from the pool of 20 OECD countries. The business cycles are extracted by the HP filter to generate the correlations over the initially defined 5-year periods.  $X$  contains the variables *trade intensity*, *sectoral structure*, *fiscal policy* and *monetary policy* as defined in Appendix 1, while  $PC_{dis}$  and  $PC_{dir}$  contain the first principal component of each institutional category.<sup>2</sup> The baseline estimation includes the first principal component for each institutional category, both concerning distance and direction, as well as the control variables trade intensity, fiscal policy, sectoral structure, and monetary policy. This result can help to give a first impression on the importance of institutional settings as well as structural reforms.

Since the principal component method makes it infeasible to identify effects of different institutional sub-indicators, we conduct an estimation procedure to take this issue into account. The following model is specified:

$$Y = \alpha + Z\delta + \lambda + u. \quad (2)$$

$Z$  is a set of explanatory variables, containing the 9 indicator differentials, the 9 direction indicators, and the 4 control variables which have potentially significant explanatory power for business cycle convergence. The 18 indicators for institutional similarity and common structural reforms plus the 4 control variables build the indicator pool.<sup>3</sup> Each indicator is taken as the variable of interest while combinations of the remaining indicators represent the information set. Finally,  $\alpha$  and  $\lambda$  capture cross-section and period specific effects. The equations are estimated by using the standard fixed-effects estimator.<sup>4</sup>

#### 4.1 Extreme-Bounds Analysis

To identify the key reform factors on business cycle co-movement within the 20 OECD countries, we perform an extreme-bounds analysis. According to Leamer (1985), an extreme-bounds analysis is an organized way of a sensitivity analysis, enabling the examination whether the inferences about the variable of interest remain basically identical when changing its information set, thus, not depending on the inclusion of additional variables.<sup>5</sup> Applied to equation (2), Leamer's approach proceeds as follows:

$$Y = \alpha + zy + \bar{Z}\delta + u. \quad (3)$$

$z$  denotes the variable of interest, the indicator, which is under examination of its robustness. The information set  $\bar{Z}$  consists of all possible combinations of three indicators picked from the complete indicator pool.<sup>6</sup> The field of analyzing business cycle synchronization within the framework of institutions and structural reforms is comparatively new. Hence, there is considerable uncertainty about what variables of  $Z$  belong to the 'true' regression model. Since labor markets are influenced by several institutional factors, and theory gives no explicit guidance about which institutional aspects affect business cycle synchronization we have to rely on statistical robustness tests to find out which are the determining institutional variables of synchronization. Changing the conditioning variables, for example, can result in conflicting effects concerning the impact of labor market institutions and

reforms on the correlation of the business cycles between countries. Therefore, Leamer proposes to compare the extreme bounds of the coefficient distribution.

However, the literature often characterizes the criterion of Leamer as too strong and restrictive, with the consequence that often almost no variable can be classified as robust. For instance, Sala-i-Martin (1997) mentions that the Leamer method suffers from the assumption that one regression for which the coefficient changes its sign is enough to reject the robustness of a variable. This might be a serious problem particularly for large sets of variables of interest. Based on this critique, there are several approaches described that provide alternative ways to relax the criterion.

Sala-i-Martin suggests alternative techniques to move away from this extreme test. The basic idea is to take account of the whole distribution of a coefficient. In order to determine the robustness of the variable, the fraction of the density function lying on the right (left) side of zero is crucial. If more than 95% of the density for the estimated parameters lies to the right (left) side of zero, then the variable is considered to be robust. Sala-i-Martin denotes the larger section as  $CDF(0)$ , whereas  $CDF$  is the Cumulative Distribution Function. Since zero divides the density into two, it is not of importance, whether the larger share of coefficients is above or below zero. Hence, per construction, the interval of the  $CDF$  is  $[0.5;1]$ . Due to the fact that the distribution of the indicator coefficients might not follow a normal distribution, Sala-i-Martin constructs two different cases.

The first case is appropriate, when the mass of estimated coefficients follow a normal distribution, whereas the second case should be used, when this assumption fails. Furthermore, it is distinguished between a weighted and an unweighted approach. Regressions, which are more likely to be close to the true model are given more weight. The weighting scheme is based on the likelihoods of each regression to compute the weighted average of the estimated coefficients as well as their variances. However, this methods should not be applied when the goodness of fit might not be a good measure in order to identify the 'true' model (for a detailed description of the methods see Sala-i-Martin 1996 and 1997). In the empirical investigation, we will only report the findings calculated with the non-normal and unweighted approach. Anyway, further estimations show that using weights and assuming normally distributed coefficients at most has a small impact on the results.

## 5. Results

### 5.1 Principal Component Estimation

In table 1, we present the results of the baseline estimation according to equation (1). Specification (a) includes all level and reform measures (the first principal component of three institutional categories, i.e., the bargaining system (BSPC), the unemployment benefit system (UBPC) and the tax system (TXPC), as well as the indicators for the employment protection (EP)). Specification (b) neglects the direction and specification (c) the distance measures of all institutional categories. Due to the construction of the institutional indicators, a positive coefficient value indicates that higher similarity of both institutional arrangements as well as reforms lead to higher synchronization. In an analogous manner, the control variable coefficients should be positive if a higher similarity concerning these variables is linked to more synchronized business cycles.

The similarity measures of the bargaining system ( $BSPC_{distance}$ ), the unemployment benefit system ( $UBPC_{distance}$ ), and the employment protection legislation ( $EP_{distance}$ ) show significance in at least one specification and exhibit a positive sign. Concerning common structural reforms, the bargaining system ( $BSPC_{direction}$ ), the employment protection ( $EP_{direction}$ ) and the unemployment benefit system ( $UBPC_{direction}$ ) turn out to be significant, the former with a negative and the latter two with a positive sign. Furthermore, three of the control variables have a positive sign in all specifications. More specifically, a high trade intensity, a comparable fiscal policy as well as similar sectoral structures are linked to synchronized business cycles.

**Table 1. Baseline Estimation**

Dependent Variable: 5-year Correlation of IIP			
Variable	(a)	(b)	(c)
BSPC <sub>distance</sub>	0.021* (0.005)	0.020* (0.003)	-
EP <sub>distance</sub>	0.201* (0.098)	0.158 (0.123)	-
UBPC <sub>distance</sub>	0.016 (0.010)	0.019* (0.009)	-
TXPC <sub>distance</sub>	0.006 (0.010)	0.004 (0.010)	-
BSPC <sub>direction</sub>	-0.049* (0.017)	-	-0.038* (0.016)
EP <sub>direction</sub>	0.190* (0.037)	-	0.193* (0.048)
UBPC <sub>direction</sub>	0.018 (0.013)	-	0.021* (0.010)
TXPC <sub>direction</sub>	0.024 (0.016)	-	0.025 (0.018)
Fiscal Policy	0.021* (0.003)	0.025* (0.004)	0.025* (0.003)
Trade Intensity	9.158* (4.400)	9.774* (4.287)	7.634 (4.274)
Sectoral Structure	1.000 (0.513)	1.001* (0.497)	0.944 (0.570)
Monetary Policy	-0.021 (0.044)	-0.022 (0.049)	-0.074 (0.042)

Estimation have been performed using a heteroscedasticity robust fixed effects estimator. The estimation framework consists of five periods from 1979 to 2003. The dependent variable is the correlation of the cyclical component of the monthly Industrial Production Index. The asterisk marks significant variables to a 5% level. Standard errors are provided in parentheses.

The estimated institutional impact gives us some information about which institutional factors matter. However, the throughout positive signs of the control variables give rise to the assumption that common shocks prevail. In the light of this, it is not easy to interpret the mixed signs of the institutional measures. Furthermore, regarding the bargaining system, for instance, we do not know whether the significant effect stems from the bargaining coordination, the bargaining centralization, or the union density. Additionally, the insignificant outcome of the tax system indicator could be due to a dampening effect of one or two tax indicators on the third indicator. This can only be detected by including all three indicators. In the next section, we examine whether the findings of the principal components estimation can be confirmed by the extreme-bounds test according to the description in section 4.1. Moreover, we draw attention to the economic interpretation of the results.

## 5.2 Extreme Bounds Estimation

The first part of this section deals with the contemporaneous influence of institutional similarity and common structural reforms on business cycle convergence. The results of the robustness test are displayed in table 2. Note, that we only report variables which have been identified as robust. The complete results can be found in table 6 of Appendix 2. The column denoted as SiM shows how much of the mass of a variable lies on one side of zero. Following Sala-i-Martin, a value larger than 95 % indicates robustness. One might argue that not only the coefficient distribution contains information about the relevance of a variable but also the share of models in which a variable is significant, compared to all models containing this particular variable. Thus, the remaining two columns report the number of significant coefficients, first at a 5% level, and second at a 10% level.<sup>7</sup>

Overall, 3 distance and 3 direction measures turn out to be robust according to the Sala-i-Martin extreme-bounds test procedure. More specifically, the employment protection, the bargaining centralization and the employment tax rate in terms of institutional similarity, and the employment protection, the employment tax rate and the direct tax rate in terms of reform similarity show robustness. But only 2 institutional indicators show more than 90% significant observations at the 5% significance level. Only the similarity of the employment tax rate and common reforms concerning the employment protection are robust both in terms of sign certainty as well as significance.

**Table 2. Tests of Robustness, contemporaneous effects**

Dependent Variable: 5-year Correlation of IIP				
	Variable	SiM	Sig (5%)	Sig (10%)
Institutional Similarity (distance)	Employment Protection	0.96	0.48	0.67
	Bargaining Centralization	0.98	0.69	0.89
	Employment Tax Rate	1.00	1.00	1.00
Institutional Change (direction)	Employment Protection	1.00	1.00	1.00
	Employment Tax Rate	0.95	0.77	0.85
	Direct Tax Rate	0.96	0.60	0.74
Control Variables	Fiscal Policy	0.99	1.00	1.00
	Trade Intensity	0.95	0.14	0.50

Results of an extreme-bounds analysis according to equation (3). Estimations have been performed using a heteroscedasticity robust fixed effects estimator. The estimation framework consists of five periods from 1979 to 2003. Column 2 shows all variables which have more than 95% of the estimated coefficient mass on one side of zero. Column 3 contains the corresponding results. Columns 4-5 display the percentage of models in which the particular variable appeared significant to the 5% (fourth column) and the 10% level (fifth column).

The results of the extreme-bounds test to some extent confirm the findings of the principal components analysis. The significant effect of the bargaining system similarity stems from the bargaining centralization, while the union density as well as the bargaining coordination are negligible. Similarly, the employment protection as well as the fiscal policy in fact matter. However, some differences occur. The extreme-bounds analysis rejects robustness of the similarity of the unemployment benefit system, the sectoral structure as well as of reforms concerning the bargaining system. Reform similarity in terms of the employment tax rate and the direct tax rate appears robust, but with rather low numbers of significant coefficients.

**Table 3. Tests of Robustness, delayed effects**

Dependent Variable: 5-year Correlation of IIP				
	Variable	SiM	Sig (5%)	Sig (10%)
Institutional Similarity (distance)	Employment Protection	0.85	0.03	0.38
	Bargaining Centralization	0.96	0.56	0.71
	Overall benefits	0.95	0.36	0.58
	Employment Tax Rate	0.99	0.96	0.99
Institutional Change (direction)	Overall Benefits	0.98	0.70	0.95
Control Variables	Fiscal Policy	0.98	0.73	0.94
	Sectoral Structure	0.99	0.93	1.00
	Trade Intensity	0.83	0.01	0.08

Results of an extreme-bounds analysis according to equation (3). Estimations have been performed using a heteroscedasticity robust fixed effects estimator. The estimation framework consists of four periods from 1984 to 2003. Column 2 shows all variables which have more than 95% of the estimated coefficient mass on one side of zero, additional to the robust variables of table 2. Column 3 contains the corresponding results. Columns 4-5 display the percentage of models in which the particular variable appeared significant to the 5% (fourth column) and the 10% level (fifth column).

The described results draw upon the assumption that reforms have a somewhat immediate effect on business cycle synchronization. But one could easily imagine that reforms need some time to make an impact on the business cycle. Thus, we conduct an extreme-bounds analysis with lagged direction indicators in order to take the possibility of a delayed effect into account. Therefore, we slightly change the estimation setup by replacing all contemporaneous direction terms by the corresponding lagged

direction terms. Similar to table 2, table 3 presents the contemporaneous distance indicators and control variables as well as the lagged structural reform indicators which pass the robustness test. Additionally, we also report the results of those distance indicators which have been identified as robust in table 2. Again, the complete results are provided in Table 7 of Appendix 2.

It emerges that only the lagged reform similarity of the overall unemployment benefit indicator is robustly related to business cycle synchronization. The findings concerning the distance and the control variables are not directly comparable to table 2 since we lose the first time period by including lagged reform indicators. Nevertheless, the results, at least for the SiM-values, are somewhat robust to this modification. While the similarity of the unemployment benefit system and the similarity of the sectoral structure gain importance, the employment protection similarity indicator and the trade intensity measure get insignificant in nearly all models. The similarity of the bargaining centralization, the employment tax rate as well as the fiscal policy remain significant.

### 5.3 Institutions, Reforms, and the Control Variables

What do the outcomes regarding institutional similarity and common reforms tell us? In fact, we find a significant and robust effect of several institutional indicators. But the low numbers of significant coefficients and the decrease in importance of some indicators through the cutting-off of the first period complicates the interpretation. In a nutshell, it appears that the similarity of the employment tax rate is an important factor for the determination of the business cycle synchronization. Furthermore, the contemporaneous similarity of structural reforms of the employment protection and the employment tax rate as well as delayed reforms of the unemployment benefit system seem to matter. While the distance indicator of employment protection is significant only for five periods, the unemployment benefits become significant merely for four periods. Additionally, both distance measures exhibit quite low numbers of significant coefficients which is why we are a bit uncertain about the importance of both indicators. The same conclusion applies to the direction measure of the direct tax rate. Similarly, the bargaining centralization never reaches the 90% level of significant coefficients. Thus, the importance of this factor is not completely unambiguous.

Concerning the economic significance of the institutional indicators we can not easily report a single coefficient value since we have a complete distribution of coefficients. Hence, table 4 displays the maximum and the minimum value as well as the median and the mean for each indicator reported in tables 2 and 3. In terms of coefficient signs and magnitudes, the outcomes of the extreme-bounds analysis are close to those estimated using principal components. Yet, the extreme-bounds test delivers more information on the driving forces of each institutional category.

**Table 4. Descriptive statistics of robust variables**

	Variable	Max	Min	Median	Mean
Institutional Similarity (distance)	Employment Protection	0.424	0.020	0.177	0.186
	Bargaining Centralization	0.384	-0.213	0.018	0.027
	Overall Benefits	0.000	-0.017	-0.005	-0.005
	Employment Tax Rate	-0.003	-0.013	-0.008	-0.008
Institutional Change (direction)	Employment Protection	0.269	0.102	0.152	0.161
	Employment Tax Rate	0.966	0.010	0.419	0.411
	Direct Tax Rate	1.044	-3.169	-0.849	-0.831
	Overall Benefits (lagged)	0.051	-0.011	0.024	0.024
Control Variables	Fiscal Policy	0.039	0.011	0.027	0.026
	Trade Intensity	10.880	-2.484	4.592	4.532
	Sectoral Structure	2.551	-1.010	1.610	1.661
	Monetary Policy	0.012	-0.132	-0.054	-0.055

Statistics derived from the complete coefficient distribution for each institutional variable. Overall, 1330 coefficients have been estimated for each indicator.

While the distance indicator coefficients for employment protection are positive throughout all models, the bargaining centralization the overall benefits and the employment tax rate show a considerable share of negative signs. This indicates that the more similar institutional conditions for the latter three variables are the less synchronized business cycles are. For example, an increase in the employment tax rate difference by 1% raises the business cycle correlation by 0.008 points. In contrast, an increase in the employment protection similarity by 1 point enhances the correlation by approximately 0.2 points. Additionally, three structural reform indicators are positively related to business cycle synchronization, i.e., the more similar a reform between two countries the higher the correlation of the business cycle. Only the direct tax rate exhibits a majority of negative signs.

At first glance, these results seem to be a bit conflicting. The positive signs of the employment protection and the control variables indicate the prevalence of common shocks. Based on this assumption we expect that similar institutional arrangements absorb and propagate shocks in a similar way. However, the three negative institutional distance indicators tell the opposite. One possible explanation which comes to mind is that not single institutional conditions matter but systems of institutional arrangements. For instance, the employment effects of labor taxes depend on the bargaining power of workers and how the costs are distributed between employers and employees (see, for instance, Daveri and Tabellini 2000). In this case, the negative effect of a high employment tax rate is dampened or even vanished by a very low bargaining power. In the same way, the negative incentive effect of considerable unemployment benefits could be compensated by strong unions which can set wages on a relatively high level.<sup>8</sup> Hence, taking these institutional interactions into account can explain why different institutional settings lead to the same economic consequences. The literature is yet to identify relevant interactions and, given the large set of institutional indicators, there might be a lot of them. Thus, it is not feasible to test all different institutional interactions. Nevertheless, we test the one specific interaction identified by Daveri and Tabellini within our estimation framework. Particularly, we estimate the following relationship:

$$Y = \alpha + UD_{dis}\beta_1 + TX1_{dis} + [(UD]_{dis} * TX1_{dis})\beta_3 + \lambda + u. \quad (4)$$

In this equation,  $Y$  is the correlation of the IIP,  $UD_{dis}$  is the union density similarity as a measure for the workers' bargaining power,  $TX1_{dis}$  is the employment tax rate similarity, while  $\alpha$  and  $\lambda$  are time and cross-section specific effects. Our central assumption is that distinct employment tax rates lead to higher correlations of the business cycle if the bargaining power is sufficiently different in both countries.<sup>9</sup> Thus, we assume that the similarity of the employment tax rate is only negative if the union density similarity is high.

The tax rate indicator totals  $-0.015$  and is highly significant with a t-value of  $-6.7676$ . The union density indicator is negative, but insignificant. The interaction term is also negative with a value of  $-0.0003$  and significant with a t-value of  $-5.482$ . The tax rate effect can then be calculated as  $-0.015 + (-0.0003 * UD_{dis})$ .<sup>10</sup> Since all institutional similarity indicators have to be negative per construction, the bracket term is positive. A difference larger than 50 percentage points between the union densities of two countries turns the negative tax effect into a positive one. Since the maximum and the mean of the union density difference amount to 76 and 24 percentage points, respectively, this is not just a hypothetical issue.

In contrast to the findings in terms of institutional similarity, the results of the structural reform indicators are in line with what we expected. The positive coefficient signs of all four measures indicate that common reforms help to synchronize cycles. We assume that mainly deregulating common structural reforms (which are flexibility increasing) help to bring business cycles more in line, although our estimation setup does not allow to test whether common structural reforms are flexibility increasing or decreasing.

Although the control variables trade intensity, sectoral structure, fiscal and monetary policy are not a central element of our study, we report the results in order to find out whether the level and direction of influence are in line with previous studies. Trade intensity has been identified as a key determinant in various contributions. We find a positive linkage between higher trade intensity and business cycle convergence. However, the effect is insignificant in various specifications. This confirms the findings

of Gruben et al. (2002) or Calderón et al. (2007) who find a positive but not always significant effect of trade. Similarly, Inklaar et al. (2008) conclude that the effect of trade is positive but relatively small. Analogously, the influence of a similar fiscal policy in our model is also positive. In other words, two countries with a similar fiscal policy are likely to have more synchronized business cycles, even if the direction of causality is not necessarily unambiguous. This result is in line with Darvas et al. (2007) and Akin (2007), who find a positive and significant impact of fiscal convergence on synchronization.

In contrast to that, the role of a common sectoral structure is still somewhat unclear. The influence seems to be positive, but the corresponding coefficient is insignificant in the five period estimation while the estimations without the first period show a highly significant sectoral structure. Hence the findings of earlier studies like Imbs (2004) or García Herrero and Ruiz (2008), indicating a positive influence of similar sectoral structures, can only be corroborated to some extent. Finally, while the monetary policy is insignificant in the principal components estimation as well as in the extreme-bounds analysis.

## 6. Conclusions

In this paper, we seek to identify robust labor market institutions influencing business cycle synchronization. Our focus lies both on differences in institutional arrangements as well as in structural reforms. Therefore, we establish a bilateral measure for structural changes and, in addition to the differences of institutional arrangements, analyze its contemporaneous and its lagged effect on business cycle convergence. Our results show that institutional similarities regarding employment protection legislation, bargaining centralization, and institutional differences concerning the employment tax rate are likely to be important determinants of higher co-movement. Additionally, common structural reforms in terms of the employment protection legislation and the employment tax rate as well as opposing reforms concerning the direct tax rate seem to instantaneously reduce business cycle differences. Reforms of the unemployment benefit system have a delayed impact since these changes likely need some time to fully materialize. The impact of the employment tax rate similarity and the reform similarity in terms of the employment protection are both highly robust and significant. In contrast, the results concerning the remaining robust distance and direction indicators show a lower degree of significance what leaves some doubts about the importance of these variables.

Although the results concerning the control variables suggest that common shocks prevail, similar institutional conditions might also lead to diverging cycles. However, we expected that higher institutional similarity results in more synchronized business cycles in the presence of common shocks. Our explanation for this unexpected result is that the link between institutions and the business cycle depends mainly on the institutional setup as a whole. In fact, we find evidence for this hypothesis by estimating an interaction term between the employment tax rate similarity and the union density similarity in two countries. It turns out that employer tax rate similarity increases synchronisation for a broad range of values of union density similarity. Consequently, similar employment tax rates increase synchronisation between two countries as long as these countries show a certain level of union density similarity. Given existing evidence from the literature on interdependent labour market institutions it is probable that such a relationship also holds for other interaction terms. Furthermore, common reforms tend to increase business cycle convergence, probably through higher economic flexibility which increases a country's resilience to asymmetric shocks.

Nevertheless, it has to be kept in mind that we made the assumption of institutions affecting synchronization, and not vice-versa. This leads to potential endogeneity in our model because closer business cycles may affect the similarity of institutional arrangements and the reforms which countries carry out. We do not control for this as it is virtually impossible to find appropriate instruments for institutions.<sup>11</sup>

While this paper helps to understand that institutional factors should be considered when dealing with business cycle synchronization, further research needs to be directed to the identification of institutional interactions and their possible influence on the business cycle. This might help to get a clearer picture about the actual impact of the similarity of institutions on the synchronization of business cycles.

## Appendix 1: Description of Data Sets

### Institutional Indicators

The Nickell-Nunziata database (see Nickell and Nunziata 2001 as well as Nickell 2006) delivers eight different groups of institutions for 20 OECD countries, where each group contains several indicators. Not all indicators show a comprehensive data coverage in terms of countries and periods. Therefore, we have to exclude some of them with insufficient data availability for our study. The indicator areas that we use in our analysis refer to employment protection, the workers' bargaining power, unemployment benefits and labor taxes. Additionally, indicators for which only limited data is available compared to other indicators of the same group will not be incorporated in the following estimations. The analyzed group of institutional indicators consists of 9 different measures, each of them linked to one of the aforementioned four institutional categories. A detailed description of the complete database is given by Nickell and Nunziata (2001) and Nickell (2006), while the institutional indicators, which have been taken into consideration for our own study, are described in the following, sticking to the definitions given by Nickell (2006).

**Table 5. Description of institutional variables**

Variable	Description	Unit	Range
EP	Employment protection legislation data from the OECD labor market statistics database using version 1 of the indicator: the strictness of employment protection legislation.	index	[0,2]
UD	Union density is Union membership/Employment and was calculated using administrative and survey data from the OECD labor market statistics database.	%	
BCO	This is a five year period index of bargaining coordination taken from OECD (2004). It is increasing in the degree of coordination in the bargaining process on the employers' as well as the unions' side.	Index	[0,5]
BCE	This is an index of bargaining centralization taken from OECD (2004) table 3.5. It is increasing in the degree of centralization.	Index	[0,5]
UB1	Gross benefit replacement rates data are provided by OECD with one observation every two years for each country. In this case the data refer to the first year of unemployment benefits, averaged over three family situations and two earnings levels. The benefits are a percentage of average earnings before tax.	%	
UB2	These are original benefit replacement rates data published by the OECD. It is defined as the average across the first five years of unemployment for three family situations and two money levels taken from <a href="http://www.oecd.org/els/social/workincentives">www.oecd.org/els/social/workincentives</a> and interpolated.	%	
TX1	The employment tax rate is ESS/(IE-ESS) with ESS equal to employers' social security contributions and IE equal to total compensation for employees. ESS is available from the OECD National Accounts detailed tables and IE from OECD Revenue Statistics.	%	
TX2	The direct tax rate is DT/HCR with DT equal to income tax plus employees' social security contributions and HCR equal to household current receipts. Figures for income tax and employees' social security contributions were taken from OECD Revenue Statistics. HCR was taken from OECD National Accounts directly for pre- 1990 and was calculated as the sum of compensation of employees, property income, social contributions and benefits and other current transfers for post- 1990.	%	
TX3	The indirect tax rate is (TX-SB)/CC with TX equal to indirect taxes, SB equal to subsidies and CC household final expenditures. All three were taken from OECD National Accounts.	%	

### Measuring Institutional Similarity and Institutional Change

Both a measure for institutional similarity as well as for institutional change are considered in order to analyze whether institutions – and changes therein – have an influence on business cycle synchronization. This yields insights into the effects of both the institutional status quo and the conduct of structural reforms. First of all, an appropriate bilateral measure for institutional similarity is required. We denote the indicators as  $P^k$ . The index  $k$  ranges from 1 to 9, thus numbering the different indicators. Our measures for institutional similarity are the absolute differences between countries in the levels of the particular indicators  $P^k$ , such that

$$Z_{dis,ijt}^k = - \left( \left| P_{it}^k - P_{jt}^k \right| \right), \quad (5)$$

with  $P_{it}^k$  defined as the level of the particular indicator  $P^k$  of country  $i$  at time  $t$ . In doing so we get 9 different bilateral indicators for institutional similarity between the countries, in the following denoted as distance. Higher (lower) values of the  $Z_{dis,ijt}^k$  coefficient in the result tables display more (less) similarity between the countries  $i$  and  $j$ . To measure institutional change, the growth rates of each indicator  $P^k$  are calculated for each country. Then the absolute differences between countries in the growth rates of the particular indicators  $P^k$  represent the measure for the (dis)similarity of institutional change. This relationship can be seen in the following expression

$$Z_{dir,ijt}^k = - \left( \left| g_{P_{it}}^k - g_{P_{jt}}^k \right| \right), \quad (6)$$

where  $g_{P_{it}}^k$  and  $g_{P_{jt}}^k$  describe the growth rates of the particular indicator  $P^k$  of countries  $i$  and  $j$  at time  $t$ .

The resulting term  $Z_{dir,ijt}^k$  is a bilateral variable measuring the relation between an institutional change conducted in countries  $i$  and  $j$ . Overall, we can exploit a total of 9 bilateral reform indicators.

Higher (smaller) values of the  $Z_{dir,ijt}^k$  coefficients in the result tables are linked to a stronger (weaker) similarity between the countries  $i$  and  $j$  with respect to indicator  $P^k$ . Henceforth, this measure for institutional change will be called direction.

### Business Cycle Synchronization

Due to the fact that business cycles are not directly observable and measurable, an appropriate methodology to estimate them is required. On the basis of the observable real GDP series of the OECD for all 20 countries, the cycles can be calculated by filtering the GDP series. However, quarterly or even monthly GDP data is not comprehensively available from the OECD. Thus, we follow Inklaar et al. (2008) in using the monthly Industrial Production Index (IIP), available from the OECD Main Economic Indicators database. Inklaar et al. also constructed GDP correlations of quarterly GDP series by merging OECD and Eurostat data. But we have some doubts regarding the reliability of the GDP series especially from earlier years which is why we confine our attention to the IIP. There are quite a few possibilities for measuring the business cycle. De Haan et al. (2008) give a short insight into the differences between alternative filtering methods. They conclude that, 'studies that use standard filters such as the Hodrick-Prescott, Baxter-King and Christiano-Fitzgerald filters are likely to yield similar results'. Valle e Azevedo (2002) analysis several filters and justifies the application of the HP filter in the context of extracting the business cycle. Thus, the commonly used HP filter with a  $\lambda$  of 14400 for monthly data and 1600 for quarterly data is applied in order to obtain the output gap as a measure of the stage in the business cycle. The connection between the business cycles of two countries is made by calculating the corresponding Pearson correlations over 5-year periods. According to Inklaar et al. (2008), we apply the Fisher's z-transformation to ensure that the dependent variable is normally distributed. In the following, the control variables included in addition to the structural reform indicators will be described.

### Trade Intensity

Trade is regarded as the major transmission channel for business cycles and a prime candidate variable for driving business cycle synchronization. To account for the likely influence of trade in this context, we construct an indicator of bilateral trade intensity, following the approach of Frankel and Rose (1998), who defined a variable measuring the share of the two countries' bilateral trade flows in the total volume of their trade flows with all partner countries. More formally, the variable is calculated as

$$trade_{ijt} = \frac{X_{ijt} + M_{ijt}}{X_{it} + M_{it} + X_{jt} + M_{jt}}, \quad (7)$$

Here,  $X_{ijt}$  stands for the volume of exports from country  $i$  to country  $j$  during period  $t$  and  $M_{ijt}$  correspondingly stands for country  $i$ 's imports of goods from country  $j$ .  $X_{it}$  and  $M_{it}$  denote the volume of country  $i$ 's total exports and imports in year  $t$ , respectively. Annual data for bilateral and total trade volumes are taken from the IMF Direction of Trade Statistics database and are measured in US dollar at current prices.

### Sectoral Structures

To measure differences in sectoral specialization of the production structure of two countries the following variable is constructed

$$sec_{ijt} = \sum_{s=1}^S |VAS_{sit} - VAS_{sjt}| \quad (8)$$

Where  $sec_{ijt}$  is the sum of the absolute differences of two countries  $i$ 's and  $j$ 's value-added shares for each sector. These value-added shares  $VAS_{sit}$  measure each sector's relative importance in the production structure of an economy and are calculated as

$$VAS_{sit} = \frac{VA_{sit}}{\sum_{s=1}^S VA_{sit}} \quad (9)$$

This measure is a modification of the measure implemented by Krugman (1991) who used sectoral employment shares rather than sector value-added shares. The data for sectoral value-added are taken from the Industry Database of the Groningen Growth and Development Center (2006). This database provides annual data for 60 sectors covering all OECD countries and thus enables a very detailed and disaggregated analysis of the sectoral differences. The use of such data is an improvement on studies such as Imbs (2004) who used sectoral data of a higher degree of aggregation, or on studies using data not covering the whole economy. For two countries with exactly the same production structure,  $sec_{ijt}$  is equal to 0, while it takes a value of 2 for two countries with completely disparate sectoral structures. However, even in the large country sample there is no country pair with a value exceeding 0.93 and the average value of  $sec_{ijt}$  is 0.48. Considering that the sample comprises mostly industrial countries, this relatively low degree of sectoral difference is not surprising.

### Fiscal Policy

Fiscal policy also seems to be a source for business cycle synchronization. In our study, we rely on the primary government net lending, measured as a percentage of GDP and taken from the OECD database, to construct the bilateral fiscal policy variable. Taking the absolute differences between countries  $i$  and  $j$ , the net lending value delivers a measure for the similarity of the countries' fiscal policies. In doing so, we follow Darvas et al. (2007), who initially developed this approach to generate a bilateral measure for fiscal policy.

### Currency Area

We construct a the correlations of the short-term interest rates, taken from the OECD database, as a measure for the similarity of monetary policy. In doing so, we follow the approach suggested by Otto et al. (2001) and taken up by Inklaar et al. (2008).

**Appendix 2: Result Tables****Table 6. Test of Robustness, contemporaneous effects, complete results**

Category	Variable	Sign (5%)	Sign (10%)	SiM
Employment Protection Legislation	EP <sub>distance</sub>	0.48	0.67	0.96
	EP <sub>direction</sub>	1.00	1.00	1.00
Bargaining System	UD <sub>distance</sub>	0.05	0.07	0.61
	UD <sub>direction</sub>	0.00	0.00	0.57
	BCO <sub>distance</sub>	0.34	0.39	0.89
	BCO <sub>direction</sub>	0.08	0.16	0.62
	BCE <sub>distance</sub>	0.69	0.89	0.98
	BCE <sub>direction</sub>	0.28	0.29	0.80
Unemployment Benefit System	FYUB <sub>distance</sub>	0.00	0.03	0.55
	FYUB <sub>direction</sub>	0.00	0.05	0.90
	OUB <sub>distance</sub>	0.18	0.28	0.89
	OUB <sub>direction</sub>	0.00	0.05	0.82
Labor Tax System	TX1 <sub>distance</sub>	1.00	1.00	1.00
	TX1 <sub>direction</sub>	0.77	0.85	0.95
	TX2 <sub>distance</sub>	0.00	0.02	0.84
	TX2 <sub>direction</sub>	0.60	0.74	0.96
	TX3 <sub>distance</sub>	0.15	0.18	0.83
	TX3 <sub>direction</sub>	0.07	0.15	0.68
Control Variables	FiscalPolicy	1.00	1.00	1.00
	TradeIntensity	0.14	0.50	0.95
	SectoralStructure	0.00	0.00	0.76
	MonetaryPolicy	0.00	0.00	0.51

Results of an extreme-bounds analysis with the correlation of the industrial production index as dependent variable. EP= Employment Protection, UD = Union Density, BCO = Bargaining Coordination, BCE = Bargaining Centralization, FYUB = First Year Unemployment Benefits, OUB = Overall Unemployment Benefits, TX1 = Employment Tax Rate, TX2 = Direct Tax Rate, TX3 = Indirect Tax Rate. Estimations have been performed using a heteroscedasticity robust fixed effects estimator. The estimation framework consists of five periods from 1979 to 2003. Column 3-5 contain results belonging to Extreme-Bounds Analysis with contemporaneous reform impact; Column 3: Share of significant coefficients at a 5% level. Column 4: Share of significant coefficients at a 10% level. Column 5 contains results belonging to Sala-i-Martin's approach, assuming a non-normal distribution and without weights.

**Table 7. Test of Robustness, delayed effects, complete results**

Category	Variable	Sign (5%)	Sign (10%)	SiM
Employment Protection Legislation	EP <sub>distance</sub>	0.00	0.04	0.85
	EP <sub>direction</sub>	0.00	0.00	0.57
Bargaining System	UD <sub>distance</sub>	0.04	0.05	0.56
	UD <sub>direction</sub>	0.00	0.00	0.65
	BCO <sub>distance</sub>	0.15	0.20	0.69
	BCO <sub>direction</sub>	0.00	0.04	0.65
	BCE <sub>distance</sub>	0.56	0.71	0.96
	BCE <sub>direction</sub>	0.44	0.55	0.88
Unemployment Benefit System	FYUB <sub>distance</sub>	0.00	0.00	0.52
	FYUB <sub>direction</sub>	0.07	0.11	0.51
	OUB <sub>distance</sub>	0.36	0.58	0.95
	OUB <sub>direction</sub>	0.69	0.95	0.98
Labor Tax System	TX1 <sub>distance</sub>	0.96	0.99	0.99
	TX1 <sub>direction</sub>	0.02	0.08	0.83
	TX2 <sub>distance</sub>	0.00	0.00	0.72
	TX2 <sub>direction</sub>	0.20	0.26	0.64
	TX3 <sub>distance</sub>	0.31	0.36	0.86
	TX3 <sub>direction</sub>	0.02	0.05	0.78
Control Variables	FiscalPolicy	0.73	0.94	0.98
	TradeIntensity	0.00	0.00	0.83
	SectoralStructure	0.93	1.00	0.99
	MonetaryPolicy	0.00	0.00	0.91

Results of an extreme-bounds analysis with the correlation of the industrial production index as dependent variable. . EP= Employment Protection, UD = Union Density, BCO = Bargaining Coordination, BCE = Bargaining Centralization, FYUB = First Year Unemployment Benefits, OUB = Overall Unemployment Benefits, TX1 = Employment Tax Rate, TX2 = Direct Tax Rate, TX3 = Indirect Tax Rate. Estimations have been performed using a heteroscedasticity robust fixed effects estimator. The estimation framework consists of five periods from 1979 to 2003. Column 3-5 contain results belonging to Extreme-Bounds Analysis with delayed reform impact; Column 3: Share of significant coefficients at a 5% level. Column 4: Share of significant coefficients at a 10% level. Column 5 contains results belonging to Sala-i-Martin's approach, assuming a non-normal distribution and without weights.

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## References

- Abbott, A., J. Easaw, and T. Xing**, 2008. "Trade Integration and Business Cycle Convergence: Is the Relation Robust across Time and Space?," *Scandinavian Journal of Economics*, 110, 403-417.
- Acemoglu, D., S. Johnson, and J. Robinson**, 2005. "Institutions as the Fundamental Cause of Long-Run Growth," *Handbook of Economic Growth*, 1, 385-472.
- Acemoglu, D., S. Johnson, J. Robinson, and Y. Thaicharoen**, 2003. "Institutional causes, macroeconomic symptoms: volatility, crises and growth," *Journal of Monetary Economics*, 50, 49-123.
- Akin, C.**, 2007. "Multiple Determinants of Business Cycle Synchronization," mimeo, George Washington University, Department of Economics.
- Andolfatto, D.**, 1996. "Business Cycles and Labor-Market Search," *American Economic Review*, 86, 112-132.
- Arpaia, A. and G. Mourre**, 2005. "Labor Market Institutions and Labor Market Performance: A Survey of the Literature," European Economy Economic Paper No. 238.
- Artis, M. and P. Claeys**, 2007. "What Holds Cycles Together?," Paper presented at the OECD Workshop on structural reforms and economic resilience: evidence and policy implications, June 2007.
- Baxter, M. and M. Kouparitsas**, 2005. "Determinants of Business Cycle Comovement: A Robust Analysis," *Journal of Monetary Economics*, 52, 113-157.
- Belot, M. and J. C. van Ours**, 2004. "Does the recent success of some OECD countries in lowering their unemployment rate lie in the clever design of their labor market reforms?," *Oxford Economic Papers* 56, 621-642.
- Blanchard, O. and F. Giavazzi**, 2003. "Macroeconomic Effects of Regulation and Deregulation in Goods and Labor Markets," *Quarterly Journal of Economics*, 118, 879-907.
- Boeri, T. and P. Garibaldi**, 2007. "Two Tier Reforms of Employment Protection: A Honeymoon Effect?," *Economic Journal*, 117, 357-385.
- Boeri, T. and J. van Ours**, 2008. *The Economics of Imperfect Labor Markets*, Princeton University Press.
- Böwer, U. and C. Guillemineau**, 2006. "Determinants of Business Cycle Synchronization across Euro Area Countries," ECB Working Paper No. 587.
- Calmfors, L. and J. Driffill**, 1988. "Bargaining Structure, Corporatism and Macroeconomic Performance," *Economic Policy*, 3, 13-61.
- Calderón, C., Chong, A., and E. Stein**, 2007. "Trade Intensity and Business Cycle Synchronization: Are Developing Countries any Different?," *Journal of International Economics*, 71, 2-21.
- Clark, T. E. and E. van Wincoop**, 2001. "Borders and Business Cycles," *Journal of International Economics*, 55, 59-85.
- Darvas, Z., A. Rose, and G. Szapáry**, 2007. "Fiscal Divergence and Business Cycle Synchronization: Irresponsibility is Idiosyncratic," In: Frankel, J. and Pissarides, C. (Eds.), NBER International Seminar on Macroeconomics 2005, MIT Press, Cambridge.
- Daveri, F. and G. Tabellini**, 2000. "Unemployment, growth and taxation in industrial countries," *Economic Policy*, 15.
- De Haan, J., R. Inklaar, and R. Jong-A-Pin**, 2008. "Will Business Cycles in the Euro Area Converge? : A Critical Survey of Empirical Research," *Journal of Economic Surveys*, 22, 234-273.
- Flanagan, R.**, 1999. "Macroeconomic Performance and Collective Bargaining: An International Perspective," *Journal of Economic Literature*, 37, 1150-1175.
- Frankel, J.A. and A. Rose**, 1998. "The Endogeneity of the Optimum Currency Area Criteria," *Economic Journal*, 108, 1009-1025.
- Frankel, J.A. and A. Rose**, 2002. "An Estimate of the Effect of Common Currencies on Trade and Income," *Quarterly Journal of Economics*, 117, 437-466.

- García Herrero, A. and J. Ruiz**, 2008. "Do Trade and Financial Linkages Foster Business Cycle Synchronization in a Small Economy? ," Banco de España Working Paper No. 0810.
- Groningen Growth and Development Centre**, 2006. "60-Industry Database, University of Groningen," available at <http://www.ggdc.net>.
- Gruben, W. C., J. Koo, and E. Millis**, 2002. "How Much Does International Trade Affect Business Cycle Synchronization? ," Research Department Working Paper 0203, Federal Reserve Bank of Dallas.
- Imbs, J.**, 2004. "Trade, Finance, Specialization and Synchronization," *Review of Economics and Statistics*, 86, 723-734.
- Inklaar, R., R. Jong-A-Pin, and J. De Haan**, 2008. "Trade and Business Cycle Synchronization in OECD Countries: A Re-Examination," *European Economic Review*, 52, 646-666.
- Krugman, P.**, 1991. *Geography and Trade*, MIT Press.
- Leamer, E.**, 1985. "Sensitivity Analysis Would Help," *American Economic Review*, 75, 308-313.
- Ljungqvist, L.**, 2001. "How Do Layoff Costs Affect Employment," *Economic Journal*, 112, 829-853.
- Magnus, J., O. Powell, and P. Prüfer**, 2010. "A comparison of two model averaging techniques with an application to growth empirics," *Journal of Econometrics*, 154, 139-153.
- Nickell, W.**, 2006. "The CEP-OECD Institutions Data Set (1960-2004)," CEP Discussion Paper No. 759. With data set: <http://cep.lse.ac.uk/pubs/download/data0759.zip>.
- Nickell, S. and R. Layard**, 1999. "Labor Market Institutions and Economic Performance," *Handbook of Labour Economics*, 3, 3029-3083.
- Nickell, S., L. Nunziata**, 2001. "Labor Market Institutions Database," CEP Discussion Paper No. 502.
- Nunziata, L.**, 2005. "Institutions and Wage Determination: a Multi-country Approach," *Oxford Bulletin of Economics and Statistics*, 67, 435-465.
- Otto, G., G. Voss, and L. Willard**, 2001. "Understanding OECD Output Correlations," Research Discussion Paper No. 2001-05, Reserve Bank of Australia.
- Rumler, F., J. Scharler**, 2011. "Labor Market Institutions and Macroeconomic Volatility in a Panel of OECD Countries," *Scottish Journal of Political Economy*, 58, 396-413.
- Sachs, A.**, 2011. "Institutions and Unemployment: Do Interactions Matter? ," ZEW Discussion Paper No. 11-057.
- Sala-i-Martin, X.**, 1996. "I just ran over four million regressions," NBER Working Paper No. 6252.
- Sala-i-Martin, X.**, 1997. "I just ran two million regressions," *American Economic Review*, 87, 178-183.
- Sala-i-Martin, X., G. Doppelhofer, and R. Miller** 2004. "Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach," *American Economic Review*, 94, 813-835.
- Valle e Azevedo, J.**, 2002. "Business Cycles: Cyclical Comovement Within the European Union in the Period 1960-1999. A Frequency Domain Approach," Bank of Portugal Working Papers 2002-05.
- Veracierto, M.**, 2008. "Firing Costs and Business Cycle Fluctuations," *International Economic Review*, 49, 1-39.
- Zanetti, F.**, 2009. "Effects of Product and Labor Market Regulation on Macroeconomic Outcomes," *Journal of Macroeconomics*, 31, 320-332.

## Footnotes

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- <sup>1</sup> The correlations are calculated following Inklaar et al. (2008). Hence, we take the cycle of the HP-filtered monthly OECD industrial production index where available, and quarterly data for the remaining countries.
- <sup>2</sup> We have not constructed the principal component of the employment protection since there is only one indicator available. The distance and direction measures of this indicator are included in  $PC_{dis}$  and  $PC_{dir}$ , respectively.
- <sup>3</sup> We also estimated the model with the control variables included in all regressions. Actually, this does not change the results substantially.
- <sup>4</sup> It has to be mentioned that the lack of valid instruments prevent us from taking into account the possible endogeneity problem of our model by applying an instrumental variable estimation.
- <sup>5</sup> More recent approaches in the spirit of Leamer have been developed by Sala-i-Martin et al. (2004) in a Bayesian or Magnus et al. (2010) in a more classical spirit. However, these approaches require a balanced data-set without missing observations to be able to work properly. This requirement limits the applicability of these methods and we rely on the classical extreme-bounds analysis.
- <sup>6</sup> In this case,  $\bar{z}$  forms the pool of all institutional indicators plus the control variables, except of the variable of interest  $z$ .
- <sup>7</sup> It is questionable what significance share a variable has to reach to become significant within the extreme-bounds analysis. This is obviously a predominantly subjective decision. A rule of thumb is to set the the threshold level at a value of 90%.
- <sup>8</sup> The argument of interacting institutions is discussed by Belot and van Ours (2004). A profound discussion can be found in Boeri and van Ours (2008). See Sachs (2011) for a recent treatment.
- <sup>9</sup> Actually, we assume that the negative employment effect of high employment taxes can be compensated by a low bargaining power of workers. According to the literature, a high worker bargaining power shifts tax costs to the firms, resulting in lower labor demand an higher unemployment.
- <sup>10</sup> We also conducted an extreme-bounds analysis with the similarity indicators for union density and the employment tax rate as well as the interaction term of both factors. We included all three components always together and estimated a SiM-value of 0.99 with over 90% significant interaction coefficients.
- <sup>11</sup> Acemoglu et al. (2003, 2005) deal with the identification of such instruments. However, they construct instruments on the basis of settler mortality rates for former colonies. This is not very sensible in our context since we are working with countries which have never been colonies.