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RESEARCH ARTICLE

Financial Markets and International Risk Sharing

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Abstract Panel analysis of 21 industrial countries shows evidence for pro-cyclicality of capital gains on domestic stock markets over a medium term horizon. Thus, with cross-border ownership of portfolio equity investments, potential for hedging against domestic output fluctuations by means of the capital gains channel of foreign liabilities is found. Individual country analysis reveals substantial heterogeneity of cyclicality patterns. Evidence suggests that this cross-country variation can be explained by the level of economic development and the size of financial markets.

Keywords International risk sharing · Capital gains · Cross-border investment · Financial globalisation · Business cycle

JEL Classification F21 · F30 · G15

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1 Introduction

This paper provides a new angle on the topic of international risk sharing. Most of the research has focused on indirect tests of risk sharing by analysing the co-movement of domestic and foreign consumption growth rates. In contrast, we employ a capital market approach in order to analyse the potential for hedging against domestic output and wealth fluctuations by means of cross-country ownership of financial assets. Accordingly, a necessary condition for the sharing of macroeconomic risks is that there are systematic patterns between macroeconomic fluctuations and capital gains on financial markets.

In times of increasing international financial integration, both investment income flows and capital gains are channels that can potentially provide international risk sharing.[1] Lane (2001) analysed the former channel using data on international investment positions, whereas the main innovation in this paper is to introduce the latter. This channel is of particular relevance to countries with large equity shares in their portfolios which make most of their returns in the form of capital gains (thus not affecting investment income flows). We focus in our analysis on capital gains on domestic financial markets (as a proxy for the foreign liability side).[2]

If domestic capital markets are partly owned by foreign investors, a pro-cyclical co-movement of capital gains with GDP growth brings about wealth stabilisation.[3] Faria et al. (2007) indeed find higher equity shares in the composition of foreign liabilities in the last decade. We analyse if this provides improved potential for international risk sharing, namely if pro-cyclicality of capital gains on equity and in addition on bond markets is observable.[4]

This paper will examine if potential for international risk sharing through the capital gains channel is empirically observable which is "essential" in order to evaluate the stabilising effects of international investments (Obstfeld 2004). Two main contributions are made: first the cyclicality of capital gains on equity and bond markets is analysed in panel data and on the country level; second, cross-country variation in cyclicality patterns is treated formally in order to find the fundamental reasons for differing degrees of international risk sharing.[5]

Accordingly, the rest of this paper is organised as follows: Section 2 places this paper in the existing literature, Section 3 presents the data and empirical

[1] See Lane and Milesi-Ferretti (2007) for a documentation of the rapid growth in cross-border financial holdings.

[2] See Table 3 in the Web Appendix for a country analysis of rates of capital gains on foreign liabilities using international investment positions data. For portfolio investments, these are usually very similar to market rates, but often less accurate and poorer in terms of data availability—see Lane and Milesi-Ferretti (2008a).

[3] The realisation of capital gains and losses involves liquidation costs however, which increase with the extent of illiquidity. This applies to FDI in particular, but less to portfolio investments.

[4] Capital gains on foreign assets, on the other hand, are influenced by a broad range of global factors such that a satisfying analysis is beyond the scope of this paper.

[5] This two-step approach is adapted from Lane's (2003) cyclicality analysis on fiscal policy.

strategy. The empirical analysis starts in the fourth section by investigating co-movements of domestic capital markets and GDP growth rates. Subsequently determinants of country heterogeneity will be approached in Section 5; eventually some concluding remarks will be made.

2 Contribution to the literature

Obstfeld (2004) provides a comparison between an idealised world of fully-enforceable state-contingent contracts and the world of asset trade in non-contingent contracts (these are bonds and loans). In the ideal world with complete Arrow-Debreu securities, a country is fully insured against domestic output shocks. Hence, fluctuations in consumption are decoupled from idiosyncratic fluctuations in output, with consumption growth rates across countries being perfectly correlated.

However, as prominently shown by Backus et al. (1995) and Lewis (1996), output growth is actually more highly correlated across countries than consumption growth (the consumption correlations puzzle). Recent work has confirmed that the degree of risk sharing remains far from perfect, but has nevertheless increased over time. For example, this can be linked to the internationalisation of portfolios, that is the declining home bias of financial investors (Sørensen et al. 2007).

Securities that could in theory deliver international risk sharing are bilateral GDP income swaps as proposed by Merton (1990) or GDP linked securities (Shiller 1993).

Due to the lack of these instruments we use the following application: When domestic GDP grows faster, the domestic stock market performance should improve accordingly; that is delivering higher capital gains for domestic and foreign investors. The benefit for foreign investors from this economic upswing is in the form of capital gains and dividend payments which represents a "benign loss" for the domestic economy. This decreases domestic income and wealth commensurately, thus providing a smoothing or "hedging" of the economic performance across the different states of the world.[6] Obviously, this smoothing mechanism also works when the economy performs poorly, since now there should be capital losses (due to falling share prices) and lower income outflows.

This approach is related to Lane (2001) who analyses international investment income flows (these are dividends for portfolio equity). However, he does not find evidence for income smoothing through these flows at business cycle frequencies.

In addition, our application is related to Davis et al. (2001) who develop a procedure to assess the gains to international financial trade in risky assets

[6] If firms choose not to pay out dividends, but instead to keep retained earnings, the mechanism works as well, since this should be reflected in higher stock prices and thus capital gains.

depending on the correlations of domestic and international equity returns and domestic output innovations.[7] Another theoretical perspective is provided by factor pricing models (for example Chen et al. 1986) where asset prices reflect innovations in macroeconomic variables such as industrial production.

It is crucial to stress that the aim of this paper is not to provide an econometric model that explains capital gains. But the emphasis rather is on the comovement of capital gains on different asset types and GDP growth in order to establish conclusions about cyclicality and the associated international risk sharing properties.

3 Empirical strategy

3.1 Data

In order to study the cyclical properties of capital markets, we constructed a dataset of 21 industrial countries.[8] This choice of the sample is very much determined by data availability both in length and scope. We are able to capture the time series from 1973 to 2006.[9]

We employ the Datastream domestic and global equity price indices in order to calculate annual rates of capital gains. These are available both in terms of domestic currency and US dollars and have the advantage of including only pure equity prices (thus without dividend payments). Hence these indices are appropriate in order to analyse the capital gains channel of international investments.

Furthermore we employ data provided by Datastream on domestic and global stock market capitalisation, as well as data on bond market capitalisation provided by the Bank of International Settlements (BIS).

For bond markets, we construct a bond price index which includes 2-year and 10-year government bonds (provided by the Datastream benchmark indices). These indices are available both in domestic currency as well as in US dollars. Then the un-weighted annual real rate of capital gains is calculated. This allows a broad range of portfolio debt securities to be taken into account. As a global bond market price index we use the Lehman Global Treasury Index (available in US dollars from 1987). In order to calculate domestic rates for this index, we employ year-end exchange rates from the IMF's International Financial Statistics.

GDP (at constant prices) and CPI data for individual countries and the world economy are retrieved from the IMF's International Financial Statistics

[7] See their paper for a model of international trade in risky financial assets under incomplete markets.

[8] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

[9] Data availability differs by country. See Appendix for an overview.

and World Economic Outlook databases. Conventionally, GDP growth rates measure the average growth rate in a given year; however, this is not appropriate for our analysis. As we are dealing with stock market rates of capital gains—which are essentially year-end to year-end rates—one has to apply the same logic to real rates of GDP growth. Consequently we construct a year-end to year-end rate of GDP growth by considering real GDP in the last quarter of a given year relative to the last quarter of the year before. Thus we obtain a real GDP growth rate which is consistent with the other variables in our analysis. In the same way we construct appropriate inflation rates in order to calculate real rates of capital gains. Output per capita data are taken from the Penn World Tables Version 6.2.

Given the data availability and the empirical focus on cyclical factors, the data used are at annual frequency.

3.2 Regression specifications

As outlined above we analyse the co-movement of domestic output innovations (that is GDP growth rates) and the performance of domestic stock and bond markets as measured by real rates of capital gains. The main focus of the paper lies on panel analysis; however, we also estimate variants of the regression specifications on a country-by-country basis. This allows for establishing potential country heterogeneity in cyclicality patterns which we seek to explain in the second step of our analysis. Moreover, it offers a robustness check by observing which countries drive the overall panel results.

3.2.1 Panel analysis

For our panel of countries we run the specification

$$kg_{it} = \alpha_i + \delta_t + \beta g_{it} + e_{it} \tag{1}$$

where e_{it} is first-order autoregressive with an error term z_{it} which is assumed to be independent and identically distributed with $N(0, \sigma_z^2)$. kg is the annual real rate of capital gains on the respective domestic stock or bond market and g is the real annual rate of domestic GDP growth. The potential for international risk sharing and thus hedging is facilitated by $\beta > 0$.[10]

The regression estimation is by least squares. We employ a within-group fixed effects estimator with first-order autoregressive disturbances (in order to adjust for persistence and auto-correlation in the error term) as well as heteroskedasticity robust standard errors.

Our choice of employing this simple, contemporaneous specification is determined by our goal to establish the direction and magnitude of the

[10] If β is < 0, thus counter-cyclical, risk sharing would be in theory possible if foreign investors take short positions in the domestic markets. However, this possibility is not very feasible on a large scale on current financial markets.

co-movement between output growth and rates of capital gains. We leave more complex estimation specifications accounting for potential drivers of financial market developments to future research at this stage.

We report panel estimations including country fixed effects (α_i) and both country and time fixed effects (δ_t). Time fixed effects have the property of controlling for common global shocks. Consequently, the domestic GDP growth rate reflects solely the idiosyncratic part of domestic growth and likewise for the rates of capital gains, whereas in the country fixed effects estimation also global factors could drive the results.

Previous studies regarding co-movement of stock markets and in the fiscal policy literature use a similar set-up. Forbes and Rigobon (1998) demonstrate that regression-based measures of cyclicality are superior to unadjusted correlation coefficients when samples have different levels of volatility. This is very applicable in our case, as for example Germany has a relatively lower output volatility than for instance Greece or Ireland.

Lane (2001) studies the cyclicality of international investment income flows in an equivalent set-up. In the fiscal policy literature Sørensen et al. (2001), Lane (2003) and Alesina et al. (2007) measure cyclicality of government spending in this particular specification. Moreover, the empirical risk sharing literature (for example Sørensen et al. 2007) focusing on growth rates of GDP and consumption employs simple co-movement estimations in a similar fashion.

We consider regression specifications with both all variables expressed in domestic currency (thus taking the perspective of a domestic investor in one of the sample's countries) and all variables expressed in terms of US dollars in order to have a common currency among all countries. The latter can be understood as approaching the question from a foreign or international investor's point of view.

In addition to focusing on annual data, it is very crucial to know if extended periods of economic growth are reflected in higher cumulative capital gains on financial markets. Or in other words: are permanent output shocks reflected in financial markets and can thus be "shared" internationally?

For this purpose we construct non-overlapping 5-year GDP growth rates and cumulative 5-year rates of financial market capital gains. We run the estimation

$$kg5_{it} = \alpha_i + \beta g5_{it} + u_{it} \tag{2}$$

where *kg5* is the cumulative 5 year real rate of capital gains on the domestic market index and *g5* is the cumulative real rate of domestic GDP growth over 5 years.

As persistence is much less of an issue over a 5-year horizon, we do not employ an AR(1) correction term in this estimation. u_{it} is independent and identically distributed with $N(0, \sigma_u^2)$. We estimate with and without country fixed effects and with both country and time fixed effects.

3.2.2 Country analysis

In the individual country specification (3), we estimate similarly to the panel specification by general least squares with a correction for first-order serial correlation in the error term. Moreover, heteroskedasticity robust standard errors are employed.

$$kg_{it} = \alpha_i + \beta_i g_{it} + e_{it} \tag{3}$$

where e_{it} is first-order autoregressive with an error term z_{it} which is assumed to be independent and identically distributed with $N(0, \sigma_z^2)$.

This estimation is the country-by-country equivalent to the country-fixed effects panel estimation. Thus we do not isolate the idiosyncratic components of GDP growth and capital gains on the stock market. In order to focus on the idiosyncratic components, we consider the co-movement of the deviation of domestic GDP growth from global GDP growth and the deviation of domestic rates of capital gains from global rates. Hence the question if the idiosyncratic part of domestic growth is reflected in the idiosyncratic part of the financial market performance is now also approached on an individual country level. Thus, we run

$$(kg_{it} - kg_{it}^*) = \alpha_i + \beta_i \left(g_{it} - g_{it}^*\right) + e_{it} \tag{4}$$

where e_{it} is first-order autoregressive with an error term z_{it} which is assumed to be independent and identically distributed with $N(0, \sigma_z^2)$. kg^* is the annual real rate of capital gains on the respective world financial index and g^* is the annual real rate of world GDP growth.

The estimation strategy is analogous to Eq. 3, that is including a correction for first-order serial correlation in the error term and heteroskedasticity robust standard errors.

We do not estimate cumulative 5 year specifications on a country-by-country basis, as we do not have a sufficient amount of data points available for individual countries.

Once the individual cyclicality coefficients are obtained from the country level estimates, we seek to explain the observed patterns across countries. For this we employ the cross-sectional specification

$$\widehat{\beta_i} = \alpha + \lambda Z_i + \nu_i \tag{5}$$

where $\widehat{\beta_i}$ are the set of estimated parameters from the country regressions above. ν_i is independent and identically distributed with $N(0, \sigma_\nu^2)$. Z_i is a set of control variables. It includes the domestic stock and bond market capitalisation (as shares of GDP) and output per capita in natural log form (in PPP terms, taken from the Penn World Tables 6.2).[11] These control variables are chosen

[11] We use average values by country for the explanatory variables over the period from 1975 to 2006 (until 2004 for GDP per capita), including only those years where actual rates of capital gains were available.

as indicators for the economic and financial development of the countries included in the sample. Weighted least squares estimation is used in order to take varying levels of accuracy for the (in the previous step) obtained dependent variable into account.[12]

This two-step approach is akin to Lane (2003) and Alesina et al. (2007) in the fiscal policy analysis. In the risk sharing literature (for example Sørensen et al. 2007), a similar analysis is carried out, however with an imposed structure on the risk sharing coefficient β and thus employing annual data of the structural variables in order to explain their role for the risk sharing coefficient. Our approach has the advantage of not being affected by short-run fluctuations and thus reflecting the impact of heterogeneous structural factors more appropriately.

4 The cyclical properties of domestic capital markets

4.1 Equity markets

4.1.1 Panel analysis

Panel analysis employing regression specification 1 shows the following (Table 1): Both in terms of domestic currency and in US dollars we find pro-cyclicality of rates of capital gains (significant at the 5% level and 1% level, respectively). This implies that in our sample a one percentage point increase in the domestic GDP growth rate co-moves with a 1.2 percentage points increase in the rate of capital gains (1.6 percentage points when estimated in US dollars). However, the result changes significantly when time fixed effects are included: insignificant β-coefficients suggests that global factors explained most of the pro-cyclicality observed before.

In terms of international risk sharing, this has crucial implications, since we are interested in isolating the idiosyncratic component of GDP growth. Our results hence imply that there is only limited evidence for a significant contemporaneous risk sharing mechanism via domestic stock market capital gains for the period of 1973 to 2006. This means that in the short-run of 1 year, the specific state of a national economy does not seem to be reflected in the idiosyncratic part of stock market capital gains.

In order to account for the fact that the cyclicality might have varied substantially over time, we divide the sample in the periods before and after 1985, thus examining if this time span exhibits different patterns.

Using country fixed effects only, shows that estimates are only significant for the financial globalisation period after 1985; when time fixed effects are added, results are (as in the full sample estimation) not significant for either period.

Moving from business cycle frequencies to a longer term horizon it is crucial to know if permanent shocks to an economy can potentially be hedged via

[12] We weight by the (in the previous step) obtained t-statistics.

Table 1 Cyclicality of capital gains on domestic stock market

	Domestic currency		US dollar	
	FE	FE + TE	FE	FE + TE
	(1)	(2)	(3)	(4)
Full sample	1.22 (0.56)**	−0.23 (0.53)	1.59 (0.62)***	−0.11 (0.58)
R^2	0.01	0.44	0.01	0.44
Observations	582	582	582	582
1974–1984	0.28 (1.13)	−0.07 (1.11)	1.02 (1.09)	0.49 (1.12)
R^2	0.00	0.39	0.01	0.33
Observations	146	146	146	146
1985–2006	1.47 (0.69)**	−0.28 (0.60)	1.18 (0.69)*	−0.09 (0.63)
R^2	0.01	0.49	0.01	0.44
Observations	420	420	420	420

Notes:
The dependent variable is the real rate of capital gains on the domestic stock market; the explanatory variable is the real GDP growth rate. The real rate of capital gains is calculated as the annual rate of return on the domestic stock market price index, deflated by the CPI inflation rate. We construct GDP growth by considering real GDP in the last quarter of a given year relative to the last quarter of the year before (accordingly for inflation rates). Estimation by generalised least squares with AR(1) correlated disturbances, heteroskedasticity robust standard errors (in parentheses) and involving country fixed effects ((1) and (3)) and country and time fixed effects ((2) and (4)). R^2 refers to the within-group measure. Time period: 1973–2006. Data availability varies by country (see Appendix). Full regression outputs are available upon request

*Significance at the 10% level

**Significance at the 5% level

***Significance at the 1% level

the stock market. Employing specification 2, as outlined above, we find the following:

The empirical evidence is very striking (Table 2): In terms of domestic currency the cyclicality coefficient is 4.2, in US dollar terms 2.4 (both significant at the 1% level). The result also holds (with coefficients being significant at conventional levels, but smaller in magnitude), when time effects are added or neither country nor time effects are included.

Thus, there is strong pro-cyclical co-movement of domestic GDP growth and the stock market over a 5 year horizon. This points towards domestic equity being "a claim on GDP" possibly not in the short run (that is 1 year), but definitely in the medium run of 5 years. Hence, in this time framework the necessary cyclical properties of the stock market are satisfied in order to generate economic or wealth stabilisation as described above.

This result is very appealing as it offers risk sharing potential on a global scale in particular when investments are made over a medium term horizon. Thus, equity capital gains can act as an effective risk sharing device, when the investment behaviour reaches the appropriate time frame. This result is in line with Giannone and Reichlin (2006) who find increasing risk sharing particularly over long horizons. Davis et al. (2001) find for six countries in their sample a positive co-movement of lagged stock market returns and domestic output

Table 2 5-year cyclicality of capital gains on domestic stock market

	Domestic currency			US dollar		
	FE	FE + TE		FE	FE + TE	
	(1)	(2)	(3)	(4)	(5)	(6)
Stock Market	4.24 (1.26)***	2.45 (1.30)**	2.57 (1.04)***	2.43 (0.96)***	1.83 (1.10)*	1.66 (0.75)**
R^2	0.12	0.37	0.05	0.07	0.19	0.04
Observations	108	108	108	108	108	108

Notes:
The explanatory variable is the cumulative real GDP growth rate over 5 years; the dependent variable is the cumulative real rate of capital gains over 5 years. The real rate of capital gains is calculated as the 5 year rate of return on the domestic stock market price index, deflated by the CPI inflation rate. We also construct cumulative 5 year GDP growth rates. Estimation by ordinary least squares with heteroskedasticity robust standard errors (in parentheses) and involving country fixed effects ((1) and (4)) and involving country and time fixed effects ((2) and (5)). R^2 refers to the within-group measure (except for columns (3) and (6)). Time period: 1980–2005. Full regression outputs are available upon request

*Significance at the 10% level

**Significance at the 5% level

***Significance at the 1% level

innovations. Liew and Vassalou (2000) also show for a sample of ten industrial countries that a positive relation exists between the return on the stock market portfolio and future economic growth. This co-movement pattern would not be captured by specifications using annual data, but could explain part of the medium-term results.

4.1.2 Country analysis

The country by country analysis (estimation 3) shows a diverse picture (Table 3): in terms of domestic currency, we find countries exhibiting pro-cyclical co-movements between GDP growth and the stock market, namely Australia, Canada, the Netherlands and Sweden. Australia shows the highest coefficient (5.3), implying that a percentage point increase of the GDP growth rates moves along with a more than five percentage point increase in stock market capital gain rates. Hence an economic expansion is also reflected in higher share prices.[13]

The other countries in the sample do not show any significant co-movements in terms of domestic currency. When the data are denominated in US dollars (column (3)) coefficients and significance levels obtained are very similar (only Canada's coefficient turns insignificant, whereas Finland's coefficient is significant). These findings are in line with Canova and de Nicolo' (1995) who find stock markets in Germany, France, Italy, United Kingdom and the United

[13]In the main tables of the country-by-country analysis we focus on reporting the estimated β-coefficients and associated standard errors in order to present the key results as clear and concise as possible. More diagnostic statistics are provided in Table 1 and Table 2 of the Web Appendix.

Table 3 Cyclicality of capital gains on domestic stock market

	Dependent variable			
	Domestic currency		US dollar	
	(1)	(2)	(3)	(4)
	Simple	Relative to global	Simple	Relative to global
Australia	5.28 (1.74)***	1.81 (2.43)	4.86 (1.99)**	1.44 (2.47)
Austria	−1.47 (2.36)	−7.29 (5.16)	−0.68 (2.74)	−8.54 (6.47)
Belgium	−1.63 (2.63)	−7.72 (3.19)**	−1.82 (2.64)	−6.93 (2.81)**
Canada	1.71 (1.00)*	0.60 (1.40)	1.35 (1.19)	−0.21 (1.28)
Denmark	0.65 (2.87)	−3.21 (1.95)*	1.72 (2.24)	−3.04 (1.84)*
Finland	3.59 (2.36)	5.59 (2.32)**	4.41 (2.04)**	5.09 (2.30)**
France	4.97 (3.65)	−2.74 (2.71)	5.21 (3.89)	−2.35 (2.61)
Germany	0.97 (2.44)	−0.36 (1.90)	1.18 (2.53)	−0.34 (1.97)
Greece	0.65 (7.03)	0.60 (7.67)	2.69 (7.42)	0.76 (7.64)
Ireland	0.77 (1.48)	−0.14 (1.50)	0.20 (1.91)	−0.28 (1.52)
Italy	1.88 (2.71)	−1.49 (2.26)	1.73 (2.79)	−0.91 (2.15)
Japan	2.31 (1.79)	0.20 (1.89)	2.14 (2.24)	0.06 (1.84)
Netherlands	3.70 (1.96)*	1.43 (1.33)	3.75 (1.66)**	1.62 (1.28)
New Zealand	0.92 (1.62)	3.13 (1.42)**	3.65 (2.36)	3.41 (1.40)**
Norway	4.26 (3.63)	−1.24 (2.14)	2.86 (3.40)	−1.31 (1.95)
Portugal	0.10 (3.44)	−1.11 (1.95)	1.28 (2.05)	−1.38 (1.97)
Spain	−0.40 (3.95)	0.74 (2.93)	1.10 (3.57)	0.98 (2.71)
Sweden	5.05 (2.43)**	3.17 (1.50)**	6.34 (1.76)***	3.01 (1.59)*
Switzerland	1.66 (2.091)	−1.82 (1.73)	1.22 (2.24)	−1.40 (1.79)
UK	−0.44 (2.57)	−3.59 (0.76)***	0.29 (2.65)	−3.79 (0.72)***
US	2.51 (1.80)	−1.71 (0.58)***	2.51 (1.81)	−1.71 (0.58)***

Notes:
The dependent variables are the real rate of capital gains on the domestic stock market ((1) and (3)) and the deviation of the rate of capital gains on the domestic stock market from the global stock market ((2) and (4)), respectively. The explanatory variables are the real GDP growth rate ((1) and (3)) and the deviation of the real domestic GDP growth rate from global GDP growth ((2) and (4)), respectively. The real rate of capital gains is calculated as the annual rate of return on the domestic stock market price index, deflated by the CPI inflation rate. We construct GDP growth by considering real GDP in the last quarter of a given year relative to the last quarter of the year before (accordingly for inflation rates). For the respective global rates, we use the same method using global stock market price indices and world GDP. Estimation by generalised least squares with AR(1) correlated disturbances and semi-robust standard errors (in parentheses). Time period: 1973–2006. Data availability varies by country (see Appendix). See Web Appendix Table 1 for more diagnostic statistics. Full regression outputs are available upon request

*Significance at the 10% level

**Significance at the 5% level

***Significance at the 1% level

States to be acyclical.[14] Furthermore Davis et al. (2001) report that domestic output innovations are uncorrelated with own equity total returns using annual data.[15]

Estimation 4 answers the question if the idiosyncratic part of domestic growth is reflected in the idiosyncratic part of the stock market performance. In domestic currency terms, Finland, New Zealand and Sweden show significant

[14] Using quarterly total returns data from 1970 to 1991.
[15] For 22 countries from 1970 to 1995.

positive coefficients. Hence for these countries the idiosyncratic part of GDP growth is also reflected in the idiosyncratic component of the stock market performance. As this also holds in terms of US dollars, it implies that an international investor is able to reap exceptional economic expansions by means of excess stock market returns in theses countries. Thus, for this group of countries international risk sharing via foreign equity liabilities is feasible.

For Belgium, Denmark, the United Kingdom and the United States, on the other hand, we find counter-cyclical relations. Remarkably, the coefficients are in the range of up to −3.6 (for United Kingdom). Applying this result means that an increase in the "excess" (relative to the world economy) GDP growth rate of one percentage point is associated with a decrease in the differential of the domestic to the world stock market of more than three percentage points. The specification in terms of US dollars shows again very similar results indicating that exchange rate movements are a minor concern in our analysis.

Overall, the potential for international risk sharing at business cycle frequencies appears to be relatively small, in particular considering idiosyncratic components. We find evidence that for example Finland and Sweden have the potential to share idiosyncratic macroeconomic risks with foreign investors, whereas for example Germany and Italy do not exhibit this potential and for countries such as Belgium and the United Kingdom, we even find de-stabilising effects via the investments of foreigners.[16]

4.2 Bond markets

4.2.1 Panel analysis

In this subsection, we look at co-movements of bond prices and real GDP growth. Again a positive co-movement of capital gains on bond markets and real GDP growth would facilitate international risk sharing. However, a significant, negative coefficient implies that a short position in the bond market by foreign investors would serve as a hedge against macroeconomic output fluctuations via foreign liability positions.

In the same fashion as for equity, panel specification 1 is employed. In terms of domestic currencies (Table 4) the coefficient −1.1 (−0.8 in US dollars) is significant (at the 1% and 5% levels, respectively). A coefficient of −0.3 (significant at the 1% level) is obtained when time fixed effects are included (insignificant in US dollar terms). These results imply that higher domestic output growth moves in line with lower prices on the domestic bond market. Intuitively this relation has some appeal, when we suppose that periods of higher interest rates (and thus lower bond prices) occur contemporaneously with economic booms. In gloomy economic periods, on the other

[16]The significant negative βs obtained by estimation 4 for Belgium, Denmark, United Kingdom and the United States could theoretically imply the potential to share idiosyncratic macroeconomic risk by short positions of foreign investors.

Table 4 Cyclicality of capital gains on domestic bond market

	Domestic currency		US dollar	
	FE	FE + TE	FE	FE + TE
	(1)	(2)	(3)	(4)
Full sample	−1.14 (0.17)***	−0.28 (0.11)***	−0.81 (0.35)**	0.02 (0.22)
R^2	0.10	0.73	0.01	0.75
Observations	409	409	409	409
1979–1995	−1.61 (0.34)***	−0.20 (0.21)	0.15 (0.49)	0.29 (0.35)
R^2	0.12	0.76	0.01	0.69
Observations	183	183	183	183
1996–2006	−0.70 (0.17)***	−0.21 (0.11)*	−2.73 (0.58)***	−0.56 (0.32)*
R^2	0.07	0.72	0.11	0.82
Observations	206	206	206	206

Notes:
The dependent variable is the real rate of capital gains on the domestic bond market; the explanatory variable is the real GDP growth rate. The real rate of capital gains is calculated as the annual rate of return on the domestic bond market price index, deflated by the CPI inflation rate. We construct GDP growth by considering real GDP in the last quarter of a given year relative to the last quarter of the year before (accordingly for inflation rates). Estimation by generalised least squares with AR(1) correlated disturbances, heteroskedasticity robust standard errors (in parentheses) and involving country fixed effects ((1) and (3)) and country and time fixed effects ((2) and (4)). R^2 refers to the within-group measure. Time period: 1979–2006. Data availability varies by country (see Appendix).Full regression outputs are available upon request

*Significance at the 10% level

**Significance at the 5% level

***Significance at the 1% level

hand, lower interest rates in order to stimulate the economy could drive bond prices up.

We refrain from a division of the sample in a pre- and a financial globalisation period, as for many of the countries data availability starts only in the late 1980s or even afterwards (see Appendix). However, we divide the sample using 1995 as the cut-off year in order to account for changes in the cyclicality patterns over time. Interestingly this reveals that the coefficients when country and time fixed effects are used are only significant (and negative) for the period after 1995. Thus we find some evidence that the sharing of idiosyncratic risks is in theory possible when foreign investors hold short positions (as suggested above), but not in the standard way of conventional "long" investments.

Over a 5 year horizon there is only marginally significant evidence (Table 5). When estimated with country and time fixed effects we find a negative coefficient (−0.3) in terms of domestic currency with a significance level of 5% (column (2)).

In light of non-significance of the other specification, the results needs to be treated with caution. Still it could indicate, that the observed countercyclicality of bond markets also holds over medium term horizons.

Table 5 5-year cyclicality of capital gains on domestic bond market

	Domestic currency			US dollar		
	FE	FE + TE		FE	FE + TE	
	(1)	(2)	(3)	(4)	(5)	(6)
Bond market	0.17(0.16)	−0.27(0.12)*	0.11(0.12)	−0.06(0.53)	−0.10(0.34)	0.15(0.36)
R^2	0.02	0.67	0.01	0.00	0.75	0.00
Observations	73	73	73	73	73	73

Notes:
The explanatory variable is the cumulative real GDP growth rate over 5 years; the dependent variable is the cumulative real rate of capital gains over 5 years. The real rate of capital gains is calculated as the 5 year rate of return on the domestic bond market price index, deflated by the CPI inflation rate. We also construct cumulative 5 year GDP growth rates. Estimation by ordinary least squares with heteroskedasticity robust standard errors (in parentheses) and involving country fixed effects ((1) and (4)) and involving country and time fixed effects ((2) and (5)). R^2 refers to the within-group measure (except for columns (3) and (6)). Time period: 1984–2004. Full regression outputs are available upon request

*Significance at the 5% level

4.2.2 Country analysis

The panel results are supported by the findings for individual countries. We observe counter-cyclicality for many countries (Table 6). Estimating specification 3, significant negative values are found for Austria, Belgium, France, Germany, Italy, Japan, the Netherlands, New Zealand and Switzerland. The largest coefficient in absolute value terms is noticeable for Belgium (−2.1). Consequently, there is no pro-cyclical co-movement observable through bond markets. However, for these countries it holds true that short positions in bond holdings may be useful hedging instruments.

The non-significance in US dollar terms (column (3)) indicates the sensitivity of bond prices to exchange rate movements. For individual countries, this is the case for the majority of countries except for Ireland and the Netherlands, where specifically a coefficient of −3.3 (compared to -1.5 in domestic currency) indicates that bilateral exchange rate movements with the US dollar reinforce the negative relation. In this case it implies that higher economic growth for the Netherlands is accompanied by an exchange rate depreciation vis-a-vis the United States, thus leading to lower returns in US dollars than in domestic currency.

Analogous to the stock market analysis, we consider specification 4. Here, we find a positive coefficient of 1.1 (significant at the 5% level) for the United Kingdom. Thus, for the United Kingdom it appears to be feasible that idiosyncratic risk is shared via portfolio debt investments in the foreign liability position. In contrast, we see significant negative coefficients for Germany, Italy and the Netherlands.

When denominated in US-dollars we find a negative cyclicality coefficient for Switzerland (however only significant at the 10% level). Interestingly, in this case it is possible for New Zealand to share idiosyncratic risk via the

Table 6 Cyclicality of capital gains on domestic bond market

	Dependent variable			
	Domestic currency		US dollar	
	(1)	(2)	(3)	(4)
	Simple	Relative to global	Simple	Relative to global
Australia	−1.15 (1.08)	−0.42 (0.27)	−0.63 (1.34)	−0.24 (1.26)
Austria	−1.65 (0.50)***	−0.40 (0.72)	−0.13 (1.58)	2.54 (2.09)
Belgium	−2.09 (0.53)***	−0.28 (0.50)	−2.73 (2.19)	−0.98 (2.71)
Canada	−0.64 (0.60)	0.29 (0.30)	−0.93 (0.92)	−0.60 (1.08)
Denmark	0.09 (0.57)	0.57 (0.39)	−0.70 (1.88)	−0.01 (1.53)
Finland	−0.15 (0.36)	0.26 (0.36)	0.52 (0.87)	1.03 (1.43)
France	−1.78 (0.49)***	−0.31 (0.65)	−2.87 (1.92)	−1.18 (2.39)
Germany	−1.23 (0.47)***	−0.85 (0.21)***	−2.12 (1.86)	−0.95 (1.45)
Greece	0.11 (1.37)	0.35 (0.20)	2.54 (12.28)	2.12 (4.54)
Ireland	−0.37 (0.31)	−0.08 (0.24)	−1.55 (0.79)*	−0.64 (0.72)
Italy	−1.89 (1.05)*	−1.50 (0.81)*	−2.52 (2.31)	−2.90 (2.02)
Japan	−0.59 (0.34)*	−0.82 (0.55)	−0.65 (1.71)	−1.53 (1.43)
Netherlands	−1.44 (0.47)***	−1.18 (0.54)**	−3.31 (1.65)*	−2.63 (1.83)
New Zealand	−0.82 (0.43)*	−0.05 (0.25)	2.08 (1.11)*	2.23 (1.00)**
Norway	0.28 (1.13)	1.01 (1.18)	−2.06 (2.32)	−0.83 (1.71)
Portugal	0.43 (0.44)	0.31 (0.42)	−1.40 (1.72)	−1.33 (1.54)
Spain	−0.80 (0.99)	0.12 (0.87)	0.56 (2.00)	1.54 (2.04)
Sweden	−0.87 (0.57)	−1.00 (0.71)	0.60 (1.65)	1.82 (1.94)
Switzerland	−1.73 (0.61)***	−1.51 (1.22)	−2.27 (2.13)	−3.54 (1.94)*
UK	0.45 (0.60)	1.05 (0.43)**	1.46 (1.41)	0.54 (1.80)
US	−0.38 (0.81)	−0.04 (0.35)	−0.38 (0.81)	−0.04 (0.35)

Notes:
The dependent variables are the real rate of capital gains on the domestic bond market ((1) and (3)) and the deviation of the rate of capital gains on the domestic bond market from the global bond market ((2) and (4)), respectively. The explanatory variables are the real GDP growth rate ((1) and (3)) and the deviation of the real domestic GDP growth rate from global GDP growth ((2) and (4)), respectively. The real rate of capital gains is calculated as the annual rate of return on the domestic bond market price index, deflated by the CPI inflation rate. We construct GDP growth by considering real GDP in the last quarter of a given year relative to the last quarter of the year before (accordingly for inflation rates). For the respective global rates, we use the same method using global bond market price indices and world GDP. Estimation by generalised least squares with AR(1) correlated disturbances and semi-robust standard errors (in parentheses). Time period: 1978–2006. Data availability varies by country (see Appendix). See Web Appendix Table 2 for more diagnostic statistics. Full regression outputs are available upon request

*Significance at the 10% level

**Significance at the 5% level

***Significance at the 1% level

bond market (indicated by a coefficient of 2.2 in US dollars, significant at the 5% level).

5 Explaining country heterogeneity

The first-step analysis revealed substantial heterogeneity in cyclicality patterns across countries. Consequently it is of interest to find – as a second step – explanations for the cross-country variation in the estimations run so far. For this we employ the cross-sectional specification 5.

Table 7 Determinants of variation in country cyclicality

	Domestic currency		US dollar	
	(1)	(2)	(3)	(4)
	Simple	Relative to global	Simple	Relative to global
Cyclicality coefficients stock market				
Stock market capitalisation	3.30 (1.12)**	20.86 (1.30)**	4.97 (1.06)**	24.19 (1.15)**
GDP-PC	4.86 (0.78)**	−6.01 (1.12)**	0.75 (0.72)	−8.56 (1.07)**
R^2	0.26	0.64	0.14	0.76
Cyclicality coefficients bond market				
Bond market capitalisation	−0.60 (0.80)	−0.60 (1.20)	−1.37 (0.31)**	−1.00 (0.52)*
GDP-PC	−0.66 (1.59)	0.63 (2.92)	−11.33 (0.47)**	−6.51 (1.14)**
R^2	0.08	0.10	0.74	0.32

Notes:
The dependent variables are the estimated beta-coefficients from the individual country analysis; the explanatory variables are country averages of GDP per capita in natural log form, domestic stock market capitalisation (as ratio to GDP) and domestic debt securities capitalisation (as ratio to GDP), respectively. Estimation by weighted least squares (weighting by t-statistics of "first-step" estimation). Standard errors in parentheses. Switzerland excluded from stock market analysis

*Significance at the 10% level

**Significance at the 1% level

In Table 7 we see the results of this approach in order to find the determinants of cyclicality in rates of capital gains. In both domestic currency and in US dollars we observe rather similar results for the $\widehat{\beta}_i$s of the real rate of capital gains on domestic equity markets.

When considering the simple $\widehat{\beta}_i$s obtained from specification 3, clear evidence is found that deeper financial markets (as indicated by a higher stock market capitalisation) lead to more pro-cyclicality of the β-coefficients. Our interpretation of this result is that a higher stock market capitalisation implies a better coverage of the economy in that the performance of listed firms is a better mirror of the overall economic performance. Hence, business cycle fluctuations are more visible in the stock market performance. Specifically for the rate of capital gains in domestic currency a one percentage point increase in the ratio leads to 0.03 unit increase in $\widehat{\beta}_i$. Hence, this result strengthens the proposition that also increasing equity shares in foreign liabilities facilitate international risk sharing.

We find GDP per capita to be positively significant (at the 1% level) for the cyclicality of stock market capital gains. This allows the conclusion that a country's pro-cyclicality indicator is increasing with higher economic development.

Looking a the $\widehat{\beta}_i$s obtained from specification 4 (these are the "idiosyncratic" β-coefficients), even more support is found for the proposition that deeper stock markets improve the risk sharing potential significantly. The estimated coefficients on stock market capitalisation are 20.9 and 24.2 (in US dollars), respectively (both significant at the 1% level). Thus, a one percentage

point increase in the stock market capitalisation to GDP ratio leads to 0.20 unit increase in $\widehat{\beta}_i$. The coefficient on GDP per capita is sill significant, but negative for this specification. This implies that financial deepening seems to be relatively more beneficial than the level of output per capita for international risk sharing. Hence, risk sharing potential is ceteris paribus highest for countries that are financially most developed (rather than in terms of output per capita).[17]

For the bond market coefficients of specifications 3 and 4, both a higher market capitalisation as well as higher GDP per capita are associated with more negative cyclicality coefficients (significant only for the US dollar denominated estimations). Thus, in contrast to the stock market analysis, we find increasing counter-cyclicality with increasing market capitalisation of bond markets.

By and large, we find evidence for more risk sharing potential via the portfolio equity channel, the more a country is financially developed. Equity and bond markets differ significantly in the way they can provide international risk sharing. Assuming deep financial markets, equity provides risk sharing via conventional "long" investments, whereas bond markets need foreign investors who go "short", which is evidently much less feasible in practice.

6 Conclusion

In this paper the ability of countries to hedge their economic performance across different states of the world is examined. When looking at capital gains on domestic stock markets, hedging is especially feasible when the investment horizon amounts to 5 years. Country analysis reveals pro-cyclicality for countries such as Finland and Sweden in terms of capital gains on domestic stock markets, whereas counter-cyclicality is found for capital gains on the bond market for a majority of countries.

This suggests that economic hedging through the capital gains channel is working for certain countries. In addition, this could be achieved for further countries with larger financial markets. Thus, we find that in times of financial globalisation with higher equity shares in international portfolios, hedging and consequently enhanced international risk sharing becomes more and more feasible. It is crucial to stress that we focus merely on the foreign liability side of international investments in this paper. Besides, the complete picture of international portfolios also incorporates foreign assets and exchange rate considerations.

In the Web Appendix (Table 3), we show the main results of an equivalent country-level cyclicality analysis using international investment positions data on foreign liabilities (employing data from Lane and Milesi-Ferretti 2007). The results obtained prove to be comparable with our findings which indicates that

[17] We drop Switzerland from the heterogeneity analysis of stock markets, as it represents an outlier in terms of its average stock market capitalisation.

focusing on capital market data does not harm our analysis, but on the contrary is more fruitful due to a longer data coverage and the avoidance of well-known measurement problems which arise with international investment data (Lane and Milesi-Ferretti 2008a).

For further research it would be interesting to extend the country coverage to developing countries for whom economic hedging might be even more crucial in light of higher output volatility. Moreover, it would be interesting to know if international risk sharing has increased over time and which role in this regard is played by the capital gains channel. The role of financial deepening and home bias appears to be important as well.

Furthermore it is obvious that hedging considerations are only one part of international investment decisions. Findings on gravity models of international asset trade prove to be very significant (for example Lane and Milesi-Ferretti 2008b). Obstfeld (2006) points out the importance of developing a consistent general equilibrium portfolio-balance model. Dynamic general equilibrium model also have attracted a lot of attention recently, in particular notably by Tille and van Wincoop (2007) as well as Devereux and Sutherland (2007). It would be interesting to link their models to data on foreign assets and liabilities in order to further evaluate the extent and potential of international risk sharing in times of financial globalisation.

Appendix

Country	Stock market	Bond market 2 years	Bond market 10 years
	Availability	Availability	Availability
Australia	1973–2006	1986–2006	1986–2006
Austria	1973–2006	1983–2006	1983–2006
Belgium	1973–2006	1983–2006	1988–2006
Canada	1973–2006	1983–2006	1983–2006
Denmark	1973–2006	1983–2006	1988–2006
Finland	1988–2006	1988–2006	1990–2006
France	1973–2006	1984–2006	1984–2006
Germany	1973–2006	1978–2006	1978–2006
Greece	1988–2006	1998–2006	1998–2006
Ireland	1973–2006	1983–2006	1983–2006
Italy	1973–2006	1987–2006	1990–2006
Japan	1973–2006	1980–2006	1982–2006
Netherlands	1973–2006	1982–2006	1986–2006
New Zealand	1988–2006	1989–2006	1990–2006
Norway	1980–2006	1995–2006	1991–2006
Portugal	1990–2006	1991–2006	1992–2006
Spain	1987–2006	1987–2006	1989–2006
Sweden	1982–2006	1985–2006	1987–2006
Switzerland	1973–2006	1988–2006	1979–2006
United Kingdom	1971–2006	1978–2006	1978–2006
United States	1973–2006	1978–2006	1978–2006

For stock markets the Datastream domestic broad market price index (*DS TOTMK*) is used. For bond markets, we construct a bond price index which includes 2-year (*DS BM02Y*) and 10-year government bonds (*DS BM10Y*)(Datastream benchmark indices). For the Norwegian short-term bond we use the Handelsbanken short-term Treasury bond index (*HMTNALL*)

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