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Bank Competition and International Financial Integration: Evidence using a new index

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Keywords: Financial Integration Index, Covered Interest Parity, Threshold Autoregressive Models, Bank Competitiveness.

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Bank Competition and International Financial Integration: Evidence using a new index

> 'The market for a given set of financial instruments and/or services is fully integrated if all potential market participants with the same relevant characteristics (1) face a single set of rules when they decide to deal with those financial instruments and/or services; (2) have equal access to the above-mentioned set of financial instruments and/or services; and (3) are treated equally when they are active in the market.'
>
> – Beale et. al (2004)

When markets are financially integrated in the sense defined above, the law of one price holds, i.e., all potential agents in both markets[1] will face identical prices for identical assets. This price equalization has important implications for the economy's growth, consumption and output volatility, exposure to crisis and for monetary policy independence through the trilemma[2].

This paper is an attempt to understand the extent to which price integration has progressed in developed and developing economies in the recent decade(s) and the various forces that have helped or hindered this convergence. Price convergence is measured by the index introduced in Pasricha (2008) that captures the size of deviations from covered interest parity as well as the speed of reversion to the no-arbitrage band. In this paper, I construct this index on a yearly basis for 54 countries for an average of 13 years per country[3], comparing interest rates on interbank loans across countries. Previous attempts at measuring price convergence in financial markets have focused on either average absolute deviations (Chinn-Ito, 2007) which do not capture the speed of arbitrage, or the beta-convergence measure (Baele et. al, 2004) which captures integration between a group of countries but does not allow one to rank different countries on

[1] with the same relevant characteristics

[2] see Kose et al. [2009] for an excellent survey

[3] The list of countries and the years for which data is available are listed in Table 1

their degree of convergence. The index developed here is the first time-varying index that allows one to rank countries and takes into account both the size of their no-arbitrage bands[4] and the speed with which the arbitrage occurs, once it is profitable.

Using this measure of price convergence, I explore the factors that contribute to this convergence, or the lack of it. My main focus is on the link between the degree of integration and the competitiveness of the domestic financial sector. While there is a large literature on the implications of domestic banking sector competitiveness for growth (Claessens and Laeven, 2005; Cetorelli, 2001), access to finance (Beck et. al, 2004) and stability (Boyd et. al., 2007; Boyd and Nicola, 2005; Allen and Gale, 2004; Hartmann and Carletti, 2002), the link between the former and the degree of international integration has not been dwelt into. Such a link is important because its existence implies that countries with partially open capital accounts would see greater price convergence with international markets if they liberalized their domestic banking sector, even without opening it to foreign players. They may also try to put sand in the wheels of international capital without appearing to do so, through tightening domestic regulation.

There are several reasons why one would expect a link between domestic financial market structure and international price convergence[5]. Freixas and Holthausen (2005) show that even in the absence of capital controls, when there is asymmetric information between domestic market and foreign market, a segmented market equilibrium may occur, with no interbank activity across the borders. When an integrated equilibrium does occur, the interbank market integration will not be perfect (the interbank rates will not be equalized), even in the presence of correspondent banking. In their model, the signal that banks

[4]The no-arbitrage band captures the minimum deviation required for arbitrage to be profitable and increases with the size of transactions costs and capital controls

[5]In the absence of capital controls and any kind of friction like asymmetric information that prevents all domestic participants from accessing foreign market and vice versa, price-convergence will occur, irrespective of the structure of domestic financial markets. It is only when either capital controls or some other frictions are present (as in the real world) that the structure of domestic financial market becomes relevant.

get about foreign banks' type is more noisy than the signal about domestic banks, leading to an interest differential at which a bank may borrow domestically and the interest rate at which it may borrow abroad (or from a correspondent bank that borrows abroad to lend domestically). Adding imperfect competition in domestic banking sector to their model will only exacerbate the domestic-foreign interest differentials and may increase the range of possibilities where a segmented equilibrium is the only possibility. Secondly, market power in the interbank market would lead to greater bid-ask spreads directly (Khemraj and Pasha, 2008; Pasricha, 2008b) and through its impact on market liquidity. Carletti, Hartmann and Spagnolo (2007) show that bank consolidation may lead to greater variance in aggregate liquidity demand and Acharya, Gromb and Yorulmazer (2008) that surplus banks may under provide liquidity when outside options of needy banks are weak. Several empirical studies in the foreign exchange market have shown that thinner markets or those with greater volatility have higher bid-ask spreads (Cheung and Chinn, 2001; Bollerslev and Melvin, 1994).

The results indeed confirm a strong link between lack of financial sector competitiveness (banking and non-banking) and lack of price convergence, particularly for low and middle income countries. Capital controls explain only a small part of deviations from covered interest parity. Crisis periods and periods of greater volatility see lower de-facto integration.

In the next section, I describe the construction of the index and in section 3, I discuss the trends in financial integration over the sample period. In section 4, I empirically examine the link between domestic financial competitiveness and financial integration. Section 5 concludes.

1 Measuring Price Convergence

1.1 Covered Interest Deviations in the Presence of Frictions

In a fully integrated world with perfectly competitive profit maximizing agents and no transactions costs or other frictions, the following Covered Interest Parity (CIP) condition would hold in equilibrium:

$$\delta_t = P\big(\frac{F_{t+k} - S_t}{S_t}\big) - (i_{t+k} - i^*_{t+k}) = 0 \tag{1}$$

where δ_t is the covered interest differential, i_{t+k} and i^*_{t+k} are respectively returns on comparable domestic and foreign assets between time t and t+k, expressed as per cent per annum. S_t is the domestic currency price of foreign currency, F_{t+k} is the forward rate or the k^{th} period domestic currency price of foreign exchange delivered in that period. P is a scaling factor, used to annualized and convert into percentage terms, the first term[6]. Since all the variables in the above equation are known a priori, any deviation from this parity in our model world represents pure profits and therefore cannot exist in equilibrium.

However, as discussed in Frenkel and Levich (1975) and in Pasricha(2008a), in a world with transactions costs, exchange or capital controls or risk of such controls, differential taxation, the measured covered differential would lie in a no-arbitrage band, even with efficient and risk neutral markets. This happens because the econometrician's measure of covered differential, which is based on the average of the forward and spot rates (rather than the bid-ask rates) and the average of the interest rates does not capture the actual profits, net of taxes and other costs of arbitrage. One should then expect the measured differential, $\hat{\delta}$ to satisfy:

$$\kappa_n \leq \hat{\delta} \leq \kappa_p \tag{2}$$

[6]for example, if the forward rates are of maturity 1 month, then $P = 1200$

where

$$\hat{\delta} = \frac{F - S}{S} - \frac{i - i^*}{1 + i^*}$$

and the precise forms of κ_n and κ_p depend on the transactions costs and capital controls (as well as the levels of exchange and interest rates)[7]. The measured deviations within the no-arbitrage bands are therefore, consistent with equilibrium and with covered interest parity, and may be unit root processes. Further, when the supply of arbitrage capital is less than perfectly elastic, due either to quantitative controls, asymmetric information, or imperfect competition in markets, then profitable deviations may not be immediately arbitraged away but in rational markets, would eventually be arbitraged away (Cheng and Cheung, 2008; Fong, Valente and Fun, 2008).

1.2 Empirical Model for Covered Interest Deviations

These considerations lead one to the choice of an Asymmetric, Self-Exciting Threshold Autoregressive Model (ASETAR) model as the empirical model to estimate the boundaries of the no-arbitrage band (called the thresholds) and the speed of reversion outside the band. This model is called 'self-exciting' because the thresholds are lags of δ itself, and asymmetric because the negative threshold is allowed to differ from the positive threshold. It takes the form:

$$\delta_t = \rho_i \delta_{t-1} + \epsilon_t \qquad \text{for} \quad \kappa_n < \delta_{t-1} < \kappa_p \tag{3}$$

$$\delta_t - \kappa_n = \rho_n(\delta_{t-1} - \kappa_n) + \epsilon_t \quad \text{for} \quad \delta_{t-1} \leq \kappa_n \tag{4}$$

$$\delta_t - \kappa_p = \rho_p(\delta_{t-1} - \kappa_p) + \epsilon_t \quad \text{for} \quad \delta_{t-1} \geq \kappa_p \tag{5}$$

where $\epsilon_t \sim N(0, \sigma^2)$ and κ_n and κ_p are the negative and positive thresholds respectively. In theory, the deviations inside the band are unit-root processes, so the model is estimated with $\rho_i = 1$. Note that this model implies that speculative activity will push the deviations to the edges of the band, rather than its center. The hypothesis of efficient arbitrage states that the AR(1) process outside the bands be stationary. If the thresholds were known, the model could

[7] These are described in Pasricha(2008a)

be estimated by ordinary least squares applied separately to the inner regime and outer regime observations. Since the thresholds are not known, they may be estimated either by a grid search, or by a sequential method suggested in Hansen(1999) that also yields confidence intervals for the thresholds. In this method, a grid search is first made for a single threshold, yielding a minimum residual sum of squares, say $S_1(\tilde{\kappa_1})$, where the function S everywhere denotes the residual sum of squares function. In a two regime model, the first search would yield the stronger of the two threshold effects. Fixing the first-stage estimate $\tilde{\kappa_1}$, the second-stage criterion is:

$$S_2(\kappa_2) = \begin{cases} S(\tilde{\kappa_1}, \kappa_2) & \text{if} \tilde{\kappa_1} < 0 \\ S(\kappa_2, \hat{\kappa_1}) & \text{if} \tilde{\kappa_1} > 0 \end{cases} \tag{6}$$

and the second-stage threshold estimate is the one that minimizes the above function, i.e.:

$$\hat{\kappa_2} = argmin\ S_2(\kappa_2) \tag{7}$$

The estimate of the first threshold is then refined as follows:

$$S_1^r(\kappa_1) = \begin{cases} S(\hat{\kappa_2}, \kappa_1) & \text{if} \hat{\kappa_2} < 0 \\ S(\kappa_1, \hat{\kappa_2}) & \text{if} \hat{\kappa_2} > 0 \end{cases} \tag{8}$$

and the refinement estimator for the first threshold is:

$$\hat{\kappa_1} = argmin\ S_1^r(\kappa_1) \tag{9}$$

As a practical matter, the search is conducted over all unique values of the actual observations between the 5^{th} and the 95^{th} percentiles and is restricted so that at least 5% of observations fall in each of the three regimes. When the model is estimated for every year using daily observations, this restricts the minimum number of observations in each regime to be between 10 and 12.

This process of optimization also yields confidence intervals for the thresholds. Define

$$L_2^r(\kappa_2) = \frac{S_2(\kappa_2) - S_2(\hat{\kappa_2})}{\sigma^2}$$

and

$$L_1^r(\kappa_1) = \frac{S_1^r(\kappa_1) - S_1^r(\hat{\kappa_1})}{\sigma^2}$$

The asymptotic $(1-\alpha)\%$ confidence intervals for κ_1 and κ_2 are the set of values of each such that $L_1^r(\kappa_1) \leq c(\alpha)$ and $L_2^r(\kappa_2) \leq c(\alpha)$. Hansen(1999) also shows that

$$c(\alpha) = -2log(1 - \sqrt{1-\alpha})$$

.

1.3 Integration Index

To construct the Integration Index, Pasricha (2008a) takes into account five different measures that derive from the model. The first is the bandwidth, which measures the size of the no-arbitrage band, and is expected to be wider the greater the transactions costs or the effective controls in an economy. The last three measures are the percentage of observations lying in the outer regimes[8]($OutObs$), the median positive and negative deviation outside the measured band ($MedDevNeg$ and $MedDevPos$ respectively) and the third quartile of continuous runs outside the band ($3rdQuartile$). These measures capture how frequent are profitable deviations from interest parity, and how fast they revert back to the band. The more elastic the supply of capital and the less effective the controls, the faster the reversion speed[9]. One could also use the AR coefficients in outer regimes or the half lives, but the results should be similar. Medians and quartiles are preferable to average deviations as they are immune to outliers.

Each of the indicators mentioned above are first normalized by subtracting from them their inter-country mean and dividing by the standard deviation. This makes the resulting index centered at zero. The normalizations are done separately for the two maturities, one and three months. For countries for which data on one of the maturities is not available, the available maturity's data is used to approximate for the missing maturity model. The Integration Index for

[8]Using percentage of observations rather than number of observations takes care of the concern about uneven sample sizes influencing the latter.

[9]Note that the paper uses daily data, and thus measured deviations are those that were present at the end of the day.

country j time t, I_{jt} is:

$$I_{jt} = \frac{\sum_k I_{jkt}}{k}$$

where

$$\begin{aligned} I_{jkt} &= -\frac{\tilde{Bandwidth}_{jkt} + \tilde{OutObs}_{jkt} + \tilde{MedDevN}_{jkt} + \tilde{MedDevP}_{jkt} + \tilde{3rdQrt}_{jkt}}{5} \\ \tilde{X}_{jkt} &= \frac{X_{jkt} - \overline{X_k}}{\sigma_k}, \end{aligned} \tag{10}$$

etc., and $\overline{X_k}$ and σ_k are, respectively the mean and standard deviation (over all country-time observations of maturity k) of X for $X = Bandwidth$, $OutObs$, $MedDevN$, $MedDevP$, $3rdQrt$. The equation (10) normalizes each of the variables (Bandwidth, OutObs etc) so that the resulting normalized variables are pure numbers and can be averaged.

Since there are no theoretical priors that allow one to assign different weights on the different components of the index based on their contribution to 'openness', this index uses a simple average. Besides being transparent, such an average is based on the premise that greater openness means both, smaller deviations from parity and deviations that are arbitraged away more quickly. The negative sign in (10) allows larger values of the index to be interpreted as greater integration.

1.4 Data and Results

To construct the index, interest rates on interbank loans of 1 and 3 month maturities were used except for Brazil, where these were unavailable, so the Certificate of Deposit rates were used. The data on interbank rates are from Bloomberg and Thomson Financial's Datastream databases for all countries except South Africa and Columbia, whose rates were sourced from Global Financial Database, as these were unavailable in Bloomberg or Datastream. The exchange rate data is all from Bloomberg and Datastream. The forward exchange rates are onshore forward rates of 1 and 3 month maturities, except for Chile where onshore forward data was unavailable so non-deliverable forwards were used. For countries

that had adopted the Euro, the exchange rates pertain to the Euro after Jan 1, 1999 or their date of accession, whichever is later. Table 1 summarizes the index for the whole sample and for high income and low and middle income country groupings respectively (World Bank Classification). High income countries have on average, greater openness than low and middle income countries (mean 0.6 compared to average openness of -0.18 for the low and middle income group). The high income countries also see lower variability in their openness. Figure 1 plots the index over time for these country groups. The figure highlights the fact that the level of price convergence is not a slow moving variable. It fluctuates from year to year, even for high income countries, much more than say the degree of legal restrictions. However, it is important to keep in mind that the figure is not on a balanced panel. New countries are added to each of the income groups as their data becomes available and this may contribute to some of the fluctuations, especially since the total number of countries in the sample is not too large. The large dip in openness around the year 1998 in the low and middle income countries is due to the Asian crisis which saw the imposition of capital controls in these countries, most effectively in Malaysia. The dip in 2001 is due to Turkey's financial crisis. Figure 3 shows the low and middle income countries' average openness excluding Malaysia, Thailand and Turkey. Noteworthy is the large dip in openness in the current crisis. While the high income countries show a positive trend in openness, the same is not true for low and middle income countries.

2 Determinants of Price Convergence

This section identifies determinants of de-facto openness as measured by price convergence. The emphasis is on the relationship between price convergence and de-jure capital controls and competitiveness of domestic banking sector. I use the following model:

$$Index_{it} = \alpha + \beta X_{it} + \gamma t + \epsilon_{it} \tag{11}$$

where $Index_{it}$ is the integration index constructed above for country i, time t, X_{it} are a set of country characteristics, detailed below and t is a time trend. The regressions are estimated using a Prais Winston procedure allowing for panel specific AR(1) correction, as the residuals from the OLS fixed effects regressions showed autocorrelation.

Explanatory variables include measures of banking competitiveness, measures of legal restrictions to cross-border capital flows, macroeconomic variables and measures of transactions costs and liquidity in the interbank and foreign exchange markets.

I use four different proxies for domestic banking sector competitiveness - the net interest margins which equal the accounting value of banks' net interest revenue as a share of their total assets, bank overhead costs to total assets ratio, return on equity for the banking sector and bank concentration ratio which is the ratio of total assets of the banking sector that are owned by the three largest banks. Each of these variables is from the world bank's financial structure database[10]. A higher level of each of the variables denotes greater monopoly power in domestic banking and therefore should be associated with lower international integration. Neither of these is a perfect measure of competitiveness, however each of these has been used as proxy for the bank competitiveness in the literature and some are better than the others. Banks with market power can charge higher rates of loans and pay lower rates on deposits (Berger and Hannan, 1989; Hannan 1991). Demirguc, Laeven and Levine (2003) find that regulatory restrictions on banking activity, including freedom of entry and lack of institutional development substantively increase net interest margins. They also find that the net interest margins increase with state control of the banking sector, and decline with development of the stock markets, which would compete with banks as a source of funding. Higher profits of a less competitive industry may be reflected in higher return on equity (ROE) or higher overhead costs (Berger and Hannan, 1998; Jayaratne and Strahan, 1998; Martinez Peria and Mody, 2004). Bank concentration ratio in theory should be higher for less

[10]For more details on the variables and sources, see appendix table.

competitive systems but in practice, the evidence is weak. It does not take into account the fact that banks may compete with non-bank financial institutions and with other financial markets or that threat of entry matters for effective competition (Panzar and Rosse, 1987, Claessens and Laeven, 2004; Beck et. al, 2006).

In order to account for the competition banks may face from non-bank financial sectors, I use a measure of financial development which is the first principal component of life insurance premiums ratio to GDP, stock market capitalization ratio to GDP, stock market total value as ratio to GDP and domestic credit to private sector as percentage of GDP. The first three are from World Bank's financial structure database and the last from World Bank's World Development Indicators database.

While the level of capital controls determine the de-facto financial integration, market players often find ways to evade the controls, so the relation need not be one-to-one. Moreover, even in the absence of capital controls, other imperfections - transactions and information costs, asymmetric information, imperfect competition etc - impinge on the price convergence with international markets, so that even in the absence of capital controls, price convergence may not be perfect. The coefficient on de-jure measure of openness is therefore expected to be positive but less than one. I use the Chinn-Ito measure of capital account openness (KA Open), which takes higher values for fewer legal restrictions on capital flows across borders.

Bank competitiveness, capital controls as well as risk of future controls may be positively related to the degree of development of institutions in the country (Claessens and Laeven, 2004; Ito and Chinn, 2007). On the other hand, for any given level of capital controls, evasion would be more the worse the institutions. I include a measure of institutional development, which is the first principal component of corruption and political risk indices from PR Group's International Country Risk Guide. Higher levels of these variables reflect lower corruption or risk. The sign of the institutional variable may be positive or negative.

As a proxy for transactions costs in currency markets, I compute the percentage bid-ask spread (as a percentage of mean rate) in the spot exchange rate markets using daily data. An average of these for the year for each currency is included as an explanatory variable (X_Spread). One would expect higher average spreads to be associated with lower openness. Similar spreads on interbank interest rates were not available for most of the countries in the sample.

I compute the coefficient of variations in the interbank and average for the 1- and 3- month forward exchange rate markets, as volatility in the markets may be used to proxy for the lack of liquidity in the markets, as well as for the risk premia.

Crisis periods often see either new capital controls imposed or renewed enforcement of existing regulations. Banking crisis periods, additionally are also periods of heightened counterparty risks and lower liquidity in interbank markets, and serve here to control for these risk premia. Both kinds of crisis periods are therefore expected to be associated with lower price convergence. I include two dummy variables for crisis periods in the regressions, one for banking crisis and another for currency crisis. Currency Crisis dummy uses the Kaminsky and Reinhart (1999) index of currency market turbulence (a weighted average of exchange rate and reserve changes) to identify crisis months and takes the value 1 for years in which there was one or more crisis month. The Bank Crisis dummy variable takes the value 1 for years in which there was a systemic banking crisis and is taken from Laeven and Valencia (2008).

Finally, a trend variable is included to test if the world has indeed become more globalized over time, GDP per capita in thousands of 2000 US dollars to test if higher income countries are more integrated after controlling for their level of financial development, institutions etc, and the ratio of trade to GDP. Greater trade integration should make it easier to evade capital controls as over invoicing of imports and under invoicing of exports are popular ways of exporting capital in countries with controls (Aizenman 2008; Aizenman and Noy, 2009; Prasad and Rajan, 2008; Claessens and Naude, 1993).

The analysis is done first for the entire sample of countries and then for the

two groups - high income and Low and middle income countries - separately. The list of countries included in each group are presented in Table 3. Table 4 presents the summary statistics of each of the regressors for all countries and by income group. Several of the variables have different mean values by income group. Table 5 presents the results of difference in means tests for some variables of interest, by income group. For each variable of interest, Table 5 presents the results of an OLS regression on the High Income dummy variable and a constant. The estimated constants are then the mean values of the dependent variable for Low and Middle Income group. High income countries have net interest margins and overhead costs that are significantly lower than low and middle income countries. The return on equity is not significantly different between the two groups, and concentration in banking assets is actually significantly larger for high income countries than for low and middle income countries. This, combined with the significantly higher level of financial development (non-bank financial sector) in the high income economies, suggests that concentration may not be the best proxy for the level of competitiveness of the banking sector. This is consistent with the results of Claessens and Laeven (2004) who create a measure of bank competitiveness based on contestability of the market and find that it does not negatively relate to concentration. Moreover, the correlation between net interest margins and de-jure controls is -0.45, indicating that countries with greater openness are also one with lower net interest margins and underscoring the validity of net interest margins as a proxy for lack of competitiveness in banking rather than for bank efficiency.

2.1 Results on Bank Competition and International Financial Integration

2.1.1 Full Sample

The results of the regressions are presented in Tables 6 to 8. Table 6 presents the results for the entire sample. The coefficient on net interest margins is negative and significant at 1 percent level, implying that less competitive banking systems

are associated with lower price convergence with the rest of the world. The X-standardized coefficient on net interest margin is -0.09[11]. This value means that a one standard deviation increase in net interest margin would lead to a fall in the integration index of 0.09, or a 0.20 standard deviation fall. As an example, if Argentina's net interest margins fell from 0.061 in 2005 to the level of net interest margins in Belgium in 2005, or 0.0149 (a 2.57 standard deviation fall) other things being equal, its integration index would rise from -0.258 to -0.026, roughly the level for Singapore in 2004.

When overhead costs as a proportion of bank assets is used as a proxy for competitiveness, the result is again a negative coefficient that is significant at 10 percent level. The coefficient on return on equity is not significant but negative, while that on concentration index is positive. Since previous studies have shown that concentration is only weakly, if at all, related to banking sector competitiveness, I looked for threshold effects in financial development variable. The idea is that markets like Hong Kong, Singapore and UK, which have concentration ratios exceeding 0.95 for one or more years (it is 0.99 for Singapore in 2005) may nevertheless have competitive banking systems that face competition from the non-bank financial sector. I therefore created a variable that is the product of concentration and negative of the financial development index, for values of financial development below the threshold, and zero otherwise. This variable would take larger (positive) values for markets that have greater concentration and lower financial development, as long as financial development is below the threshold, and is zero otherwise. For values of financial development between -0.9 (roughly the 34^{th} percentile) and -1.50 (the 17^{th} percentile) the coefficient of the interaction term was negative and significant [12]. The interaction term in Table 6, column (4) uses the threshold -0.9. This suggests that at low levels of financial development, the coefficient of concentration variable is smaller,

[11]The X-standardized coefficient is the beta multiplied by the standard deviation of the X-variable.

[12]For thresholds lower than the 17^{th} percentile, the coefficient was still negative but not significant, which may be because the number of observations actually used in regressions for which the threshold was not crossed was too low

although it is still positive.

The coefficient for de-jure openness is positive and significant and roughly the same size in all columns of Table 6. The X-standardized coefficient for de-jure openness is lower than the one for net interest margins (0.07), but larger than that for overheads. These results indicate that although capital controls do lead to lower price convergence, however, the relationship is far from one to one. This is consistent with the widely held view that market players find ways around controls and with other studies on the effectiveness of capital controls[13].

Both exchange rate spreads and coefficient of variation in exchange rates enter with a negative sign, as expected and are significant in all regressions in the full country sample, indicating that liquidity and shocks play an important role in determining price-convergence. There is a significant positive trend in openness, indicating that the recent wave of globalization has led to price convergence. Currency crisis are associated with a significant decline in openness, other things being the same, but in the full sample, the same is not true for banking crisis.

2.1.2 Results by Income Group

Table 7 presents the results using data on high income countries only. In this country grouping, the only variables that enter significantly are the level of legal restrictions, a trend and the level of institutional development. All have a positive sign, indicating that the fewer the restrictions on flows and the better the institutions, the higher the level of openness. Given the high level of de-jure openness in these countries, it is not surprising that most of the banking competitiveness variables are not significant. As discussed in the introduction, when there are no or few constraints on access to overseas financial markets, the level of banking competition becomes irrelevant. The positive and significant coefficient on return on equity may only reflect greater efficiency in these markets. The R^2 in the high-income country regressions are also quite low.

[13]See, for example, Garber 1998, Garcia 2006 and Aizenman 2004 for studies on evasion of capital controls

In contrast, the R^2 for low and middle income country sample are very high, around 0.7 for each specification. The banking sector competitiveness indicators, net interest margins, overheads and return on equity, all have negative coefficients that are larger in magnitude than for the full sample, and significant at the 1 percent level. The concentration index is not significant. Currency crisis and greater volatility in the forex markets are both associated with significantly low levels of de-facto openness, whereas both institutional quality and financial development are associated with higher de-facto openness. De-jure restrictions matter, but the coefficients are smaller than for the high income country sample and not always significant. Trade and GDP enter with negative signs and are both significant but that may just reflect the fact that there were several crisis episodes in the emerging markets with higher GDPs and trade-openness in the sample under consideration and that we have a smaller time series for these countries than for higher income countries.

3 Concluding Remarks

This paper develops a price based measure of financial openness for 54 countries and for an average of 13 years per country. This index captures an important aspect of international financial integration - the degree to which interest rates are aligned with international markets - that has so far been missing in the studies of impact of financial openness on growth, macroeconomic volatility as well as contagion. While there is a clear trend of increasing openness in the high income countries before the onset of current crisis, the same was not true for the developing countries.

Further, this paper makes a contribution to the literature on determinants of de-facto integration and looks at a previously ignored angle - the relationship between banking sector competitiveness and de-facto integration. Although none of the measures used are perfect, they all point to a strong link between bank competitiveness and price convergence in international markets, especially for low and middle income countries. This has several policy implications. The

restrictions on international integration are not the sum total of controls on cross border transactions - domestic regulations impinge on international integration. Liberalizing domestic financial sectors may provide all the benefits of more efficient domestic allocation of resources but in addition would provide the benefits from a greater international integration. Schaeck et. al. (2006) find that more competitive banking systems are more stable and Fecht et. al. (2007) that greater international integration of interbank markets enchances resiliance to ideosyncratic shocks. The link between the two may be that more competitive systems are also more integrated with the rest of the world.

The paper also finds that the determinants of price integration differ between developed and developing countries. Periods of volatility and currency crisis are periods of low price-integration for developing countries. Moreover, for this group, while the link between capital controls and price-convergence exists, it is not strong, providing further proof that capital controls do get evaded. In both the developed and developing country samples, greater financial development is associated with greater de-facto openness. Trade openness is not a significant determinant of de-facto integration in developed markets but is associated with lower integration in the developing countries sample. This may be because the study ignores threshold effects. Increasing trade openness may increase convergence but only when the level of de-jure controls are high and when corruption is high. The impact of tightening of capital controls on de-facto integration may also depend on the level of institutional development. These thresholds effects may be a subject of future research.

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Table 1. Integration Index Availability

Market	N	Begin Year	End Year
Argentina	5	2004	2008
Australia	23	1986	2008
Austria	20	1989	2008
Belgium	19	1990	2008
Brazil	6	2003	2008
Bulgaria	5	2004	2008
Canada	24	1985	2008
Chile	7	2002	2008
China	7	2002	2008
Colombia	5	2004	2008
Croatia	6	2003	2008
Czech Republic	12	1997	2008
Denmark	21	1988	2008
Estonia	10	1999	2008
Finland	17	1992	2008
France	20	1989	2008
Germany	18	1991	2008
Greece	12	1997	2008
Hong Kong	23	1986	2008
Hungary	11	1998	2008
Iceland	5	2004	2008
India	10	1999	2008
Indonesia	9	2000	2008
Ireland	20	1989	2008
Israel	8	2001	2008
Italy	18	1991	2008
Japan	13	1996	2008
Kazakhstan	5	2004	2008
Kuwait	7	2002	2008
Latvia	8	2001	2008
Lithuania	9	2000	2008
Malaysia	19	1990	2008
Mexico	12	1997	2008
Netherlands	20	1989	2008
New Zealand	23	1986	2008
Norway	23	1986	2008
Pakistan	5	2004	2008
Philippines	12	1997	2008
Poland	10	1999	2008
Portugal	16	1993	2008
Romania	5	2004	2008

Table 1 (cont'd)

Market	N	Begin Year	End Year
Russian Federation	5	2004	2008
Saudi Arabia	7	2002	2008
Singapore	23	1986	2008
Slovakia	7	2002	2008
Slovenia	5	2004	2008
South Africa	12	1997	2008
Spain	20	1989	2008
Sweden	22	1987	2008
Switzerland	25	1984	2008
Thailand	13	1996	2008
Turkey	10	1999	2008
United Arab Emirates	2	2007	2008
United Kingdom	25	1984	2008
Total	704	1984	2008

Table 2. International Integration Index: Summary Statistics

	N	Mean	Std_Dev	Max	Min	CV
All Countries	704	0.00	0.48	0.54	-4.88	..
High Income Countries	519	0.06	0.33	0.54	-2.20	5.32
Low and Middle Income Countries	185	-0.18	0.73	0.50	-4.88	-4.11

Table 3. Countries by Income Group

High Income Countries		
High Income, OECD:	Iceland	Switzerland
Australia	Ireland	United Kingdom
Austria	Netherlands	*High Income, Non OECD:*
Belgium	Italy	Estonia
Canada	Japan	Hong Kong
Czech Republic	Netherlands	Israel
Denmark	New Zealand	Kuwait
Finland	Norway	Saudi Arabia
France	Portugal	Singapore
Germany	Slovakia	Slovenia
Greece	Spain	United Arab Emirates
Hungary	Sweden	

Low and Middle Income Countries		
Upper Middle Income:		*Lower Middle Income*
Argentina	Malaysia	China
Brazil	Mexico	Colombia
Bulgaria	Poland	India
Chile	Romania	Indonesia
Croatia	Russian Federation	Philippines
Kazakhstan	South Africa	Thailand
Latvia	Turkey	*Low Income*
Lithuania		Pakistan

Table 4. Summary Statistics

	N	Mean	Std_Dev	Max	Min	CV
KA Open	637	1.68	1.18	2.53	-1.13	0.70
CV_IB	704	0.12	0.11	0.99	0.00	0.88
CV_XF	704	0.04	0.03	0.43	0.00	0.73
X_Spread	648	0.06	0.09	0.66	0.00	1.42
Institutions	702	0.00	1.30	2.34	-4.05	..
Trade	574	0.92	0.65	4.74	0.19	0.70
GDPpc2000USD	595	16.55	10.22	41.45	0.44	0.62
Overheads	593	0.03	0.02	0.12	0.00	0.55
Net Interest Margins	593	0.03	0.02	0.18	0.01	0.60
Concentration	597	0.68	0.19	1.00	0.16	0.27
ROE	586	0.09	0.14	1.03	-1.44	1.59
Financial Development	529	0.00	1.61	6.86	-2.19	
High Income Countries						
KA Open	474	2.14	0.69	2.53	-1.13	0.32
CV_IB	519	0.12	0.11	0.99	0.00	0.94
CV_XF	519	0.04	0.02	0.22	0.00	0.56
X_Spread	490	0.05	0.07	0.66	0.00	1.38
Institutions	517	0.56	0.93	2.34	-2.26	1.67
Trade	433	0.93	0.69	4.74	0.19	0.74
GDPpc2000USD	454	20.71	7.92	41.45	3.79	0.38
Overheads	433	0.03	0.02	0.12	0.00	0.52
Net Interest Margins	433	0.03	0.01	0.08	0.01	0.39
Concentration	437	0.72	0.18	1.00	0.30	0.25
ROE	426	0.09	0.10	1.03	-0.50	1.15
Financial Development	397	0.24	1.56	6.86	-1.89	6.59
Low and Middle Income Countries						
KA Open	163	0.33	1.26	2.53	-1.13	3.82
CV_IB	185	0.13	0.09	0.46	0.00	0.71
CV_XF	185	0.04	0.04	0.43	0.00	0.99
X_Spread	158	0.09	0.12	0.66	0.00	1.29
Institutions	185	-1.56	0.84	0.50	-4.05	-0.54
Trade	141	0.89	0.49	0.23	0.25	0.55
GDPpc2000USD	141	3.16	1.79	8.69	0.44	0.57

Table 4 (cont'd)

	N	Mean	Std_Dev	Max	Min	CV
Overheads	160	0.04	0.02	0.12	0.01	0.52
Net Interest Margins	160	0.05	0.03	0.18	0.01	0.56
Concentration	160	0.57	0.17	1.00	0.16	0.30
ROE	160	0.08	0.21	1.01	-1.44	2.46
Financial Development	132	-0.71	1.55	4.23	-2.19	-2.17

Note. — GDP per capita is in thousands of 2000 US dollars.

Table 5. Difference in Means Tests

	Net Int Margin	Overhead	ROE	Concentration	FinclDevpt	Instn	KA Open
High_Income	-0.02***	-0.01***	0.00	0.14***	0.95***	2.11***	1.81***
	(0.00)	(0.00)	(0.01)	(0.02)	(0.16)	(0.08)	(0.08)
Constant	0.05***	0.04***	0.08***	0.57***	-0.71***	-1.56***	0.33***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.14)	(0.07)	(0.07)
Observations	593	593	586	597	529	702	637
R^2	0.269	0.080	0.000	0.118	0.065	0.515	0.451

Note. — Net Int Margin refers to Net Interest Margins, FinclDEvpt is the Financial Development Index, Instn refers to Institutional index. The table shows the output of OLS regression of the variable in the column header on the dummy variable High_Income and a constant. The estimated constant term is the mean of the dependent variable for Low and Middle income countries. $*$ $p < 0.1$, $**$ $p < 0.05$, $***$ $p < 0.01$.

Table 6. Explaining De-facto Integration

VARIABLES	1	2	3	4
KA Open	0.06*	0.07**	0.06**	0.06*
	(0.03)	(0.03)	(0.03)	(0.03)
CV_IB	-0.04	-0.06	-0.10	-0.09
	(0.13)	(0.13)	(0.12)	(0.12)
CV_X	-4.36***	-5.37***	-5.48***	-5.44***
	(1.13)	(1.15)	(1.11)	(1.13)
X_Spread	-0.69**	-0.78**	-0.78**	-0.84**
	(0.32)	(0.33)	(0.32)	(0.33)
Bank Crisis	-0.10	-0.09	-0.11	-0.08
	(0.08)	(0.08)	(0.09)	(0.09)
Currency Crisis	-0.26***	-0.26***	-0.26***	-0.25***
	(0.09)	(0.09)	(0.09)	(0.08)
Trend	0.03***	0.03***	0.03***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
Institution	0.05	0.06**	0.05*	0.04
	(0.03)	(0.03)	(0.03)	(0.03)
Financial Development	0.02	0.02	0.03	0.01
	(0.02)	(0.02)	(0.02)	(0.02)
Trade	-0.12***	-0.12***	-0.11**	-0.10**
	(0.05)	(0.04)	(0.05)	(0.04)
GDPpc2000USD	-0.01	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Net Interest Margin	-5.02***			
	(1.25)			
Overheads		-1.96*		
		(1.06)		
ROE			-0.09	
			(0.22)	
Concentration				0.34***
				(0.11)
Concentration* Low FinclDevpt				-0.10*
				(0.06)
Constant	-0.02	-0.14	-0.17	-0.32*
	(0.16)	(0.16)	(0.17)	(0.17)
Observations	448	448	439	450
R^2	0.326	0.316	0.315	0.330
Number of coden	51	51	51	51

Note. — Regressions use Prais-Winston 2SLS proceedure with panel specific AR(1) error processes. Standard errors in parentheses.$*$ $p < 0.1$, $**$ $p < 0.05$, $***$ $p < 0.01$.

Table 7. Explaining De-facto Integration: High Income Countries

VARIABLES	1	2	3	4
KA Open	0.13***	0.12***	0.12***	0.14***
	(0.05)	(0.05)	(0.04)	(0.04)
CV_IB	0.04	0.04	0.04	0.03
	(0.11)	(0.11)	(0.12)	(0.11)
CV_X	0.52	0.58	0.99	0.43
	(0.97)	(0.96)	(1.06)	(0.97)
X_spread	0.06	0.04	0.05	0.03
	(0.44)	(0.43)	(0.41)	(0.42)
Bank Crisis	-0.03	-0.03	-0.03	-0.03
	(0.09)	(0.09)	(0.09)	(0.09)
Currency Crisis	-0.07	-0.07	-0.07	-0.07
	(0.05)	(0.05)	(0.05)	(0.05)
Trend	0.03***	0.03***	0.02***	0.02***
	(0.01)	(0.01)	(0.01)	(0.01)
Institutions	0.07*	0.07*	0.06*	0.06*
	(0.04)	(0.04)	(0.04)	(0.03)
Financial Development	0.02	0.02	0.02	0.03
	(0.02)	(0.02)	(0.02)	(0.02)
Trade	-0.00	-0.01	-0.00	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)
GDPpc2000USD	-0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Net Interest Margin	-0.62			
	(2.42)			
Overheads		-1.29		
		(1.12)		
Return on Equity			0.29*	
			(0.16)	
Concentration				0.14
				(0.12)
Constant	-0.70***	-0.68***	-0.76***	-0.79***
	(0.17)	(0.16)	(0.15)	(0.17)
Observations	343	343	334	345
R^2	0.165	0.168	0.170	0.165
Number of coden	30	30	30	30

Note. — Regressions use Prais-Winston 2SLS proceedure with panel specific AR(1) error processes. Standard errors in parentheses.$*$ $p < 0.1$, $**$ $p < 0.05$, $***$ $p < 0.01$.

Table 8. Explaining De-facto Integration: Low and Middle Income Countries

VARIABLES	1	2	3	4
Ka Open	0.09**	0.07	0.10***	0.08*
	(0.04)	(0.04)	(0.04)	(0.05)
CV_IB	-0.74	-0.56	-0.94**	-0.65
	(0.47)	(0.44)	(0.43)	(0.45)
CV_X	-1.26	-3.59**	-3.44**	-4.14**
	(1.64)	(1.68)	(1.48)	(1.70)
X_spread	-0.36	-0.36	-0.30	-0.48
	(0.39)	(0.40)	(0.36)	(0.41)
Bank Crisis	-0.10	-0.08	-0.03	-0.05
	(0.14)	(0.15)	(0.14)	(0.14)
Currency Crisis	-1.77***	-1.77***	-1.86***	-1.66***
	(0.51)	(0.54)	(0.56)	(0.59)
Trend	0.04*	0.03	0.02	0.03
	(0.02)	(0.02)	(0.02)	(0.02)
Institutions	0.10*	0.12**	0.07	0.12**
	(0.06)	(0.06)	(0.05)	(0.06)
Financial Development	0.13***	0.13***	0.13***	0.13***
	(0.02)	(0.03)	(0.03)	(0.03)
Trade	-0.48***	-0.48***	-0.35***	-0.38***
	(0.11)	(0.10)	(0.10)	(0.10)
GDPpc2000USD	-0.04**	-0.04*	-0.07***	-0.07***
	(0.02)	(0.02)	(0.02)	(0.02)
Net Interest Margins	-9.02***			
	(1.78)			
Overheads		-6.33***		
		(2.11)		
ROE			-0.95***	
			(0.34)	
Concentration				0.14
				(0.27)
Constant	0.56	0.52	0.52	0.31
	(0.47)	(0.55)	(0.47)	(0.54)
Observations	105	105	105	105
R^2	0.701	0.678	0.678	0.674
Number of coden	21	21	21	21

Note. — Regressions use Prais-Winston 2SLS proceedure with panel specific AR(1) error processes. Standard errors in parentheses.$*$ $p < 0.1$, $**$ $p < 0.05$, $***$ $p < 0.01$.

Figure 1 . Integration Index, by Income Group

Figure 2 . Integration Index, by Income Group.
Excluding Malaysia, Thailand and Turkey.

Appendix: Data Sources

Variable Name	Description & Source
Bank Crisis	Dummy Variable, 1 if the year is a banking crisis year. *Source*: Laeven and Valencia (2008)
Concentration	Share of the three largest banks' assets in total assets of the banking sector in the country. *Source*: Beck et. al. (2000)
Currency Crisis	Dummy Variable, 1 if the year has a crisis month. Crisis month identified as months where an index of currency market pressure (defined as a weighted average of exchange rate and reserve changes) exceeds the mean by 3 or more standard deviations, as in Kaminsky and Reinhart (1999). Data on exchange rates, inflation rates and reserve assets from IMF International Financial Statistics database.
CV_IB	Average of the within-year coefficient of variation in 1 and 3 month interbank interest rates. *Source*: Bloomberg, Global Financial Database and Datastream
CV_X	Average of the within-year coefficient of variation in 1 and 3 month forward exchange rates. *Source*: Bloomberg and Datastream
Financial Development	Financial Development index, constructed as first principal component of stock market capitalization, life insurance premium, stock market value traded, and domestic credit to private sector as % of GDP. Higher values indicate greater development. Data for the components was sourced from Beck et. al. (2000) for the first three and World Bank's World Development Indicators for domestic credit to private sector.
GDPpc2000USD	Per capita GDP in thousands of 2000 USD. *Source*: World Bank's World Development Indicators.

Data Sources, Contd.

Variable Name	Description & Source
Index	Integration index constructed using TAR models on CIP differentials. The index is centered at 0 and higher values indicate greater openness. The US is assumed to be the home country in the construction of CIP deviations. Differentials are based on onshore forward rates, except for Chile, where NDF rates were used. The daily data on onshore forward rates, spot rates and interbank interest rates on 1 and 3 month maturity loans are from Bloomberg, Datastream and Global Financial Database. Closing prices used in all calculations.
Institutions	Institutional variable, first principal component of ICRG Corruption and Political Risk variables. *Source*: PRG International Country Risk Guide.
KA Open	Chinn Ito (2007) measure of de-jure openness, higher values indicate greater legal restrictions on flows of capital.
Net Interest Margin.	Net Interest Margins in Banking. This variable equals the accounting value of banks' net interest revenue as a share of its total assets. *Source*: Beck et.al (2000)
Overheads	Accounting value of a country's banks' overhead costs as a share of their total assets. *Source*: Beck et. al. (2000)
ROE	Banks' return on equity. *Source*: Beck et.al. (2000)
Trade	Trade as % of GDP. *Source*: World Bank's World Development Indicators database
X_Spread	Yearly average of daily closing bid-ask spread on the spot exchange rate, as a percentage of the mean rate. *Source*: Thomson Financial's Datastream