

Article Title Page

[Article title] **Measures of Financial Openness and Interdependence**

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Acknowledgments (if applicable): This paper benefited greatly from the research assistance that Puspa Amri, Han Chen, Yoonmin Kim, and Amy Yuen provided the authors. Clark and Hallerberg thank David Andrews for useful comments on a related paper entitled "How Should Political Scientists Measure International Capital Mobility." We thank Penny Angkinand, Eric Chiu, and Levan Efremidze for their helpful comments. All errors are ours.

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Structured Abstract:

Purpose: This study reviews concepts and measurements related to financial globalization such as financial openness, financial integration, monetary interdependence, and the mobility and movement of capital.



Design/methodology/approach: This paper surveys the theoretical and empirical literature on monetary interdependence and financial globalization. The major ways in which these concepts are measured empirically are presented and critiqued.

Findings: Disagreements about the degree of financial integration and capital mobility are in part explained by the different approaches to measuring these concepts. One major challenge in obtaining a good measure is controlling for other major factors that may influence observed correlations among financial variables. While we still cannot estimate these relationships precisely, we can safely say that while high for many countries, few if any financial markets are perfectly integrated across countries.

Originality: By offering a comprehensive analysis of these different measurements, this study underscores the different implications for national policies and the operation of the international monetary system of different dimensions of globalization. In particular, the proposition that financial globalization has left most countries with little autonomy for domestic monetary policy is subject to serious debate, at least in the short-run.

Keywords: Capital controls, financial integration, capital mobility, interest rate interdependence

Article Classification: Research paper

For internal production use only

Running Heads:

1. Introduction

The increased globalization of the world economy has had major and in some cases dramatic effects on the interaction among national economies, the effectiveness of national economic policies, and the influence of global economic and financial developments on national economies and financial markets. Through international feedbacks globalization can even influence how domestic monetary and fiscal policies affect the domestic economy. Globalization also has important implications for the operation of business firms and investors.

To better understand these effects and their implications we need to have good measures of the various aspects of globalization. While many popular discussions sound as if there has been a dichotomous pre and post globalization, this is a gross oversimplification. Globalization is a matter of degree, not an either/or condition, and these degrees can vary across different dimensions of globalization as well as across countries and time.

In this paper we focus on the measurement of the financial aspects of globalization. The effects of developments in this area can go far beyond their technical economic and financial aspects. There has been an abundance of research in the last several decades that investigates how increasing internationalization in its many forms affects government policies. Many of these analyses either implicitly or explicitly assume that increasing capital mobility will cause major changes in the capabilities of nation-states. Governments lose some level of autonomy over policy because the “invisible hand” of capital movements rewards those states that pursue capital-friendly policies and punishes those states that favor other factors of production. In most extreme form some

have predicted that “globalization” more generally will ultimately spell the end of the nation-state as the discipline of international markets replaces the government as the ultimate policy maker on economic issues (Ohmae, 1995).

At less drastic view is that particular policy options will no longer be available in a world of increasing economic integration. For example European social democrats express concern that greater integration will spell the end of the welfare state. States with more developed policies to protect workers’ rights will be more expensive places to locate investments and will lose out on their more Anglo-Saxon competitors unless they too enact policies more favorable to capital (Sinn, 1994).. Still others have argued that the constraints on government action already exist and are merely becoming more binding as capital mobility increases (Frieden and Rogowski, 1996).

In the economics literature considerable attention is given to how the degree of capital mobility and choice of exchange rate regime affects the strength of monetary and fiscal policies, how well alternative exchange rate regimes act as automatic macroeconomic stabilizers in the face of shocks, how economic disturbances are transmitted internationally, the workability of adjustably pegged exchange rate regimes,¹ the effectiveness of official intervention in the foreign exchange market, the ability of central banks to sterilize the effects of payments imbalances on the domestic money supply, and the extent to which it is desirable to coordinate national monetary and fiscal policies internationally.²

¹ The higher is capital mobility the greater is the problem of the one-way speculative option under pegged exchange rates.

² The relationships of these issues to the degree of capital mobility are covered in almost any text on international economics or international money and finance. Underlying many of these relationships is the trilemma or impossible trinity which shows that over the long run countries cannot have all three of fixed

While there has certainly been a substantial increase in the degree of capital mobility facing most countries in recent decades, high capital mobility need not imply perfect capital mobility. In part because of the mathematical convenience of assuming perfect capital mobility in open economy models there has been an unfortunate tendency to assume that we now live in a world of virtually perfect capital mobility. The evidence that we review, however, suggests that it is not generally the case. This in turn has quite important implications for policy. Thus, for example, while it is accurate to say that U.S. monetary policy can have an important impact on other countries, it is quite an exaggeration to say, as some have, that the U.S. sets monetary policy for the world.

The following section offers a brief overview of the development of increased financial globalization in the period after World War II. Section 3 presents various concepts of financial openness and interdependence, and their interrelationships. We then review and critique empirical measures of various aspects of financial globalization. We first look at savings-investment correlations and their implications. This is followed by discussions of measures of capital controls and of the magnitudes of capital flows. Section 7 focuses on different measures of interest interdependence. A final section concludes.

2. The Development of Increased Financial Globalization

exchange rates, no controls, and independent monetary policy. With imperfect capital mobility, however, all three may be pursued in the short run. Government efforts to continue violated the trilemma constraints for too long are a frequent cause of currency crises. See Willett (2007.) For empirical estimates of these relationships see Aizenman, Chinn and Ito (2010).

Recent work has identified a number of major sources of the increase in capital mobility. These include advances in communications and information technologies, the creation of innovative financial instruments that help facilitate cross border capital flows, the removal of legal barriers to trade by national authorities, and the rapid increase in trade flows Webb (1991). Since only one of these recognized sources of capital mobility is under the direct control of policy makers (namely, deregulation) it seems reasonable to conclude that the levels of capital mobility and financial integration are largely structural characteristics of the international system (Andrews, 1994; Webb, 1991).

While there is broad consensus that there was a tremendous increase in the degree of financial integration among advanced capitalist nations between the 1960s and the 1980s, it is not clear that this has constituted a stark transition from Frieden's (1991) "before capital mobility" (BCM) world to the "after capital mobility" (ACM) world.³ Empirical studies generally find that for advanced and emerging market (EM) economies capital mobility is high but not perfect. The 1970s were clearly a decade of transition for the advanced economies. The financing of increase in trade flows that resulted from the reduction of tariff barriers in the 1960s required an almost immediate increase in capital flows. This initial increase in capital flows did not require state action to liberalize capital controls, and in fact the flows often occurred despite the best efforts of governments to curtail them.⁴ Webb argues that by 1978 the nature of the international system had

³ The acronyms used here are borrowed from Frieden (1991). See Frieden (1991), Webb (1991), (1995), Andrews (1994), and Cohen (1993) on the timing and significance of the increase in capital mobility.

⁴ Webb (1995) cites a 1973 Bundesbank report that recent experience had "made it abundantly clear that even stronger administrative action against capital flows from foreign countries... does not suffice when speculative expectations run particularly high." Webb (1995) 336, n.80). Similarly, Cohen (1993) argues that "restrictions merely invite more and more sophisticated forms of evasion, as governments from Europe to South Asia to Latin America have learned to their regret.

changed to a point where there was a “striking unwillingness of governments to use trade and capital controls to limit the external imbalances generated by different macroeconomic politics in different countries” (Webb, 1991; 309). A key development was the breakdown of the Bretton Woods exchange rate system in the early 1970s. One of the major causes was the increasing capital mobility that “made it impossible for governments to stabilize exchange rates without subordinating monetary policy to that end” (Webb, 1991; Gowa, 1983; Odell, 1982).

Large increases in flows of financial capital to EM and developing countries not surprisingly began later than for advanced economies. In the late 1970s and early 1980s this particularly occurred in the form of bank lending to governments. With the Latin American debt crisis of the 1980s such flows came to a screeching halt. With the move toward both domestic and international financial liberalization in many of these countries, large financial flows began to re-emerge in the late 1980s and early 1990s. Again these sharply fell off to many regions in the wake of financial and currency crises in the mid and late 1990s. Since then there have been several periods of increased flows followed by sharp reversals. These have given rise to considerable policy and research focusing on capital flow surges and sudden stops, a topic addressed by Efremidze et al. (2011) in the first part of this special issue.

3. An Overview of the Concepts of Financial Openness and Interdependence

The interrelationships among the concepts of financial openness, integration, and interdependence, and capital mobility and capital flows can be confusing. Like trade

openness, there are two major concepts of financial openness. The first and broader concept refers to how much a country is dependent on and/or influenced by international financial flows. The second and narrower concept refers to a country's policies. Here greater openness refers to fewer government imposed constraints such as various forms of taxes and capital controls. With respect to the latter there is a fine and often ambiguous line between some forms of capital controls and prudential regulation.

Capital mobility is the mechanism that links together countries' financial markets. The mobility of financial capital in its technical sense is not identical to the magnitude of capital flows. It refers rather to the quantity of capital that would flow in response to a given change in incentives.⁵ Where capital mobility is less than perfect, i.e. financial markets are less than perfectly integrated, there may be an important time dimension. Thus it will sometimes be important to consider not only the magnitude of the full response but also how quickly it occurs. With fully efficiently integrated markets the response would be instantaneous (or at least very quick).

The major categories of incentives that influence financial capital flows are interest rate differentials, expectations of changes in exchange rates, expectations of the appreciation or depreciation of the prices of stocks and bonds, and perceptions of political risk.⁶ In this paper we focus primarily on the first two sets of incentives. The

⁵ In the 1960s and '70s it was popular to estimate capital flow equations where the coefficients on interest rate variables would give measures of the degree of capital mobility [see, for example, Branson (1968)]. This type of study has gone out of fashion but a close analog is frequently estimated today, however. Here an "offset coefficient" is estimated which measures the extent to which an autonomous change in the domestic monetary base is offset by international capital flows. This provides a continuous measure between zero and one where zero implies no offset. This approach is discussed in the accompanying paper by Willett *et al.* (2011) on currency policies.

⁶ Credit risk refers to the possibility that debtors will not be able to meet their obligations such as occurred with Lehman Brothers during the US subprime crisis. Political risk refers to the possibility that

accompanying paper by Li *et al.* (2012) deals with international financial flows associated with stocks and bonds. These are often lumped together under the heading of portfolio investment.⁷

The actual international movement of capital is the product of the incentives to move capital and the degree of capital mobility. Thus a low level of capital flows between two countries does not necessarily indicate that capital mobility between them is low. Likewise substantial capital flows may result from large incentives such as occurred during episodes of capital flight, even though capital mobility is moderate. We should note that due to the benefits of diversification two way flows of capital between countries can be quite rational. Generally capital mobility refers to changes in net flows.

Assuming no risk of default or changes in capital controls, the difference in the rates of return between countries on short term financial investments is the interest rate differential plus any change in exchange rates. To protect themselves from exchange rate risk international investors often cover themselves by buying forward contracts. This is called covered interest arbitrage and responds to covered interest rate differentials, i.e. the interest rate differential adjusted for the cost of buying forward cover.⁸ If investors do not buy cover then they are engaging in uncovered interest arbitrage. This is a form of

governments may impose policies such as capital controls or nationalization that impede repayments. The combination of these two types of risks is often called country risk.

⁷Direct investment responds to expected profit opportunities to lower costs and/or raise revenue and is not directly covered in these papers. However, greater direct investment as with the activities of multinational corporations more generally tend to increase the degree of financial capital mobility through the financing and hedging activities of these corporations.

⁸ Note that forward exchange may sell at either a premium or a discount relative to spot rates. Thus if the forward pound is selling at a premium relative to the dollar, then the forward dollar is selling at a discount relative to the pound. The covered interest differential is zero when this premium or discount just offsets the difference in interest rates. The true net cost of forward cover is the transactions cost which usually occurs in the form of the spread between buying and selling rates.

speculation since investors have an open position in foreign currency. In the language of traders it is often misleadingly called risk arbitrage or the carry trade. As will be discussed in section 7, it is the existence of uncovered interest rate differentials (i.e. the interest differential plus the expected change in the exchange rate) that is a valid indicator of the degree of capital mobility, not the covered differential.

Like financial openness, the degree of financial integration among countries refers in the broad sense to the degree of capital mobility among them and in the narrower sense to the degree of government imposed barriers to capital movements. These are not limited to outright capital controls but can also include differences in regulatory requirements and tax systems. Discussions of a particular country are generally phrased in terms of how integrated it is with global financial markets. There are also frequent discussions of the degree of integration among particular sets of countries such as the Eurozone.

Technically the degree of financial integration and the degree of financial interdependence in the broad sense are the same thing. The more integrated are financial markets, the greater is their interdependence. Note that the degree of interdependence among different segments of the financial sector can also be an important consideration. For example in the recent financial crisis, the problems in the market for securities based on subprime mortgages in the United States spread both domestically and internationally into markets for bank credit and money market funds. This type of spread is often called contagion and will be discussed in the accompanying paper by Li *et al.* (2012). Non crises related interdependence can also be important. An example is how a change in a central bank's short-term policy rate chains through to effects on the interest rates on bank loans or banks' short-term borrowing from each other.

The degree of international financial interdependence is usually discussed in terms of how strongly financial developments in one country, including changes in monetary policy, affect the financial sectors in other countries and vice versa. The degree of financial interdependence is often asymmetric. Generally larger countries will have a bigger effect on smaller countries than vice versa. Thus, for example, financial developments in the United States usually have much larger effects on Canada and Mexico than developments in these countries have on the United States. Thus even perfect capital mobility need not imply that the degree of financial interdependence among countries will be the same. Furthermore for a given country there may be differences in responsiveness of capital flows to changes in incentives for inflows versus outflows, generated for example by different perceptions of riskiness of home versus foreign investment.

In the extreme many of the concepts coincide. Perfect capital mobility implies full financial openness and financial market integration. These in turn are closely related to the concept of exchange market efficiency. Simple exchange market efficiency assumes that speculators are risk neutral so that there is no risk premium. This concept of efficiency in both foreign exchange and stock markets are frequently investigated by testing whether the predictions implied by factors such as interest rate differentials and forward rates are unbiased predictors of future spot rates. Perfect capital mobility implies rational expectations and exchange market efficiency such that international interest rate differentials, forward premiums or discounts, and expected changes in exchange rates are

all equal.⁹ As noted above, this does not mean that there will always be large capital flows, however. For example, there is now often a global component to expectations about stock and bond prices. This is brought about in part by the anticipation of the effects of economic developments in some countries on economic activities in other countries through the effects on trade flows. Thus news about the outlook for the major economies in Europe may have a direct expectations effect on equity prices in Asia without there being a need for any capital flows.

The effects of financial interdependence are not limited to effects on financial markets. The resulting effects on exchange rates, interest rates, and trade flows can have substantial impacts on economic activity in many countries. And in equilibrium changes in capital flows will induce changes in trade balances. This leads to a financial concept of capital mobility called real capital mobility. This refers to the extent to which trade or current account balances are affected by the flows of financial capital. In balance of payments equilibrium net capital flows and the current account are equal in magnitude and opposite in sign. A net transfer of resources among countries only occurs through current account surpluses and deficits. Thus, for example, capital and foreign aid flows from advanced to low income economies give rise to net resource transfers only to the extent that they result in current account imbalances. This is referred to as the transfer problem; how financial flows are converted into flows of real goods and services. This is discussed further in the next section.

⁹ A second concept of market efficiency allows for the possibility of risk premia which in turn implies that interest rate differentials and forward rates can be biased predictors of future spot rates even in efficient markets. While many efforts have been made it is not an easy matter to distinguish what proportion of biased prediction are due to risk premia versus biased expectations are difficult to determine, although this does not keep some experts from having strongly held views on the subject.

Finally there is an important distinction between monetary and financial integration. Monetary integration is a very different type of concept which refers to the unification of exchange rates through various forms of fixed exchange rates such as the formation of common currency areas such as the Eurozone. A high level of capital mobility (financial integration) is often considered one of the important criteria for determining how well a common currency area would work, although this view has been the subject of criticism.¹⁰ Monetary interdependence is more directly related to the measures discussed in this paper and refers to the degree to which changes in monetary policy in one country affects the exchange rate and monetary conditions in other countries. Thus it is a subset of financial interdependence.

4. Savings-Investment Correlations

In contrast to those scholars who argue that capital became much more mobile sometime in the mid-1970s, many studies employing the savings-investment correlation approach concluded that capital remained immobile at the systemic level. Feldstein and Horioka (1980) popularized this approach which has spurred a vast literature on, first, whether or not such correlations exist, and second, what the implications are.

The original Feldstein-Horioka argument is quite simple: savings will be invested in whatever place it can receive the highest rate of return. When capital is perfectly immobile, domestic savings fully determine the level of domestic investment.¹¹ There is

¹⁰ These criteria are discussed in the literature on optimum currency areas, a key conclusion of which is that the relative costs and benefits of monetary integration vary systematically across countries so that there is no one exchange rate regime that is best for all currencies. For recent discussion and references to the literature see Willett (2003).

¹¹ Note that domestic savings are the combination of private savings plus net public savings which will be positive if the government is running a budget surplus and negative if it is running a deficit.

no other way to finance the investment in real terms. In contrast, when capital is completely mobile, an increase in savings in a given country should not necessarily result in any additional domestic investment because that money can go abroad without cost. Similarly, domestic investments will not depend on domestic savings because firms that need funds can easily get them on world capital markets. Feldstein and Horioka therefore presume that, in a world of perfect capital mobility, the correlation between a country's saving and investment should be equal to zero, while in the world of perfect capital immobility the correlation should be exact at one. Of course we would generally expect capital mobility to lie between these extremes with increases in capital mobility reducing the correlation.

A system-wide measure of capital mobility can be created by regressing domestic investment on domestic savings (country-specific correlations can also be estimated:

$$\left(\frac{I}{GDP}\right)_i = \beta_0 + \beta_1 \left(\frac{S}{GDP}\right)_i + u_i$$

where β_1 is an indicator of capital mobility in the system such that capital is perfectly immobile when it equals one and perfectly mobile when it equals zero. Feldstein and Horioka find a coefficient of close to 0.9 for the sample period 1960-1974. This strongly suggests that capital was not very mobile in real terms. Feldstein and Bacchetta (1991) updated the study to the immediate years after the collapse of the Bretton Woods system (1974-1986), and find an almost identical coefficient.

The use of savings investment coefficients as an indicator for capital mobility has been criticised (e.g.; Schuler and Heinemann, 2002).¹² Since both savings and investment are pro-cyclical, estimates of the relationship between them may be biased upward. Second, because world interest rates are likely to be influenced by changes in the savings rates of large countries, the assumption that capital mobility will lead to a substantial decoupling of domestic investment from domestic savings need not hold for large countries.¹³

The correlations may also be influenced by the pattern of shocks that hit. This is also a major problem with measures that focus on co-variations of interest rates and stock prices. Feldstein and Horioka were well aware of the pro-cyclical issue and sought to ameliorate it by averaging savings and investment over a sufficiently long period to remove the cyclical component. It is useful to consider the correlations over time. The period before World War I is considered to be one of high capital mobility, and, consistent with expectations. Bayoumi (1990) finds no correlation between savings and investment for the period 1880-1913. Obstfeld's (1995; 250) conclusion for this period is broadly similar. He also analyzes the period 1926-1938 when capital mobility was expected to be low and finds a coefficient that is statistically indistinguishable from one.

Frankel (1986), (1993) suggests that a reason for the high relations during periods considered to have high financial mobility. He argues that the high correlations reflect more the lower levels of integration of goods markets than of financial markets. This makes sense since it is imbalances in current accounts that generate transfers of real

¹² A few authors have also questioned what the exact nature of the savings-investment correlations is. Frankel (1986, 1993) in particular argues that the correlation indicates the low integration of material goods markets instead of capital markets.

¹³ See, among others, Harberger (1980).

resources that allow real domestic investment to differ from real domestic savings. This is the concept of real capital mobility discussed in section 3. There is clear evidence that goods markets generally adjust more slowly than financial markets and this makes good economic sense based on relative costs of adjustment.

In general the estimates of capital mobility based on savings-investment correlations find a lower increase in capital mobility than is suggested by observations that by the late 1960s and early 1970s the mobility of short term capital had risen greatly. Efforts to maintain the Bretton Woods type adjustable pegs had become quite difficult because of the sizes of the funds that flowed when exchange rate parities became widely viewed in the private markets as being substantially over or under valued – the famous one-way speculative option. Here we see the importance of different types of measures for different purposes. While real capital mobility was fairly low, financial capital mobility was sufficiently high to help bring down the Bretton Woods system.

A somewhat similar type of approach to that of savings-investment correlations focuses on the extent to which consumption co-moves between countries. This approach was pioneered by Obstfeld (1989). The intuition behind tests of consumption correlations (*international risk sharing*) is that financial openness ought to afford individuals the opportunity to smoothen consumption over time as they can borrow and lend on international financial markets. Thus, consumption in any one country should co-move less with income over time, and, if preferences are similar, consumption should be correlated across countries.¹⁴ Such measures are subject to objections similar to those raised against the savings-investment correlations, the most important being that the

¹⁴ A weaker form of risk sharing states that the degree of cross-country consumption co-movements exceeds that of output co-movements.

correlations will be influenced by the pattern of shocks in addition to the degree of capital mobility. Again they often suggest lower levels of capital mobility than studies that focus directly on the behavior of financial flows.

5. Capital Controls

Perhaps the most popular method to measure capital mobility across countries in empirical work is to look at the restrictions governments place on capital inflows and outflows. The reliability of such data relies on several assumptions—that governments can regulate capital flows; that they are equally enforced from country to country; that their effectiveness does not change in the time period for which they are examined; and that the relevant measures are included in the data analysis while the omitted measures are not. Findings that capital controls have no significant impact on economic growth, for example, may be just as interesting as results that indicate that their use is correlated with the degree of independence of the central banks.¹⁵ Their very presence raises interesting questions. For example, why do some states adopt them while others do not? Likewise the relationships between capital controls and currency crises have generated considerable interest. While one frequently mentioned argument for capital controls is to reduce the incidence of currency crises, several studies have found a positive association between capital controls and crises. More recent work on controls on capital outflows

¹⁵ Both results are reported in Alesina *et al.* (1994). Using a more comprehensive measure, however, Quinn(2003) finds a negative association of controls with growth.

versus inflows finds a positive association for controls on outflows but a negative effect of controls on inflows.¹⁶

The earliest studies on the effects of capital controls used dichotomous measures that simply indicated whether countries had any form of restrictions on their capital accounts based on data published by the IMF since 1950 in *Exchange Arrangements and Exchange Restrictions*. Such studies proved to be of quite limited value since almost all of the interesting questions about the effects of controls depend on the extent and intensity of their coverage, not just whether there are any controls or not.

There are also questions of whether control measures should be limited to capital account items or also include restrictions on payments for current account transactions. To deal with these problems several large data sets have been compiled which provide more graduated measures. One type pioneered by Dennis Quinn (1997), (2003) develops measures of the degree of tightness on intensity of capital controls. Another type developed by researchers at the IMF, most recently (Schindler 2009), looks at the breadth of coverage of capital controls.¹⁷ Unfortunately there have been only limited attempts to combine these two approaches for large data sets. An exception is Potchamanawong *et al.* (2008).

One large data set that has become quite popular has been constructed by Chinn and Ito (2008). This is based on calculations of the principal components of several sub

¹⁶See the analysis and references in Chiu and Willett (2011) and Potchamanawong *et al.* (2008)

¹⁷ There are numerous studies that develop more refined measures for individual countries or small group of countries. See, for example, Ghosh (2011)

measures of capital controls. The rationale for using principal components in this context is not clear, however.

Studies that compare the measures from these new data sets with detailed qualitative studies of the history of capital controls for particular countries often find substantial failures of the large N measures to capture important changes in control programs. For example, while one of the standard explanations for the generation of the Asian crisis in 1997-98 was substantial liberalization of capital accounts without sufficient regulatory supervision many of the major data sets code these years for the Asian economies as having high levels of capital controls (see Willett *et al.*, 2005). For more recent analyses along these lines for India and Korea see Ghosh (2011) and Willett *et al.* (2009). Thus we conclude that while recent large N data sets on capital controls have improved substantially, they are still far from the levels of accuracy that would be desirable. (For more detailed analysis of the different capital measures and the uses to which they have been put see Potchamanawong *et al.* (2008) and the section on capital controls on the CIEPS web site.¹⁸)

6. Actual Stocks and Flows of Capital

While capital account restrictions tell us something about government behavior, capital flows and stock tell us about the behavior of investors (Rajan and Siregar, 2003). While there is merit in examining actual movements of cross-border capital flows, especially when analyzing particular episodes, these have limitations as measures of financial

¹⁸ <http://www.cgu.edu/pages/1380.asp>

integration. As noted in section 3, a country that is highly integrated with international capital markets – in the sense of there being no significant difference in domestic and international rates of return – may experience little if any international portfolio capital flows (at least debt related flows).

While there has been a tendency of researchers to focus on net flows for some purposes it is important to look at both inflows and outflows. For example when looking at capital flow surges and sudden stops this is crucial (see Efremidze *et al.*, 2011 in part one of this special issue). Recent work has focused instead on capital stocks that countries have, which in practice estimate gross stocks of foreign assets and liabilities as a percent of GDP. Lane and Milesi-Ferretti (2007) have the most comprehensive dataset, covering 145 countries over the time period 1970-2004.

Beginning with the OECD countries where there are data for most countries, Quinn's data indicate a steady decline in the use of capital controls, with the pace picking up in the late 1980s. The Lane and Milesi-Ferretti data, in contrast, has a U-shaped curve. Foreign assets and liabilities averaged about 40% of GDP in 1970, and, after collapsing in the mid-1970s, did not reach the 1970 level again until the late 1990s. Patterns in Latin and Central America are different – capital restrictions increase steadily from the 1950s through 1980, then reverse but generally remain in place. The 1990s see a rapid repudiation of capital controls, with both Latin and Central America reaching OECD levels by 1998. In terms of assets and liabilities, data are more limited, but the trend indicates a jump in the late 1990s.

7. Measures of Interest Rate Interdependence

The most straight forward way to test for whether financial markets are fully integrated, i.e., capital mobility between them is perfect, is to investigate whether there are unexploited profit opportunities for moving funds from one to the other. We can also adapt this approach to studying how strongly interest rate changes in one country affect those in other countries, i.e. the degree of their financial interdependence.

The starting point for such analyses are the interest rate parity conditions. The basic intuition behind parity conditions is that in perfectly integrated financial markets, arbitrage equalizes the prices of identical assets, i.e. the law of one price holds. Hence we could, in principle, use measures of interest rate interdependence as an indicator of the degree of financial integration between markets.

Fully efficient risk-neutral markets would be fully integrated and there would be no abnormal profit opportunities for arbitrage between them. There are many tests for financial and foreign exchange market efficiency. These generally look for whether there are predictable patterns in variables that provide profit opportunities. A strong disadvantage of many of these types of tests from the standpoint of measuring financial interdependence is that they have a zero-one nature and do not provide measures of the degree of imperfect capital mobility.

Using measures of the degree to which interest rates in one market are affected by changes in another has the advantage of giving us a metric of the degree of interdependence running from one when the adjust is full to zero when there is no interdependence.

Interest rates may differ between countries for a host of reasons besides imperfect capital mobility. Examples are different rates of inflation and expected changes in the exchange rate, various risk premia, and different types of shocks. Thus it is important to add a number of controls when estimating such relationships.

A convenient starting point to understand the conditions under which the interest rates of two countries may differ is the interest rate parity condition.

$$R_t = R_t^f + E_t(s_{t+n} - s_t) + rp_t \quad (7.1)$$

where R_t is the domestic nominal interest rate, R_t^f is the foreign (“base”) nominal interest rate, s_t is the current spot rate (exchange rate is in logs),¹⁹ and rp_t is a risk premium reflected in the difference between the forward rate and the expected future spot rate. Both the expected exchange rate and the risk premium are unobservable, in general, and we therefore have to use proxies for them.

The two most commonly used interest parity conditions are covered interest rate parity (CIP) condition and uncovered parity (UIP).²⁰ CIP basically states that the

¹⁹ Throughout this section the exchange rate is quoted as the domestic price of foreign currency. Properly, we should set up the relationship as $(1 + R_t) = (1 + R_t^f) \times \frac{E_t(S_{t+n})}{S_t} \times (1 + rp_t)$. Taking logs this results approximately in equation (7.1).

²⁰ There are two additional arbitrage conditions which we will not consider in detail here: the real interest rate parity (RIP) condition and the closed interest parity condition. The RIP combines UIP and purchasing power parity together with the Fisher equation to yield equality of the respective real interest rates (see Obstfeld and Taylor, 2004; Meese and Rogoff, 1988; and Edison and Pauls (1993). The closed interest parity condition states that the returns on identical instruments of the same currency but traded in different markets (such as onshore and offshore markets) should be equalized (see Obstfeld, 1998); Frankel and Okwongu, 1996).

difference between the current spot rate and the forward rate will equal the interest rate differential between similar assets measured in local currencies:

$$R_t = R_t^f + (f_{t+n} - s_t) \quad (7.2)$$

where f is the (log of the) forward exchange rate.

The nexus between the UIP and the CIP is apparent by decomposing equation (7.2). Following Frankel (1991):

$$R_t - R_t^f - E_t(s_{t+n} - s_t) = [R_t - R_t^f - (f_{t+n} - s_t)] + (f_{t+n} - E_t s_{t+n}) \quad (7.3)$$

where the first bracketed term on the right hand side is the CIP (sometimes referred to as country or political risk premium) and the second term is the currency risk premium. CIP must hold if UIP holds but not *vice versa*. If CIP holds but UIP is rejected, this implies that forward rates are biased predictors of future spot rates. This can be caused by risk premia or by inefficient speculation. Not surprisingly CIP is found to hold much more often than UIP.

The extent to which CIP holds is often, but incorrectly, taken as an indicator of the degree of capital mobility. The failure of CIP to hold a good indicator but due to risk aversion it can hold even when capital mobility is low (see Willett, *Ahn and Keil.*, 2002). UIP does not suffer from this problem and the extent to which it holds is the appropriate measure of the degree of capital mobility. In change form it can be used as a valuable indicator of how changes in interest rates in one country affect those in other countries, i.e., of their degree of financial interdependence.

7.1 The Uncovered Interest Parity Condition

Thus UIP has become popular as a tool of measuring monetary policy independence (Frankel *et. al.*, 2004; Shambaugh, 2004). As indicated in Table 1 we would expect UIP to hold better with credibly fixed exchange rates and the absence of capital controls.

Table 1: Closeness of Interest Rate Co-Movements and Policy Regimes

	peg (fix)	nonpeg (float)
free (more) capital mobility or (less or) no capital controls	no independent monetary policy (β_1 closer to 1; highest value)	more independent monetary policy (β_1 closer to 0; second highest value)
no (less) capital mobility or (more) capital controls	more independent monetary policy (β_1 closer to 0; second lowest value)	more independent monetary policy (β_1 closer to 0; lowest value)

Obstfeld and Taylor (2004, 185-6) find supportive evidence of the suggested patterns in the table when comparing the slope coefficient and exchange rate classifications using a panel of countries over long periods of time with various switches in regimes.

One difficulty in using the UIP equation is that it relies on an unobservable variable: the expected future exchange rate. There are three common specifications for the expected change in the exchange rate based on the behavior of exchange rates: (i) perfect foresight, (ii) extrapolative expectations, (iii) static expectations. No one of these is unambiguously best so it is important to test for the sensitivity of estimates to all three

proxies. In some cases survey data of expectations have been available (see Frankel and Froot, 1989).

Testing seems, at first, straightforward. Consider the following thought experiment involving a sample of East Asian countries: assume that there were fewer capital controls or that there was more capital mobility for the post Asian Financial Crisis period than before. In such a situation, we would expect those countries that opted more towards a floating (fixed) exchange rate regime to show a smaller (larger) slope coefficient than before the crisis. On the other hand, we would expect, if nothing else, no change in the slope for countries that stayed in the same exchange rate regime (see, e.g., Keil, 2011).

While looking at the extent UIP holds is conceptually the most appropriate measure of the extent of financial integration, for many policy issues one of the most important policy questions involves how changes in monetary policy in one country affect other countries, i.e. how great is the degree of financial interdependence. For this purpose, the most relevant approach is to estimate how much policy induced changes in interest rates in one country affect the interest and exchange rates of other countries. Note that these relationships will often be asymmetric: changes in interest rates in Japan should have a bigger effect on Taiwan than *vice versa*.

As with estimates of UIP in general, a major difficulty in such estimation is adjusting sufficiently for the other factors that may influence interest rate correlations across countries. The correlations between the interest rates of two smaller economies may reflect more the influence of global monetary conditions affecting both rather than direct financial interdependence between the two. It is often argued that this is the case

among many Asian economies. Thus one needs to control for global interest rates (Keil, 2011).

Moreover, changing levels of inflation rates can also be an important factor. It is easy to transform the UIP specification into a relationship between the respective inflation rates, as long as the differences between real interest rates does not vary greatly. As a result, UIP results can be driven by inflation rate convergence which has been observed at different periods across countries in the past (Keil, 2011).

Matters become even more complicated when adjustments are not instantaneous and dynamics must be taken into account. There are also questions about whether the moments of the probability distributions of inflation and interest rates remain invariant over time.²¹ Given these problems it isn't surprising that estimates of this type are often quite unstable. Thus at this point we should not give great weight to any one particular set of estimates.

8. Concluding Remarks

Given the wide variety of approaches to estimating capital mobility and the degree of financial interdependence it is not surprising that there is so much disagreement among economists on these questions. As noted a major difficulty is in trying to control for the major factors other than direct financial interdependence that may influence the

²¹ Discussion of these issues becomes rather technical. Shambaugh (2004) and Frankel et.al. (2004) are a good starting point for the interested reader. A longer version of this paper, which is placed on our website, deals with these issues in more detail.

correlations among financial variables such as interest rates. The better job we can do in controlling for such factors, the more reliable our estimates will become. For now we do not have the consistency of results necessary for us to have confidence in anything like precise estimates of the degree of financial interdependence among different sets of countries. This does not mean that we do not know anything, however or that there is not a great deal more highly productive research that can be done.

We can be highly confident that for most countries the level of capital mobility has been much in the last decades of the 20th century and early 21st century than in the first few decades after the establishment of the Bretton Woods international monetary system at the end of World War II. We can also safely say that while high for many countries and close to perfect among the offshore Eurocurrency markets, few if any financial markets are perfectly integrated across countries. Consequently, most countries have some scope to sterilize the monetary effects of international financial flows, at least in the short-run.

We should also note that there are many important aspects of international financial flows beyond the extent to which they are integrated. For example, we have learned from sad experience that international financial markets have often been too trusting and failed to give strong early warning signs of growing financial problems. (See Willett (2000).) The Asian, Argentine, US subprime, and euro crises give vivid examples. Likewise there is much to learn about the causes of the sudden stops of financial flows. (See Efremidze et al (2011).

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