Business Cycle Interdependence and the Role of FDI:

Study on the US and the BRIC economies

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Abstract

Due to globalization business cycles are getting more interdependent. During the process of globalization, emerging countries have gained economic importance. The new structure of the world economy brings important implications for business cycles around the world. One source that might contribute to business cycle interdependence between emerging and developed economies are Foreign Direct Investments (FDI's). Since the mid 80's FDI flows have grown severely. The aim of this thesis is to answer whether the business cycles of the emerging BRIC countries and the US are interdependent and to investigate the influence FDI has on this interdependency. The findings reveal that there is a structural break towards more business cycle interdependence between the BRIC countries and the US. The results also indicate that when FDI linkage becomes stronger, there is more business cycle synchronization.

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1   Introduction

Business cycles become more interdependent due to globalization. During the process of globalization, emerging countries have gained economic importance (Akin & Kose, 2008). The Chinese economy for instance has been the fastest growing economy throughout the process of globalization. For this reason China is the main source of world economy growth. More recently India is also following China's development (Winter and Yusuf, 2007). The new structure of the world economy leads to important implications for business cycles around the world. The increasing importance of emerging countries, especially the trade shares of the largest emerging Asian countries, China and India, have led to faster worldwide growth (Fidrmuc & Korhonen, 2009).

This thesis therefore investigates the business cycle interdependence of the emerging BRIC economies, Brazil, Russia, India and China with one developed economy, the US. As one of the most important economies of the world, the US is a good representation of a developed economy. The recent financial crisis is a good example of the large influence the US economy has on the world economy, as it adversely impacted Asian and European economies. China being the number one emerging economy and India the follow up are a good proxy for emerging economies together with the two other BRIC countries Brazil and Russia that are also growing very fast.

One source that might contribute to business cycle interdependence are Foreign Direct Investments (FDI's). Since the mid 80's FDI has grown severely. FDI has certain advantages and disadvantages for the home and the host country. The main advantages for the home countries are access to new markets and increased cost efficiency. The latter may be realized through lower wage costs and input costs. FDI also has advantages for the host country. FDI is not as liquid and tradable as for instance portfolio investment, making FDI flows more stable. This makes FDI especially attractive for emerging economies, because it reduces speculation risk (Onen, 2008). FDI also leads to disadvantages. Borensztein et all (1995) argues that domestic companies have better access to the home markets and have an informational advantage over foreign companies. A foreign company that enters a new market has to create other synergies in order to compensate for the informational and other disadvantages to be able to compete with the domestic company.

There is no consensus in the literature about the relationship between FDI and economic growth, but in recent literature there is more evidence of a positive correlation between FDI and growth.

A negative relation between FDI and growth can be explained if there are no spillover effects. Alfaro (2003) finds that in the primary sector, which by nature consists of agriculture and mining, the relationship between FDI and growth is negative as there are little spillover effects.

This could mean that the increase of FDI between developed and emerging economies could be a factor of influence on their business cycle interdependence. Since FDI shows an increasing trend and its effect on growth remains uncertain this research tries to explain the effect of FDI on the interdependence between the business cycles of the developed economy and emerging economies.

The research question of the this thesis is: *"Are the business cycles between the emerging BRIC economies and the most powerful developed economy in the world, the US, interdependent and what influence does FDI has on this interdependency?"*

The content of this report has the following structure. In section 2 some theoretical aspects about business cycles and FDI will be discussed. Section 3 contains the empirical test on the business cycle interdependence. In section 4 FDI and trade will be introduced as a determinant for business cycle interdependence. Finally in section 6 the main conclusions will be summarized.

Based on literature review, and own empirical research, the main research question of this thesis will be answered.

2   Business Cycle Interdependence and Foreign Direct Investment

This chapter contains various aspects of business cycle interdependence and Foreign Direct Investment (FDI). To start with the definition of business cycle interdependence, followed by the definition of FDI, finally to conclude with a literature review of business cycle interdependence and FDI.

2.1   What is business cycle interdependence?

Business cycles can be defined in two ways, classical cycles and deviation cycles. In the classical cycle the turning points of the cycle are based on an absolute increase or decline in GDP and in the case of a deviation cycle turning points are based on deviations from the GDP growth rate from an appropriate defined trend rate of GDP growth (Mintz, 1969). Business cycle interdependence refers to business cycles getting more synchronized due to globalization (Akin & Kose, 2008).

2.2   What is FDI?

To define FDI the description that the Organization of Economic Cooperation and Development (OECD) applies for FDI will be used. The reason for this is that the majority of the FDI data found was retrieved from DataStream and the source that DataStream indicated when this information was retrieved was the OECD. The definition of FDI according to OECD is the most proper one for this research.

The definition of FDI according the OECD is as follows:

"Foreign direct investment reflects the objective of obtaining a lasting interest by a resident entity in one economy (''direct investor") in an entity resident in an economy other than that of the investor (''direct investment enterprise").
The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence on the management of the enterprise. Direct investment involves both the initial transaction between the two entities and all subsequent capital transactions between them and among affiliated enterprises, both incorporated and unincorporated".

The definition used for foreign direct investors (outward investment for a reporting country) is:

"An individual, an incorporated or unincorporated public or private enterprise, a government, a group of related individuals, or a group of related incorporated and/or unincorporated enterprises which has a direct investment enterprise operating in a country other than the country or countries of residence of the foreign direct investor or investors".

And a direct investment enterprise (inward investment for reporting country) according to the OECD is:

"An incorporated or unincorporated enterprise in which a foreign investor owns 10 per cent or more of the ordinary shares or voting power of an incorporated enterprise or the equivalent of an unincorporated enterprise".

According to Jansen and Stokman (2004), it is possible in the short run to become more sensitive to economic fluctuations taking place overseas as the inward and outward FDI positions increase, especially for the home economy.

2.3   Literature review

There is a lot of literature available about business cycle interdependence and FDI. In the subparagraphs below a theoretical framework on business cycle interdependence and FDI will be discussed.

2.3.1   Development of business cycle interdependence

The shift in the global economic landscape has shifted drastically since the mid 1980's. There has been a fast increase in trade and financial linkages across countries and emerging market economies have increasingly become major players and account for a large share of global growth. These developments, together with the credit crises, have stirred up a discussion about international business cycle interdependence (Kose et al., 2008).

On the one hand it is said that because of globalization there has been an increase in international economic interdependence leading to more synchronized business cycles.

Due to the openness in trade and financial flows, economies are more sensitive to external shocks. These shocks can therefore be spilled over across countries leading to an increase in business cycle interdependence. On the other hand however, the vast growth in emerging economies recently, seems unaffected by the decreasing growth in various developed economies. This raised questions about the business cycle interdependence between developed and emerging economies. According to various economists emerging economies have decoupled rather than converged from developed economies, meaning that the business cycles between emerging and developed economies are decoupled.

These two views lead to different implications about the development of global business cycles (Kose et al., 2008).

2.3.2   Channels influencing business cycle interdependence

Business cycle interdependence is influenced by three dimensions, namely international trade in goods and services, international trade in financial assets such as equity, bond and cross border credit relations, and internationalization of production through FDI (Jansen and Stokman, 2004). The first dimension is called the traditional channel. According to Jansen and Stokman it is unlikely that deeper trade linkages contribute significantly to the recent rise in output correlations. Output correlation is what they use to determined business cycle interdependence. Although imports and exports as a share of GDP have in general increased, there has been no clear across the board acceleration of this trend recently. The second dimension of international trade in financial assets gains in importance as a channel for increasing business cycle interdependence. The reason presented by Jansen and Stokman (2004) is the rapid increase in recent years in cross border holdings of portfolio assets. Two studies, one by Goetzmann, Li and Rouwenhorst (2001), the other Berben and Jansen (2002) find that output correlations between stock markets of the major countries have greatly increased over the last twenty years, with the exception of Japan. The third and last dimension is the internationalization of production trough FDI.

This research will explore the influence that FDI has on business cycle interdependence between emerging and developed economies. Later in this chapter FDI will be highlighted.

2.3.3   Research on business cycle interdependence

There has been a lot of empirical research about the question whether business cycles are recouping or decoupling.

Mink en all (2007) investigate synchronicity and business cycle co-movement in the euro area. They look at the development of synchronicity and co-movement of the euro area from 1970 until 2005. They take the euro area as reference and look at the synchronicity and co-movement between the euro area's reference cycle and the individual countries business cycle. Their results show that synchronicity and co-movement fluctuate substantially over time and differ between countries. The business cycles of France, Germany, and the Netherlands are very similar to that of the euro area. While Finland, Greece, and Italy have rather low levels of synchronicity and co-movement. The conclusion of the authors of this paper is that even though the euro area continues its process of integration, synchronicity and co-movement for the area as a whole does not indicate an upward tendency.

Kim et all (2009) investigate the degree of economic interdependence between emerging Asia and the industrial G7 economies to answer the question, whether emerging Asia is recoupling or decoupling. They estimate the degree of economic interdependence before the Asian crisis in 1997/1998 and after the Asian crisis. Their results indicate that economic interdependence increased significantly in the post crisis period, which would suggest recoupling in recent years. They find that output shocks from major industrial economies have a significant positive effect on emerging Asian economies and that this relation also exists the other way around. This means that output shocks from emerging Asian countries have a significant positive effect on output in major industrial countries. The authors conclude that the results suggest that there exists a bi-directional interdependence between emerging Asia and industrial economies.

The research of Mink et all (2007) was restricted to the euro area and that of Kim (2009) et all too Asian economies and industrial economies. Kose et all (2008) did research on global business cycle interdependence. They analyzed 106 countries that were categorized into three groups, namely industrial countries, emerging economies and other developing economies over the period 1960-2005. From their results they conclude that during the period of globalization, which in their paper is from 1985 until 2005 there was some convergence of business cycle movements among the group of industrial economies and among the group of emerging market economies. Within each of these two groups of economies there is evidence of synchronization, while between them, there is evidence of decoupling.

Wälti (2010) also did research on a more global basis. He tested for a structural break in the degree of business cycle interdependence between emerging economies and advanced economies in recent years. There are thirty emerging markets included in his sample and twenty-six advanced economies. The emerging markets are divided in four groups, namely Asian, Latin American, Eastern European and all emerging economies. The four aggregate groups of advanced economies are either all twenty-six advanced economies, or the G7, or the US or a European group. The sample period is between 1980 and 2008. The results of the research Wälti (2010) conducted show that there is a structural break towards more business cycle interdependence between emerging and advanced economies in recent years.

2.3.4 History of FDI

During 1945-1960 the US was the most important Foreign Direct Investor in the world. They contributed for about half of the FDI in the world in 1960. In the 1960s and 1970s, FDI was mainly between developed economies. Since then, other countries have joined the process and nowadays FDI is a global concept entailing both developed and emerging economies (Lipsey, 2001). In figure 1 the global FDI flows from 1990 until 2008 are presented (UNCTAD).

Figure 1: Global FDI Flows between 1990-2008 (in Billions of US Dollars)
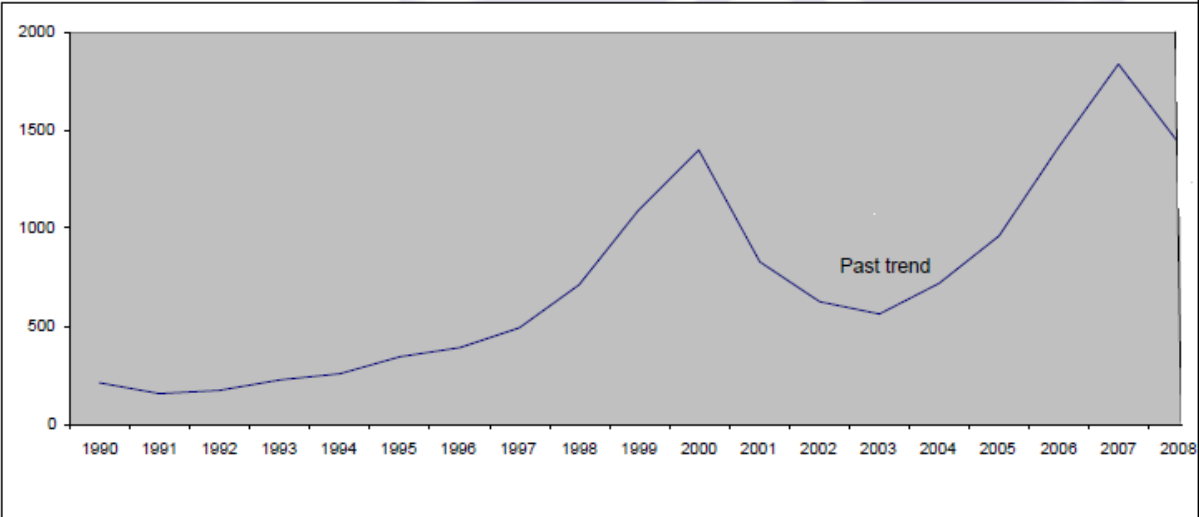
Source: UNCTAD

As can be seen from figure one, FDI has increased drastically throughout the years, reaching its peak in 1999. The reason for the downturn in 2000 are cross border mergers and acquisitions (M&A's). Cross border M&A's constitute to a large fraction of FDI.

The cross border M&A's after reaching a peak, were slowing down in 2000, because of the overall slowdown in economic growth. In 2002 the trend of global FDI was rising again and did not change until the 2008 crisis. In 2008 the worldwide flows were decreasing by more than 20%. Due to this crisis the capacity of companies to invest weakened, because of reduced access to financial resources, both internally and externally. And their tendency to invest has been affected a lot by decreasing growth projections and increasing risks. Being at the center of the crisis, developed economies suffered from a one-third reduction in total FDI inflows in 2008. Developing economies also felt the impact of the crisis, but not immediately. In the first half of 2010 global FDI observed a slight recovery.

2.3.5   Type of FDI investment

FDI can be divided in Greenfield-FDI (Greenfield investment) and Acquisition-FDI (cross border M&A's) (Ferrett, 2005).

A Greenfield invest is an investment made to set up a new facility of production, distribution or research in the host country (Johnson 2006). A Greenfield investment represents a net addition to the capital stock of the host country, while a cross border M&A represents a change in the ownership of pre-existing production facilities in the host country (Ferret, 2005).

There is distinction between horizontal FDI and vertical FDI. Horizontal FDI occurs when the same production activities are undertaken in multiple countries and vertical FDI takes place when the production process is fragmented internationally, placing each stage of the production in the country with the cheapest production costs (Aizenman & Marion 2004).

2.3.6   Motivations for FDI

There are different motives for an investor to engage in a FDI. The most common reasons are resource-seeking factors, market-seeking factors and efficiency seeking factors (Bell and Young, 1998 and Mirza, 1999). The motive behind resource-seeking investments is to access factors of production that are not available in the home country. Generally, this type of FDI takes place in emerging economies. Market seeking investments are being used to enter new markets or to maintain existing ones.

Efficiency seeking factors are motivated by creating new sources of competitiveness and strengthening existing ones (Campos & Kinoshita, 2003). In table 1 on the next page an overview is provided of the determinants of the most commonly used motives for FDI.

Table 1: Determinants of the most commonly used motives for FDI

Resource seeking FDI	Market seeking FDI	Efficiency seeking FDI
• raw materials • low costs inputs • physical infrastructure • natural resources	• market size • market growth • regional integration	• productivity-adjusted labor Costs • sufficiently skilled labor • business-related services • trade policy

Source: UNCTAD

The resources concerning resource seeking FDI are raw materials, low cost inputs like labor, physical infrastructure and natural resources (Campos & Kinoshita, 2002). Campos & Kinoshita (2002) give an example of market seeking FDI.

According to them if there are tariffs or other forms of barriers in a country where a firm used to export to, the firm has to relocate production to the host country. The reason according them for this type of investment is to better serve a local market by local production and market size and market growth of the host economy are the main factors which encourage market-seeking FDI.

UNCTAD also mentioned regional integration as a factor. Efficiency seeking FDI's determinants are productivity-adjusted labor costs, sufficiently skilled labor, business-related services and trade policy.

2.3.7   FDI hotspots in the world

In the World Investment Prospects Survey 2007-2009 of the United Nations the most attractive economies for the location of FDI from 2007–2009 as the total number of responses is given. Meaning the total number of firms that find a certain country the most attractive. In figure 2 on the next page these numbers are presented.

Figure 2: Survey most attractive economies for the location of FDI from 2007-2009
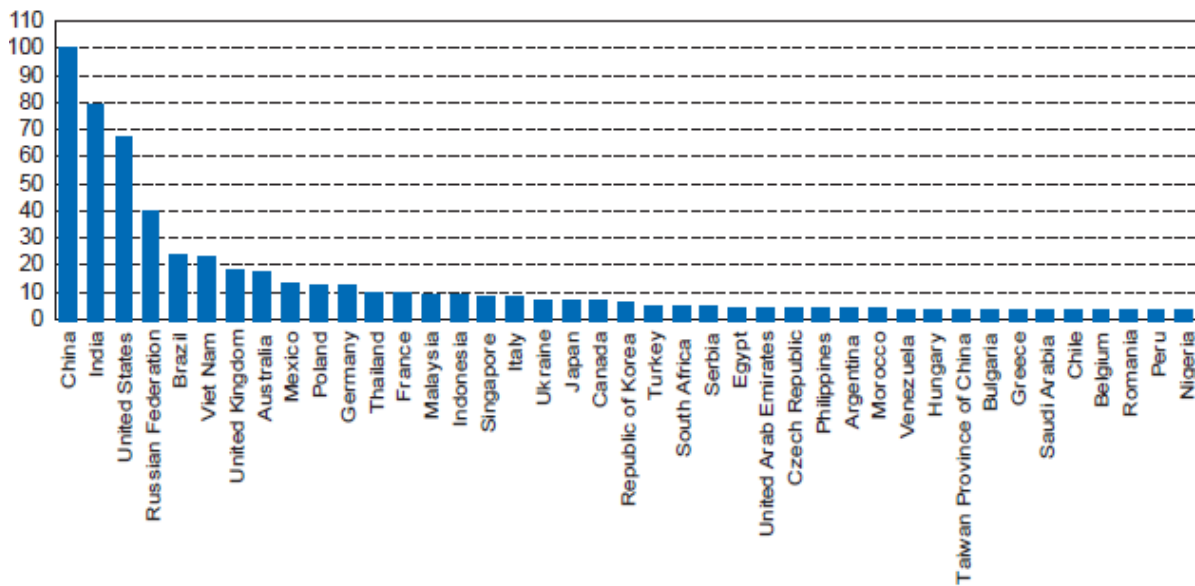
Note: In total there were 191 responses. Each respondent listed their top 5 FDI locations. So the table shows the total number of responses that find a certain FDI location the most attractive.

The two leading most attractive countries according to the experts for FDI are China and India as can be seen in figure 2. The US is ranked the third most attractive location for FDI in the world and Russia and Brazil are respectively fourth and fifth. India and China are among the few emerging economies in the world where it is possible to find all three motivations discussed in paragraph 2.2.3 (resource seeking, market seeking and efficiency seeking FDI). The experts therefore consider an increase in FDI towards China and India as the most probable development.

The FDI will increasingly be oriented towards new regions in these countries (Central China and mid-sized towns in India), because costs are getting higher in the well-known locations such as Bangalore (India) and Shenzhen or Shanghai (China). There are also some negative elements which are important to take into consideration.

For example the lack of protection of intellectual rights in China or the high turnover of manpower in some areas in India (World Investment Prospects Survey 2007-2009).

In 2009 the US was still the number one recipient of FDI in the world and China rose to the second place. India and Russia made it to the top 10 and Brazil was in the top 15.

FDI is a key feature of globalization and could therefore have an impact on business cycle interdependence between developed and emerging economies. Therefore in the next Chapter empirical studies about the relation between business cycle interdependence and FDI will be discussed.

2.3.8   The relation between business cycle interdependence and FDI

There is a lot of research about financial integration and business cycle interdependence, but research on FDI and business cycle interdependence is scarcer.

In the paper by Jansen and Stokman (2004) the authors state that the internationalization of production trough FDI is a new channel that exists next to the traditional channel and the channel of international trade in financial assets.

The explanation the authors give for the relation between business cycle interdependence and FDI is that, as the inward and outward FDI positions get larger, it is especially possible for the domestic economy to become more sensitive to economic fluctuations taking place abroad on the short run. If the economic condition in the home country that supplies FDI deteriorates, the financial position of the FDI supplier weakens, which can lead to cut backs in employment, wages and investments in the host country.

Jansen and Stokman (2004) use bilateral data on FDI positions and a sample period between 1982 and 2001 for Canada, France, Germany, Netherlands, the UK and the US for their research. They look at the bilateral linkages of these six countries among themselves and with six other countries (Australia, Belgium, Italy, Japan, Sweden and Switzerland) and make use of five measures of international output synchronization to illustrate the relationship between FDI and international business cycle interdependence.

The five measures of international output synchronization are: correlation of the quarterly growth rates of real GDP, quarterly output gaps, quarterly business cycle coherence, correlation of annual growth rates of real GDP and annual output gaps. They also study the matter of international trade patterns and the effect this has on business cycle synchronization.

Jansen and Stokman (2004) conclude that before 1995 there is no strong evidence of an independent role of FDI in explaining business cycle relations between countries, when taking both FDI and foreign trade relations in account.

According to the researchers trade patterns are more prone in explaining the pattern of business cycle synchronization than FDI linkages are, in the years immediately following the reunification of Germany and the collapse of the Japanese asset market bubble (1990–1994). But the rapid growth of FDI since 1995 seems to have changed this.

In the years 1995–2001, FDI linkages are much better able to explain the pattern of business cycle patterns than foreign trade relations. They also mention two policy implications.

The first one is that increasing economic interdependence through FDI results in more synchronized business cycles.

The second implication is that FDI seems to have become an important channel for the transmission of disturbances and therefore FDI linkages should be added to the macroeconomic models which are used for making forecasts, creating scenarios and conducting policy analyses by national policy makers and international organizations.

In other papers FDI has also been investigated as a factor of influence on business cycle interdependence between economies. Only the difference with the Jansen en Stokman (2004) paper is that the influence of financial linkages on business cycle interdependence is researched and FDI is (one of) the variable(s) chosen to represent financial linkage.

One paper that discusses this is the paper by Otto et all (2001). For their study they use bilateral FDI data and correlations to determine business cycle interdependence in OECD countries. They give a number of reasons on how the extent of foreign direct investment can be related to the degree of business cycle correlation. They state that countries that are strongly integrated through FDI can give shocks to each other through the changes in FDI positions that are caused by idiosyncratic shocks. However in their own view this is not a particularly important channel, because the size of these flows (on average) relative to GDP is likely to be small and because they don't expect that these flows will be very cyclical.

Other explanations that the authors find more likely are that multinational firms can transmit the effects of local macroeconomic shocks throughout the organization. This could mean that shocks to some extent are transmitted from one economy to another. In the same way if FDI is provided by multinationals that are outsourcing the production of intermediate inputs to another country, a change in the demand for the final product can easily be passed to the countries that provide the intermediate inputs. The final reason the authors give is that FDI can also be used to transfer technology and ideas between economies, which can also have an influence on the correlation of business cycles.

Otto et all (2001) also look at another possibility. Namely that strong FDI linkages can have a negative effect on business cycle synchronization.

Firms engage in FDI in order to reduce the risk they face by expanding and diversifying into markets with different cyclical patterns. In this case, FDI can be inversely related to business cycle correlations.

This possibility doesn't seem likely to the authors because their study shows that OECD countries with strong FDI linkages have more synchronized business cycles.

Garcia-Herrero and Ruiz (2008) also look at *financial* linkages and business cycle synchronization and they take total bilateral financial flows, which consists of portfolio and FDI flows from the balance of payment of Spain, to measure financial integration. They take Spain, a small open economy as a benchmark for their results.

The authors results indicate that business cycle synchronization between Spain and the EU increased substantially in the period from 1960 to 1995. After that period it has decreased a bit and now it is relatively stable. Business cycle synchronization between Spain and the G7 countries (Canada, France, Germany, Italy, Japan, United Kingdom and United States) increased rapidly between 1970 and 1976, but then declined again. From the time (1986) that Spain joined the EU the synchronization has risen, but on a slower rate than the synchronization with the EU countries. Since the late 1980's business cycles in Spain and Latin American economies move in reverse of each other. Overall business cycles were the most synchronized with each other from 1975 to 1985. As for FDI linkages between Spain and the rest of the world, those were non-existent before the mid 1980's. Since then FDI linkages rose rapidly with the EU and to a lesser extend with the G7 countries. FDI with Latin American economies also increased but with a more modest past.

The regression performed by Garcia-Herrero and Ruiz (2008) results in a negative relation between financial linkages and business cycle synchronization.

The reason the authors present for their result is that financial linkages allow resources between economies to be transferred easier, which could cause less synchronized (decoupled) business cycles.

3   Empirical test on Business cycle interdependence

In this chapter research about the business cycle interdependence between the emerging BRIC countries and the US will be performed.

First the data will be discussed, and then the research method and graphical analysis will follow. Finally at the end of the chapter the results will be presented.

3.1   Data

For the estimation of the business cycle interdependence quarterly GDP data at current prices in US dollars will be used.

The data on quarterly GDP at constant prices of the US and the BRIC countries can be collected from DataStream. The source DataStream uses is either the OECD or the IMF. The sample period is the first quarter of 2000 until the second quarter of 2009. Data on GDP for the US, Brazil, Russia and India are available prior to 1999, but data on the GDP for China is only available from 1999 onwards. The GDP data of the BRIC countries is given in the local currency, thus the exchange rates from DataStream are used to change the currency in which the GDP is expressed into the US dollar currency.

Business cycles can be defined in different ways. Kose et all (2008) defines a business cycle as the growth rate of real GDP. Wälti (2009) however explains that emerging economies, over the last 20 years or so, have experienced rapid economic growth, while the growth rate for developed economies has been relatively lower.

He states that although the difference between the growth rates of emerging and developed economies has increased, this does not mean that their business cycles are decoupling. The trend growth rate of emerging economies over the last 20 years has increased significantly, but that doesn't support that there is an increasing movement away from the trend between emerging and developing economies. So the measure of Kose et all is flawed when comparing emerging and developed economies.

The correct way to define business cycles according to Wälti (2010) is as the difference between actual GDP and trend GDP, divided by trend GDP (output gap). When this approach is used the standardized business cycle has zero mean and a variance of unity and can be obtained by subtracting the mean of the output gap and dividing it by its standard deviation.

The three most commonly used de-trending methods in empirical macroeconomics are the First Difference (FD), the Hodrick-Prescott (HP), and the Baxter-King (BK) approximate band-pass filter. Aadland (2002) researched the three filters and concludes that the BK filter appears to be the least distortionary and easiest to adjust across frequencies.

The BK filter will be used to de-trend GDP. For the execution Eviews 7 will be used. The BK filter loses 4 quarters of data at the beginning and at end of the sample, hence the sample period of the first quarter of 2000 until the second quarter of 2009. In table 3 on the next page the descriptive statistics of the GDP per country are reported.

Table 3: Descriptive statistics GDP (in billion of US dollars)

	US	Brazil	Russia	India	China
N	38	38	38	38	38
Mean	3036	228	15	197	577
Maximum	3621	485	25	342	1416
Minimum	2427	107	7	118	219
Std. Dev	403	101	4	73	315

The *N* represents the number of observations. With the sample period from the first quarter of 2000 until the second quarter of 2009, this leads to thirty-eight observations per country. The *Mean* is the average GDP in billions of US dollars between 2000 and 2009. The average GDP of the US is significantly higher than the average GDP in the other countries. The *Maximum* is the highest value of the GDP in the sample period and the *Minimum* is the lowest value of the GDP in the sample period. For the BRIC countries the difference between the minimum and maximum GDP is relatively large. Especially for China, where the maximum GDP is approximately 6 times higher than the minimum GDP. This difference is due to the increasing GDP growth in the BRIC economies. The *Standard deviation* shows the variance from the average (mean). The variance is also higher in the BRIC economies than in the US, indicating that the GDP in the emerging BRIC economies is more volatile than in the developed US.

In the next chapter the effect of FDI on business cycle interdependence will be tested so data on FDI is also needed. However data on country specific FDI is harder to locate than GDP data. To collect the data DataStream was used. Data on FDI between the BRIC countries and the US was available only on a yearly basis from 1985 until 2007, so that will be the sample period. There are however years missing.

But to solve that problem a pooled estimation was used increasing the number of observations to 48. To match the frequency of the data, yearly GDP data for the BRIC countries and the US was also collected from DataStream using the OECD as the source. In table 4 on the next page the descriptive statistics of the FDI per country are reported.

Table 4: Descriptive statistics FDI (in millions of US dollars)

	N	Mean	Maximum	Minimum	Std. Dev
Inflow in US from Brazil	23	87	985	-470	305
Inflow in US from Russia	12	27	486	-155	161
Inflow in US from India	15	216	1523	-16	436
Inflow in US from China	15	43	347	-120	116
Outflow from US to Brazil	23	2450	7138	-290	2230
Outflow from US to Russia	18	456	2334	-404	887
Outflow from US to India	21	510	3726	43	863
Outflow from US to China	23	1310	5710	-113	1542

The *N* stands for the number of observations. Because of some missing values for FDI the number of observations differs between the countries. On average India invests more in the US than the other BRIC countries do and the US invests on average the most in Brazil. There is more outflow from the US to the BRIC countries, than there is inflow of FDI from the BRIC countries in the US. The difference between the maximum and minimum are larger for the flows going from the US into the BRIC economies, than for the flows that are received by the US from the BRIC economies. This could indicate that US FDI outflows are growing faster than BRIC economies FDI outflows. The standard deviation indicates that FDI from BRIC countries are more volatile than FDI from the US.

According to Jansen and Stokman (2001), it is likely that countries with strong FDI links will also trade a lot with each other. Therefore data on the imports between the BRIC countries and the US and the other way around is gathered. We extracted the data from DataStream using the IMF Direction of Trade Statistics. The sample period chosen is the same as for FDI, namely from 1985 until 2007. In table 5 on the next page the descriptive statistics of the imports per country are reported.

Table 5: Descriptive statistics imports (in millions of US dollars)

	Mean	Maximum	Minimum	Std. Dev
Imports US from Brazil	13262	28031	7232	6774
Imports US from Russia	7950	20731	511	6052
Imports US from India	8968	25113	2464	6707
Imports US from China	92886	340117	4224	99470
Imports Brazil from US	10151	20791	3107	5068
Imports Russia from US	3636	9501	2070	1909
Imports India from US	4281	18708	1429	3914
Imports China from US	21465	69997	4718	18297

Note: the number of observations is 23 for all countries

The average US imports from China are higher than the US imports from the other BRIC countries. The average China imports from the US are also higher than the other BRIC economies imports from the US. This indicates that the US trades more with China than it trades with the other BRIC countries. The differences between the maximum and minimum imports are quite large. This could be explained by increasing trade relations between the BRIC economies and the US. Trade between Brazil and the US is the least volatile. Perhaps the distance between the US and Brazil is a factor influencing the volatility. Brazil and the US are on the same continent, while the other BRIC countries are overseas.

3.2   Research method

The methods that are mostly used to determine business cycle interdependence are based on correlations (Kose et al, 2003; Loretan and English, 2000; Imbs, 2004). The drawback according to Wälti (2010) of using correlations is that they have to be estimated over relatively large sub-samples of the data. This means that they do not have enough variation over recent years. So in an ideal world a measure of business cycle interdependence that varies from year to year from the beginning until the end of the sample will provide the best results. Because this kind of time variation would allow to identify a structural break more precisely than correlation coefficient can.

Another approach is that of Mink et all (2007). They say that when the output gaps of two economies are in the same phase, so either both output gaps are positive or both output gaps are negative, they are synchronized and have the value 1. If this is not the case the value is -1.

The advantage of this method is that this approach allows computing business cycle interdependence for every year. This is important for testing for a structural break in recent years. But there is also a major drawback to this method.

If you have two countries and one country has a small positive output gap and the output gap of the other country is highly positive, the value appointed to these countries would be 1. While in fact their business cycles aren't very synchronized. Another example is when one country has a small positive output gap, while the other country has a small negative output gap. The value here would be -1, while actually their business cycles are relatively synchronized (Wälti, 2010).

In order to investigate business cycle interdependence between the emerging countries and the developed one, we will use a new innovative measure that was also used by Wälti (2010), namely the Euclidean distance. According to Wälti (2010) the Euclidean distance between two standardized random variables provides the same information as a correlation coefficient. The business cycle interdependence between the emerging countries and the US is given by:

$$(1) \; \emptyset_{i,dev}(t) = |g_e(t) - g_{dev}(t)|$$

ge is the business cycle of any of the emerging economies and g_{dev} is the business cycle of the developed economy, in year t.

The business cycle of the emerging economies and the developed economy are perfectly synchronized when $\emptyset_{i,us} = 0$.

Any deviation from zero means less than perfect synchronization and the higher the value of $\emptyset_{i,us}$ is, the larger the distance between business cycles and the less synchronized the business cycles are.

Regression analysis depicts and evaluates the relationship between a given variable and one or more other variables. To test the business cycle interdependence we will use Pooled Ordinary Least Square (OLS). With Pooled OLS we will be able to test the interdependence of the business cycles. The model presented here was used by Wälti (2010):

$$(2) \; \text{GAP-EME}_{i,t} = \alpha + \beta \, \text{GAP-DEV}_t + \gamma \, \text{GAP-DEV}_t * D_t + \varepsilon_{i,t}$$

GAP-EME_i is the business cycle of emerging economy *i*, *GAP-DEV* is the business cycle of the US and *D* is the dummy variable introduces to test for a structural break. In *GAP-EME_i* the business cycles of all the BRIC economies are pooled. Instead of estimating the model separately for all the BRIC economies, we estimate a single model by pooling the data.

When γ is negative and statistically significant, a significantly lower degree of business cycle interdependence exists between the BRIC economies and the US. To make this intuition more straightforward we will differentiate equation 2.

$$\frac{\partial \, GAP-EMEi,t}{\partial \, GAP-DEVt} = \begin{cases} \beta & when \; D = 0 \\ \beta + \gamma & when \; D = 1 \end{cases}$$

So when the dummy variable D takes a value of 1 in a certain year, we can see if there is a structural break towards more or less business cycle interdependence by the sign of γ. If γ is positive (negative), then the business cycle of the emerging economies in a certain year is synchronized (decoupled) with the business cycle of the US. By using a dummy variable we can test the business cycle interdependence between the BRIC countries and the US.

I expect that the business cycles of the BRIC economies and the US will be interdependent. The increasing growth of the BRIC countries and their increasing influence on global growth will increase economic interdependence between the BRIC economies and the US and lead to more synchronized business cycles.

3.4 Graphical analysis

In figure 3 on the next page the average degree of business cycle interdependence over time between the BRIC countries and the US is depicted.

Figure 3: Business cycle interdependence between the BRIC countries and the US (2000Q1-2009Q2)

Euclidean Distance
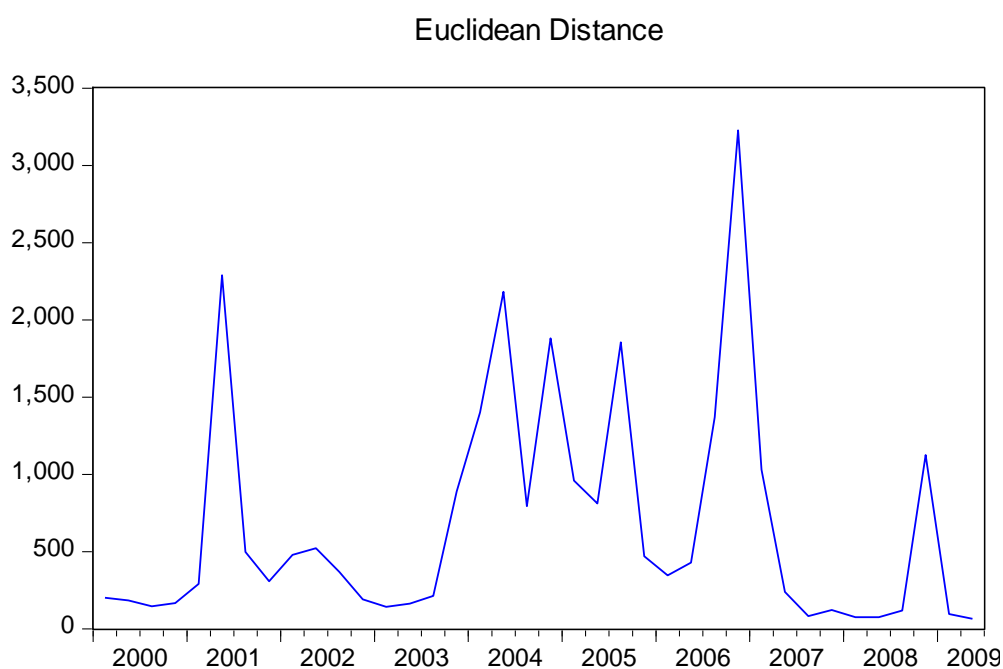
If the average distance between the business cycle of the two emerging economies with respect to the developed economy decreased (increased), than business cycles are getting more synchronized (decoupled). If we look at the business cycle interdependence between the BRIC countries and the US we observe that, there is al lot of movement, but in recent years their business cycles seem to be more synchronized. Although it seems that in recent years the business cycles of the BRIC economies and the US are more synchronized, we need econometric evidence to draw significant conclusions. In the next paragraph the results of the empirical tests will be discussed.

3.3   Results

First a pool unit root test was performed to check if the series are stationary. The result can be found in table 6 on the next page.

Table 6: Unit root test

Pool unit root test: Summary
Series: GAP_EME, GAP_DEV

Method	Statistic	Prob.**
Null: Unit root (assumes common unit root process)		
Levin, Lin & Chu t*	-12.9553	0.0000
Null: Unit root (assumes individual unit root process)		
Im, Pesaran and Shin W-stat	-10.8330	0.0000
ADF - Fisher Chi-square	87.8774	0.0000
PP - Fisher Chi-square	87.8812	0.0000

The null hypothesis of a unit root is violated, so the series are stationary.

Finally table 7 presents the results of the simple pooled OLS estimation of equation 2 to determine the business cycle interdependence between the emerging BRIC countries and developed US. In the first row the coefficient of the output gap of the US is given and the p-value of that coefficient. In the second row the structural break is reported together with the p-value. And finally in the third row, the R-squared is reported.

Table 7: Regression output

	2000	2001	2002	2003	2004	2005	2006	2007	2008
GAP_DEV	0.004 (0,04**)	0,003 (0,00*)	0,004 (0,04**)	0,003 (0,00*)	0,005 (0,00*)	0,005 (0,00*)	0,006 (0,00*)	0,006 (0,00*)	0,002 (0,03**)
Structural break	0.08 (0,08***)	0,04 (0,05**)	0,09 (0,08***)	0,09 (0,02**)	0,10 (0,01*)	0,11 (0,02**)	0,11 (0,04**)	0,10 (0,10***)	0,08 (0,11***)
R-squared	0.360	0.312	0.358	0.361	0.368	0.310	0.380	0.396	0.316

p-value that is significant at 0,01   **p-value that is significant at 0,05*   ***p-value that is significant at 0,10*

The coefficient γ which represents the structural break is positive and statistically significant in all regressions. Meaning there is a structural break towards more business cycle interdependence between the BRIC countries and the US. The output gap coefficient is also positive and significant. Overall the results indicate business cycle synchronization rather than business cycle decoupling between the BRIC countries and the US. The R-squared lies between the 0,30 and 0,40. On average this model explains the relation between the business cycle interdependence and FDI and trade for 35%, which is not extremely well, however it does explain the relation and the results are significant.

These results do not implicate that the business cycles between other emerging and developed economies will also be synchronized. To give conclusions concerning the latter, this research has to be extended on a much larger scale.

4   FDI, trade and business cycle interdependence

Until now the focus has been on business cycle interdependence. In this chapter FDI and trade will be introduced in the model to test the effect FDI and trade have on business cycle interdependence. First the research method will be described and then the results.

4.2   Research method

To test the effect of FDI on business cycle interdependence Pooled OLS will be used. The model for testing the influence of FDI on the business cycle interdependence is:

$$(3) \; \gamma_{i,us,t} = \alpha + \; \beta \; FDI_{i,us,t-1}$$

$\gamma_{i,us,t}$ is the business cycle interdependence (Euclidean distance) between emerging economy *i* and the US at time *t* and *FDI*$_{i,us,t-1}$ is the FDI integration between the emerging economy *i* and the US at time *t-1*. We lag FDI for one period due to endogeneity, which means that FDI not only influences the Euclidean distance, but that the Euclidean distance can also be influenced by FDI.

If β is negative (positive) and significant this would mean that business cycle interdependence is stronger (weaker) between emerging en developed economies when the FDI integration between these economies are tighter. As FDI is still growing, the relationship, whether positive or negative with business cycle interdependence, will lead to interesting insides. We would expect that the more FDI integrated emerging and developed economies are, the more their business cycle would be significantly interdependent. There are also contradicting results to my view regarding *financial* integration. For instance Heathcote and Perry (2004) and Garcia-Herrero and Ruiz (2008), whose study is mentioned in the previous chapter, find a negative effect of financial integration on business cycle interdependence.

They state that domestic investors want to diversify to less correlated economies abroad, and thus financial integration would lead to less business cycle interdependence.

The model that is used is similar to that of Jansen & Stokman, but instead of the Euclidean distance they use output correlations. The output correlation is between the reporting country i and partner countries j (11 countries).

The reporting countries are Canada, France, Germany, Netherlands, the UK and the US and because they have 6 reporting countries they include dummy variables for each reporting country i that takes the value of one if the observation refers to reporting country i and is zero otherwise. Thus the only difference between their model and the one that is used in this thesis are the dummy variables. Because the Euclidean distance is measured between the BRIC countries as a group and the US on the other side instead of taking one BRIC county compared to the US, the need for a dummy variable is unnecessary. FDI integration is defined as the sum of the emerging economies FDI flow in the developed economy and the developed economy FDI flow into the emerging economies at time t-1. And then we divide this by the GDP of the emerging economies respectively the US at time t-1. Jansen & Stokman (2001) use a similar approach, the difference is that the FDI linkage they use is a time average.

Because the Euclidean distance is investigated, which presents business cycle interdependence, when FDI is introduced as a variable influencing interdependency, averaging FDI throughout the years is not useful. If FDI is averaged out, it is not possible to observe how the Euclidean distance changes when the FDI linkage becomes stronger or weaker.

The relationship between international trade and business cycle interdependence will be investigated along the same line as was done for FDI. So the model we will use for testing the influence of FDI on the business cycle interdependence is:

$$(4) \quad \gamma_{i,us,t} = \alpha + \beta \, Trade_{i,us,t-1}$$

$\gamma_{i,us,t}$ is the business cycle interdependence (Euclidean distance) between emerging economy i and the US at time t and $Trade_{i,us,t}$ is the Trade linkage between the emerging economy i and the US at time $t-1$. If β is negative (positive) and significant this would mean that business cycle interdependence is stronger (weaker) between emerging en developed economies when the Trade linkage between these economies are tighter.

The trade linkage is defined as the sum of the imports of the BRIC with the US and the sum of the imports of the US with the BRIC countries at time t-1. This is divided by the GDP at time t-1 of the BRIC countries respectively the US. This is similar to the definition of Jansen and Stokman (2001). But Jansen and Stokman take a time average and as explained in the previous chapter, a time average has not been used in this research.

Finally FDI and trade together are introduced in the model to test FDI and trade linkage as determinants of the business cycle interdependence between the BRIC countries and the US. The proposed model looks as follows:

$$(5)\ \gamma_{i,us,t} = \alpha + \beta\ FDI_{i,us,t-1} + \delta\ Trade_{i,us,t-1}$$

4.3   Results
First a pool unit root test was done to check for stationarity. The results are reported in table 8.

Table 8: FDI and trade unit root test

Pool unit root test: Summary
Series: FDI

Method	Statistic	Prob.**
Null: Unit root (assumes common unit root process)		
Levin, Lin & Chu t*	-3.26730	0.0005

Pool unit root test: Summary
Series: TRADE

Method	Statistic	Prob.**
Null: Unit root (assumes common unit root process)		
Levin, Lin & Chu t*	1.58576	0.9436

The results indicate stationarity of FDI and non-stationarity of trade. To make trade stationary, first difference log is used and a unit root test is repeated. The results of this test are available in table 9 on the next page.

Table 9: Trade unit root test

Pool unit root test: Summary
Series: DLOG(TRADE)

Method	Statistic	Prob.**
Null: Unit root (assumes common unit root process)		
Levin, Lin & Chu t*	-3.31860	0.0005

The null hypothesis of a unit root can be rejected, so we have stationarity now. And as can be seen from table 10 the null hypothesis of a normal distribution is not violated, so we also have a normal distribution.

Table 10: Normality test

	EUCLIDEAN_DISTANCE	DLOG(TRADE)	FDI
Jarque-Bera	1.245587	2.495936	1.871827
Probability	0.536444	0.287088	0.392227

In table 11 the results of equation 5 are presented.

Table 11: Pooled estimation with FDI and trade

Dependent Variable: EUCLIDEAN_DISTANCE
Method: Pooled Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.31101	1.266662	8.140296	0.0000
DLOG(TRADE)	84.55231	17.18153	4.921117	0.0000
FDI	-8.133655	2.163991	-3.758636	0.0007
R-squared	0.457582			

According to the estimation output there is a positive and significant relation between trade and the Euclidean distance at a 1% significant level, which means that more trade leads to a bigger deviation of the Euclidean distance from zero. This implies that trade between the BRIC countries and the US has a negative impact on their business cycle interdependence. FDI however has a significant negative coefficient, thus more FDI between the BRIC countries and the US has a positive effect on business cycle interdependence between the BRIC economies and the US. The R squared is about 0,46.

This means that this model explains the relation between the business cycle interdependence and FDI and trade reasonably well. However in table 12 the correlation between FDI and trade are presented. As can be seen there is quite an amount of correlation between these two variables.

Table 12: Correlation

	FDI	DLOG(TRADE)
FDI	1.000000	0.533333
DLOG(TRADE)	0.533333	1.000000

The correlation between these variables thus leads to multicollinearity. This means that the predictive power of the model as a whole is still reliable, but that the individual determinants of the model may not be valid. Because of the correlation between FDI and trade equation we will estimate equation 3 and equation 4, which consists either of FDI or of trade as a determinant, but not both.

The regression results of equation 3 are reported in table 13.

Table 13: Pooled estimation with FDI

Dependent Variable: EUCLIDEAN_DISTANCE
Method: Pooled Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.44264	1.528916	8.792270	0.0000
FDI	-6.334519	2.566319	-2.468329	0.0182
R-squared	0.138178			

As we can see FDI still has a significant negative relation at the 5% level, with the Euclidean distance. So FDI between the BRIC economies and the US foster business cycle interdependence between these countries.

The results of the regression on equation 4 are available in table 14 on the next page.

Table 14: Pooled estimation with trade

Dependent Variable: EUCLIDEAN_DISTANCE
Method: Pooled Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	28.68974	3.232092	8.876524	0.0000
DLOG(TRADE)	-18.84103	54.66637	-0.344655	0.7312
R-squared	0.001379			

Now trade is negative instead of positive, which means that the stronger trade linkages between the merging BRIC countries and developed US are, the more interdependent their business cycles are. However the results are not significant and the R squared is very low.

4.4   Implications

When business cycle interdependence is regressed with FDI and trade as the determinants, the results are significant and the R-square of the model is reasonably high. In this model the stronger the FDI linkage between the BRIC countries and the US becomes, the more interdependent there business cycle is. However for trade the opposite is true. So the tighter the trade linkage between the BRIC economies and the US is the less business cycle interdependence exists. But because of the high correlation between FDI and trade, their coefficients may not be valid.

Therefore only a model with FDI or trade has been used and this leads to interesting insights, namely when the FDI linkage becomes stronger, there is more business cycle synchronization and also when trade linkages become stronger this also influences business cycle interdependence positively. However the results for trade are not significant.

Otto et all (2001) and Jansen and Stokman (2008) also find that FDI linkages foster business cycle synchronization. The explanation provided by Otto et all (2001) for this relation is that multinational firms are able to transmit the effects of local macroeconomic shocks throughout the organization. This could mean that shocks to some extent are transmitted from one economy to another. In the same way if FDI is provided by multinationals that are outsourcing the production of intermediate inputs to another country, a change in the demand for the final product can easily be passed to the countries that provide the intermediate inputs and hence influence business cycle co-movements.

Another reason stated by the authors is that FDI can also be used to transfer technology and ideas between economies, which can also have an influence on the correlation of business cycles. These reasons could be an explanation for the relation found in this thesis.

Jansen and Stokman (2008) also give two policy implications. First that increasing economic interdependence through FDI results in more synchronized business cycles and second that FDI seems to have become an important channel for the transmission of disturbances and therefore FD linkages should be added to the macroeconomic models which are used for making forecasts, creating scenarios and conducting policy analyses by national policy makers and international organizations. Because of the small focus of the study conducted in this thesis (emerging BRIC countries and developed US), it is not possible to conclude that FDI should be added to macroeconomics models which are used for making forecasts, creating scenarios and conducting policy analyses by national policy makers and international organizations.

As a consequence more research on a global basis has to be executed, to determine the effect FDI had on business cycle interdependence globally. Not only looking at business cycle interdependence between emerging and developed economies and the influence FDI has on this interdependency, but also to see what kind of relation between business cycle interdependence and FDI exists within a group of emerging economies and within a group of developed economies.

5   Conclusion

The US has always been one of the strongest economic forces of the world. But nowadays emerging economies are getting more involved in the world economy, because of the booming business in several emerging countries. The fastest growing emerging economies, being the BRIC countries. But how does this change affects the business cycle interdependence, are the BRIC economies strongly tied to the world economy?

The aim of this thesis was to answer whether business cycle between the emerging BRIC countries and the US are interdependent and to research the influence FDI has on this interdependency. The expectation was that business cycles between the BRIC economies and the US are getting more interdependent and that stronger FDI linkages between the BRIC countries and the US contribute to more interdependency among them.

The findings reveal that there is a structural break towards more business cycle interdependence between the BRIC countries and the US. These findings are overall significant.

When trade and FDI are introduced together the findings reveal that the stronger the FDI linkage between the BRIC countries and the US becomes the more interdependent there business cycle is. However for trade the opposite is true. This means that the tighter the trade linkage between the BRIC economies and the US is, the less business cycle interdependence there exists. The results in this model are significant, but because of the <u>high</u> correlation between FDI and trade, their coefficients may not be valid. When the Euclidean distance is regressed either with FDI or with trade, the results of these two regressions indicate that when FDI linkage becomes stronger, there is more business cycle synchronization. And when trade linkages become stronger this also influences business cycle interdependence positively. However the results for trade are not significant.

The reasons why FDI have this effect on business cycle interdependence can be due to the ability of multinational firms to transmit the effects of local macroeconomic shocks throughout the organization, which could mean that shocks to some extent are transmitted from one economy to another. In the same way if FDI is provided by multinationals that are outsourcing the production of intermediate inputs to another country, a change in the demand for the final product can easily be passed to the countries that provide the intermediate inputs and hence influence business cycle co-movements. Another reason is that FDI can also be used to transfer technology and ideas between economies, which can also have an influence on the interdependence of business cycles.

Because of the small focus of the study conducted in this thesis it is not possible to conclude that FDI should be added to macroeconomics models which are used for making forecasts, creating scenarios and conducting policy analyses by national policy makers and international organizations. Therefore in order to do that, the impact of FDI linkages on business cycle interdependence, has to be approached more globally.

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