The Extensive Margin of Trade and Business Cycle synchronization

J.-S. PENTECOTE, J.-C. POUTINEAU, F. RONDEAU*
CREM CNRS 6211 - University of Rennes 1

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Abstract

This paper underlines the negative influence of the extensive margin of international trade on business cycle convergence. In a two country DSGE model with flexible prices we show that an increase in the extensive margin of trade reduces the coupling of business cycles with regard to a trade increase affecting only the intensive margin. This phenomenon comes from a dampening in the terms of trade adjustment. Empirically we find that, for a group of eleven european countries between 1995 and 2007, an increase of 1% in the extensive margin of bilateral trade has reduced business cycle synchronisation by something between 0.328% and 0.247%, depending on wether we take into account the negative impact of the extensive margin on specialisation.

Keywords: Trade, Business cycles, Integration, Specialization.
JEL: F4; F44; F15

1 Introduction

The effect of international trade as a key determinant of business cycle synchronization between countries is still under debate. Summing up the existing empirical literature one cannot find a clear evidence regarding the positive impact of an increase in bilateral trade flows on business cycle correlation between trading partners. One strand of the litterature (examplified by Canova and Dellas,1993, Frankel and Rose,1998, Baxter and Kouparitsas, 2003, Kose and

*Corresponding author, fabien.rondeau@univ-rennes1.fr, 7 place Hoche 35000 Rennes, France. The authors are grateful to Nathalie Colombier for helpful assistance.
Yi, 2006, Abbott and Xing, 2007,) find that trade appears as the main factor of business cycles synchronization. In contrast, some other studies (such as Inklaar and al., 2008, Abbott and al., 2008, Jong-A-Pin and de Haan, 2008, Imbs, 2004 and 2010, ) challenge this view. As an example, even if Jong-A-Pin and de Haan (2008) confirm that trade intensity affects business cycle synchronization, they find that the effect is much smaller than asserted by previous articles and that other factors (such as specialization and the convergence in monetary and fiscal policies) have a similar impact on business cycle synchronization. Accordingly, Imbs(2004) find that trade intensity does not affect business cycle convergence but that specialization patterns have a sizeable impact on business cycles. and that economic regions with strong financial links are significantly more synchronized.

To understand why an increase in bilateral trade flows may have such a contrasted influence on business cycle synchronisation our paper distinguishes the rise in bilateral trade that comes from an increase in the quantity of goods that are already traded (ie, the intensive margin of trade) from the increase that comes from the number of varieties that are traded (ie, the extensive margin of trade). Adopting both a theoretical and an empirical approach, we show that an increase in the extensive margin of trade tends to reduce the coupling of business cycles with regard to a trade increase affecting only existing traded goods.

In a two country DSGE model with flexible prices and firm heterogeneity, we underline the key role of the terms of trade as a key factor to explain the greater disynchronization of business cycles following an increase of the extensive margin of trade. Indeed, when the number of traded varieties is fixed, a positive productivity shock in the domestic economy increases income in this country but worsens its terms of trade. This worsening of the terms of trade operates as a transfer mechanism between the two countries and dampens the divergence of income growth. In contrast, assuming that the number of traded varieties fluctuates, the correcting effect of a terms of trade adjustment disappears. Indeed, following the increase in domestic consumption, foreign firms find profitable to enter the tradable segment thus offering more foreign goods to export towards the domestic country. This, in turn, leads to a significantly dampening in the deterioration of the domestic terms of trade that implies a greater divergence of income growth rates between countries. This vanishing role of the terms of trade deterioration as a correction mechanism to provide international adjustment when trade moves at the extensive margin confirms the ones already obtained by other studies (Corsetti, Martin, and Pesenti (2007) or Galstyan and Lane (2008)).

We test empirically this negative impact of the extensive margin of trade on business cycle synchronisation on a group of eleven european countries (Belgium-Luxembourg, France, Ger-
many, Ireland, Italy, Portugal, Spain, the Netherlands, Finland and Austria) between 1995 and 2007. This group of countries has been chosen as, according to Abbott and al (2008), the relationship between trade intensity and the business cycle correlation exists mainly for the European countries. To get a quantified estimation of the impact of the extensive margin of trade on business cycle synchronisation, we follow the approach initially developed by Imbs (2004). Estimating a three equation system that combines business cycle synchronisation, the extensive margin of trade and the specialisation of countries, and controlling for financial and fiscal variables, we find that the extensive margin affects negatively and significantly business cycle synchronisation. This result is also robust to the estimation method (ordinary least squares or three stages least squares). For the data set we find that an increase of 1% in the extensive margin of bilateral trade reduces business cycle synchronisation by something between 0.328% and -0.247% depending on whether we take into account the negative impact of the extensive margin on specialisation.

The rest of the paper is organised as follows: section 2 introduces a two country general intertemporal equilibrium model with firm heterogeneity. Section 3 contrast the consequences of a 1% percent asymmetric productivity shock on output convergence depending on whether bilateral trade increase affects the number of varieties that are traded between countries. Section 4 reports the econometric results. Section 5 concludes.

2 A model of international trade and business cycle fluctuations with heterogenous firms

The model describes a two country world with flexible prices. It is populated by a great number of households and a great number of firms. The number of each type of agents is normalised to 1. Each individual firm is specialised in the production of a given variety of goods that is imperfectly substitutable in the consumer bundle. The number of firms fluctuates between the traded and the non traded sectors, depending on their productivity level. The capital of national firms is entirely owned by the residents of the country.

2.1 The representative household

The representative consumer \( i \) of the domestic country maximes,

\[
\text{Max}_{c_t(i), l_t(i), h_t+1(i)} \quad E_t \sum_{j=0}^{\infty} \beta^j \left[ \ln c_{t+j}(i) - \frac{\Xi ((l_{t+j}(i))^{1+\kappa})}{1 + \kappa} \right],
\]
subject to
\[ E_t \beta^j \{ wt_{t+j}^{t+j} + b_{t+j}(i) - c_{t+j}(i) - (1 + r_{t+j})^{-1} b_{t+1+j}(i) \} = 0, \]
\[ j = 0, 1, 2, ..., (\lambda_{t+j}). \]

We combine the first order conditions that solve this problem to get an Euler bond equation and a labour supply curve,
\[ c_t^{-1}(i) = \beta(1 + r_t)E_t c_{t+1}^{-1}(i), \]
\[ \Xi (l_t(i))^\kappa = c_t^{-1}(i) w_t. \]

At a given period \( t \) the consumer allocates total consumption \( c_t(i) \) between (tradable and non tradable) home goods and (imported) foreign goods. The consumption and consumption price indexes are defined according to the CES aggregators,
\[ c_t(i) = \left( \int_0^{n_{D,t}} c_{D,t}(\omega, i) \frac{\theta-1}{\pi} d\omega + \int_0^{n_{X,t}} c_{X,t}(\omega, i) \frac{\theta-1}{\pi} dj + \int_0^{n_{*X,t}} c_{M,t}(\omega, i) \frac{\theta-1}{\pi} d\omega \right)^{1/\theta}, \]
\[ P_{c,t} = \left( \int_0^{n_{D,t}} p_{D,t}(\omega)^{1-\theta} d\omega + \int_0^{n_{X,t}} p_{X,t}(\omega)^{1-\theta} d\omega + \int_0^{n_{*X,t}} p_{M,t}(\omega)^{1-\theta} d\omega \right)^{1/1-\theta}, \]
where, \( \theta \) is the elasticity of substitution across goods, \( c_{D,t}(\omega, i), c_{X,t}(\omega, i), c_{M,t}(\omega, i) \) represent the individual demand of national non traded goods, traded domestic goods and foreign imports, where \( p_{D,t}(\omega), p_{X,t}(\omega), p_{M,t}(\omega) \) are the associate nominal prices. Variables \( n_{D,t} \) and \( n_{X,t} \) are respectively the number of domestic tradable and non tradable goods, and \( n_{*X,t} \) is the number of imported goods from the foreign economy. Defining the real price of good \( \omega \) of sector \( j = \{ D, X, M \} \) as \( \rho_{j,t}(\omega) = \frac{p_{j,t}(\omega)}{P_{c,t}} \), we can write the demand of a representative good of each segment of the domestic goods market as,
\[ c_{D,t}(\omega, i) = \rho_{D,t}(\omega)^{-\theta} c_t(i), \]
\[ c_{X,t}(\omega, i) = \rho_{X,t}(\omega)^{-\theta} c_t(i), \]
\[ c_{M,t}(\omega, i) = \rho_{M,t}(\omega)^{-\theta} c_t(i). \]

2.2 The representative firm

The total number of firms operating in the economy is normalised to 1. Each firm \( \omega \) produces a specific good and it is equipped with a specific production function, \( y_t(\omega) \). The production
function of the representative firm that produces the good of type $\omega$ is,

$$y_t(\omega) = z(\omega) A_t \ell_t^d(\omega).$$

Following the literature, we assume that firm heterogeneity comes from a specific shock $z(\omega)$ that corrects the total productivity level of firms in the economy, $A_t$. We assume that productivity $z(\omega)$ is drawn from a Pareto distribution with lower bound $z_{\text{min}}$ and shape parameter $k > (\theta - 1)$. The pdf and cdf of $z$ are $g(z) = k z_{\text{min}}^k / z^{k+1}$ and $G(z) = 1 - (z_{\text{min}} / z)^k$. $A_t$ is homogeneous to all firms and evolves according to,

$$\log A_t = \rho \log A_{t-1} + \xi_{A,t},$$

where $\xi_{A,t}$ is a white noise. Each firm $\omega$ maximizes its profit,

$$\pi_t(\omega) = \rho_t(\omega) y_t^d(\omega) - \frac{w_t}{z(\omega) A_t} y_{D,t}^d(\omega),$$

and fixes the optimal selling price according to,

$$\rho_t(\omega) = \frac{\theta}{\theta - 1} \frac{w_t}{z(\omega) A_t}.$$

The level of profit depends on the segment of the goods market on which the firm operates. If it operates on the non traded segment, it faces a demand curve, $y_{t}^d(\omega) = \rho_{D,t}^{-\theta}(\omega) c_t$, with $c_t = \int_0^1 c_t(i) \, di$, and the profit function writes,

$$\pi_{D,t}(\omega) = \frac{1}{\theta} \rho_{D,t}^{1-\theta}(\omega) c_t.$$

If it serves the traded segment of the goods market, the firm faces the demand for goods, $y_{t}^d(\omega) = \rho_{X,t}^{-\theta}(\omega) c_t + \rho_{M,t}^{*\theta}(\omega) c_t^*$. Given transportation costs, $\rho_{M,t}^{*\theta}(\omega) = (1 + \tau) q_t^{-\theta} \rho_{X,t}(\omega)$, so that, the demand function addressed to firms that produce traded goods is defined by $y_{t}^d(\omega) = \rho_{X,t}^{-\theta}(\omega)[c_t + q_t^\theta(1 + \tau)^{-\theta} c_t^*]$, and the profit function writes,

$$\pi_{X,t}(\omega) = \frac{1}{\theta} \rho_{X,t}^{1-\theta}(\omega)[c_t + q_t^\theta(1 + \tau)^{-\theta} c_t^*] - f_e \frac{w_t}{A_t},$$

where $f_e \frac{w_t}{A_t}$ represents the entry cost of firms on the traded goods market segment.

### 2.3 Sectoral analysis

The distribution of firms between the two sectors depends on a cut-off point $z_X$, that defines the minimal value of the specific productivity needed to be able to export (ie, to incur the entry cost that must be paid to stay on the traded segment). The cut-off point between the
two sectors is determined by the last firm that enters the traded segment. Its level of individual productivity \( z(\omega) = z_X \) is such that it breaks even. Thus, the cut off point is determined by \( \pi_{D,t}(\omega, z_X) = \pi_{X,t}(\omega, z_X) \), ie,

\[
\frac{1}{\theta} \rho_{D,t}^1(\omega) c_t = \frac{1}{\theta} \rho_{X,t}^1(\omega) [c_t + q_t^\theta (1 + \tau)^{-\theta} c_t^*] - f_e \frac{w_t}{A_t},
\]

where \( \rho_{D,t}(\omega, z_X) = \rho_{X,t}(\omega, z_X) \). The cut off point is such that, the marginal gain of exporting (ie, to have access to the foreign demand) is equal to the marginal cost of entering the export segment of the goods market, ie,

\[
\frac{1}{\theta} \rho_{X,t}^1(\omega, z_X) q_t^\theta (1 + \tau)^{-\theta} c_t^* = f_e \frac{w_t}{A_t},
\]

and it is defined according to,

\[
z_X = \frac{f_c}{(\theta - 1)} \left( \frac{\theta (1 + \tau) w_t}{q_t A_t} \right)^{\frac{\theta}{\theta - 1}} c_t^{*1-\theta}.
\]

In period \( t \) there are \( n_{D,t} \) firms that operate in the non traded goods sector and \( n_{X,t} \) firms that operate in the traded sector. In the economy the distribution of firms between the two sectors depends on individual productivity levels. The relative weight of exporting firms is determined by the cut off point \( z_X \), since \( n_{X,t} = 1 - G(z_X) \). Given the Pareto distribution, \( G(z) = 1 - (z_{min}/z)^k \), so that we get, \( n_{X,t} = (z_{min}/z_X)^k \). The sectoral aggregation of firms requires the computation of the average productivity level of each sector, \( \bar{z}_{D,t}, \bar{z}_{X,t}, \bar{z}_{**D,t}, \bar{z}_{**X,t} \). Using the characteristics of the above probability and defining \( \nabla = \left( \frac{k}{\pi - (\theta - 1)} \right) \), we get,

\[
\bar{z}_t = \left[ \int_{z_{min}}^\infty z^{\theta - 1} dG(z) \right]^{\frac{1}{\theta - 1}} = \nabla^{\frac{1}{\theta - 1}} z_{min},
\]

\[
\bar{z}_{X,t} = \left[ \frac{1}{1 - G(z)} \int_{z_X}^\infty z^{\theta - 1} dG(z) \right]^{\frac{1}{\theta - 1}} = \nabla^{\frac{1}{\theta - 1}} z_{X,t}.
\]

Since, \( \bar{z}_t = (1 - (z_{min}/z_X)^k) \bar{z}_{D,t} + (z_{min}/z_X)^k \bar{z}_{X,t} \), we get,

\[
\bar{z}_{D,t} = \nabla^{\frac{1}{\theta - 1}} \left( \frac{z_{min} - z_{min}^{1-k} z_{X,t}^{1-k}}{1 - z_{min}^{k} z_{X,t}^{k}} \right).
\]

Since the analysis is symmetric in the foreign country, we can summarize the sectoral relations of the model with the following system of 18 equations,

\[
z_X = \frac{f_c}{(\theta - 1)} \left( \frac{\theta (1 + \tau) w_t}{q_t A_t} \right)^{\frac{\theta}{\theta - 1}} c_t^{*1-\theta},
\]
$$z_X^* = \frac{f_e}{\theta (1 + \tau)} \left( \theta (1 + \tau) q_t \frac{w_t^*}{A_t^*} \right)^{\frac{1}{1-\theta}},$$

$$\ddot{z}_{X,t} = \nabla \frac{1}{1-\theta} z_{X,t}, \quad \ddot{z}_{D,t} = \nabla \frac{1}{1-\theta} \left( \frac{z_{\min} - z_{\min}^k z_{X,t}^{1-k}}{1 - z_{\min}^k z_{X,t}^{1-k}} \right),$$

$$\ddot{z}_{X,t}^* = \nabla \frac{1}{1-\theta} z_{X,t}^*, \quad \ddot{z}_{D,t}^* = \nabla \frac{1}{1-\theta} \left( \frac{z_{\min}^* - z_{\min}^k z_{X,t}^{1-k}}{1 - z_{\min}^k z_{X,t}^{1-k}} \right),$$

$$n_{X,t} = z_{\min}^k z_{X,t}^{1-k}, \quad n_{D,t} = 1 - z_{\min}^k z_{X,t}^{1-k},$$

$$n_{X,t}^* = z_{\min}^k z_{X,t}^{1-k}, \quad n_{D,t}^* = 1 - z_{\min}^k z_{X,t}^{1-k},$$

$$\tilde{\rho}_{X,t} = \frac{\theta}{\theta - 1} \frac{w_t}{z_{X,t}}, \quad \tilde{\rho}_{D,t} = \frac{\theta}{\theta - 1} \frac{w_t}{\bar{z}_{D,t} A_t},$$

$$\tilde{\rho}_{X,t}^* = \frac{\theta}{\theta - 1} \frac{w_t^*}{\bar{z}_{X,t}^* A_t}, \quad \tilde{\rho}_{D,t}^* = \frac{\theta}{\theta - 1} \frac{w_t^*}{\bar{z}_{D,t}^* A_t},$$

$$\tilde{y}_{X,t} = \tilde{\rho}_{X,t}^\sigma [c_t + q_t^\theta (1 + \tau)^{-\theta} c_t^*], \quad \tilde{y}_{D,t} = \tilde{\rho}_{D,t}^\sigma [c_t],$$

$$\ddot{y}_{X,t} = \tilde{\rho}_{X,t}^{\sigma-\theta} \left[ c_t^* + q_t^\theta (1 + \tau)^{-\theta} c_t^* \right], \quad \ddot{y}_{D,t} = \tilde{\rho}_{D,t}^{\sigma-\theta} [c_t^*].$$

### 2.4 Aggregation and general equilibrium

The aggregate level of output is defined according to,

$$\tilde{\rho} \tilde{y}_t = \int_0^1 \rho_t (\omega) y_t (\omega) d\omega = n_{D,t} \tilde{\rho}_{D,t} \tilde{y}_{D,t} + n_{X,t} \tilde{\rho}_{X,t} \tilde{y}_{X,t},$$

$$\tilde{\rho}_t^\gamma \tilde{y}^*_t = \int_0^1 \rho_t^\gamma (\omega) y_t^* (\omega) d\omega = n_{D,t}^* \tilde{\rho}_{D,t}^\gamma \tilde{y}_{D,t}^* + n_{X,t}^* \tilde{\rho}_{X,t}^\gamma \tilde{y}_{X,t}^*,$$

and consumption price indexes according to,

$$1 = n_{D,t} \tilde{\rho}_{D,t}^{1-\theta} + n_{X,t} \tilde{\rho}_{X,t}^{1-\theta} + n_{x,t} \tilde{\rho}_{M,t}^{1-\theta},$$

$$1 = n_{D,t}^* \tilde{\rho}_{D,t}^{1-\theta} + n_{X,t}^* \tilde{\rho}_{X,t}^{1-\theta} + n_{x,t} \tilde{\rho}_{M,t}^{1-\theta}.$$

In this setting, a competitive equilibrium is defined as a sequence of quantities

$$\{Q_t\}_{t=0}^\infty = \{c_t, c_t^*, \tilde{\rho}_t \tilde{y}_t, \tilde{\rho}_t^\gamma \tilde{y}_t^*, l_t, l_t^*, n_{X,t}, n_{X,t}^*, n_{D,t}, n_{D,t}^*, \tilde{y}_{X,t}, \tilde{y}_{X,t}^*, \tilde{y}_{D,t}, \tilde{y}_{D,t}^*\}_{t=0}^\infty,$$

and a sequence of real prices,

$$\{P_t\}_{t=0}^\infty = \{r_t, r_t^*, w_t, w_t^*, \tilde{\rho}_X, \tilde{\rho}_X^*, \tilde{\rho}_{D,t}, \tilde{\rho}_{D,t}^\gamma q_t\}_{t=0}^\infty.$$
such that, for a given sequence of prices \( \{P_t\}_{t=0}^{\infty} \), the realization of shocks \( \{S_t\}_{t=0}^{\infty} = \{A_t, A_t^*\}_{t=0}^{\infty} \), the sequence \( \{Q_t\}_{t=0}^{\infty} \) respects first order conditions for households and maximizes firm profits. For a given sequence of quantities \( \{Q_t\}_{t=0}^{\infty} \), the realization of shocks \( \{S_t\}_{t=0}^{\infty} = \{A_t, A_t^*\}_{t=0}^{\infty} \), the sequence \( \{P_t\}_{t=0}^{\infty} \), guarantees labour market cleaning, 

\[
\int_0^1 l_t (j) \, dj = \int_0^1 l_t (\omega) \, d\omega \quad \text{and} \quad \int_0^1 l_t^* (j) \, dj = \int_0^1 l_t^* (\omega) \, d\omega
\]

goods market equilibrium, 

\[
\int_0^1 c_t (j) \, dj = \int_0^1 \rho_t (\omega) y_t (\omega) \, d\omega \quad \text{and} \quad \int_0^1 c_t^* (j) \, dj = \int_0^1 \rho_t^* (\omega) y_t^* (\omega) \, d\omega
\]

and finally current account equilibrium, 

\[
q_t = \frac{n_{X,t} \rho_{X,t}}{n_{X,t} \rho_{X,t}^*} \frac{c_t - l_t}{c_t - l_t^*} \]

3 The Negative Contribution of the Extensive Margin on Business Cycle synchronization

3.1 The model in log deviation

The model can be solved in steady state by assuming that all the exogenous sources of variability are fixed at their expected value. We assume that the two country are perfectly symmetric. To compute the steady state, we assume that all shocks are zero, so that \( A = 1 \); the real wage is set equal to 1, and \( z_{min} \) is equal to 1. In this situation, the average productivity level of firms is, \( \bar{z} = \nabla^{1/\theta} \). Combining goods market equilibrium, \( c = \bar{\rho} \bar{y} \), the consumption/labour trade-off, \( \Xi (l)^\kappa = c^{-1} \), and the aggregate production function, \( \bar{\rho} \bar{y} = \bar{z} l \), we get, \( l = \left( \nabla^{1/\theta} \Xi \right)^{1/\kappa} \) and \( c = \Xi^{-1/\kappa} \nabla^{\kappa/\theta} \Xi^{-\theta} \). Using standard techniques, we defines the model in log linear terms around this steady state equilibrium as follows,

\[
\hat{c}_t = E_t \hat{c}_{t+1} - (r_t - r),
\]

\[
\hat{c}_t^* = E_t \hat{c}_{t+1}^* - (r_t^* - r),
\]

\[
\kappa \hat{l}_t = \hat{w}_t - \hat{c}_t,
\]

\[
\kappa \hat{l}_t^* = \hat{w}_t^* - \hat{c}_t^*,
\]

\[
\hat{\rho}_{X,t} = \hat{w}_t - \hat{A}_t - \hat{z}_{X,t},
\]

\[
\hat{\rho}_{X,t}^* = \hat{w}_t^* - \hat{A}_t^* - \hat{z}_{X,t}^*.
\]
\[ \hat{\rho}_{D,t} = \hat{w}_t - \hat{A}_t + \alpha \hat{z}_{D,t}, \]
\[ \hat{\rho}^*_D,t = \hat{w}^*_t - \hat{A}^*_t + \alpha \hat{z}^*_D,t, \]
\[ \hat{y}_{X,t} = -\theta \hat{\rho}_{X,t} + \hat{c}_t + (1 - \theta) \hat{q}_t + \hat{c}^*_t, \]
\[ \hat{y}^*_X,t = -\theta \hat{\rho}^*_X,t + \hat{c}^*_t + (1 - \theta) \hat{q}_t + \hat{c}_t, \]
\[ \hat{y}_{D,t} = -\theta \hat{\rho}_{D,t} + \hat{c}_t, \]
\[ \hat{y}^*_D,t = -\theta \hat{\rho}^*_X,t + \hat{c}_t, \]
\[ \hat{c}_t = A_t + \hat{t}_t + (1 - \alpha) \gamma \hat{z}_{X,t}, \]
\[ \hat{c}^*_t = A^*_t + \hat{t}_t + (1 - \alpha) \gamma \hat{z}^*_{X,t}, \]
\[ \hat{n}_{D,t} + \hat{n}^*_{X,t} + \hat{n}^*_{X,t} = (\theta - 1) \left( \hat{\rho}_{D,t} + \hat{\rho}^*_{X,t} + \hat{q}_t + \hat{q}^*_t - \hat{\rho}^*_X,t \right), \]
\[ \hat{n}^*_{D,t} + \hat{n}^*_{X,t} + \hat{n}^*_{X,t} = (\theta - 1) \left( \hat{\rho}^*_D,t + \hat{\rho}^*_X,t - \hat{q}_t + \hat{q}^*_t - \hat{\rho}^*_X,t \right), \]
\[ \hat{n}_{X,t} - (\theta - 1) \hat{\rho}_{X,t} + (\hat{q}_t + \hat{q}^*_t) = \hat{n}^*_{X,t} - (\theta - 1) \hat{\rho}^*_X,t + \hat{c}_t, \]
\[ \hat{A}_t = \rho \hat{A}_{t-1} + \xi_{A,t}, \]
\[ \hat{A}^*_t = \rho \hat{A}^*_t_{t-1} + \xi^*_{A,t}, \]
\[ \hat{z}_X = \frac{\theta}{\theta - 1} \left( \hat{w}_t - \hat{A}_t - \hat{q}_t \right) - (\theta - 1) \hat{c}_t, \]
\[ \hat{z}^*_X = \frac{\theta}{\theta - 1} \left( \hat{w}^*_t - \hat{A}^*_t + \hat{q}_t \right) - (\theta - 1) \hat{c}_t, \]
\[ \hat{n}_{X,t} = -k \hat{z}_{X,t}, \]
\[ \hat{n}^*_{X,t} = -k \hat{z}^*_{X,t}, \]
\[ \hat{n}_{D,t} = k \hat{z}_{X,t}, \]
\[ \hat{n}^*_{D,t} = k \hat{z}^*_{X,t}, \]

with, \( \alpha = \left( \frac{(1-z_{X,t}^{-k})z_{X,t}^{-k} + (1-z_{X,t}^{-k})(k-1)z_{X,t}^{1-k}}{(1-z_{X,t}^{-k})(1-z_{X,t}^{-k})} \right) \). The set of 25 log linear equations, may provide solution paths for the following 25 variables: \( \hat{c}_t, (r_t - r), \hat{t}_t, \hat{w}, \hat{\rho}_{D,t} \), \( \hat{\rho}_{X,t}, \hat{z}_{X,t}, \hat{n}_{X,t}, \hat{n}_{D,t}, \hat{y}_{X,t}, \hat{y}_{D,t}, \hat{A}_t, \hat{c}^*_t, (r^*_t - r), \hat{t}^*_t, \hat{w}^*_t, \hat{\rho}^*_{D,t} \), \( \hat{\rho}^*_{X,t}, \hat{z}^*_X,t, \hat{n}^*_{X,t}, \hat{n}^*_{D,t}, \hat{y}^*_X,t, \hat{y}^*_D,t, \hat{A}^*_t, \hat{q}_t \). In what follows we will compare this setting with a more standard model where trade occurs only at the intensive margin. To get this second setting, we delete the last 6 equations that govern the distribution of firms among sectors and impose that \( \hat{z}_{X,t} = \hat{n}_{X,t} = \hat{n}_{D,t} = \hat{z}^*_X,t = \hat{n}^*_X,t = \hat{n}^*_D,t = 0 \) in the other relations.
3.2 Impulse response functions

To get some insights on the consequences of productivity shocks on the relation between the extensive margin of trade and the convergence of output growth rates we study the consequences of an asymmetric one percent productivity shock in the domestic country; We adopt the following benchmark values for parameters. First, $\kappa = 5$ is the inverse of the intertemporal elasticity of substitution of labour supply which lies in the range of parameters presented by Canzoneri, Cumby and Diba (2007). The elasticity of substitution in aggregate consumption is equal to $\theta = 3.7$ and corresponds to the value proposed by Bilbiie Ghironi and Melitz (2010). The shape of the pareto distribution $k$ is such that it should be greater than $(\theta - 1)$; we have chosen $k = 3$ to match this condition. The iceberg cost represents 30% of the value of the traded goods so that $\tau = 0.3$. Finally we set $\Xi = 1$, $f_k = 1$, and $\rho = 0.9$.

The results of the simulation for this baseline calibration of parameters are reported in figures 1 and 2 for the main variables of interest. We contrast the IRF of an asymmetric 1% increase in domestic aggregate productivity in two situation: the plain curves represent the adjustment of the corresponding variable when the number of traded varieties evolves) while the dotted curves represent the adjustment of the world economy when the number of traded varieties is fixed. As shown in the first graph of figure 1, the extensive margin of trade contributes negatively to business cycle convergence, as it increases output dispersion by 50% at the impact period with regard to the fixed variety version of the model.

To understand the role of the extensive margin of trade as a process that reduces business cycle, it is worthwhile to analyse first the international adjustment in a setting where trade occurs at the intensive margin. In this situation, a positive productivity shock in the domestic economy increases income and thus aggregate consumption in this economy. following the increase in the supply of home goods prices must fall, thus the terms of trade must deteriorate. As the terms of trade are defined as the relative price of imports in terms of exports, the worsening is represented by a 0.02% increase. Indeed, the surge in aggregate consumption in the domestic economy falls on foreign exports and conversely a part of the increase in the supply of domestic exports must be bought by foreigners. Thus the relative price of foreign tradable in terms of domestic tradables must increase. This deterioration of the terms of trade operates as a transfer between the two countries and dampens the divergence of income growth rates after an asymmetric productivity shock.

When trade operates at both intensive and extensive margin, terms of trade movements are dramatically lower as noted by Corsetti et al. (2007). Since the number of firms operating in each sector is endogeneous to the model, the supply of foreign exports is now modified.
Indeed, the increase in domestic consumption favors the demand for foreign exports. Ceteris paribus, this lowers the cut-off point, \( z^*_{X,t} \), and makes the entry of foreign firms on the tradable segment profitable. Thus the number of foreign goods that are traded increases much more than the reduction in individual supply of foreign firms that operate on this market segment. As a consequence, there is a net increase in the supply of foreign goods. Here, at the impact period we even notice a small improvement in the terms of trade due to the big reaction of the foreign supply of tradable since \( \hat{\text{tot}} = -0.009 \).

As noted in the graphs, this implies a greater divergence of income growth rate given the big reaction of the foreign traded sector.

Thus in the absence of firm entry the adjustment only relies on the adjustment of relative price. This correction mechanism that dampens the divergence of income growth rate disappears when trade growth operates at the extensive margin. Thus, endogenous firm entry affects positively business cycle divergence.

As underlined by the graphs of figure 2, one shall note that most of the extensive margin of trade comes from the foreign country (around 90%). Indeed, as the supply of foreign goods increases since it is directly affected by the increase in domestic aggregate consumption. In the meanwhile the increase in the number of traded varieties in the domestic economy is very low (it represents almost 10% of the increase in the number of foreign traded varieties). Indeed, in the domestic economy the value of the cut-off point is affected by two opposite effects: on the one hand, the initial productivity shock lowers the cut-off point, and favors ceteris paribus the entry of domestic firms on the traded sector; on the other hand the reduction in foreign demand for domestic exports due to the decrease in aggregate consumption in the foreign economy increases the value of the cut-off point, which makes firm entry on the traded sector less profitable. Thus, the relative number of firms between sectors remains quite stable in the domestic economy. The most noticeable impact of the productivity shock in the domestic economy is on the production of non-traded goods that is significant increased in each of the firms. Finally, the rise in the domestic consumption is done both in terms of domestic non-traded goods and in terms of foreign traded goods, as the relative price of the latter does not increase as much as in the baseline case where trade increase occurs only at the intensive margin.

3.3 The correlation between the extensive margin of international trade and the divergence of business cycles

In this subsection we evaluate how the volatility of the main variables of interest (measured by the standard deviations of business cycle desynchronisation, of the terms of trade, and of the total...
number of traded varieties) and the correlation between the business cycle desynchronisation and the number of traded varieties are affected by different values of parameters. The benchmark calibration (bc) is: $\kappa = 5, \theta = 3.7, k = 3, \tau = 0.2, \Xi = 1, f_e = 1, \rho = 0.9, \sigma^*_A = \sigma^*_A = 0.7$.

In Table 1, we compare the model with the extensive margin (model EM) to a model with a fixed number of traded varieties (model IM). We evaluate how figures reported in the benchmark situation (first row, bc) are affected by a greater integration of the goods market between trading partners (rows 2 and 3), by a reduction in the elasticity of substitution (rows 4 and 5) and by a reduction in firm heterogeneity (rows 6 and 7) and by the degree of macroeconomic heterogeneity of the trading partners (rows 8 and 9).

In the benchmark calibration, The extensive margin of trade clearly increases the desynchronisation of business cycles while it decreases drastically the volatility of the terms of trade. As underline above, since the foreign economy reacts by offering more traded varieties following an asymmetric productivity shock in the domestic economy, the adjustment of the terms of trade is dampened. The greater part of the international adjustment is carried through an increase in traded varieties of goods (the standard deviation of the total number of traded varieties is close to twice that of the standard deviation of business cycle divergence). In this benchmark calibration 12% of the dispersion of business cycles between countries is explained by the volatility of the number of varieties in international trade.

The consequences of a greater trade integration between countries is analysed through a reduction in the value of the iceberg shipping cost $\tau$. This reduction in the value of parameter $\tau$ does not affect the volatility of the IM model, as it affects the economy through a reduction of
value of the cut off points $z_x$ and $z^*_x$. For a given distribution of shocks this reduction of the value of cut off points increases the volatility of the number of traded varieties. As a byproduct, since more international adjustment is carried through the existing number of traded varieties, the volatility of the terms of trade is significantly reduced. The decrease in the iceberg shipping cost reduces the home bias in consumption. As a consequence since consumption patterns become more homogenous, it reduces the volatility of business cycle desynchronisation, as shown in the figures.

A reduction in the elasticity of substitution (parameter $\theta$) has clearly a different impact on the macroeconomy, depending on the structure of trade evolution between countries. Indeed, in the IM model, this reduction of the elasticity of substitution implies that there should be an increase in relative price adjustment to keep the equilibrium of the model (ie, this increases the volatility of the terms of trade). In contrast since in the EM model, the terms of trade play a negligible role in international adjustment. As most of the international adjustment on the goods market is implemented by an adjustment in the number of traded varieties, a reduction in the elasticity of substitution between varieties reduces the number of new goods that are traded. This in turn also reduces the volatility of the business cycle desynchronisation.

A reduction of firms heterogeneity (represented here by an increase in the value of the shape parameter $k$), increases the volatility of the number of varieties that are traded. Indeed, as firms are more homogenous, there is less dispersion of firms around the cut off points $z_x$ and $z^*_x$. In this case, a productivity shock that reduces the values of $z_x$ or $z^*_x$ has a greater impact on the number of traded goods since they are distributed closer to the cut off point. Since firms are more homogenous, the distribution of shocks is more symmetric among countries, and this implies a reduction in the volatility of business cycle synchronisation. Finally as goods become more homogenous, the adjustment in relative price plays a greater role to balance the goods market, and the volatility of the terms of trade increases.

Finally, a reduction of the standard deviation of shocks in the foreign economy ($\sigma^*_A$) reduces the average volatility of aggregates in the world economy while it increases significantly the correlation between business cycle desynchronisation and the number of traded varieties. Here, when countries become more heterogenous, a greater part of business cycle desynchronisation comes from the increase in traded varieties.
4 Estimation

4.1 Data

We test the negative impact of the extensive margin of trade on business cycle synchronisation for 11 European countries: Belgium-Luxembourg, France, Germany, Ireland, Italy, Portugal, Spain, the Netherlands, Finland and Austria from 1995 to 2007. We present in appendix A the construction of the variables used in the econometric study. First, we use the same indicator of synchronisation as the theoretical modelisation i.e. the difference between the two GDP growth rates (Synchro). GDP data (Y) are extracted from the OECD database.

Regarding trade statistics and the distinction between the intensive and the extensive margin of trade we use the CEPII-BACI database with 5,000 varieties of products from 1995 to 2007. We define the extensive margin as the value of new exports between two countries for one year divided by the total bilateral trade (ME). Since, as already suggested by Imbs (2004) and Inklaar et al. (2008), specialization matters to study the relation between trade synchronisation and trade flows, we define this variable as the absolute difference of the GDP share of an industry in two countries (Specia). We get the sectoral data for 27 sectors from the OECD database.

We also account for financial linkages between country pairs as suggested by Otto, Voss, and Willard (2001). Various measures are considered in our regressions to control for bilateral financial integration. Firstly, we compute yearly averages of monthly real interest rate differentials. The latter are built from nominal interest rates and consumer price indices. Financial dependencies in the short run are captured through interest rates on three-month treasury bills (IFI1). The corresponding time series are extracted from the OECD database from 1996:01 to 2007:12. Secondly, real equity returns are calculated on the basis of monthly nominal stock market indices and consumer price indices (IFI3). We use OECD data from the same sample period as before. Thirdly, we also take the logarithm of the standard deviation of the difference of real bilateral exchange rates into account (rxxvol). There are taken from the Pacific Retrieval Interface of the British Colombia University.

Fourthly, we include the absolute difference between the net foreign asset (NFA) positions of a country pair as it is done in Imbs (2004) and Inklaar et al. (2008). This last variable is used as an index of (bilateral) capital restrictions (IFI4). The NFA annual data series were downloaded from the last version of Lane and Milesi-Feretti’s (2009) database. To get comparable results with

\[ \text{Synchro}^2_t = \frac{1}{2} \ln \left( \frac{1 + C}{1 - C} \right), \]

where \( C \) is the pairwise correlation coefficient for each country pair. But results were very closed.

\[ \text{IFI2} \] is constructed with the rates on ten-year maturity government bonds to control for financial linkages at a longer horizon but results are closed.

\[ \text{IFI3} \]
Inklaar et al. (2008), we consider absolute differences between the GDP ratios of the cumulated current accounts for each country pair. Finally, as Inklaar et al. (2008), cyclically adjusted government primary balance (as a percentage of potential GDP, from the OECD database) are used as exogenous variable (\textit{fisc}).

As stressed by Clark and van Wincoop (2001), output correlations among countries (or regions) can also be influenced by distance factors. Dummy variables from the CEPII bilateral distance database are used to control for contiguity (border effect) and common language. Economic distance between pairs of countries is proxied by the log of the distance (in km) between their capital cities (respectively \textit{contig, lang} and \textit{dist} variables). \textit{pibprod} measures the effect of size on trade.

### 4.2 Estimation results

We follow Imbs’ (2005) empirical strategy by estimating a system of three equations. To appreciate the influence of the extensive margin of trade on business cycle synchronisation, we replace the trade intensity variable used in his article by the computed index of extensive margin of trade (\textit{ME}). For each country pair \((i,j)\), the extensive margin is used as an endogenous variable, together with the synchronization of GDPs and the relative specialization index. Additional control variables are also included in each of these equations in order to account for international financial integration, distance factors, and the similarity of the economic policy stance.

\[
\begin{align*}
\text{Synchro}_{ij,t} &= \alpha_0 + \alpha_1 ME_{ij,t} + \alpha_2 Specia_{ij,t} + \alpha_3 Fisc_{ij,t} + \alpha_4 If1_{ij,t} + \alpha_5 Rxrvol_{ij,t} + \epsilon_{1ij,t} \\
ME_{ij,t} &= \beta_0 + \beta_1 Specia_{ij,t} + \beta_2 Fisc_{ij,t} + \beta_3 If1_{ij,t} + \beta_4 Rxrvol_{ij,t} + \beta_5 G_{ij,t} + \epsilon_{2ij,t} \\
Specia_{ij,t} &= \gamma_0 + \gamma_1 ME_{ij,t} + \gamma_2 If1_{ij,t} + \gamma_3 If4_{ij,t} + \gamma_4 G_{ij,t} + \epsilon_{3ij,t}
\end{align*}
\]

with \(G\) the gravity variables (distance, contiguity, language and size). As it is now standard in the relevant litterature (references ???), we check the robustness of the results, by estimating this model by the OLS and 3SLS methods. The sample is made of 121 bilateral trade relations from 1996 to 2007. The corresponding estimates are reported in table 2 below.

Table 2 reports that all results underline the negative contribution of the extensive margin of trade, specialization and the volatility of the bilateral real exchange rate to the comovements in domestic and foreign output gaps. Financial integration has a positive effect on synchronisation and the fiscal variable has no significant impact.
### Table 1: Estimation results

<table>
<thead>
<tr>
<th></th>
<th>OLS Synchro</th>
<th>OLS Synchro</th>
<th>OLS Synchro</th>
<th>3SLS Synchro</th>
<th>EM Specia</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM</td>
<td>-0.381</td>
<td>-0.098</td>
<td>-0.106</td>
<td>-0.328</td>
<td>-3.856</td>
</tr>
<tr>
<td></td>
<td>(18.71)***</td>
<td>(5.47)***</td>
<td>(5.87)***</td>
<td>(5.72)***</td>
<td>(1.83)*</td>
</tr>
<tr>
<td>Specia</td>
<td>-0.050</td>
<td>-0.053</td>
<td>-0.021</td>
<td>-0.028</td>
<td>(1.80)*</td>
</tr>
<tr>
<td></td>
<td>(29.39)***</td>
<td>(14.04)***</td>
<td>(1.80)***</td>
<td>(1.00)</td>
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<tr>
<td>Fisc</td>
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<td>0.040</td>
<td>0.060</td>
<td>(1.46)</td>
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<tr>
<td></td>
<td>(1.46)</td>
<td>(1.02)</td>
<td>(1.59)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ifi1</td>
<td>0.060</td>
<td>0.142</td>
<td>0.230</td>
<td>1.843</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.32)**</td>
<td>(4.53)***</td>
<td>(3.99)***</td>
<td>(4.08)***</td>
<td></td>
</tr>
<tr>
<td>Rxrvol</td>
<td>-0.047</td>
<td>-0.033</td>
<td>0.041</td>
<td>(3.12)***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.12)***</td>
<td>(1.88)*</td>
<td>(1.50)</td>
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<td>pibprod</td>
<td>4.397</td>
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<td></td>
<td>(3.92)***</td>
<td>(5.82)***</td>
<td></td>
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<td></td>
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<tr>
<td>distw2</td>
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<td>0.008</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(7.97)***</td>
<td>(2.30)***</td>
<td></td>
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<td>lang</td>
<td>-0.625</td>
<td>-5.615</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.98)**</td>
<td>(4.12)***</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>contig</td>
<td>-0.151</td>
<td>10.875</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.30)</td>
<td>(6.25)***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ifi4</td>
<td>8.647</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(6.97)***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.223</td>
<td>-36.997</td>
<td>-309.038</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.49)</td>
<td>(3.91)***</td>
<td>(5.26)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Obs.</td>
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<td>1080</td>
<td>1080</td>
<td>1080</td>
<td>1080</td>
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<tr>
<td>R2</td>
<td>0.24</td>
<td>0.58</td>
<td>0.59</td>
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</table>

Absolute value of z statistics in parentheses.

*, **, *** significant at 10%, 5% and 1%.
In particular, a 1% rise in the extensive margin of bilateral trade reduces the synchronization of output growth rates by 0.1 to 0.3%. Interestingly, the effect of the extensive margin is higher than the effect of sectoral specialization.

As underlined in the first three columns with the OLS estimation, the effect of the extensive margin of trade fluctuates between -0.381 and -0.098, depending on whether we take into account the effect of specialization. In any case the variable EM remains significant at 1%. This new evidence of a significant link between the extensive margin and the decoupling of business cycles contrasts with the absence of a statistically significant influence of the intensive margin *per se* on business cycle synchronisation. This last phenomenon is widely documented in the existing literature and it is related to the fact that greater trade intensity between two countries can lead to either positive or negative spillover effects from one country’s economic activity to another (see Otto et al. (2001)). The net impact depends on whether the “pull” factor from the demand side dominate the opposite force due to greater specialization of the industry to capture the comparative advantage. This explanation is also in line with the “trade–comovement puzzle” discussed by Kose and Yi (2006). Deeper trade links between two countries may indeed to two conflicting forces on comovements in domestic and foreign outputs under complete markets. As such, a domestic productivity–shock would imply a negative resource–shifting effect which can compensate for increased synchronization through a ‘trade-magnification’ effect in the similarity of the responses of demands for (and/or supplies of) goods in the two economies. A similar argument is raised in Calderon et al. (2007) to explain how the trade–synchronization relationship may differ among country groups of various level of development.

To correct the endogeneity bias between the extensive margin and the specialisation of trade, we adopt a 3SLS procedure that corresponds to the system of equations presented above. In the 3 SLS estimation procedure, we obtain an unambiguous negative influence of the industrial specialization on the synchronization of business cycles. This link appears to be quite robust to the possible endogeneity of the trade and specialization variables, despite a loss in its statistical significance. This supports previous empirical findings such as Imbs (2006), in sharp contrast with Baxter and Kouparitsas’ (2005) strong skepticism. As stressed by the latter authors, the role played by the structure of sectoral productions seems to be highly sensitive to the econometric specification.

Regarding the effect of the extensive margin of trade on business cycle desynchronisation,
we find that an increase of 1% in the extensive margin of bilateral trade (ie, a 1% increase in
the international exchange of new varieties) led to a direct reduction of 0.328% of business cycle
synchronisation between the corresponding European countries between 1995 and 2007.

One can note that this value should be corrected to take into account the fact that the extensive
dependent variable margin affects negatively specialisation that in turn affects negatively the synchronisation
of business cycles. Nevertheless this indirect channel is not significant at 1% since both the
estimated effect of EM on specia and on specia on Synchro are only significant at 10%. In any
case, even corrected the total impact of EM on synchronisation should still be very close to 0.3% (it should
be equal to (-0.328)+(-0.021).(-3.856)=-0.247).

Business cycles tend also to be more synchronized in case of diverging fiscal paths or monetary policies between Member States (as described by the positive influence of the \textit{fisc} and \textit{ifi1} variables in table 1, respectively). However, this result is at odds with Otto et al.’s (2001)
premise according to which a positive link should be expected. Their estimates reveal a similar
negative, though not significant, relationship. The absence of a policy coordination effect on
comovements in the European business cycles is also documented in Clark and van Wincoop
(2001). This lack of evidence may be due to the ambivalent role of national policies which, as
the former authors argue, can either boost or dampen cyclical fluctuations in aggregate output.

Finally, the volatility of the real exchange rate has a significantly negative contribution to
the bilateral comovements in GDPs. All these effects prove to be robust to the choice of the
panel model, even though the random effect specification leads to a stronger impact of the fiscal
policy variable.

5 Conclusion

In this paper we have investigated theoretically and empirically the role of the extensive margin
of trade on business cycle synchronization. First, in a two country world where the evolution of
trade combines both existing and new varieties of goods we have underlined the fact that the
extensive margin reduces business cycle convergence by dampening the fluctuations of the terms
of trade between countries. Furthermore, we find that the correlation between the number of
traded varieties and the desynchronisation of business cycles is always positive under a wide
range of calibration.

To get a quantitative value of this effect, we have estimated this negative impact of the
extensive margin of trade on business cycle synchronization for a group of 11 European countries
between 1995 and 2007. The estimation of a three-system equations confirms the negative effect of the extensive margin on synchronization. Even if the extensive margin decreases the degree of specialization, the total effect is still negative. Controlling for specialization and financial integration we find that an increase of 1\% in the extensive margin of bilateral trade reduces business cycle synchronisation by something between 0.328\% and -0.247\% depending on wether we take into account the negative impact of the extensive margin on specialisation.
References


## A Data

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>Measure</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchro</td>
<td>Bilateral difference of GDP growth rates</td>
<td>$\text{Synchro}_{ij,t} = -</td>
<td>\Delta \ln Y_{i,t} - \ln Y_{j,t}</td>
</tr>
<tr>
<td>Synchro2</td>
<td>Bilateral correlation of detrended output</td>
<td>$C_{ij,t} = \frac{1}{2} \ln \left( \frac{(1+C_{ij,t})}{(1-C_{ij,t})} \right)$</td>
<td>OECD</td>
</tr>
<tr>
<td>EM</td>
<td>Bilateral share of the extensive margin on the total trade</td>
<td>$\text{EM}<em>{ij,t} = \sum_k \frac{E</em>{X_{ij,k,t}}}{\sum_k X_{ij,k,t}}$ with $E_{X_{ij,k,t}}$ the value of exports at the period $t$ if there is no export from $i$ to $j$ for the good $k$ at the period $t-1$.</td>
<td>CEPII, BACI</td>
</tr>
<tr>
<td>Specia</td>
<td>Sectoral specialization</td>
<td>$\text{specia} = \sum_s</td>
<td>V_{is} - V_{js}</td>
</tr>
<tr>
<td>Fisc</td>
<td>Cyclically adjusted budget deficit correlation</td>
<td></td>
<td>OECD</td>
</tr>
<tr>
<td>IFI1</td>
<td>Volatility of the bilateral spread of short-term interest rates</td>
<td>$\text{IFI1}<em>{ij,t} = \ln(\sigma(r</em>{i,t} - r_{j,t}))$</td>
<td>OECD</td>
</tr>
<tr>
<td>IFI2</td>
<td>Volatility of the bilateral spread of long-term interest rates</td>
<td>$\text{IFI2}<em>{ij,t} = \ln(\sigma(r</em>{i,t} - r_{j,t}))$</td>
<td>OECD</td>
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<tr>
<td>IFI3</td>
<td>Volatility of the bilateral difference between stock indexes</td>
<td></td>
<td>OECD</td>
</tr>
<tr>
<td>IFI4</td>
<td>The absolute difference of NFA positions stock indexes</td>
<td></td>
<td>Lane and Milesi-Feretti’s (2009) database</td>
</tr>
<tr>
<td>Rxrvol</td>
<td>Volatility of the difference of real bilateral exchange rates</td>
<td>$\text{Rxrvol}<em>{ij,t} = \ln(\sigma(e</em>{i,t} - e_{j,t}))$ with $e_{i,t}$ the US dollar rate for the domestic currency.</td>
<td>British Columbia University</td>
</tr>
<tr>
<td>Size</td>
<td>The product of GDP</td>
<td>$\text{Size} = \log(Y_{i,t}\times Y_{j,t})$</td>
<td>CEPII</td>
</tr>
<tr>
<td>Dist</td>
<td>The log of distance (in Km) between capital cities</td>
<td></td>
<td>CEPII</td>
</tr>
<tr>
<td>Lang</td>
<td>Dummy for a common language</td>
<td></td>
<td>CEPII</td>
</tr>
<tr>
<td>Contig</td>
<td>Dummy if countries are adjacent to one another</td>
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<td>CEPII</td>
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