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Growth and Finance, European Integration and the Lisbon Strategy*

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Abstract

This article considers the relationship between financial and technological integration in Europe. It finds that market-based financial systems support output growth, investment and total factor productivity (TFP) more than bank-based ones. It identifies three groups of countries and estimates the probability of transition between the groups. It finds that financial integration might be a necessary but not sufficient condition for moving towards the 'Lisbon benchmark'.

Introduction

There is broad agreement that deeper integration spurs growth and this is particularly true of European integration. Integration can take place across several areas or markets, some of which have received less attention than others. In this article we look at the relationship between financial integration and technological (or innovation driven) integration in Europe. On financial integration Guiso *et al.* (2004) have shown that, if European financial markets were to achieve a degree of integration similar to that of the US, a substantial growth dividend could be gained. Technological integration, understood here as convergence towards an innovation-driven growth mechanism, lies at the heart of the Lisbon agenda, which has recently received new impetus following the Kok report (2004), endorsed by the European Commission. Bearing in mind the goal of

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raising the long-term rate of growth of the European economy, it is important to explore the relationship between financial integration and technological integration. In this article we ask to what extent financial development and financial integration can support growth by enhancing technological accumulation and technological integration. Financial integration influences growth directly and indirectly, to the extent that it facilitates technology accumulation and technological integration, which translate into higher (productivity) growth. Gains from integration can be large when there are differences in integration across countries and several national economies can benefit from catching up towards the 'benchmark'. Despite recent progress, national specificities in the technology–finance–growth nexus are still relevant in Europe, and one may ask to what extent they represent an obstacle to the process of integration and hence to growth.

The debate on the growth–finance relationship that has developed over the last decade has centred on the relative merits of bank-based versus market-based financial systems (one example is Beck and Levine, 2000; another is provided by Demirguç-Kunt and Maksimovic, 2000, who explore firm-level data).[1] The empirical evidence remains inconclusive on this issue and cross-section results (Beck and Levine, 2002) indicate that the difference in the source of external financing does not matter for the impact on growth. What matters seems to be the size of financial systems as well as legal aspects such as governance rules and creditor protection. The size of financial markets is also important to the extent that it allows for diversification, and to some extent complementarity, of external finance sources (Davies, 2001). Time series analysis (Arestis *et al.,* 2001; Shan *et al.*, 2002) points to the relative importance of bank-based systems. More importantly, they note specific national differences in the growth–finance nexus. Nonetheless, as Guiso *et al.* (2004) point out, financial integration in Europe may have progressed further than national data on financial development show, to the extent that firms can access finance outside their national borders. This suggests that participation in a regional agreement could, *per se*, bring benefits from financial development even if national specificities persist.

A benchmark for technological integration (or convergence) still needs to be identified. In Lisbon, in March 2000 the European Council set the goal of making Europe the 'most dynamic, knowledge-based economy in the world by 2010'. However we need a more operational content for this definition in order to assess progress towards such a goal, and the contribution of finance to such a process. In this article we suggest a way of defining such a benchmark.

We proceed along the following steps. First, we identify the contribution of finance to growth, directly and indirectly, though technology accumulation.

[1] For a review of the literature and the implications for EU integration, see Carettoni *et al.* (2001), Manzocchi and Padoan (2004) and Thiel (2001).

In doing so, we take into account the different models of growth and finance traditionally discussed in the literature, the market-based and the bank-based relationship. We also provide some evidence of the national differences in such relationships. We then identify a 'technological benchmark' that is broadly based on the indicators contained in the Kok report,[2] while also taking into account financial variables, and we offer some evidence as to the likelihood of convergence of European countries towards such a benchmark.

The rest of the article is organized as follows. Section I develops a simple growth model that highlights the growth–finance relationship and the interaction between innovation and financial development, thus looking at the direct and indirect channels that link finance to growth. Sections II and III describe the empirical methodology and the estimation results of the growth–finance nexus, through both cross-section and country-specific equations. Section IV discusses the implications for financial integration and connects them to the Lisbon strategy. It then provides some evidence of the possible convergence towards the technological benchmark. Finally, the article concludes.

I. A Simple Model

The literature recognizes two main (possibly interacting) channels through which financial development affects growth: total factor productivity enhancement and efficiency in transforming savings into investments. The first channel assumes that a well-developed financial structure may more efficiently select projects with higher productivity. The second channel implies that financial development translates savings into higher investment, notwithstanding a selection effect.

In this section we present an extremely simple growth model, which allows the financial sector to play a role in the determination of the output growth rate. This model is useful for discussing the role of financial integration. Our starting point is the set-up put forward by Pagano (1993); to assess the potential effects of financial development on growth he uses the *AK* model, with the production function written as:

$$Y_t = AK_t \tag{1.1}$$

where Y is production, K capital, and A accounts for total factor productivity (TFP).

Investment I is determined according to the following equation for capital accumulation:

[2] None of which refers to financial development.

$$I_t = K_{t+1} - (1 - \delta)K_t \tag{1.2}$$

where δ indicates depreciation of capital goods.

The traditional investment–savings equality conditions is modified into:

$$\eta S_t = I_t \tag{1.3}$$

to account for the proportion $1 - \eta$ of savings S forgone in the process of financial intermediation.

After denoting by s the gross saving rate S/Y, the steady-state growth rate can be written as:

$$g = A\eta s - \delta \tag{1.4}$$

This expression offers a simple idea of the channels through which finance may influence growth: by increasing total factor productivity A, by raising η, i.e. increasing the share of savings channelled to firms, and by affecting the saving rate s. An efficient financial sector should achieve a high value of η, thus reducing the loss of resources required to transform savings into investments: the fraction $1 - \eta$ accrues to financial firms as the difference between lending and borrowing rates, and to brokers and dealers as a price (compensation) for their intermediation. The financial sector can also contribute to growth by raising A, i.e. by selecting investment projects with the highest marginal productivity of capital. Collecting information on alternative projects (Greenwood and Jovanovic, 1990) and providing risk-sharing to the most promising technologies are the two key activities to this purpose. Finally, the impact of financial intermediation on the savings rate is more ambiguous and not generally assessed.

The EU integration process influences A, η and s. To clarify the point, let us distinguish between financial integration and technological integration. In terms of the model above, financial integration influences (increases) η and, possibly, s. This is consistent with results put forward by Guiso *et al.* (2004). As mentioned above, they define integration not necessarily as the case in which all EU national financial markets reach the same level of benchmark integration, but as a case in which all EU firms have the same (benchmark) access to financial markets. Hence, with full integration, η is the highest possible for all countries. Technological integration may be thought of as the case in which national economies reach the same degree of technological advancement, hence all countries should achieve the highest possible level of A. Therefore, financial integration affects growth both directly and indirectly through its support of technological accumulation.

To see this in more detail, and in order to gain further insight, we turn to a more complex model. The model builds on Greenwood *et al.* (1997) and on Boucekkine *et al.* (2003) who highlight the role of embodied technological progress, itself related, in the recent phase of EU integration, to the growing importance of IT,[3] and replicate some stylized facts, such as the decline in the relative price of capital, and the rise in the equipment–output ratio. Both these features are present in the recent growth history of the US; they are also playing an important role in the EU.

In what follows, variables are expressed in per capita terms. The production function is a traditional Cobb-Douglas:

$$y_t = a_t k_t^{1-\alpha} \tag{1.5}$$

as above, we consider a loss of resources due to financial intermediation ($\eta < 1$):

$$i_t = \eta s_t \tag{1.6}$$

Output can be either consumed or saved:

$$y_t = c_t + s_t \tag{1.7}$$

and capital accumulates according to the following law of motion:

$$\dot{k}_t = q_t i_t - (\delta + n)k_t \tag{1.8}$$

In this setting a_t and q_t represent, respectively, disembodied and embodied technological progress: an increase in a_t raises the productivity of the whole capital stock regardless of its vintage while, in contrast, q_t affects only new equipment (being *embodied*). Moreover δ and n are the deprecation rate and the growth rate of population.

Utility is written as:

$$u(c_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma} \tag{1.9}$$

so that the current value Hamiltonian is given by:

$$H_t = \left(\frac{c_t^{1-\sigma} - 1}{1-\sigma}\right) e^{-(\rho-n)t} + \mu\left[\eta q_t (a_t k_t^{1-\alpha} - c_t) - (\delta + n)k_t\right] \tag{1.10}$$

Working out the model leads to the two conditions:

(1.11a)

$$H_c = 0 \Rightarrow c_t^{-\sigma} e^{-(\rho-n)t} - \mu\eta q_t = 0$$

(1.11b)

and then produces the following expression for the steady state growth rate of consumption (and output):

[3] Whose link with financial (stock market) development has been discussed in depth by Hobijn and Jovanovic (2001).

$$H_k = -\dot{\mu} \Rightarrow -\dot{\mu} = \mu\eta q_t a_t (1-\alpha)k_t^{-\alpha} - \mu(\delta + n)$$
$$\frac{\dot{c}_t}{c_t} = \frac{1}{\sigma}\left[\eta q_t a_t (1-\alpha)k_t^{-\alpha} - \delta - \rho - \frac{\dot{q}_t}{q_t}\right] = g \tag{1.12}$$

When compared to other standard optimal growth models, this result shows that embodied technological progress (that we may think of as being related to IT) affects growth negatively through an 'obsolescence' factor $(\hat{q}_t / q_t)$ and positively through a 'modernization' factor (q_t).

The net effect is undetermined *a priori*, but the positive term is multiplied by the degree of efficiency η of the financial sector. This implies that the efficiency of the financial system enhances the positive impact of technological progress on growth. This very simple model can be modified to endogenize technological progress. If we consider learning-by-doing led growth, we may make technological progress depend on capital in the following way:[4]

$$a_t = ak_t^{\gamma} \tag{1.13}$$
$$q_t = qk_t^{\lambda} \tag{1.14}$$

Then, we impose social returns to capital to be constant ($1-\alpha + \delta + \gamma = 1$), in order to have sustained and constant growth.

Following the usual procedure, we write:

$$H_t = \left(\frac{c_t^{1-\alpha} - 1}{1-\sigma}\right)e^{-(\rho-n)t} + \mu\left[\eta(aq - \delta - n)k_t - \eta qk_t^{\lambda}c_t\right] \tag{1.15a}$$

$$H_c = 0 \Rightarrow c_t^{-\sigma}e^{-(\rho-n)t} - \mu\eta qk_t^{\lambda} = 0 \tag{1.15b}$$

$$H_k = -\dot{\mu} \Rightarrow -\dot{\mu} = \mu\eta(aq - \delta - n) - \mu\lambda\eta qk_t^{\lambda-1}c_t \tag{1.15c}$$

Results for the steady state growth rates of consumption and per capita output are:

$$\frac{\dot{c}_t}{c_t} = \frac{1}{\sigma}\left[\eta aq(1-\alpha) - \delta - \rho - \lambda\frac{\dot{k}_t}{k_t}\right] \tag{1.16}$$

[4] Making *disembodied* technological progress depend on capital stock might seem somewhat strange. However, although it is not incorporated in capital goods of a specific vintage, this kind of technological progress can be reasonably seen as the result of previous investments, that in turn determine the current level of capital stock.

$$g = \left(\frac{1}{\sigma + \frac{\lambda}{1-\lambda}} \right) \left[\eta aq(1-\alpha) - \delta - \rho \right] \tag{1.17}$$

It is interesting to note that the latter generalizes Pagano's result. In fact the *AK* dynamics are preserved by social constant returns to capital (*aq* plays the same role as *A*). However, two important differences arise: the obsolescence effect acting through λ, and the $(1 - \alpha)$ term representing the sub-optimality of the decentralized equilibrium (firms do not look at *social* returns to capital).

In conclusion, financial integration spurs growth through η (financial efficiency *per se*), and by contributing to productivity growth (*A* in Pagano's model), or to technological progress (be it embodied, or disembodied, respectively *q* and *a* in our model). As the literature suggests (see, for instance, Beck and Levine, 2002, for an excellent review and an assessment), the distinction between embodied or disembodied technological progress matters as far as the different role of market and credit is concerned, given that IT and embodied technological progress may require more market-based financial systems. For instance, advocates of a market-based system argue that banks are inherently biased towards 'conservative' investments: then, it should come as no surprise that the IT revolution (embodied technological progress) has been prevalently financed through markets. Our model would suggest from one side that having a more market-oriented system could help exploiting the effects of 'technological revolutions' acting through embodied technological progress while, on the other side, financial development *as a whole* could help magnify the difference between 'modernization' and 'obsolescence' effects. These two implications, due to our distinction between different kinds of technological progress, could not be drawn from Pagano's (1993) model.

II. Estimating the Growth–Finance Relationship

In what follows we provide estimation results of the growth–finance relationship for a number of OECD countries, concentrating mainly on two issues: firstly, to what extent financial variables affect growth, both directly and indirectly, and how much the type of financial development (market or banks) matter; secondly, to what extent country-specific factors may affect the growth–finance nexus. We carry out both panel and country-specific estimation, also resorting to ECM specifications.

Section II presents a general analysis performed through a first set of panel estimates of the growth–finance nexus. The panel estimation of ECM models and the presentation of country-specific results are discussed in Section III.

Panel Estimation

We propose to take as dependent variables, firstly, GDP growth; secondly, investment; and, thirdly, total factor productivity (TFP). In the first case we estimate directly the impact of finance on growth. The other two variables capture the indirect impact of finance on growth. Investment as a dependent variable can be seen under two perspectives. First, recalling the identity $i_t = \eta s_t$, investment reflects both the efficiency of financial markets and the propensity to save. Second, investment can also be considered as a vehicle of innovation to the extent that new capital goods incorporate new technologies and that capital deepening may be associated with process innovation. Finally, the impact of finance on TFP can be interpreted as the role that finance plays in supporting technological accumulation. To assess the role of finance we consider a number of different variables related to both bank- and market-based finance widely used in the empirical literature (see the Appendix for a detailed description of the data). We assume that different growth variables, implying different growth 'mechanisms', are also likely to be affected by different financial variables: the same view is shared, for instance, by Benhabib and Spiegel (2000).

Performing panel data estimations is a common practice in the empirics of the growth–finance nexus (see, for example, Levine and Zervos, 1998; Beck and Levine, 2002). To minimize problems associated with the presence of highly diverse country groups when the cross-sectional dimension dominates the time dimension, we increase the time dimension of the panel using three-year averages[5] in most cases, and focus on OECD countries.[6]

Specification of Equations for GDP and Investment

When GDP growth enters as a dependent variable, we consider the following equation:

$$Ygr_t = \alpha_0 + \alpha_1 i_t + \alpha_2 \pi_t + \alpha_3 Popgr_t + \alpha_4 ly0 + \alpha_5 f_t + \alpha_6 dumcm_t + \varepsilon_t \tag{2.1}$$

where, abstracting from time indexes, Ygr is the growth rate of real GDP, $i = I/Y$ stands for the output share of investment I, π is inflation, $Popgr$ is the growth rate of population, $ly0$, the log of initial per capita income level and takes into account convergence effects, f is the financial development variable,

[5] Instead of using five-year averages (that smooth over cyclical effects), as is common practice in the literature. However, estimations calculated using five-year averages (available upon request) do not contradict our findings.
[6] The list of countries in panel estimation is specified below. Empirical analyses that concentrate on OECD countries (e.g. Andrés *et al.,* 1999) have generally failed to detect strong links between finance and growth using panel data techniques. A notable exception is Leahy *et al.* (2001), who perform ECM estimations and whose contribution is complemented by our country-specific analysis.

and *dumcm* is a dummy variable for the possible effects of the European Union (Community) membership.

Equation (2.1) is based on the equation introduced by Mankiw *et al.* (1992), and adopted by Khan and Senhadji (2000) to test the growth–finance relationship. We use their specification and add inflation and the *cm* dummy.

As for investment, we consider two different formulations, namely:

$$\log I_t = \beta_o + \beta_1 \log Y_t + \beta_2 \log(1 + r_t) + \beta_3 f_t + \beta_4 dumcm_t + \varepsilon_t \tag{2.2}$$

and

$$i_t = \gamma_0 = \gamma_1 \log(1 + r_t) + \gamma_2 f_t + \gamma_3 dumcm_t + \varepsilon_t \tag{2.3}$$

where f, I, i and Y are defined as above and r_t is an adjusted real long-term interest rate.

Both equations (2.2) and (2.3) assess to what extent fixed capital formation is explained by financial development and the price of capital. Equation (2.3) takes the investment/GDP ratio as a dependent variable following Benhabib and Spiegel (2000).

Results

We estimate equations (2.1) to (2.3) by means of both GLS and 2SLS techniques. GLS results are reported in Tables 1, 4 and 7. Since the financial development indicator could indeed be endogenous, it is instrumented with a set of instruments that include its lagged value, the lagged dependent variable and a time trend. 2SLS results are reported in Tables 2 and 5. Table 3 contains 2SLS results where both financial development and investment as a ratio of GDP are considered as being potentially endogenous: among the variables used to instrument the former, we employ its lagged value. Table 6 reports 2SLS results where both log$Y$ and the financial development indicator are taken as endogenous.

When estimating equation (2.1) (GDP growth as a dependent variable), a pool of 42 countries is considered. We add to the 30 OECD countries,[7] 12 emerging market economies: Argentina, Brazil, Chile, Colombia and Uruguay (the most developed southern American economies), China and India (large and fast-growing Asian economies), South Africa and Tunisia (data-reliable and fast growing African economies), Israel, Slovenia and Croatia. Our estimations[8] show (Tables 1–3) that standard growth theory results are confirmed. Population

[7] Australia, Austria, Belgium, Canada, Switzerland, Czech Republic, Denmark, Spain, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, Norway, New Zealand, Poland, Portugal, Slovak Republic, Sweden, Turkey, the United Kingdom and the United States.

[8] In most estimations, the sample shrinks to 38 countries due to data availability.

Table 1: Three-year Averages; Dependent Variable: Growth Rate of Real GDP (*ygr*); Estimation Method: GLS

Independent Variables	*Financial Development Indicators* *smc*	*vtr*	*tur*	*dmb*	*lil*	*prc*
*ly*0	–4.082**	–3.329**	–3.330**	–2.629**	–2.751**	–2.649**
	(–4.92)	(–4.76)	(–3.95)	(–5.93)	(–5.65)	(–5.93)
Infl	–0.001*	–0.002**	–0.002**	–0.003**	–0.003**	–0.003**
	(–2.00)	(–2.67)	(–2.11)	(–3.50)	(–3.53)	(–3.46)
popgr	0.679*	1.009**	0.0872**	0.978**	1.034**	0.977**
	(2.39)	(3.76)	(2.99)	(6.01)	(5.67)	(5.95)
I/Y	0.108**	0.117**	0.105**	0.160**	0.168**	0.158**
	(3.46)	(3.88)	(3.22)	(8.35)	(7.67)	(8.13)
dumcm	0.777*	1.036*	1.035*	0.455	0.669*	0.407
	(1.72)	(2.50)	(2.29)	(1.61)	(1.95)	(1.43)
fd	1.209**	0.847*	0.408	–0.777	–1.172	–0.614
	(3.63)	(2.01)	(1.39)	(–2.19)*	(–2.38)*	(–1.51)
const	15.065**	11.839**	12.324**	9.436**	9.833**	9.437**
	(4.76)	(4.40)	(3.80)	(5.62)	(5.25)	(5.57)
Obs	294	293	280	443	369	436
(Countries)	(38)	(38)	(38)	(38)	(33)	(38)
R^2	0.291	0.276	0.257	0.280	0.311	0.276

Source: Authors' own data.
Notes: ** and * denote significance at 1 and 10% respectively; t-statistics are reported in parenthesis.

Table 2: Three-year Averages; Dependent Variable: Growth Rate of Real GDP (*ygr*); Estimation Method: 2SLS(1)

Independent Variables	*Financial Development Indicators* *smc*	*vtr*	*tur*	*dmb*	*lil*	*prc*
*ly*0	–3.617**	–3.378**	–3.040**	–2.806**	–2.989**	–2.825**
	(–5.74)	(–4.83)	(–4.47)	(–6.48)	(–6.62)	(–6.53)
infl	–0.002*	–0.002*	–0.002*	–0.002**	–0.003**	–0.002**
	(–2.20)	(–2.15)	(–2.30)	(–3.36)	(–3.56)	(–3.31)
popgr	0.617*	0.718*	0.767**	0.889**	0.885**	0.889**
	(2.31)	(2.54)	(2.71)	(5.33)	(4.92)	(5.31)
I/Y	0.120**	0.119**	0.128**	0.152**	0.159**	0.148**
	(4.29)	(3.68)	(3.99)	(7.93)	(7.63)	(7.74)
dumcm	0.456	0.808*	0.735*	0.434	0.612*	0.373
	(1.18)	(1.89)	(1.79)	(1.58)	(1.93)	(1.36)
fd	1.112**	0.093	0.138	–0.474	–0.975*	–0.252
	(2.87)	(0.18)	(0.35)	(–1.20)	(–2.12)	–0.62)
const	13.148**	12.624**	10.993**	10.143**	10.929**	10.179**
	(5.32)	(4.62)	(4.11)	(6.14)	(6.22)	(6.16)
Obs	245	255	241	405	336	398
(Countries)	(38)	(38)	(38)	(38)	(33)	(38)
R^2	0.300	0.237	0.248	0.278	0.315	0.273

Source: Authors' own data.
Notes: ** and * denote significance at 1 and 10% respectively; t-statistics are reported in parenthesis.

Table 3: Three–year Averages; Dependent Variable: Growth Rate of Real GDP (ygr); Estimation Method: 2SLS(2)

Independent Variables	*Financial Development Indicators* *smc*	*vtr*	*tur*	*dmb*	*lil*	*prc*
*ly*0	–3.494**	–3.069**	–2.565**	–2.578**	–2.741**	–2.575**
	(–6.26)	(–5.03)	(–4.47)	(–5.88)	(–5.98)	(–5.86)
infl	–0.002*	–0.002*	–0.002**	–0.003**	–0.003**	–0.003**
	(–2.45)	(–2.56)	(–2.72)	(–3.64)	(–3.69)	(–3.58)
popgr	0.423*	0.605*	0.690**	0.809**	0.839**	0.805**
	(1.67)	(2.28)	(2.65)	(4.79)	(4.61)	(4.73)
I/Y	0.057*	0.034	0.048	0.089**	0.103**	0.086**
	(2.04)	(1.02)	(1.51)	(4.23)	(4.56)	(4.11)
dumcm	0.228	0.593	0.530	0.315	0.525	0.277
	(0.65)	(1.52)	(1.44)	(1.13)	(1.64)	(1.00)
fd	1.306**	0.529	0.523	–0.150	–0.563	–0.014
	(3.71)	(1.05)	(1.36)	(–0.37)	(–1.20)	(–0.03)
const	14.186**	13.316**	10.812**	10.599**	11.031**	10.576**
	(6.37)	(5.49)	(4.72)	(6.34)	(6.21)	(6.31)
Obs	245	255	241	405	336	398
(Countries)	(38)	(38)	(38)	(38)	(33)	(38)
R^2	0.285	0.222	0.328	0.259	0.303	0.255

Source: Authors' own data.
Notes: ** and * denote significance at 1 and 10% respectively; t-statistics are reported in parenthesis.

Table 4: Three-year Averages; Dependent Variable: Log of Real Investment (log(*I*)); Estimation Method: GLS

Independent Variables	*Financial Development Indicators* *smc*	*vtr*	*tur*	*dmb*	*lil*	*prc*
log(*Y*)	1.011**	1.014**	1.012**	0.993**	0.989**	0.989**
	(54.60)	(52.69)	(55.02)	(57.71)	(49.05)	(55.92)
log(1+*r*)	–0.247	–0.451*	–0.286	–0.365*	–0.705**	–0.428*
	(–1.18)	(–2.16)	(–1.34)	(–1.72)	(–2.95)	(–1.96)
dumcm	–0.039	–0.036	–0.029	–0.047	–0.146**	–0.056*
	(–1.24)	(–1.13)	(–0.93)	(–1.63)	(–3.80)	(–1.80)
fd	0.063*	0.053*	0.034*	–0.015	0.111*	0.023
	(2.42)	(2.07)	(1.74)	(–0.46)	(2.03)	(0.60)
const	–1.645**	–1.711**	–1.684**	–1.269**	–1.226**	–1.208**
	(–4.62)	(–4.65)	(–4.79)	(–3.94)	(–3.28)	(–3.64)
Obs	192	197	191	272	220	26
(Countries)	(28)	(28)	(28)	(28)	(23)	(28)
R^2	0.984	0.985	0.985	0.980	0.981	0.981

Source: Authors' own data.
Notes: ** and * denote significance at 1 and 10% respectively; t-statistics are reported in parenthesis.

Table 5:Three-year Averages; Dependent Variable: Log of Real Investment (log(*I*)); Estimation Method: 2SLS(1)

Independent Variables	*Financial Development Indicators* *smc*	*vtr*	*tur*	*dmb*	*lil*	*prc*
log(*Y*)	0.989**	0.988**	0.987**	0.977**	0.976**	0.984**
	(53.37)	(51.11)	(51.23)	(52.80)	(47.88)	(54.06)
log(1+*r*)	0.148	0.096	–0.074	–0.361*	–0.672	–0.352
	(0.58)	(0.35)	(–0.27)	(–1.67)	(–2.87)**	(–1.62)
dumcm	–0.049	–0.055*	–0.039	–0.053	–0.152**	–0.059*
	(–1.56)	(–1.71)	(–1.23)	(–1.80)	(–4.00)	(–1.89)
fd	0.099**	0.124**	0.092**	0.011	0.128*	–0.011
	(3.32)	(3.87)	(3.40)	(0.24)	(2.20)	(–0.26)
const	–1.276**	–1.246**	–1.236**	–0.982**	–0.988**	–1.101**
	(–3.59)	(–3.36)	(–3.35)	(–2.87)	(–2.62)	(–3.25)
Obs	169	174	167	258	208	251
(Countries)	(28)	(28)	(28)	(28)	(23)	(28)
R^2	0.984	0.985	0.985	0.982	0.983	0.982

Source: Authors' own data.
Notes: ** and * denote significance at 1 and 10% respectively; t-statistics are reported in parenthesis.

Table 6: Three-year Averages; Dependent Variable: Log of Real Investment (log (*I*)); Estimation Method: 2SLS(2)

Independent Variables	*Financial Development Indicators* *smc*	*vtr*	*tur*	*dmb*	*lil*	*prc*
log (*Y*)	0.998**	0.995**	0.992**	0.989*	0.986**	0.995**
	(54.66)	(54.45)	(52.58)	(54.27)	(48.90)	(54.66)
log(1+*r*)	0.138	0.093	–0.086	–0.380*	–0.698**	–0.377*
	(0.54)	(0.34)	(–0.32)	(–1.76)	(–2.98)	(–1.74)
dumcm	–0.045	–0.053*	–0.039	–0.054*	–0.154**	–0.060*
	(–1.46)	(–1.67)	(–1.23)	(–1.86)	(–4.06)	(–1.93)
fd	0.090**	0.119**	0.097**	0.009	0.138*	–0.008
	(2.99)	(3.72)	(3.57)	(0.19)	(2.37)	(–0.19)
const	–1.448**	–1.387**	–1.333**	–1.211**	–1.187**	–1.303**
	(–4.14)	(–3.96)	(–3.69)	(–3.58)	(–3.19)	(–3.85)
Obs	169	174	167	258	208	251
(Countries)	(28)	(28)	(28)	(28)	(23)	(28)
R^2	0.984	0.985	0.985	0.982	0.983	0.982

Source: Authors' own data.
Notes: ** and * denote significance at 1 and 10% respectively; t-statistics are reported in parenthesis.

Table 7: Three-year Averages; Dependent Variable: Investment/GDP Ratio *(I/Y)*; Estimation Method: GLS

Independent Variables	*Financial Development Indicators* *smc*		*vtr*		*tur*		*dmb*		*lil*		*prc*	
log(1+*r*)	–6.046 (–1.23)	3.106 (0.53)	–10.733* (–2.17)	–9.630* (–1.99)	–6.455 (–1.27)	0.178 (0.03)	–10.923* (–2.15)	–11.18* (–2.24)	–20.00** (–3.48)	–19.64** (–3.43)	–12.82* (–2.45)	–11.62* (–2.25)
dumcm	–1.000 (–1.33)	–1.176 (–1.58)	–0.908 (–1.19)	–1.044 (–1.41)	–0.710 (–0.96)	–0.746 (–1.00)	–1.140 (–1.64)	–1.087 (–1.55)	–3.477** (–3.76)	–3.446** (–3.73)	–1.396* (–1.87)	–1.389* (–1.88)
fd	1.526* (2.55)		1.177* (2.05)		0.627 (1.36)		–0.677 (–0.93)		2.054* (1.68)		–0.007 (–0.001)	
fd_{-1}		2.672** (3.86)		2.216** (3.20)		1.154* (2.40)		–0.716 (–0.93)		1.709 (1.39)		–0.400 (–0.45)
Obs (Countries)	192 (28)	176 (28)	197 (28)	194 (28)	191 (28)	175 (28)	272 (28)	270 (28)	222 (23)	220 (23)	265 (28)	264 (28)
R^2	0.047	0.052	0.076	0.076	0.104	0.118	0.082	0.028	0.127	0.117	0.048	0.038

Source: Authors’ own data.
Notes: ** and * denote significance at 1 and 10% respectively; t-statistics are reported in parenthesis.

growth and capital accumulation (as proxied by *I/Y*) support growth, which also benefits from a catching-up effect. Inflation depresses growth moderately but significantly. These results are unchanged if we use the five-year average specifications (instead of three years).

EU membership enhances growth: the common market dummy is always positively linked to growth although it turns out to be significant only in some specifications. The dummy becomes non-significant when we add a variable accounting for trade openness: this suggests that joining the common market stimulates growth through trade (these specific results are available on request).

As far as financial variables are concerned, stock market capitalization has a significant positive effect in all the cases we considered. Other market-related variables, although weakly significant in most cases, enter the regressions with a positive sign, while some credit variables may have a limited significant negative impact (which however tends to lose significance once 2SLS techniques are implemented).

When investment enters as a dependent variable both as a log of the level and as a share of output (Tables 4–7), we are forced to limit our pool to a maximum of 30 OECD countries. When log*I* enters as a dependent variable, output is always significant. Stock market variables significantly affect investment. The real interest rate negatively affects investment, but its parameter is significant only when the financial variable is bank-based. Moreover, in such cases, the common market dummy, which always enters with a negative sign, is significant. These results are largely confirmed when the ratio *I/Y* is taken as a dependent variable. In such a case, the negative impact of the interest rate on investment is more pronounced.

To sum up, controlling for the traditional determinants of growth, our results indicate that market-based financial systems stimulate both output growth and investment more than bank-based ones. Our results also indicate that EU membership enhances output growth.

Total Factor Productivity (TFP)

The equation we estimate is:

$$TFP = \alpha_0 + \alpha_1 \cdot TFP_0 + \alpha_2 \cdot \pi + \alpha_3 \cdot \frac{I}{Y} + \alpha_4 \cdot f + \alpha_5 \cdot OP + \alpha_6 \cdot dumcm \qquad (2.4)$$

where *TFP* is the total factor productivity, as computed by Baier *et al.* (2002), π is the inflation rate, *I/Y* and *OP* are, respectively, the investment share of GDP and an openness indicator, while *dumcm* and *f* are, as before, the EU dummy and the financial development indicators. TFP data are end-of-period observations (1960, 1970, 1980, 1990 and 2000), while the explanatory variables are five-year 'backward' averages (1966–70 as the average for 1970, 1976–80 for 1980, and so on). The possible reverse-causality problem is thus avoided, and we can perform GLS estimation. Our panel includes 61 countries: all OECD countries, Latin American countries and some Asian and African countries for which reliable data on financial development are available.

The structure of equation (2.4) draws on Senhadji (2000) and Miller and Upadhyay (2002). Both include a human capital measure among the independent variables. We have tested this variable as proxied by the average years of schooling (from the Barro-Lee dataset), but it turned out to be always non-significant.

Looking at the results in Table 8 we see that, as expected, inflation affects negatively TFP while investment increases it; openness is not significant in most cases. The common market dummy is always highly significant suggesting that integration affects technological accumulation. When the common market dummy is not included, financial development indicators are significant, with the correct sign, in four cases out of six; market variables seem to matter more than banks. When the common market dummy is retained, financial variables tend to become non-significant (with the exception of VTR). In conclusion, market-based finance does seem to have some effect on technological accumulation, but the latter turns out to be strongly affected by EU membership as well. Our results may also suggest that the positive impact of EU membership can be, at least partially, related to financial development.

III. ECM Models

Country-specific and panel analysis of the growth–finance relationship can also be carried out through the estimation of suitable error correction models (ECM). This should allow us to detect possible co-integration between variables (provided that the different variables are integrated of the same order)[9] and proves very useful for analysing country-specific aspects of the growth–finance nexus.

Specification of Equations

We consider either GDP or investment as dependent variables. In the first case we consider the following equation:

$$Y_t = \alpha_0 + \alpha_1 i_t + \alpha_2 \pi_t + \alpha_3 f_t + \varepsilon_t \tag{3.1}$$

where Y_t is real GDP, $i_t = (I_t/Y_t)$ is the output share of investment, π_t is inflation and f_t represents the financial development indicator. Equation (3.1) has

[9] Unit root tests results are available on request.

Table 8: Dependent Variable: *tfp* (Level); Estimation Method: GLS

Independent Variables	*Financial Development Indicators* *smc*		*vtr*		*tur*		*lil*		*prcfd*		*dmb*	
*tfp*0	0.59*** (8.20)	0.63*** (7.93)	0.61*** (8.39)	0.65*** (8.14)	0.62*** (8.35)	0.67*** (8.33)	0.74*** (13.32)	0.76*** (13.28)	0.73*** (13.81)	0.76*** (13.34)	0.74*** (13.77)	0.76*** (13.39)
infl	–0.03** (–2.06)	–0.03** (–2.03)	–0.03** (–2.27)	–0.03** (–2.29)	–0.03** (–2.06)	–0.03** (–2.04)	–0.04*** (–2.84)	–0.04*** (–2.86)	–0.04*** (–2.97)	–0.04*** (–2.93)	–0.04*** (–3.02)	–0.04*** (–2.98)
I/Y	2.96*** (5.43)	3.12*** (5.27)	2.58*** (4.89)	2.65*** (4.65)	3.09*** (5.44)	3.25*** (5.31)	1.91*** (4.38)	2.04*** (4.51)	2.01*** (4.86)	2.11*** (4.83)	2.09*** (5.11)	2.16*** (5.05)
fd	14.71 (1.54)	18.40* (1.85)	21.48** (2.16)	27.40*** (2.71)	4.65 (0.69)	7.81 (1.13)	13.29 (1.12)	15.93 (1.31)	9.86 (0.89)	18.95* (1.68)	7.78 (0.77)	16.39* (1.64)
op	–0.13 (–1.41)	–0.13 (–1.26)	–0.10 (–1.15)	–0.09 (–0.93)	–0.08 (–0.92)	–0.07 (–0.68)	–0.15* (–1.92)	–0.15* (–1.86)	–0.13* (–1.74)	–0.12 (–1.60)	–0.14* (–1.95)	–0.14* (–1.79)
dumcm	36.69*** (3.95)		35.42*** (3.79)		36.84*** (3.87)		27.75*** (2.99)		30.53*** (3.89)		28.88*** (3.64)	
const	22.39 (1.55)	18.65 (1.17)	26.33* (1.82)	23.34 (1.46)	14.48 (0.98)	7.90 (0.49)	22.36** (2.05)	18.25 (1.61)	22.63** (2.13)	18.05 (1.59)	22.93** (2.17)	18.24* (1.64)
Obs (Countries)	145 (61)	145 (61)	151 (61)	151 (61)	141 (61)	141 (61)	205 (57)	205 (57)	220 (61)	220 (61)	224 (61)	224 (61)
R^2	0.70	0.65	0.69	0.64	0.69	0.63	0.68	0.66	0.69	0.66	0.69	0.66

Source: Authors' own data.

Notes: ***,** and* denote significance at 1, 5 and 10% respectively; t-statistics are reported in parenthesis.

already been tested by Christopoulos and Tsionas (2004) in an analysis of the growth–finance nexus in developing countries.

When investment enters as a dependent variable, our reference equation is that proposed by Leahy *et al.* (2001):

$$I_t = \beta_0 + \beta_1 Y_t + \beta_2 (1 + r_t) + \beta_3 f_t + \varepsilon_t \tag{3.2}$$

where f_t, i_t and Y_t are defined as above and r_t is an adjusted real long-term interest rate.

To introduce the ECM specification, we generalize (3.1) and (3.2) as:

$$g_t = \gamma_0 + \gamma_1 x_t + \gamma_2 y_t + \gamma_3 f_t + \varepsilon_t \tag{3.3}$$

where g_t is the dependent variable, f_t is the financial development variable and x_t and y_t are additional explanatory variables. Provided that the variables are co-integrated, an OLS regression yields a 'super-consistent' estimator of the co-integration parameters (γs in 3.3), and the residual can be used to estimate the ECM formulation, which may be written as:

$$\begin{aligned} \Delta g_t &= \delta_0 + \delta_1 (g_{t-1} - \gamma_0 - \gamma_1 x_{t-1} - \gamma_2 y_{t-1} - \gamma_3 f_{t-1}) \\ &+ \sum_j \delta_{2j} \Delta g_{t-1} + \sum_i \delta_{3i} \Delta x_{t-1} + \sum_i \delta_{4i} \Delta y_{t-1} + \sum_i \delta_{5i} \Delta x_{t-1} + \sum_i \delta_{6i} \Delta x_{t-1} + u_t \end{aligned} \tag{3.4}$$

The parameter δ_1 represents the 'speed of adjustment' of the error correction process to the long-run equilibrium.[10]

Results

When GDP enters as a dependent variable, 11 OECD countries are considered: Australia, Belgium, France, Germany, Italy, Japan, Korea, Spain, Sweden, the UK and the United States. To assess co-integration, we perform the Johansen (1988) test for each country. Two versions of the test are considered, depending on whether the intercept is included in the co-integrating equation or not. We retain the version with intercept whenever the latter is significant in the co-integrating relationship. The results (see Tables 9a–9j) are quite clear-cut: the null hypothesis of no co-integration ($R = 0$) is rejected at a high level of significance for the vast majority of countries and indicators, while the hypothesis of one co-integrating vector is widely accepted. We then proceed to estimate the long-run relationship. We omit the ECM co-efficient as it turned out to be non-significant. The impact of financial development is significantly positive in most cases (Italy is a notable exception). In several country cases, both bank and market variables are indeed significant, lending support to the hypothesis that the size, rather than the type, of financial deepening matters

[10] A negative δ_1 would imply that the short-run adjustment is driven by the size of the gap between actual and equilibrium values of the variables.

Table 9a: Belgium, GDP

Financial Dev't Indicators	*I/Y*	*Inflation*	*FD*	*Intercept*	*R = 0*	*R ≤ 1*	*R ≤ 2*	*Lags*
	Co-integrating Equation (Long-run Relationship)				*Johansen Co-integration Tests: Likelihood Ratios and Lags*			
cps	–148.67*	1.02*	68.36**	61.72**	47.29°	16.77	4.44	1
lil	–204.45*	1.10	94.90**	45.70*	43.16	20.09	4.72	2
prc	–109.52	0.93*	87.84**	50.82**	47.63°	17.94	3.81	2
smc	–39.92	–0.15	69.05**	59.92**	55.19°	25.94	10.12	1
tur	180.72**	–1.07	111.00**	23.61	58.36°°	24.80	13.01	1
vtr	55.27	–1.05*	224.84**	54.32**	56.29°°	23.67	9.16	1

Source: Authors' own data.
Notes: * and ** denote statistical ignificance at the 10% and 1% level respectively. ° and °° denote rejection of the null hypothesis of no co-integration at the 5% and 1% level respectively. Critical values for the likelihood ratios are 54.46, 35.65 and 20.04 (45.58, 29.75 and 16.31 when no deterministic trend – no intercept – is assumed). The same applies for Tables 9b–j below.

Table 9b: France, GDP

Financial Dev't Indicators	*I/Y*	*Inflation*	*FD*	*Intercept*	*R = 0*	*R ≤ 1*	*R ≤ 2*	*Lags*
	Co-integrating Equation (Long-run Relationship)				*Johansen Co-integration Tests: Likelihood Ratios and Lags*			
cps	–97.45	0.06	55.72**	42.81**	41.87	24.20	9.81	2
lil	–447.54**	–0.31	135.60**	69.68*	40.54	22.45	7.40	2
prc	–74.33	0.08	56.88**	38.35*	47.40°	28.29	12.35	2
smc	–80.81	–0.25	52.87**	74.87**	54.60°°	28.18	5.24	1
tur	278.05**	–1.23**	41.38**		57.02°°	15.89	5.35	1
vtr	–48.06	–1.06**	45.69**	78.87**	57.61°°	20.54	3.33	1

Source and Notes: As Table 9a.

Table 9c: Germany, GDP

Financial Dev't Indicators	*I/Y*	*Inflation*	*FD*	*Intercept*	*R = 0*	*R ≤ 1*	*R ≤ 2*	*Lags*
	Co-integrating Equation (Long-run Relationship)				*Johansen Co-integration Tests: Likelihood Ratios and Lags*			
cps	79.40**	–0.21	44.93**	–31.16**	48.42°	23.69	7.14	1
lil	141.91**	–0.44*	103.53**	–68.27**	48.32°	25.61	10.66	2
prc	62.40**	–0.07	46.24**	–24.99**	53.17°	22.39	6.73	1
smc	242.14**	–0.36	48.56**	–31.88**	67.60°°	27.21	12.99	1
tur	289.19**	–1.11*	3.88**	–33.74**	64.96°°	24.49	8.90	1
vtr	284.54**	–1.00**	15.85**	–32.79**	94.32°°	38.22°°	19.29°	1

Source and Notes: As Table 9a.

Table 9d: Italy, GDP

Financial Dev't Indicators	*Co-integrating Equation (Long-run Relationship)* I/Y	*Inflation*	*FD*	*Intercept*	*Johansen Co-integration Tests: Likelihood Ratios and Lags* R = 0	*R ≤ 1*	*R ≤ 2*	*Lags*
cps	–115.34**	0.26*	–14.22*	44.72**	81.46°°	31.79°	7.81	2
lil	–88.71	0.34**	–17.18*	42.26**	77.40°°	30.62°	7.84	2
prc	–66.82	0.18*	–21.67**	38.45**	65.71°°	30.19°	7.32	1
smc	–47.21**	–0.03	14.17*	23.94**	69.85°°	30.31°	9.00	1
tur	–52.20*	–0.15*	0.54	27.61**	67.24°°	17.74	5.89	1
tur	83.39**	–0.50**	6.55**		50.63°°	19.15	4.03	2
vtr	–64.01*	–0.12	1.21	29.96**	44.98	18.35	6.16	2

Source and Notes: As Table 9a.

Table 9e: Japan, GDP

Financial Dev't Indicators	*Co-integrating Equation (Long-run Relationship)* I/Y	*Inflation*	*FD*	*Intercept*	*Johansen Co-integration Tests: Likelihood Ratios and Lags* R = 0	*R ≤ 1*	*R ≤ 2*	*Lags*
cps	–14793.84**	26.74*	7974.93**		48.12°°	21.63	6.98	2
lil	6237.96*	–24.68*	2980.92**	–2713.71**	62.72°°	18.44	8.04	1
prc	–4947.13	4.31	7203.43**	–2015.11*	52.63°	26.09	10.76	2
smc	1872.09	–175.30*	976.96*	3259.69	59.01°°	21.17	7.80	1
tur	19248.83**	–318.01**	–1759.36**		65.33°	26.47°	5.23	1
vtr	16397.91**	–279.17**	–306.71		61.12°°	23.52	8.56	2

Source and Notes: As Table 9a.

Table 9f: Korea, GDP

Financial Dev't Indicators	*Co-integrating Equation (Long-run Relationship)* I/Y	*Inflation*	*FD*	*Intercept*	*Johansen Co-integration Tests: Likelihood Ratios and Lags* R = 0	*R ≤ 1*	*R ≤ 2*	*Lags*
cps	9002.47**	–16.96*	7160.09**	–3905.78**	55.12°°	28.28	11.72	1
lil	7322.20**	–19.97**	4807.86**	–2266.42**	68.98°°	29.21	10.19	1
prc	7660.28**	–7.71	7880.50**	–3656.43**	82.76°°	30.76°	9.40	2
smc	15243.12**	–57.32**	1500.27	–2579.87*	127.13°°	67.05°°	28.21°°	2
tur	15774.53**	–40.21**	1118.00**	–3061.64**	72.18°°	31.83°	13.97	1
vtr	12459.77**	–40.85**	1952.49**	–1938.84*	66.55°°	22.81	5.51	1

Source and Notes: As Table 9a.

Table 9g: Spain, GDP

Financial Dev't Indicators	*Co-integrating Equation (Long-run Relationship)* *I/Y*	*Inflation*	*FD*	*Intercept*	*Johansen Co-integration Tests: Likelihood Ratios and Lags* *R = 0*	*R ≤ 1*	*R ≤ 2*	*Lags*
cps	–1345.35	–11.53	859.14*	319.68*				
lil	–2837.37**	–7.49*	2165.47**	–370.13*	56.01°°	29.09	9.24	1
prc	–1441.12**	–10.94**	1460.73**	16.65	48.76°	24.09	8.61	1
smc	183.09	–9.68**	351.27**	563.77**	72.36°°	34.67°	12.92	1
tur	1105.84*	–11.97**	64.48*	434.87**	54.78°°	28.94	11.33	1
vtr	665.79	–12.86**	117.34*	546.69**	50.35°	27.02	8.42	1

Source and Notes: As Table 9a.

Table 9h: Sweden, GDP

Financial Dev't Indicators	*Co-integrating Equation (Long-run Relationship)* *I/Y*	*Inflation*	*FD*	*Intercept*	*Johansen Co-integration Tests: Likelihood Ratios and Lags* *R = 0*	*R ≤ 1*	*R ≤ 2*	*Lags*
cps	–106.55**	–0.02	23.85**	24.11**	54.61°°	23.85	8.42	1
lil	–34.66**	0.09*	–44.57**	42.73**	41.42	21.26	6.00	1
prc	–90.59**	0.09	17.96**	22.85**	57.43°°	29.95°	4.34	1
smc	7.70	–0.08	5.21**	11.85**	74.01°°	29.37	4.91	2
tur	40.35*	–0.27**	5.92**	7.24*	52.61°	26.19	11.91	1
vtr	27.82 *	–0.25 **	5.47 *	10.33 **	82.08 °°	21.73	4.69	2

Source and Notes: As Table 9a.

Table 9i: United Kingdom, GDP

Financial Dev't Indicators	*Co-integrating Equation (Long-run Relationship)* *I/Y*	*Inflation*	*FD*	*Intercept*	*Johansen Co-integration Tests: Likelihood Ratios and Lags* *R = 0*	*R ≤ 1*	*R ≤ 2*	*Lags*
cps	–11.01*	0.06**	3.31**	5.04**	46.21	26.83	14.01	2
lil	–10.31*	0.07**	4.42**	4.26**	63.52°°	29.68°	12.89	2
prc	–7.73*	0.05**	3.14**	4.63**	56.99°°	27.60	13.22	2
smc	3.74*	–0.01	2.45**	3.50**	99.62°°	44.8°°	15.18	2
tur	–1.21	–0.09**	1.75**	6.21**	57.71°°	23.28	9.42	1
vtr	2.40	–0.06**	2.07**	5.32**	72.97°°	28.16	10.19	2

Source and Notes: As Table 9a.

Table 9j: United States, GDP

Financial Dev't Indicators	*Co-integrating Equation (Long-run Relationship)*				*Johansen Co-integration Tests: Likelihood Ratios and Lags*			
	I/Y	*Inflation*	*FD*	*Intercept*	*R = 0*	*R ≤ 1*	*R ≤ 2*	*Lags*
cps	84.12	–1.04**	273.45**	–55.95**	60.95°°	26.87	14.42	2
lil	274.97	–0.62	–70.43	52.96	71.90°°	27.15	13.60	1
prc	–102.67	–1.32*	189.47**	–40.43*	67.94°°	28.73	16.02	1
smc	–207.10*	–0.27	40.85**	70.16**	72.37°°	42.33°°	13.29	1
tur	–283.25**	0.33	37.19**	83.25**	58.93°°	27.31	8.25	1
vtr	–180.79	–0.51	29.91**	80.19**	75.73°°	33.19°	9.23	1

Source and Notes: As Table 9a.

for growth. Evidence is more mixed about the long-run impact of inflation and investment share on GDP. Finally, let us underline that the huge variability in the size of coefficients is due to the fact that real GDP is expressed in national currency units (differently from the panel estimation we will describe below), and then it does not hide anything pathological.

When investment enters as a growth variable, we extend our pool to 18 countries by adding Austria, Canada, Denmark, Netherlands New Zealand, Norway and Switzerland. We estimate the complete ECM equation as in (3.4). We retain, and report in Table 10, only cases in which: co-integration tests give satisfactory results; explanatory variables enter with the expected sign in the co-integrating relationship and are significant; and the error correction term is significant at least at the 10 per cent level in the ECM estimation. In addition, we allow both an intercept and a time trend to enter the co-integrating relationship.[11] We find that our strong requirements are met in several cases, with the error correction term having the expected negative sign. While both market and bank variables enter significantly some differences may be singled out. Both banks and markets exert an influence on investment, in countries that are traditionally associated with the 'Anglo-Saxon' model (Australia, Denmark, Netherlands, UK), but also in some countries usually belonging to the 'continental' model (Germany, Japan). In only a few cases do either market (Austria, US) or bank (Belgium, France, Italy, Korea, Norway, New Zealand, Switzerland) seem to prevail.

To reconsider all these country-specific results in a unified framework, we have also tried to run panel regressions based on a *dynamic fixed effects* version (model) of equation (3.4). To ensure homogeneity of the data, here

[11] Of course, the specification of the Johansen test is chosen in order to take into account the possible presence of intercept and time (deterministic – linear trend).

Table 10: ECM Models of the Investment/Financial Development Relationship (Country-specific)

Country, Fin. Dev't Indicator	*Error Correction Term: Long-run Coefficient*	*Co-integrating Equation (Long-run Relationship)*					*Johansen Co-integration Tests: Likelihood Ratios and Lags*		
		Real GDP	*(1+r)*	*FD*	*Intercept*	*Time Trend*	*R=0*	*R≤1*	*R≤2*
Australia lil	–0.25** (–2.97)	0.68**	–2.35**	1.63**			51.33°°	21.05	10.61
Australia tur	–0.85** (–2.52)	0.91**	–0.30	0.04*	–1.32**		64.20°°	35.80°	21.38°
Austria smc	–0.70* (–2.14)	0.66**	–2.98*	0.14**			42.74°	22.85	9.32
Austria tur	–0.29* (–2.24)	0.59**	–5.14*	0.08**			46.59°°	27.23°	9.28
Austria vtr	–0.51* (–2.09)	0.93**	–2.91*	0.03*	–1.08*		51.58°	22.00	7.26
Belgium lil	–0.36* (–2.08)	0.89**	–0.63*	0.29**	–1.00**		64.13°°	25.65	10.66
Denmark prc	–0.27* (–1.94)	1.14**	–2.88**	0.32**	–1.47**		55.89°°	27.29	11.45
Denmark smc	–0.72** (–3.40)	0.41**	–3.58**	0.10**			58.67°°	27.72°	12.31
Denmark **SMC**	–2.14** (–3.11)	3.26**	–2.70**	0.21**	–4.34**	–0.06**	94.05°°	45.20°	20.73
Denmark tur	–0.70** (–3.17)	0.38**	–3.69**	0.03*			45.58°°	28.72°	12.64°
Denmark vtr	–0.74** (–3.33)	0.39**	–3.79**	0.02**			61.23°°	33.98°°	14.16°
Denmark **VTR**	–1.54* (–2.19)	3.57**	–2.50**	0.06**	–4.96**	–0.07**	173.13°°	62.97°°	25.67°
France cps	–0.35* (–2.38)	0.64**	–1.18*	0.23**			49.19°°	25.96°	11.44
France prc	–0.38** (–2.87)	0.64**	–1.25**	0.22**			52.69°°	30.46°°	12.97°
Germany cps	–0.19** (–2.79)	0.57**	–2.59	0.30**			50.32°°	20.49	8.49
Germany smc	–0.43** (–4.28)	0.70**	–4.23*	0.23**			46.39°°	21.60	7.58
Germany tur	–0.46* (–2.81)	0.61**	–4.86*	0.12**			68.43°°	31.67°	10.89
Germany vtr	–0.47** (–3.64)	0.64**	–4.66*	0.08**			63.05°°	31.62°°	12.00
Italy cps	–0.60** (–4.43)	0.85**	–0.31	0.25**	–1.06**		60.73°°	34.63	20.0°
Japan cps	–0.60** (–4.87)	0.85**	–0.51*	0.53**			65.70°°	30.04°°	11.82
Japan **CPS**	–0.49* (–2.65)	1.38*	–0.43*	0.35**	–3.89**	–0.02**	88.85°°	47.67°	19.13
Japan lil	–0.47** (–3.49)	0.83**	–0.50*	0.25**			53.24°°	18.06	7.01

Table 10: ECM Models of the Investment/Financial Development Relationship (Country-specific) (Contd)

Country, Fin. Dev't Indicator	*Error Correction Term: Long-run Coefficient*	*Co-integrating Equation (Long-run Relationship)*					*Johansen Co-integration Tests: Likelihood Ratios and Lags*		
		Real GDP	*(1+r)*	*FD*	*Intercept*	*Time Trend*	*R=0*	*R≤1*	*R≤2*
Japan prc	–0.63** (–4.52)	0.85**	–0.50*	0.45**			67.43°°	36.89°°	9.91
Japan smc	–0.66* (–1.93)	0.86**	–1.06*	0.12**			49.84°°	17.51	6.16
Japan vtr	–1.04* (–2.35)	2.09**	–1.84**	0.02*	–9.28**	–0.04**	85.65°°	50.50°°	21.82
Korea prc	–0.34* (–2.67)	0.92**	1.26	0.85**			76.69°°	36.70°°	6.53
Netherlands prc	–0.20* (–1.72)	0.22**	–2.94**	0.48**			54.12°°	23.80	7.58
Netherlands smc	–0.79* (–2.30)	0.19**	–1.02*	0.22**			37.80	19.88	7.92
Norway cps	–0.16* (–1.79)	0.54**	–4.27**	0.39**			47.79°°	23.66	8.54
Norway lil	–0.15* (–1.88)	0.73**	–3.31**	1.11**			41.89°	19.55	9.26
New Zealand cps	–0.49** (–4.09)	0.77**	–0.63*	0.10**			44.10°	21.60	6.15
Switzerland cps	–0.44* (–1.93)	0.91**	–2.07**	0.38**	–1.40**		58.66°°	30.17°°	12.81
Switzerland prc	–0.44* (–2.04)	0.89**	–1.97**	0.37**	–1.37**		50.65°	28.16	13.17
UK cps	–0.14* (–1.72)	0.11**	–1.37*	0.37**			43.48°	20.15	5.76
UK vtr	–0.60* (–2.62)	1.04**	–0.55*	0.05*	–1.78**		58.73°	24.41	11.63
United States vtr	–0.66** (–3.13)	0.58**	–0.71*	0.17**			62.13 °°	32.44 °°	14.45 °

Source: Authors' own data.
Notes: * and ** denote statistical significance at the 10% and 1% level respectively. ° and °° denote rejection of the null hypothesis of no co-integration at the 5% and 1% level respectively. Critical values for the 1% significance likelihood ratio are: 45.58 when no deterministic trend is assumed, 54.46 with deterministic trend and 70.05 with linear trend (time trend in the co-integrating equation).

GDP and investment are taken at their real, PPP value, as given by the Penn World Tables.

Looking at the results (reported in Tables 11 and 12) we can see how the error correction term enters with the right sign (negative) and is significant. Moreover, explanatory variables other than financial development indicators enter with the right sign, although they fail sometimes to be strongly significant. Financial development, regardless of its nature (banks or markets), is always significant in the long-run relationship implied by the ECM, and affects positively both GDP and investments.

Summing up the Estimation Results

From our estimation exercises some general conclusions may be drawn. Finance does affect growth, both directly and indirectly, through technology accumulation. Market-based, more than bank-based financial development seems to be relevant in this respect. EU membership has also played a role in boosting growth especially through technology accumulation. While there is evidence of similar growth–finance relations across countries, the growth–finance nexus is far from homogeneous as the relative weight of credit and market finance varies across countries.

These results are consistent with the predictions of the model described in Section I. Financial development (irrespective of the distinction between bank-based and market-based systems) spurs growth through financial efficiency, by contributing to productivity in general, or to technological progress. As the literature suggests, the distinction between embodied or disembodied technological progress matters as far as the different role of market and credit is concerned to the extent that innovation and embodied technological progress require more market-based financial systems. But, to the extent that process innovation, itself partly related to new technologies, is investment driven, credit finance might continue to play an important role. EU membership seems to be particularly relevant in explaining TFP, the level of which is also positively affected by financial development.

IV. From Financial Development to Technological Integration

The next step is to investigate further to what extent financial development can affect technological integration. To do this we need to develop a benchmark for technological integration. We do so by looking at the integration implications of the Lisbon strategy.

Defining a Benchmark for the Lisbon strategy

At the summit held in Lisbon in March 2000, the European Council set the goal to make Europe the 'most dynamic, knowledge-based economy in the world by 2010'. To facilitate this kind of process, the Commission had selected a number of structural indicators to form a framework for the guidance of national policies. These indicators are ideally based on an economic model that, once implemented, should lead to sustained and sustainable growth. The underlying principle is that economic growth is associated with growth in

Table 11: Panel ECM Estimation of the Investment/Financial Development Relationship

Fin. Dev't Indicator	*Error Correction Term: Adjustment Coefficient*	*Co-integrating Equation (Long-run Coefficients)*			*Obs (Countries)*
		Real GDP	*(1+r)*	*fd*	
lil	–0.28** (–9.34)	0.86**	–0.34*	0.26**	634 (20)
prc	–0.25** (–9.42)	0.86**	–0.21	0.13**	773 (25)
cps	–0.26** (–10.00)	0.85**	–0.28	0.09**	796 (25)
dmb	–0.36** (–8.12)	0.86**	–0.37*	0.05**	471 (25)
tur	–0.37** (–8.80)	0.86**	–0.27	0.03**	463 (25)
vtr	–0.39** (–8.57)	0.87**	–0.22	0.03**	487 (25)

Source: Authors' own data.
Note: * and ** denote statistical significance at the 10% and 1% level respectively.

Table 12: Panel ECM Estimation of the GDP / Financial Development Relationship

Fin. Dev't Indicator	*Error Correction Term: Adjustment Coefficient*	*Co-integrating Equation (Long-run Coefficients)*			*Obs (Countries)*
		I/Y	*Inflation*	*fd*	
lil	–0.22** (–5.77)	–0.03	–0.03*	0.43**	707 (20)
prc	–0.25** (–6.70)	–0.04	–0.05**	0.33**	890 (25)
dmb	–0.28** (–7.63)	0.04	–0.06	0.26**	917 (25)
smc	–0.50** (–6.23)	–0.07	–0.14**	0.12**	495 (25)
tur	–0.42** (–6.07)	0.12 *	–0.24**	– 0.04**	487 (25)
vtr	–0.51** (–7.23)	–0.11*	–0.21**	0.02**	521 (25)

Source: Authors' own data.
Note: * and ** denote statistical significance at the 10% and 1% level respectively.

employment and in innovation activities. At the same time growth must be achieved through, and is supported by, macroeconomic and financial stability as assured by the respect of monetary stability and of the Stability and Growth Pact. The indicators offer a framework for national economic policies based on the comparison of national performances between EU Member States, as well as with non-EU economies, so as to identify best practices and benchmarks to guide national policies. The Kok (2004) report has suggested a shorter list of 14 indicators, which retain the overall philosophy outlined above, but have the merit of streamlining the methodology. We build on this suggestion by looking at a comparable number of indicators, while also adding some variables related to financial development that have been omitted in the list indicated by the Kok report.

We build on a paper by Morelli *et al.* (2003) to identify a 'common growth model' towards which the EU economies should converge if policies indicated by the Lisbon strategy are implemented. We apply principal component analysis to a number of variables reflecting, with some approximation[12] the Kok report indicators for the EU-15 Member States and other OECD economies that are technologically advanced (US, Japan, Canada, Australia and Norway) over the period 1980–2000. The variables are: real GDP growth; the activity rate of the population between 15 and 64 years of age; the ratio of R&D expenditure to GDP; the employment rate in the R&D sector; productivity of R&D expenditure as proxied by the ratio between patents and R&D expenditure; FDI inflows as a share of GDP; the rate of growth of real labour costs; the rate of growth of labour productivity; the ratio of public investment over GDP; the debt to GDP ratio; the deficit to GDP ratio; and, a measure of the degree of trade integration. All variables have been considered in levels and in growth rates (when applicable). We also include three financial variables: private credit over GDP, stock market value traded over GDP, and a variable describing the evolution of financial systems towards a market-based structure (stock market capitalization over private credit).

Like Morelli *et al.* (2003), we first apply principal components analysis, which leads to the following relationship between variables. Real GDP is positively correlated with the growth of the activity rate and both variables are negatively correlated with the rate of growth of unemployment. Output growth rates are positively correlated with growth in the activity rate, and negatively correlated with unemployment growth. Innovation indicators, such as the relation of R&D to GDP, R&D productivity and employment in the R&D sectors as well as two financial indicators are negatively correlated with the unemployment rate. In sum, to the extent to which the Lisbon indicators

[12] We did not replicate the exact list suggested in the Kok report to give more weight to innovation-related indicators as well as to fiscal policy indicators while keeping the number of indicators at a low level.

are based on a common economic model, this boils down, not surprisingly, to a relationship between employment, growth and innovation. The inclusion of financial variables reinforces the results by Morelli *et al.* and does not contradict the results obtained in the estimation results.

As a next step, we carried out a cluster analysis. Cluster analysis identifies three groups of countries that share common features, as described in Table 13, and are as follows.

Group 1: strong structure. Countries in this group – the US, Japan, the two largest continental EU countries, and the UK – share a common structure. Important common features are a favourable employment outlook, both in terms of activity ratio and employment in the innovative sectors, a low rate of growth of unemployment (and a high rate of growth of real labour costs), a strong innovative position and above average financial market variables. We will refer to this group as the 'Lisbon benchmark' for technological convergence.[13]

Group 2: dynamic economies. Countries included in this group – the Netherlands, Denmark, and Ireland, as well as Australia and Canada – are relatively small and fast growing economies that are able to exploit the benefits of innovation. They share similar values in the rate of change of variables rather than in their levels. Growth rates of both employment and GDP are higher than average. Unemployment grows less. Level variables above average include productivity in R&D, and foreign direct investment as a share of GDP. The rate of change of the financial system (market with respect to credit) is also above average.

Group 3: weak structure. The remaining countries – the Mediterranean countries and Belgium – share a weak structure, associated with unemployment above average, a low activity rate, as well as low employment in innovative activities, low R&D expenditure and low R&D productivity. Credit finance is above average and market finance is below average.

Let us now compare our results with those of Guiso *et al.* (2004). They have assessed the growth gains for EU countries that would be obtained if EU financial markets were to reach a degree of 'optimal' integration, as represented by the US financial market benchmark. They also consider a 'sub-optimal' case where the benchmark is represented by a degree of EU financial integration matching that of the UK, the Netherlands and Sweden. They define integration,

[13] We are aware that, while such a definition fits well for the US and possibly the UK it is less fitting for the other economies included in the group, especially if more recent performance is taken into account. Nevertheless the presence of the US and UK in the group is consistent with the general philosophy of the Lisbon strategy to the extent that the US offers a 'benchmark' for a knowledge-based economy.

Table 13: Cluster Analysis

	Above Average	*Below Average*	*Countries*
Group 1: Strong structure	– Activity rate (% pop. 15–64)	– Growth of unemployment rate	Germany, France, Luxembourg Austria, Finland, Sweden, UK, Norway, US, Japan
	– R&D expenditure (% GDP)	– Deficit (% GDP)	
	– Employment rate in R&D sectors	– Govt public debt (% GDP)	
	– Growth of real labour costs		
	– Credit and market finance (% GDP)		
Group 2: Dynamic economies	– Growth of activity rate	– Growth of unemployment rate	Netherlands, Denmark, Australia, Canada, Ireland
	– GDP growth	– Public investments (in % GDP)	
	– Productivity of R&D expenditure		
	– FDI inflows (in % GDP)		
	– Relative financial development		
Group 3: Weak structure	– Unemployment rate	– Activity rate (% of pop. 15–64)	Belgium, Greece, Spain, Italy, Portugal
	– Government debt (% GDP)	– Employment rate in R&D	
	– Public investment (% GDP)	– R&D expenditure (in % GDP)	
	– Government deficit (% GDP)	– Productivity of R&D expenditure	
	– Credit finance (% of GDP)	– Market finance (in % of GDP)	

Source: Authors' own data.

not necessarily as the case in which all EU national financial markets reach the same level of benchmark integration but as a case in which all EU firms have the same (benchmark) access to financial markets. They also assume that industrial specialization in each country does not change and that optimal access to external finance is sector specific; that is, determined by technological factors. Not surprisingly the benefits of financial integration for growth are most relevant in those countries that exhibit the highest degree of financial backwardness: Greece, Italy, Portugal and Spain, but also Belgium, Denmark and Germany. With the exception of the last two these countries belong to the weak structure group 3.

Guiso *et al.* (2004) also show that financial integration is best achieved by improvements in the legal environment in which financial markets operate. The assumption is that financially backward countries are also those displaying the least advanced legislation in accounting standards, creditor protection and rule of law. It is interesting to note that these countries also display the most restrictive legislation as far as other markets are concerned. Boeri *et al.* (2000) group the OECD countries according to the degree of labour and product market regulation. They identify four groups: firstly, countries which combine strict regulation in both labour and product markets (France, Italy, Greece and Spain); secondly, continental European countries with relatively restrictive product market regulation, but with different employment protection legislation (Germany, Austria, the Netherlands, Finland and Portugal being more restrictive than Belgium and Denmark); thirdly, common law countries characterized by a relatively liberal approach in both labour and product markets (the US, the UK, Canada, Ireland, Australia and New Zealand); and, finally, Sweden which, together with Japan, combines relatively restrictive labour market regulation with relatively few product market restrictions. It is not surprising that countries with most restrictive regulations are, to a large extent, the same countries included in the 'weak structure' cluster and the laggards in financial integration. Also, it is not surprising that countries included in the 'strong structure' and 'dynamic economies' groups display less restrictive regulations.

Technological Convergence

Guiso *et al.* (2004) show that financial integration is beneficial for growth on the assumption that productive specialization does not change. However, the Lisbon strategy implies that countries move up the technology ladder and specialize in more knowledge-intensive sectors. Financial integration should support such a transition. To what extent can we expect convergence towards the 'Lisbon benchmark', identified by the strong structure group? We estimate the probability of transition between the three clusters over the period

1980–2000. Results are reported in Table 14. Values in the main diagonal are very high, indicating a strong level of inertia. The probability of remaining in a cluster at the end of a period is high. In spite of the high level of inertia, the probability of weak structure countries (group 3) moving on to the group of dynamic economies (group 2) is 13 per cent, while the latter have a probability of 24 per cent to move on to the strong structure group (group 1). The probability of moving directly from group 3 to group 1 is zero. Once a country leaves group 3 it is practically impossible to fall back into it while there is a high probability of falling back from group 1 to group 2. Cluster analysis allocates 58 per cent of the countries to group 1, 14 per cent to group 2, and 29 per cent to group 3. Given these initial values and the transition probabilities, we check whether the Markov process leads countries to converge towards one single cluster or towards increased diversification. Results are reported in Figure 1. They indicate that a convergence process takes place. At the end of the process, the percentage of group 2 countries rises to 40 per cent, while the weak structure group falls to 10 per cent. Group 1 initially shrinks to 44 per cent and eventually rises back to 50 per cent. In general, the overall structure of EU economies improves as the share of weak structure countries falls by two-thirds. However, there is not necessarily a full convergence towards the 'Lisbon benchmark'.

For countries belonging to groups 2 and 3, moving on the strong structure groups would imply among other things, stronger innovation efforts as identified, for example, by R&D spending. However, changes in the financial sector would also be necessary as these countries should move towards a more market-based system to the extent that this is necessary to support more knowledge intensive activities. Countries belonging to the strong structure, the 'Lisbon benchmark', would remain in this group also because of the positive contribution of external finance. On the other hand, Spain and Italy, two countries included in the weak structure group, might follow different paths, ending up in different groups at the end of the process, irrespective of the contribution of external finance. In other words, financial integration might be a necessary but not sufficient condition for moving towards the 'Lisbon benchmark'.

Table 14: Transition Matrix

	Target Cluster (%)		
Cluster of Origin	*1*	*2*	*3*
1	81	18	1
2	24	74	2
3	0	13	88

Source: Authors' own data computation.

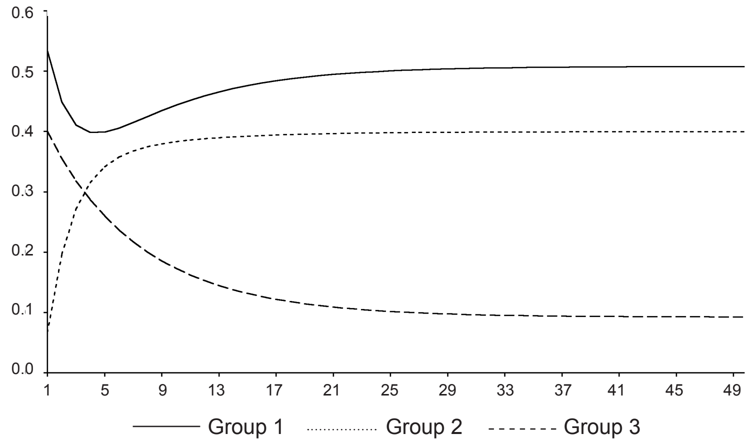

Figure 1: Convergence Patterns
Source: Authors' own data.
Note: Years are indicated in the horizontal axis.

Conclusions

As has been shown in Section I, financial integration spurs growth through financial efficiency *per se*, and by contributing to productivity growth or to technological progress (be it embodied, or disembodied). As the literature suggests, the distinction between embodied or disembodied technological progress matters as far as the different role of market and credit is concerned to the extent that IT and disembodied technological progress may require more market-based financial systems, while bank-based systems, by supporting investment, might contribute to technological progress as embodied in new physical capital.

We carried out estimations of the growth–finance relationship concentrating on two issues: firstly, to what extent financial variables affect growth, both directly and indirectly; and, secondly, to what extent country-specific factors affect the growth–finance nexus. In our panel estimation, controlling for the traditional determinants of growth, we find that market-based financial systems support output growth, investment and TFP more than bank-based ones. We also find that EU membership enhances output growth and, especially, TFP. This latter effect can, itself, be partially explained by the role of finance.

Country-specific analysis of the growth–finance relationship is carried out through the estimation of error correction models (ECM). We find that the impact of financial development is significantly positive in most cases (Italy is a notable exception). In several country cases, both bank and market variables are significant, lending support to the hypothesis that it is the size, rather than the type, of financial deepening that matters for growth. Both banks and markets exert an influence on investment in countries traditionally associated with the 'Anglo-Saxon' model (Australia, Denmark, the Netherlands and the UK), but also in some countries belonging to the 'continental' model (such as Germany or Japan). In only a few cases do either market (such as Austria or the US) or bank (Belgium, France, Italy, Korea, Norway, New Zealand and Switzerland) seem to prevail. Overall, our empirical results are consistent with the predictions of the model described in Section I.

We then investigate to what extent financial development can affect innovation driven growth. To do this we develop a benchmark for technological integration by looking at the implications of the 'Lisbon strategy'. We build on the Kok report (Kok, 2004) that has suggested a list of 14 indicators against which to assess progress towards the Lisbon strategy. We consider a comparable list of indicators including some financial development variables which have been omitted in the list in the Kok report. Through cluster analysis applied to the EU-15 and a number of other industrial countries, we identify three groups of countries. Group 1 (strong structure) that includes the US, Japan, the two largest continental EU countries and the UK. Countries in this group share a favourable employment outlook, a low rate of growth of unemployment, a strong innovative position and above average financial variables (both market and credit). We refer to this group as the 'Lisbon benchmark', if only because it includes the US (and the UK). Group 2 ('dynamic economies') includes relatively small and fact growing economies such as the Netherlands, Denmark and Ireland, as well as Australia and Canada. Countries in this group share similar values in the rate of change of variables. Growth rates of both employment and GDP are higher than average. Unemployment grows less. Variables above average include productivity in R&D, foreign direct investment as a share of GDP, and the rate of change of the financial system (market with respect to credit). Group 3 ('weak structure') includes the Mediterranean countries and Belgium. They share unemployment above average, and low activity rate, as well as low employment in innovative activities, low R&D expenditure and low R&D productivity. Credit finance is above average and market finance is below average.

We estimate the probability of transition between the three clusters over the period 1980–2000 and we find that while there is a high probability for countries in groups 2 and 3 to move towards the 'Lisbon benchmark', there is not necessarily a complete convergence. For countries belonging to groups 2 and 3 to move on to the strong structure groups would imply upgrading among other things, their innovation efforts as identified, for example by R&D spending. However, changes in the financial sector would also be necessary as they should move towards a more market-based system to the extent that this is necessary to support more knowledge intensive activities. Countries belonging to the strong structure would remain in this group also because of the positive contribution of finance. Finally, Spain and Italy, two countries included in the weak structure group, might follow different paths, ending up in different groups, irrespective of the contribution of finance. In other words, financial integration might be a necessary but not sufficient condition for moving towards the 'Lisbon benchmark'. While probabilities of transition can be considered only as weak evidence of convergence, our results suggest that country inertia in factors driving growth and finance-industry relations may slow down the move towards a common benchmark model. A second suggestion is that, as the Lisbon strategy implies a shift towards more knowledge intensive growth, convergence towards the 'Lisbon benchmark' should be facilitated in those countries where technology accumulation is stronger and where market-based finance is more relevant, or where firms have an easier access to market-based finance or to a more integrated European financial market. Hence countries lagging behind might see their distance from the best performers increase rather than the reverse.

Appendix: Data Description

Y,GDP: real per capita income GDP/POP; IFS, 1960–2001.

I: real investment is gross fixed capital formation at constant prices; IFS, 1960–2001. [Real *PPP* values for GDP and investments as well as data for population are taken from the latest version of Summers and Heston's Penn World Tables (PWT 6.1)]

pop: population; IFS, 1960–2001.

inflation: yearly % change of the CPI: consumer price index; IFS, 1960–2001.

int, r_t : adjusted real long-term interest rate, computed as the real long-term interest rate (nominal long-term rate, derived from government bonds, minus inflation) times the ratio of the deflators of investments and GDP, respectively; IFS, 1960–2001.

tfp: total factor productivity, as computed by Baier *et al.* (2002).

dumcm: EU dummy (1 for each year as a member of EC/EU, 0 otherwise).

op: openness indicator (taken from the Penn World Tables, version 6.1).

fd: financial development indicator. It can be one of the following:

- *cps*: claims on the private sector by deposit money banks[14] over GDP, IFS, 1960–2001.

[14] Loans issued by deposit money banks to the private sector, thus excluding loans to governments and public enterprises. This variable provides a gross measure of the degree of financial intermediation carried out by the banking sector.

- *dmb*: ratio of deposit money banks assets to total financial assets;[15] World Bank, 1960–2000.
- *prc*: private credit by deposit money banks[16] over GDP; World Bank, 1960–2000.
- *lil*: liquid liabilities[17] over GDP; World Bank, 1960–2000.
- *smc*: stock market capitalization[18] over GDP; World Bank, 1975–2000.
- *tur*: stock market turnover ratio;[19] World Bank, 1975–2000.
- *vtr*: stock market total value traded[20] over GDP; World Bank, 1960–2000.

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[15] Provides an indication of the relative size of the banking system in the financial system.
[16] In the World Bank database, it corresponds to CPS.
[17] Includes currency and interest-bearing liabilities of financial intermediaries; it offers a measure of overall financial intermediation (thus, broader than the banking system), but it does not take into account the stock market.
[18] Value of the listed shares on the stock markets. It is a measure of the access to fund raising in the stock market. Being a stock 'measure', however, it is highly influenced by past values.
[19] Value of shares traded in domestic stock exchange over total value of listed shares. Measuring the trading value of the market relative to its size, it accounts for the intensity of activity of the domestic stock market.
[20] Total value of shares on the domestic markets (computed as price × quantity).

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