Review of International Economics, 18(5), 865–881, 2010
DOI:10.1111/j.1467-9396.2010.00913.x

Business Cycle Comovement and Labor Market Institutions: An Empirical Investigation

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Abstract

This paper examines the empirical link between labor market institutions and international business cycle synchronization. Using a data panel of 20 OECD countries over the 1964–2003 period, we evaluate how cross-country labor market heterogeneity affects business cycle comovement. Our estimation strategy controls for a large set of possible factors influencing cross-country GDP correlation, which allows a comparison of our results with those found in previous studies. We find that bilateral trade, trade similarity, monetary and fiscal convergence, as well as EMU membership lead to more synchronized cycles. Our results show that labor market regulations affect the extent of business cycle synchronization. Disparities in employment protection laws and direct taxation tend to lower international comovement while divergence in union density, unemployment benefits, and indirect taxation enhance cross-country correlations. The level of labor market regulations also matters. Heavier employment taxes are found to raise GDP comovement.

1. Introduction

The paper investigates the main determinants of international business cycle (hereafter, BC) comovement among OECD countries. The recent empirical literature suggests that countries with highly integrated goods markets exhibit a stronger BC correlation. Frankel and Rose (1998) as well as Inklaar et al. (2008) find that extensive bilateral trade flows are associated with higher GDP comovement, while Engel and Rose (2002) stress the role of currency unions. Other factors beyond trade are found to be important determinants of BC comovement. Some contributions notably underline the role of similarity in economic structure, either industrial similarity (Engel and Rose, 2002; Imbs, 2004) or similarity in trade (Baxter and Kouparitsas, 2005). Convergence in macroeconomic policy is also found to matter. Darvas et al. (2005) obtain that countries with similar budget positions tend to display more correlated business cycles, while Otto et al. (2001) underline the role of convergence in monetary policy. These dimensions constitute channels through which shocks in one country can be transmitted to others. Baxter and Kouparitsas (2005) empirically study the robustness of various candidate explanations to GDP comovement. They find that each of them plays a significant role in BC synchronization. However, when all variables are included in the

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regression, only one of them is robust, namely bilateral trade. They deny a significant role to industrial similarity and currency unions, in contrast to Imbs (2001) and Engel and Rose (2002).

The question of the determinants of BC comovement thus remains an open issue—see de Haan et al. (2008) for a survey. Our paper contributes to the debate by assessing the impact of labor market institutions (LMIs hereafter) on the cross-country GDP correlation across OECD countries. Bower and Guillemeau (2006) assess in the euro area the role of labor market heterogeneity on GDP comovement, captured through the single dimension of divergence in trade union density (i.e. the share of workers who are union members). However, their analysis fails to find a robust impact of LMIs on GDP synchronization. Rather than the cross-country heterogeneity dimension, Artis et al. (2008) investigate how the level of labor market regulations affect GDP comovement among OECD countries. The degree of labor market (in)flexibility in a country pair is captured by the overall level of employment protection in both countries. They find that more stringent employment protection laws result in less correlated business cycles. Our paper extends these papers by investigating a panel of OECD countries with a larger set of LMIs. Sachs and Schleer (2009) evaluate the effects of cross-country similarity in various labor market regulations on the extent of BC synchronization, using data-panel analysis on OECD countries since 1979. They find that a greater similarity in LMIs, notably in the degree of wage coordination and labor taxes, enhances GDP comovement. Their results are not fully convincing though. First, they fail to find a robust role of bilateral trade in GDP correlation. This is a surprising result, which contradicts the widespread finding in the literature (Baxter and Kouparitsas, 2005, among others). Second, their analysis is not immune to econometric concerns, related to potential endogeneity bias between their explanatory and dependent variables. We pay particular attention to this dimension in our econometric specification.

The estimations are based on data covering 20 OECD countries over the 1964–2003 period. Our estimation strategy puts into perspective the results obtained by Imbs (2004), Baxter and Kouparitsas (2005), Bower and Guillemeau (2006), and Artis et al. (2008), that use cross-section analysis, thereby discarding the specific time-varying dimension in their data. This is a serious limit of the methodology as it is likely to give spurious interpretations of the coefficients associated with control variables, in particular when covering such a long time horizon. In contrast, we estimate the effects of LMIs on GDP comovement by exploiting time-series variation as well as cross-sectional variance. We ensure the robustness of the link by including a set of control variables, commonly viewed as important determinants of GDP comovement, in the estimated equation. In doing so, we evaluate the findings of previous empirical works. Our results thus confirm the widespread view, that bilateral trade is a key determinant of BC synchronization. In accordance with Imbs (2001), similarity in the economic structure also matters. Notably, we find that similarity in traded goods (precisely, in imports) significantly enhances GDP comovement. As in Darvas et al. (2005), we obtain evidence that convergence in fiscal policy contributes to more synchronized cycles. Furthermore, monetary synchronization and membership to EMU significantly raises cross-country GDP correlation. This is in accordance with the findings of Otto et al. (2001) and Engel and Rose (2002) regarding the role of monetary coordination and currency unions, respectively.

Our empirical results show that labor market heterogeneity reduces BC synchronization among OECD countries. Divergence in employment protection and direct taxation are found to have a robust dampening effect on GDP comovement. In contrast, disparity in union density, unemployment benefits, and indirect taxation enhance

BC synchronization. Indeed, in the case of asymmetric shocks, divergent LMIs can ease adjustments on the labor market, thereby producing more correlated fluctuations. Our results also show that the level of labor market regulation matters, in accordance with Artis et al. (2008). Our results lay stress on the role of employment taxes. Heavier taxes are found to significantly raise GDP comovement among OECD countries.

The paper is structured as follows. Section 2 presents the empirical strategy and the data. In section 3, we estimate a baseline regression excluding LMIs, in order to account for GDP comovement using the standard determinants identified in the literature. This allows us to determine the key determinants of business cycle comovement to include as control variables in the subsequent regressions. We then evaluate the role of LMIs in GDP comovement, starting from this baseline regression. This is done in section 4. After discussing the economic mechanisms behind the impact of LMIs on GDP comovement, we study the role of labor market heterogeneity and inflexibility on GDP synchronization. Section 5 concludes.

2. The Estimated Equation

The Empirical Strategy

BC synchronization (denoted ρ^{y}) is captured by the cross-country correlations on the cyclical components of GDP series, using data over 20 OECD countries observed from 1964 to 2003. As in Darvas et al. (2005), the data are split into four decades (1964–73, 1974–83, 1984–93, 1994–2003), yielding a sample of 760 observations and 190 country pairs. We thus estimate the effects of labor market regulations on GDP comovement by exploiting time-series variation as well as cross-sectional variance.

To convincingly establish the robustness of the relationship, we need to check two elements related to the potential endogeneity between LMIs and GDP comovement. First, we need to ensure that causality goes in the right direction. Second, it has to be the case that the effect captured by LMIs is not attributable to an omitted-variable bias.

The first point refers to reversed causality. It could indeed be argued that it is a closer synchronization in business cycles that is responsible for convergence in labor market regulations. In our view, it is not likely to be the case that medium-run variables such as output cross-correlation affect the evolution of structural variables like LMIs. From an econometric point of view, though, the possibility of reverse causality should be controlled for. As a result, our measure of divergence in LMIs for each country pair $\{i, j\}$ is based on the labor market situation in both countries at the beginning of each decade, while the cross-country correlation in output is based on the mean of quarterly observations over the whole decade. Although it is not, strictly speaking, an instrumental-variables method, it does control for reverse causality, since differences in LMIs at the beginning of the decade (1964, 1974, 1984, 1994) could hardly be explained by the joint behavior of output over the following decade.

Regarding the second point, we need to ensure that other variables are not responsible for the relationship between BC synchronization and differences in LMIs. This leads us to include observable and unobservable control variables that are likely to influence GDP comovement in the regression. We thus include a set X_{ijt} (as denoted in equation (1)) of observable control variables, based on the literature's findings regarding the determinants of BC synchronization. The estimated equation also includes a set of unobservable variables in order to capture various elements that influence GDP correlation, beyond the impact of labor market heterogeneity and other control

variables. We thus include country fixed effects, as in Baxter and Kouparitsas (2005) (among others), as well as time-effect-specific variables. The benchmark regression is accordingly written as:

$$\rho^{y}_{ijt} = \alpha + \gamma DLMI_{ijt} + \kappa X_{ijt} + \mu_i + \mu_j + \lambda_t + \varepsilon_{ijt}, \quad (1)$$

with ρ^{y}_{ijt} the cross-country correlation of HP-filtered GDP between country i and country j over decade t; $DLMI_{ijt}$ measures the divergence in LMIs between countries i and j at the beginning of decade t; μ_i, μ_j denote the country and decade fixed effects, respectively; ε_{ijt} is the usual residual with standard properties (mean equal to 0, homoskedastic, uncorrelated with itself, uncorrelated with the fixed effects μ_i and μ_j, λ_t or any control variable). However, explanatory variables are allowed to be correlated with individual effects μ_i and μ_j. In equation (1), we study the role of labor market heterogeneity.

Alternatively, one could argue that it is the design of LMIs, i.e. the degree of labor market (in)flexibility, rather than its cross-country divergence, that matters in the extent of GDP comovement. Using OECD data, Artis et al. (2008) indeed find that stringent employment protection laws result in a lower BC synchronization. Patureau (2009) reaches a similar prediction in a two-country dynamic general-equilibrium model. This leads us to investigate the question by estimating the effect of the level of LMIs on GDP comovement according to the following equation:[1]

$$\rho^{y}_{ijt} = \alpha + \beta LMI_{ijt} + \kappa X_{ijt} + \mu_i + \mu_j + \lambda_t + \varepsilon_{ijt}, \quad (2)$$

where LMI_{ijt} measures the degree of labor market inflexibility in the pair of countries i and j (at the beginning of decade t). The following sections investigate the role of LMIs on international comovement, based on equations (1) or (2). To do so, we adopt the following strategy. In a first step (section 3), we estimate the baseline specification by focusing on the impact of a set of variables that have been found to be key determinants of GDP comovement, excluding LMIs (i.e. imposing $\gamma = 0$ and $\beta = 0$ in equations (1) and (2), respectively). As noted by Baxter and Kouparitsas (2005), there is no clear-cut consensus on the driving forces behind BC comovement. This step then allows us to confront the various and even conflicting literature's findings. It leads us to identify bilateral trade intensity, similarity in imports, convergence in budget and monetary positions, as well as membership of the European Monetary Union (EMU) as the main factors of BC comovement. Subsequent regressions therefore always include these dimensions in the set of control variables X_{ijt} (as well as country and time fixed effects).

In a second step (section 4), we study the role of LMIs in BC synchronization, by including them in the baseline specification. We thereby determine whether LMIs matter beyond the usual determinants of GDP comovement. We primarily study the role of labor market heterogeneity, captured by the cross-country difference in the various LMIs (equation (1)). We then investigate the role of the degree of labor market flexibility on GDP comovement (equation (2)). In each case, we assess the role of employment protection, unemployment benefit generosity, wage-bargaining coordination, and tax wedge components. Whereas most related studies (e.g. Bower and Guillemeau, 2006; Artis et al., 2008) capture labor market regulations using a limited number of LMIs (and mainly employment protection laws), one originality of the paper is to extend the analysis to broader aspects of labor market regulations.

The Database

The dependent variable We use quarterly GDP time series (1964:1–2003:4) among 20 OECD countries. As in Darvas et al. (2005), the data are split into four decades. The data file as well as definitions, sources, and descriptive statistics are available on the corresponding author's webpage.

Labor market institutions The LMI dataset comes from Nickell (2006). We use employment protection law (*EPL*), bargaining coordination (*co*), union density (*udnet*), generosity of unemployment benefits (*UB*), and the tax wedge components, i.e. the employer's tax rate, also referred to as employment tax (tw_1), the employee's direct tax rate (tw_2), and the indirect tax rate (tw_3). For each labor market indicator, we investigate the impact of its cross-country divergence on BC synchronization. For each country pair (i, j) (and decade t), this divergence is captured by the absolute difference in LMIs:

$$DLMI_{ijt} = |LMI_{it} - LMI_{jt}|, \tag{3}$$

where $LMI_{it} = EPL_{it}, udnet_{it}, co_{it}, UB_{it}, tw_{1,it}, tw_{2,it}, tw_{3,it}$ in country i, and the equivalent in country j, evaluated at the beginning of each decade t. A higher value is interpreted as a larger difference in LMIs. In addition, we explore how labor market rigidity affects BC synchronization. As in Artis et al. (2008), we define the variable LMI_{ijt} that captures the level of labor market rigidities for a country pair:

$$LMI_{ijt} = LMI_{it} + LMI_{jt}. \tag{4}$$

Given the way the variables are built, the higher the LMI variable, the more regulated this dimension of the labor market functioning. We then interpret LMI_{ijt} as an indicator of the degree of labor market rigidity in a given country pair (along the LMI dimension under focus).

Control variables We follow the literature by estimating the impact of potential determinants of GDP comovement, i.e. capital endowments, trade, similarity in economic structure, and divergence in macroeconomic policies.

Factor endowments We consider endowments in the stock of physical capital per worker. Trade theory predicts a close relationship between factor endowments, trade, and international business cycles. Specifically, the Heckscher–Ohlin theory predicts that divergence in factor endowments favors trade. As in Baxter and Kouparitsas (2005), we consider bilateral indicators of capital endowments that capture the maximum value of the variable between the two countries. Theory thus predicts that the higher the maximum factor endowments between the two countries, the lower the comovement. Accordingly, we expect negative coefficients associated with this variable.

Trade We consider different measures of trade intensity.

Bilateral trade intensity The relation between BC comovement and trade has been extensively debated, both theoretically and empirically. In the classical Ricardian theory as well as in New Trade theory (Helpman and Krugman, 1985), trade leads to an increase in sectorial specialization. If the source of shocks is sectorial, then trade

should reduce cross-country GDP correlation. Yet, it can also play a role as a transmission channel of exogenous changes that are common to the countries. Trade intensity should then lead to increased BC comovement. As in Imbs (2004) and Darvas et al. (2005), our measure of bilateral trade intensity is the sum of bilateral exports and imports between countries i and j, divided by total GDP in both countries.

Total trade intensity This variable is meant to capture the degree of openness in both countries, independently of the extent of bilateral trade between them. According to Baxter and Kouparitsas (2005), this variable may capture the flow of technological transmission that occurs through trade in general, not with a specific trading partner. Besides, it may be a good measure of the extent to which a country is exposed to global shocks. We thus expect that higher trade, in aggregate, leads to more correlated business cycles. As in Baxter and Kouparitsas (2005), we calculate the extent of total trade in a country pair (i, j) as the sum of countries i and j's total exports and imports, divided by the sum of the GDPs. We expect a positive sign associated with this variable.

Trade agreements The existence of trade agreements is meant to increase the extent of trade among countries, as empirically shown by Frankel and Rose (1998) (among others). It is likely to enhance GDP cross-correlation as well. We build a dummy variable to capture membership of the European Monetary Union, and we expect a positive sign. One cannot exclude that the dummy capturing membership to EMU also captures the effects of similarity in monetary policy, beyond the pure role of trade and currency agreements. In any case, we expect a positive sign associated with this dummy.[2]

Similarity in economic structure If the primary source of GDP fluctuations is sector-specific—as supported by Stockman's (1988) findings—then countries with greater similarity in economic structure should be more correlated, everything else equal. Economic similarity is captured by similarity in trade baskets (precisely, similarity in the basket of imported goods) or in service share. Related literature typically obtains that more economic similarity enhances GDP comovement. Accordingly, we expect a positive (resp. negative) sign associated with our measure of trade similarity (difference in the service share).

Macroeconomic policy Darvas et al. (2005) and Otto et al. (2001), respectively, underline the role of fiscal and monetary convergence in accounting for BC comovement. We follow these contributions by evaluating the role of both dimensions. Our measure of fiscal divergence is the cross-country absolute difference in the primary budget position, measured as a percentage of national GDP. Besides, disparity in monetary policy is measured as the average absolute value of the short-run interest rate differential. As underlined by Darvas et al. (2005), the expected sign for measures of fiscal or monetary policy is ambiguous. In the presence of country-specific shocks, accommodating policies could actually result in having simultaneously cross-country divergence in economic policies and more synchronized cycles. In that case, the coefficient of our measure of economic policy similarity is expected to be positively signed. In contrast, economic policy may constitute per se a source of asymmetrical shock across countries. In that case, divergence in economic policy reduces BC synchronization. Darvas et al.'s (2005) empirical results support this last case, as they obtain a negative coefficient associated

with fiscal divergence. Otto et al. (2001) also obtain a significant negative effect of divergence in monetary policy on BC synchronization among OECD countries. We thus expect a negative sign of the coefficients associated with both variables.

3. GDP Comovement: A Baseline Regression

Table 1 reports the estimation results of the baseline specification without LMIs ($\gamma = 0$ in equation (1) or $\beta = 0$ in equation (2)). To identify the main determinants of GDP comovement, we proceed as follows. All potential explanatory variables are included simultaneously in the regression, so as to evaluate the most significant ones (columns A and B, without country and time fixed effects). We then investigate the robustness of the estimates to various econometric specifications: the inclusion of time and country fixed effects (columns C and D), with instrumental variables on bilateral trade, fiscal and monetary divergence (columns E, F, and G), with the BP filter (column H) and the inclusion of country-pair fixed effects (rather than country fixed effects, column I).[3] In the process of eliminating insignificant variables from the estimated equation, we check that these are found insignificant both individually and jointly (as indicated by the Wald test and its associated p-value in Table 1).[4]

Most empirical studies conclude that bilateral trade intensity is the foremost candidate explanation to BC comovement (Frankel and Rose, 1998; Baxter and Kouparitsas, 2005; Artis et al., 2008, among others). Our results confirm this finding. Bilateral trade is estimated significant in most specifications. In addition, it is bilateral trade that matters, rather than total trade intensity. Our results suggest that, in OECD countries, the impact of trade on GDP comovement depends on the trading partner. In line with Darvas et al. (2005), divergence in governments' budget positions results in lower GDP comovement. In addition, the dummy variable capturing membership to EMU appears robustly significant with the expected sign: when both countries are EMU members, we observe a higher GDP comovement. In addition, convergence in monetary policy significantly enhances GDP comovement, as in Otto et al. (2001). Since the dummy "Both EMU" also captures European convergence, we can conclude that monetary integration appears significant beyond the monetary and international integration inherent in the EMU process.

Results in Table 1 also show that similarity in economic structure (through import similarity) has a significant impact on GDP comovement. Difference in service share is never estimated significant. The empirical literature does not reach any clear-cut consensus with regards to the role of similarity in economic structure. Imbs (2001) highlights the role of industrial similarity as a major factor in BC synchronization, whereas Otto et al. (2001) and Baxter and Kouparitsas (2005) obtain that it is not robust to the inclusion of other control variables. Our results are in line with these findings. The role of similarity in service share is not found to significantly matter. However, similarity in traded goods (precisely, in imports) significantly enhances GDP comovement. The effect is robust to the inclusion of other variables. This result may somehow be viewed as reconciling Baxter and Kouparitsas (2005) and Imbs (2001) on the respective roles of trade intensity and economic similarity. Results reported in column D of Table 1 suggest that bilateral trade, import similarity, fiscal and monetary convergence as well as EMU membership have a robust impact on GDP comovement, after controlling for time effects and country fixed effects. In columns E to H, we evaluate their robustness to an alternative model's specification.

Table 1. Baseline Regression

	Dependent variable: Cross-country GDP correlation								
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
	Baseline								
Method	OLS	OLS	OLS	OLS	IV	IV	IV	IV	OLS
Filter	HP	HP	HP	HP	HP	HP	HP	BP	HP
Bilat. trade	0.0487***	0.0515***	0.0361**	0.0342**	0.0993***	0.0419***	0.0357***	0.102***	0.0138
	(0.015)	(0.013)	(0.014)	(0.016)	(0.023)	(0.014)	(0.013)	(0.025)	(0.078)
Trade similarity	0.317***	0.312***	0.361***	0.351***	0.318***	0.336***	0.415***	0.300***	0.202
	(0.086)	(0.087)	(0.11)	(0.095)	(0.11)	(0.11)	(0.11)	(0.11)	(0.13)
D budget	–0.0360***	–0.0353***	–0.0375***	–0.0375***	–0.0391***	–0.103***	–0.0359***	–0.0458***	–0.0508***
	(0.0065)	(0.0064)	(0.0070)	(0.0074)	(0.0068)	(0.027)	(0.0084)	(0.0073)	(0.0073)
Int. rate diff.	–0.0135*	–0.0153**	–0.0216**	–0.0214**	–0.0171**	–0.0138	–0.0435***	–0.0195**	–0.0277**
	(0.0073)	(0.0069)	(0.0085)	(0.0085)	(0.0085)	(0.0088)	(0.013)	(0.0093)	(0.011)
Both EMU	0.280***	0.276***	0.241***	0.243***	0.216***	0.190***	0.194***	0.189***	0.121**
	(0.029)	(0.026)	(0.041)	(0.055)	(0.041)	(0.052)	(0.045)	(0.045)	(0.047)
MAXK	–0.0520***	–0.0502***	0.0154						
	(0.016)	(0.015)	(0.026)						
Total trade	–0.0310								
	(0.067)								
D serv. share	–0.00371								
	(0.0023)								
Observations	540	550	550	550	550	550	426	550	550
R^2	0.24	0.24	0.40	0.40	0.38	0.30	0.48	0.36	0.58
Country FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Decade FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	No	No	No	No	No	No	No	No	Yes
Instruments	No	No	No	No	Bilat. trade	D budget	Int. rate diff.	Bilat. trade	No
Wald test	1.39		0.35						
p-Value	0.252		0.555						
F-stat. (1SLS)					172	18	104	172	
DWH test					0.000	0.002	0.187	0.0001	
OI test					0.8895	0.161	0.653	0.859	

Notes: Standard errors in parentheses with ***, **, and * respectively denoting significance at the 1%, 5%, and 10% levels. Robust standard errors calculated assuming clustering by country pair. Instruments for trade: distance between capitals, common language, common border. Instruments for diff. in primary budget positions: Government nonwage consumption/GDP differential of the two countries, government investment/GDP differential of the two countries and direct business tax/GDP differential of the two countries (all as average of the absolute value of the cross-country differential). Instruments for interest rates differential: interest rate spread at the beginning of each decade and a financial integration measure. In models A and C: Wald joint hypothesis tests on all the variables found insignificant individually. IV tests: the instrument quality measure is the *F*—from the first-stage regression (1SLS). DWH refers to the marginal significance level from a Durbin–Wu–Hausman test for consistency of the OLS estimate. OI refers to the marginal significance level for the test of the Sargan overidentification restrictions test.

In columns E, F, and G, we run regressions using instrumental variables (IV) on bilateral trade, differences in budget positions, and interest rates, respectively. The fact that all variables are built as averages over the decade may raise a potential endogeneity bias. As standard in the literature (Rose, 2000; Otto et al., 2001), we instrument trade using gravity variables (distance, common language, and common border). We instrument differences in primary budget positions using variables closely similar to those retained by Darvas et al. (2005).[5] Finally, we instrument the interest rate differential using two variables: the interest rate spread at the beginning of the decade and a measure of financial integration. Tests show that there are no endogeneity problems associated with this measure of monetary convergence. In columns E, F, and G, bilateral trade, import similarity, monetary and fiscal similarity as well as EMU membership remain significant. It is also the case when GDP comovement is measured with GDP series filtered with the bandpass method (column H).

Finally, when country pair fixed effects are included (column I), the impact of trade and trade similarity on GDP comovement becomes insignificant. This result may be accounted for, recalling that country-pair fixed effects capture elements that do not vary over time and are specific to each country pair. Such elements are typically gravity variables, which are commonly found to drive bilateral trade. Given the leading role of bilateral trade on GDP comovement found in the literature, we will consider a benchmark regression with bilateral trade as a significant variable. This specification makes our results comparable with the related literature. Our baseline regression therefore includes country fixed effects, as well as decade fixed effects. Besides, as indicated by the associated tests, we adopt a baseline regression with IV on bilateral trade (column E), so as to correct for mis-specification associated with OLS due to endogeneity of trade, as in Otto et al. (2001), Darvas et al. (2005), or Artis et al. (2008).[6] In our baseline regression, extensive bilateral trade, trade similarity, monetary and fiscal convergence as well as membership to EMU enhance GDP comovement. Do LMIs affect international synchronization beyond these standard determinants? In what way? Section 4 aims at providing answers to these questions.

4. GDP Comovement and Labor Market Institutions

Economic Mechanisms behind LMIs' Impact on GDP Synchronization

The link between LMIs and GDP comovement can be rationalized within the theoretical framework of a model with wage bargaining. In Belot and Van Ours's (2004) right-to-manage framework (where wages are bargained between firms and workers, while employment is set by firms alone) the negotiated wage depends on the LMIs in place, i.e. employment protection laws, unemployment benefits, labor taxes, trade unions' bargaining power, and the degree of centralization of the wage bargaining process. Through their impact on wages, labor market regulations affect the responses of employment and output to exogenous shocks. Blanchard and Giavazzi (2003) show that institutions that strengthen the workers' bargaining power imply more rigid labor markets, as wage adjustments become more difficult to implement. In addition, as noted by Sachs and Schleer (2009), stringent employment protection, by limiting job turnover, lowers the firms' flexibility to respond to changes in aggregate demand. These elements suggest that, in countries with flexible LMIs, output responds more and faster to exogenous shocks, while countries with more rigid LMIs are

characterized by dampened employment turnover and/or limited changes in the firms' labor demand. This leads to the prediction that, following a common shock, divergence in LMIs, by implying diverging output responses, reduces the extent of BC synchronization. In contrast, and based on similar mechanisms, asymmetric shocks may also lead to less synchronized cycles in a country pair with similar LMIs. The impact of LMI divergence on BC synchronization is thus not clearly determined in a theoretical model. This is illustrated by the findings of Fonseca et al. (forthcoming) in a two-country DSGE model. They indeed show that differences in employment protection, in unemployment benefits, or in tax wedges may have a significant dampening effect on the cross-country GDP correlation. Yet, the effects are not trivial as they are notably affected by the degree of real wage rigidity. With a large degree of real wage rigidity, the impacts of heterogeneity in unemployment benefits and in tax wedges do not affect GDP comovement.

We have so far focused on cross-country heterogeneity in LMIs. However, the level of labor market (in)flexibility may also matter. Artis et al. (2008) indeed suggest that more stringent employment protection regulations lead to less correlated business cycles. Indeed, highly regulated labor markets foster specialization and therefore gives rise to idiosyncratic cycles. With high firing costs, workers, who face a higher probability of remaining in the firm, tend to develop more firm-specific skills. High employment protection therefore reduces the probability that firm- or industry-specific skills become redundant. In contrast, in economies with low employment protection, workers have an incentive to acquire general skills that can be easily transferred between firms and sectors. Thus, employment protection may foster specialization, which in turn results in less synchronized cycles. Thus, if at least one of the two countries under consideration is characterized by an inflexible labor market, one would expect to find a negative impact on the bilateral correlation. This paper extends Artis et al.'s (2008) empirical investigation to the other dimensions of labor market flexibility. As suggested by Blanchard and Giavazzi (2003), countries with inflexible bargaining processes and strong trade unions face sluggish wage responses to macroeconomic shocks, which could also imply that a national specific random component (e.g. strike) is playing a more important role. In that case, business cycles are expected to be less similar across countries. In addition, rigid economies may become more specialized on capital-intensive industries because they substitute inflexible labor input by flexible capital factor, as in the theoretical framework of Fonseca et al. (forthcoming). This implies that rigid economies are more different. Through both channels, more rigid LMIs cause business cycles to be less synchronized.[7]

Things are not necessarily so cut-off though, as rigid labor market regulations may also enhance GDP comovement. In Patureau's (2009) two-country model, more generous unemployment benefits substantially raise international comovement. As it raises the workers' outside option in the bargaining process, a higher unemployment benefits ratio makes the households more reluctant to change wages and hours. Adjustment to exogenous shocks occurs in both countries more through the number of employees (extensive margin) rather than the number of worked hours (intensive margin). However, filling a job vacancy requires time and search costs. The limited response of wage and hours induce more persistent responses of total employment and output in both countries. In quantitative terms then, the more generous the unemployment benefits, the larger the extent of international BC comovement. For similar reasons, heavier employment taxes (tw_1) also favor adjustment through the extensive margin, thereby leading to more synchronized cycles. Theoretical models do not yield a clear-cut prediction on the expected impact of labor market regulations on GDP

comovement, neither in their cross-country heterogeneity dimension nor their level. The next subsections provide answers as to the empirically relevant economic mechanisms.

GDP Comovement and Labor Market Heterogeneity

Table 2 reports the estimated impact of heterogeneity of LMIs on cross-country synchronization when each LMI is included in the benchmark regression (columns A–G), all LMIs (column H), only significant LMIs (column I, based on the Wald test). First, column I reports evidence of more synchronized cycles within country pairs with similar EPLs and employees' direct labor taxes (tw_2). This is consistent with the idea that, following a common shock, the convergence in LMIs leads to similar propagation mechanisms in both countries. This empirical result is in line with the predictions obtained by Fonseca et al. (forthcoming) in a two-country DSGE model, according to which similarity in employment protection enhances GDP comovement in the advent of symmetric and asymmetric shocks. Second, in contrast to Bower and Guillemeau (2006) and Sachs and Schleer (2009), our results indicate a significant effect of heterogeneity in union density and indirect taxes (tw_3). Divergence in the generosity of the unemployment benefits system is also found to matter, as in Sachs and Schleer (2009). The estimated coefficients are positive. Heterogeneity in union density, unemployment benefits, and indirect taxes are associated with more synchronized cycles. This result can be rationalized if we think of the propagation mechanisms of asymmetric shocks. Consider the effects at work in the simple two-country Walrasian BC model (Backus et al., 1995). In the wake of a positive technological shock in the Home country, Home output responds a lot to the positive shock while there is little response in the Foreign country, leading to a low cross-country GDP correlation. With rigid labor markets in the Home country (high union density, generous unemployment benefits or heavy indirect taxation), macroeconomic responses to idiosyncratic shocks are dampened. This, in turn, enhances cross-country GDP correlation if the Foreign country is also able to respond to the Home shock, which is possible with more flexible LMIs (low union density, unemployment benefits or indirect taxes). As a result, with asymmetric shocks, divergence in LMIs leads to more synchronized cycles. Our empirical results are consistent with this analysis.

GDP Comovement and the Level of LMIs

Cross-country correlations might also be affected by the level of LMIs. Table 3 reports the estimations on the baseline regression supplemented with LMIs in levels, one by one (columns A–G), all together (H), and with only significant LMIs (column I). From Table 3, one can first note that the overall level of employment protection in a country pair does not appear significant, in contrast to Artis et al. (2008). This may be attributable to differences in the econometric specification. The cross-section specification chosen by Artis et al. (2008) constitutes a framework in which EPL is more likely to appear significant than in our data-panel framework. In that case, indeed, the EPL variable has to match the cross-section and time structure of GDP comovement in order to be significant. Our results nevertheless stand in accordance with Artis et al. (2008), as the level of labor market regulations is found to matter through employment taxes.

Column I indicates that countries with high employment tax tw_1 display more synchronized cycles. This effect could be linked to the fact that European countries

Table 2. GDP Comovement and LMI Heterogeneity

	Dependent variable: Cross-country GDP correlation								
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
Bilat. trade	0.0863***	0.108***	0.0988***	0.0998***	0.0885***	0.0971***	0.0982***	0.0807***	0.0858***
	(0.022)	(0.026)	(0.024)	(0.024)	(0.023)	(0.023)	(0.022)	(0.025)	(0.024)
Trade similarity	0.285***	0.328***	0.316***	0.311***	0.365***	0.274**	0.359***	0.338***	0.287**
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.12)	(0.11)
Int. rate diff.	–0.0174**	–0.0188**	–0.0171**	–0.0177**	–0.0150*	–0.0144*	–0.0178**	–0.0178**	–0.0169**
	(0.0082)	(0.0085)	(0.0085)	(0.0084)	(0.0085)	(0.0087)	(0.0082)	(0.0081)	(0.0081)
D budget	–0.0388***	–0.0401***	–0.0391***	–0.0369***	–0.0433***	–0.0407***	–0.0385***	–0.0441***	–0.0385***
	(0.0067)	(0.0068)	(0.0068)	(0.0067)	(0.0064)	(0.0065)	(0.0068)	(0.0065)	(0.0066)
Both EMU	0.209***	0.216***	0.216***	0.240***	0.196***	0.217***	0.245***	0.194***	0.257***
	(0.041)	(0.040)	(0.041)	(0.042)	(0.043)	(0.045)	(0.040)	(0.048)	(0.047)
D *EPL*	–0.0607**							–0.0451*	–0.0535**
	(0.026)							(0.028)	(0.025)
D *Udnet*		0.00262***						0.00181**	0.00181**
		(0.00088)						(0.00091)	(0.00088)
D *CO*			–0.00414					–0.00820	
			(0.029)					(0.032)	
D *UB*				0.00520***				0.00510***	0.00577***
				(0.0018)				(0.0018)	(0.0017)
D tw_1					–0.00313*			–0.00141	
					(0.0019)			(0.0021)	
D tw_2						–0.00359		–0.00872**	–0.00829**
						(0.0038)		(0.0038)	(0.0037)
D tw_3							0.01000***	0.00558*	0.00842***
							(0.0031)	(0.0034)	(0.0033)
Observations	550	550	550	550	515	514	550	481	514
R^2	0.39	0.38	0.38	0.39	0.40	0.36	0.39	0.40	0.40
Wald test								0.5	
p-Value								0.779	
F-stat. (1SLS)								127	147
DWH test								0.002	0.000
OI test								0.618	0.622

Notes: Robust standard errors in parentheses with ***, **, and * respectively denoting significance at the 1%, 5%, and 10% levels. Robust standard errors calculated assuming clustering by country pair. Decade and country FE included. IV on trade in all regressions. Instruments for trade: distance between capitals, common language, common border. IV tests: the instrument quality measure is the *F*—from the first-stage regression (1SLS). DWH refers to the marginal significance level from a Durbin–Wu–Hausman test for consistency of the OLS estimate. OI refers to the marginal significance level for the test of the Sargan overidentification restrictions test.

Table 3. GDP Comovement and the Level of LMI

	Dependent variable: Cross-country GDP correlation									
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
Bilat. trade	0.0986***	0.0991***	0.0988***	0.0991***	0.100***	0.102***	0.100***	0.101***	0.100***	0.100***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Trade similarity	0.322***	0.316***	0.295***	0.312***	0.362***	0.280**	0.334***	0.341***	0.341***	0.362***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.12)	(0.11)	(0.11)
Int. rate diff.	–0.0173**	–0.0177**	–0.0159*	–0.0167**	–0.0143*	–0.0151*	–0.0164*	–0.0143*	–0.0130	–0.0143*
	(0.0085)	(0.0085)	(0.0084)	(0.0085)	(0.0084)	(0.0087)	(0.0085)	(0.0086)	(0.0084)	(0.0084)
D budget	–0.0389***	–0.0374***	–0.0390***	–0.0378***	–0.0422***	–0.0414***	–0.0404***	–0.0414***	–0.0401***	–0.0422***
	(0.0069)	(0.0068)	(0.0067)	(0.0069)	(0.0065)	(0.0067)	(0.0067)	(0.0070)	(0.0066)	(0.0065)
Both EMU	0.219***	0.228***	0.250***	0.215***	0.188***	0.218***	0.224***	0.198***	0.206***	0.188***
	(0.042)	(0.040)	(0.043)	(0.040)	(0.045)	(0.046)	(0.041)	(0.052)	(0.046)	(0.045)
EPL	–0.0191							–0.0615		
	(0.049)							(0.055)		
Udnet		0.00375***						0.00248		
		(0.0014)						(0.0019)		
CO			–0.0592**					–0.0624*	–0.0458	
			(0.027)					(0.033)	(0.030)	
UB				0.00142				0.00281*	0.00239	
				(0.0015)				(0.0017)	(0.0015)	
tw_1					0.00665*			0.00890**	0.00699*	0.00665*
					(0.0036)			(0.0037)	(0.0036)	(0.0036)
tw_2						–0.00354		–0.000598		
						(0.0062)		(0.0083)		
tw_3							–0.00529	–0.00682		
							(0.0042)	(0.0057)		
Observations	550	550	550	550	515	514	550	481	515	515
R^2	0.38	0.39	0.38	0.38	0.40	0.36	0.38	0.37	0.40	0.40
Wald test								4.79	4.20	
p-Value								0.309	0.123	
F-stat.								152		159
DWH test								0.000		0.000
OI test								0.584		0.797

Notes: Observations clustered by country pair. Robust standard errors in parentheses with ***, **, and * respectively denoting significance at the 1%, 5%, and 10% levels. IV on trade, in all regressions. Instruments for trade: distance between capitals, common language, common border. IV tests: the instrument quality measure is the *F*—from the first-stage regression (1SLS). DWH refers to the marginal significance level from a Durbin–Wu–Hausman test for consistency of the OLS estimate. OI refers to the marginal significance level for the test of the Sargan overidentification restrictions test.

characterized by heavy employment taxes also display correlated cycles. However, the effect of employment taxes appears beyond the EMU membership, indicating that the effect of labor market taxes on GDP comovement appears beyond the European specificity.[8] The positive effects of high employment taxes on GDP comovement can be rationalized using theoretical insights of Patureau's (2009) two-country model. These empirical results suggest that, following an asymmetric shock, labor market inflexibility induced by heavier employment taxation, could lead to more synchronized cycles.

Robustness Analysis

Table 4 reports the estimation results when we explore the robustness of our findings to (i) instrumental variables on fiscal convergence (columns C–D), (ii) the inclusion of country-pair fixed effects (columns E–F), and (iii) the filtering method (columns G–H). For each robustness analysis, we conduct estimations with LMIs in cross-country difference and in level. For sake of comparison, we report the results of the corresponding benchmark regressions (columns A and B, identical to column I in Tables 2 and 3). Our results remain unchanged when using the bandpass filter to capture GDP cyclical component (columns G–H). When instrumenting on primary budget (column D), the level of employment taxes become insignificant. It may be due to the fact that these variables are directly linked to the primary deficit. Except in that case, though, results reported in Table 4 confirm the significant effects of employment taxes on GDP comovement. With regard to labor market heterogeneity, Table 4 confirms that divergence in employment protection laws and direct taxes (disparity in union net density, unemployment benefits, and indirect taxation) lead to less (more) synchronized cycles. These results remain robust, even with country-pair fixed effects (column E).

5. Conclusion

The paper investigates the determinants of cross-country GDP correlations in a panel data of 20 OECD countries over 40 years of quarterly data. Our results are consistent with the literature's findings. We confirm the role of bilateral trade, similarity in fiscal policy, and membership to EMU as significant determinants of BC comovement. We also present new empirical evidence on the effects of LMIs on GDP comovement. We show that the various dimensions of labor market regulations significantly affect the magnitude of BC synchronization. In contrast to the approach retained in Bower and Guillemeau (2006) and Artis et al. (2008), this suggests that one cannot sum up the whole effects of labor market regulations through a single dimension. Furthermore, the effects are far from trivial, as labor market regulations are shown to affect the extent of BC synchronization, both through their cross-country heterogeneity and their overall level. Disparity in employment protection laws and direct taxation yield lower cross-country GDP correlation. In contrast, divergence in unemployment benefit generosity, union density, and indirect taxes enhances BC synchronization. Finally, the level of LMIs matters as well. Labor market inflexibility induced by high employment taxes lead to more correlated business cycles. The sensitivity analysis confirms that these results are robust. This finding of the link between LMI heterogeneity, inflexible labor markets, and BC synchronization may be of particular interest for policymakers in the eurozone's perspective. Our overall results thus give support to the view that harmonization in labor market regulations (namely, in employment protection laws) can ease the conduct of monetary policy within the euro area.

Table 4. Robustness Analysis

	Dependent variable: Cross-country GDP correlation							
	Benchmark regression		*IV on D budget*		*Country-pair FE*		*BP filter*	
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
Bilat. trade	0.0858***	0.100***	0.0384***	0.0410***	–0.0115	–0.0142	0.0960***	0.102***
	(0.024)	(0.023)	(0.014)	(0.014)	(0.071)	(0.081)	(0.026)	(0.024)
Trade similarity	0.287**	0.362***	0.283**	0.395***	0.248*	0.265**	0.264**	0.378***
	(0.11)	(0.11)	(0.11)	(0.12)	(0.13)	(0.13)	(0.12)	(0.117)
Int. rate diff.	–0.0169**	–0.0143*	–0.0135*	–0.0122	–0.0265**	–0.0220*	–0.0185**	–0.0170*
	(0.0081)	(0.0084)	(0.0082)	(0.0087)	(0.011)	(0.012)	(0.0090)	(0.009)
D budget	–0.0385***	–0.0422***	–0.0845***	–0.112***	–0.0473***	–0.0552***	–0.0459***	–0.050***
	(0.0066)	(0.0065)	(0.027)	(0.030)	(0.0078)	(0.0074)	(0.0071)	(0.007)
Both EMU	0.257***	0.188***	0.232***	0.148**	0.183***	0.0952*	0.220***	0.149***
	(0.047)	(0.045)	(0.057)	(0.061)	(0.057)	(0.051)	(0.051)	(0.049)
D *EPL*	–0.0535**		–0.0708***		–0.0806*		–0.0502*	
	(0.025)		(0.027)		(0.046)		(0.028)	
D *Udnet*	0.00181**		0.00170*		0.000352		0.00196**	
	(0.00088)		(0.00090)		(0.0017)		(0.00092)	
D *UB*	0.00577***		0.00448**		0.00485**		0.00591***	
	(0.0017)		(0.0019)		(0.0023)		(0.0018)	
D tw_2	–0.00829**		–0.00944**		–0.0142*		–0.00750*	
	(0.0037)		(0.0040)		(0.0077)		(0.0039)	
D tw_3	0.00842***		0.00720**		0.0127**		0.0097***	
	(0.0033)		(0.0035)		(0.0054)		(0.0034)	
tw_1		0.00665*		0.00397		0.00877**		0.0072*
		(0.0036)		(0.0043)		(0.0035)		(0.0041)
Observations	514	515	514	515	514	515	514	515
R^2	0.40	0.40	0.36	0.31	0.56	0.60	0.37	0.39

Notes: Standard errors in parentheses with ***, **, and * respectively denoting significance at the 1%, 5%, and 10% levels. Robust standard errors calculated assuming clustering by country pair. Decade fixed effects included. Instruments for trade: distance between capitals, common language, common border. Instruments for diff. in primary budget positions: government nonwage consumption/GDP differential of the two countries, government investment/GDP differential of the two countries and direct business tax/GDP differential of the two countries (all as average of the absolute value of the cross-country differential).

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Notes

1. In preliminary experiments, we include LMI_{ijt} and $DLMI_{ijt}$ simultaneously in the baseline regression. Even through the estimated coefficients were not significantly altered, we do not consider these results are reliable. We indeed get multicollinearity problems as indicated by the

standard multicollinearity tests (large value for the condition number) when including both LMIs in level and in difference in the baseline regression. This drives us to run separate regressions on LMI_{ijt} and $DLMI_{ijt}$.

2. In preliminary experiments, we also investigate the role of a dummy capturing membership to the European Community (rather than the EMU). We obtain quite similar results, as this dummy is also found to be one of the main determinants of GDP comovement. However, we retain the dummy capturing membership to EMU as it turns out to be more significant and robust in our various sensitivity checks. Results with the dummy "Both EC" are available upon request.

3. In that case, country fixed effects μ_i and μ_j are replaced by country-pair fixed effects μ_{ij} in equation (1) or (2), with μ_{ij} invariant across time and specific for each country pair $\{i, j\}$.

4. We have tried several combinations of control variables. We present here the estimation results with the highest R^2. All regressions present significant estimates on bilateral trade, import similarity, divergence in monetary and fiscal policy, and EMU dummy. In addition, all regressions in Tables 1 to 4 pass multicollinearity tests.

5. IV tests are reported at the bottom of Table 1. F-statistics and overidentification (OI) tests confirm the validity of our instruments, as they are found to be correlated with the instrumented variable and uncorrelated with the error term of the structural equation. Further, Durbin–Wu–Hausman (DWH) tests indicate that we can reject the hypothesis that the IV and the OLS estimates are similar, providing support for using IV methods. In contrast, based on these tests, the measure of monetary policy convergence does not suffer from endogeneity issues.

6. Standard IV tests also suggest some endogeneity associated with difference in primary budget positions. We rather retain IV on trade as our baseline specification since we have more confidence in the variables used to instrument trade, as geographical variables are undoubtedly exogenous to GDP comovement, in contrast to those retained to instrument fiscal convergence (even though we check that they are valid instruments). IV tests in Table 1 confirm the improved quality of estimation when instrumenting on bilateral trade. Furthermore, the explanatory power of the regression is much reduced when instrumenting differences in budget positions.

7. We thank an anonymous referee for stressing this point.

8. Indeed, the effect of the level of employment taxes remains significant and positive if we run the regression on non-EMU members only.