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ON THE MEASUREMENT OF FOREIGN DIRECT INVESTMENT AND ITS RELATIONSHIP TO ACTIVITIES OF MULTINATIONAL CORPORATIONS

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Abstract

This paper discusses the different concepts of measuring multinational corporations' activities to provide empirical researchers helpful guidelines about which measures to use in their work. I discuss which economic relations exist between the measures and show that a tight relationship can be established in theory and is indeed present in the actual data. A main conclusion is that foreign direct investment (FDI) stock data is generally recommendable to measure the importance of multinational firms but the preferred measure depends on the analytical question under investigation.

The second part of the paper argues that estimating the determinants of multinational firms by using static equilibrium models can be quantitatively misleading and hence be problematic for our understanding of multinational firms and for the design of policy. In this context, I suggest some guidelines how data on multinationals could and should be used for empirical estimation.

Keywords: Multinationals, FDI, Measurement, Balance of Payments

JEL classification: C51, F2, E01

Highlights:

- I compare different concepts for measuring the relevance of multinational corporations
- FDI stock generally performs well
- Dynamic misspecification can be a serious problem of empirical models estimating equilibrium effects on multinational firms

Non-Technical Summary

Policy makers and academics have become increasingly interested in foreign direct investment (FDI). This is not surprising, given the fact that FDI is the most relevant form of capital inflow for many countries, especially developing and emerging economies. Furthermore, increasing globalisation also led to a growing interest in the activities of multinational corporations (MNCs), which is often proxied by FDI data.

Despite the large amount of work on FDI and MNCs, no contribution so far has systematically asked which economic assumptions are necessary for FDI to consistently measure the activities of MNCs. The aim of this paper is to fill this gap. Therefore, the different concepts of measuring the activities of MNCs are first discussed. They include financial account data on FDI and operational data such as sales and employment. Then, a fictional accounting example is given to illustrate that FDI data can by far underestimate the amount of assets that MNCs control and that it can be problematic from an economic perspective to interpret FDI as a pure capital inflow.

Sections 4 and 5 then discuss the economic relationships between the previously introduced data and show how important these relations are in practice. It is first shown that in equilibrium FDI flows are a simple function of FDI stocks. Hence, both could generally be used to measure the same thing. Empirical investigation shows that this equilibrium identity is reflected strongly in the actually observed FDI data on an aggregate level.

Then, a standard production function is taken to illustrate the economic relationships between measures for sales, FDI, and employment. It is shown that these three measures are indeed tantamount to each other, if relative factor prices do not change and there is no technological progress which favours a certain factor. However, under the realistic assumption that MNCs have easier access to capital or that technological progress is labour-saving, employment data is likely to be a downward biased measure of MNCs relevance in a host economy, while data proxying for capital, such as FDI, is likely to be an upward biased measure for MNCs relevance in the host economy. Sales data, on the other hand, suffer from ambiguous signals over time. For example, low prices of MNCs products might decrease recorded sales data in the short run, although they might be an indication of high price competitiveness and hence increasing relevance of MNCs in the long run. It is thus argued that FDI data should be preferable since capital markets generally take into account future sales. This intuition is substantiated with a look at the actual data which shows a high correlation of FDI stocks with MNCs operational data, with differences across correlations corresponding to the previously described economic intuition. Overall, the paper therefore suggests that FDI stock data is a decent proxy for the activities of MNCs.

Section 6 then looks at the dynamics of a MNC's response to a changing market environment. It is argued that this response is necessarily sluggish, especially for multinational firms since they will encounter difficulties in selling down their assets when an adverse shock

occurs. This is not only relevant in the actual policy discussion about firms' deleveraging process but also has implications for the econometric modelling of FDI determinants. It is argued that conventional estimation techniques in the literature (such as fixed or random effect panel data models) can produce quantitatively misleading results. The paper rather favours dynamic or between-effect estimation for equilibrium models addressing the determinants or consequences of FDI, but also shows that FDI flow data can be used for conventional models.

The paper therefore provides guidelines for applied economic research on FDI and highlights that the appropriateness of different approaches to the data largely depend on the specific research question. Finally, the investigation of the dynamics of MNCs adjustment to a changing business environment also questions the prevailing theoretical perception of MNCs because a suppressed deleveraging path conflicts with theoretical models that overemphasise the high productivity of MNCs. This issue hence provides scope for further theoretical and empirical research.

THOMASINA: *If there is an equation for a curve like a bell, there must be an equation for one like a bluebell, and if a bluebell, why not a rose? Do we believe nature is written in numbers?*
SEPTIMUS: *We do.*
THOMASINA: *Then why do your shapes describe only the shapes of manufacture?*
SEPTIMUS: *I do not know.*
THOMASINA: *Armed thus, God could only make a cabinet.*
SEPTIMUS: *He has mastery of equations which lead into infinities where we cannot follow.*
THOMASINA: *What a faint-heart! We must work outward from the middle of the maze. We will start with something simple.*

Tom Stoppard - *Arcadia*

1. Motivation

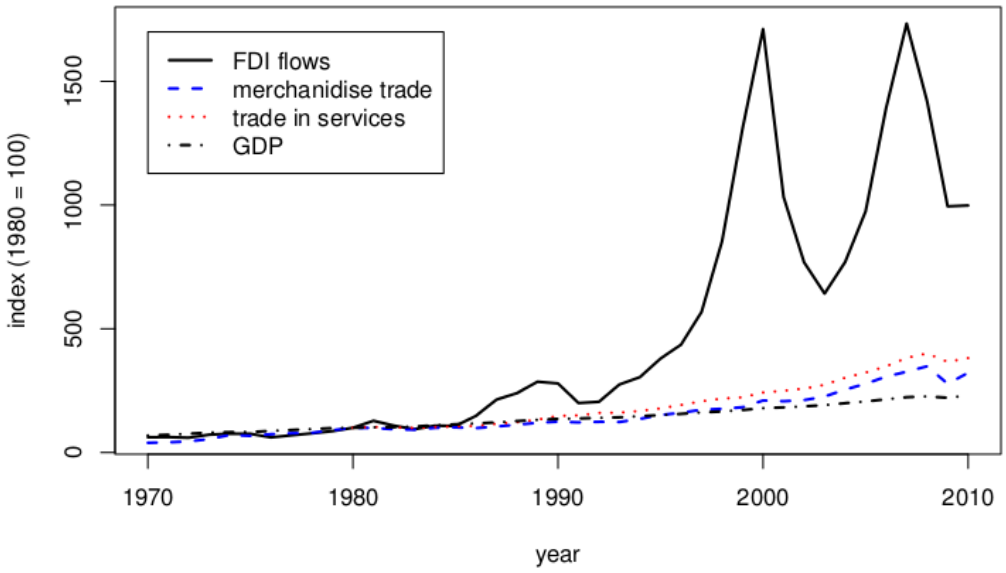
International capital flows in the form of foreign direct investment (FDI) have increased considerably throughout the last decades. As can be seen from figure 1, FDI surged to about the tenfold of its 1980 level in the last thirty years, while merchandise and services trade increased by a factor of 3.2 and 3.8, respectively, still outperforming GDP which roughly doubled throughout the period (factor 2.3).[1] This highlights that FDI plays an important role in the recent process usually referred to as 'globalization,' which is not only limited to a quantitative increase in international capital flows: to the extent that FDI is investment of multinational corporations (MNCs), it also qualitatively re-structures the production process more and more globally (cf. Baldwin and Martin, 1999, ch. 4.2; Gereffi, 2005, p. 161; Bair, 2005). A main aim of this paper is to discuss and investigate—analytically and empirically—whether FDI data only measures financial stakes of parent firms in their affiliate or whether it can also be used as a measure for the extent of MNCs' economic activities in the host economy, although FDI data per se does not purport to measure the latter (cf. Lipsey, 2001, p. 14).

This seems indeed necessary since a growing number of academic contributions reflects the increased relevance of FDI and MNCs: as can be seen from table 1, the number of SSCI-listed journal articles including 'Multinational Corporation,' 'Multinational Firm,' 'MNC,' 'Foreign Direct Investment,' or 'FDI' in their title has grown considerable over the last decades, even when "price"-deflating it to account for the increased number of overall articles published.[2] This was not so much driven by MNC related articles, which remained

[1] The figure uses UNCTAD data for FDI flows, trade in merchandises, trade in services, and gross domestic product (GDP) for the world in total, using the GDP deflator to compute constant prices. FDI flows are inflows, trade data are (imports + exports)/2. FDI flows are taken rather than stocks because the other series are flow variables as well. The series are indexed with 1980 = 100.

[2] Precisely, I compare articles published in journals captured by the 'Social Science Citation Index' under

Figure 1: Development of Selected Global Macro Variables



fairly stable in real terms (see last line of the table),[3] but rather by FDI related articles: By any meaningful definition of 'price stability,' the development of FDI related articles was clearly inflationary. Even more, the real increase in FDI related articles by far outnumbers the increase of real FDI in the three decades 1980 - 2010.

In combination with the advancement of empirical methods and computational power, the growing interest in MNCs has resulted in an increasing ad hoc practice to quantify their operations. There are several methods in the literature to measure the relevance of multinational firms, first and foremost data on FDI stocks and on sales of multinationals' foreign affiliates, but also data on FDI flows and various operational data of multinationals' foreign affiliates, such as employment data. Few studies explicitly explain why they use a specific measure, but rather assume implicitly that the different data are to some extent tantamount to each other.[4] Neither do most of them motivate the precise functional form of their es-

the listing of 'Economics' and 'Business' having one of the above-mentioned terms in their title to the development of the keyword 'price' in titles of corresponding articles. The latter serves as a proxy for total articles published because 'price' is assumed to be a central category of market economies and its investigation therefore should not follow too dramatic cycles and fashions over the decades. The recent boom in commodity and housing prices might have had an impact on this measure, however, it is remarkable that the share of MNC/FDI related articles increased despite the peak of price related articles between 2006 and 2010. It could not be identified from SSCI, which specific goods were the overall 'price' drivers in this period. SSCI was accessed in February, 2012.

[3] A substitution from 'Multinational Corporation' to 'MNC' took place. Summing up both of them, the real development was -0.28 % p.a.

[4] Among the exceptions worth noticing is Davies (2008, p. 263f) who discusses different findings between

period	"Multi-national Corporation"	"Multi-national Firm"	"Foreign Direct Investment"	"FDI"	"MNC"	"Price"	(1)-(5) /(6)
1951-1960	0	0	0	0	0	437	
1961-1970	9	1	5	0	0	1,080	1.4%
1971-1975	31	24	12	0	3	901	7.8%
1976-1980	34	10	23	2	8	1,357	5.7%
1981-1985	28	7	28	1	8	1,525	4.7%
1986-1990	9	3	50	4	4	1,667	4.2%
1991-1995	10	6	84	11	1	1,708	6.6%
1996-2000	12	3	164	30	7	1,704	12.7%
2001-2005	12	10	247	95	26	1,856	21.0%
2006-2010	29	21	370	280	48	2,707	27.6%
2011	8	3	86	76	15	574	32.8%
growth p.a.	-2.79%	0.17%	7.21%	15.22%	3.74%		

Statistics are limited to business & economics journals. Growth p.a. is the 'real' growth rate (deflated by the 'price' series) p.a. over the 30 years 1976-80 to 2006-10

Table 1: Mentioning of Keywords in Social Science Citation Index (in Title)

timable model[5] when trying to estimate determinants of MNCs' activities. The aim of this paper is hence to go 'back to the basics' of how to measure MNCs' activities.[6] Therefore, the measures mentioned above are discussed in more detail before I demonstrate what advantages and drawbacks these measures might have in view of an underlying Cobb-Douglas production function with or without different forms of technological progress and potential differences in factor prices, and under the assumption that MNCs produce technologically and allocatively efficient. I then provide empirical evidence that most measures of MNCs' activities are in fact highly correlated to each other. Finally, I investigate in how far these different measures and different functional forms of the estimable model lead to diverging parameter estimates in a very parsimonious model of MNCs' determinants before concluding the paper with a summary what empirical researchers but also policy makers and economists

a FDI stock and a sales data sample by asking what economic mechanisms and data recording techniques may cause this sensitivity. However, his discussion is mainly focused on the specific application.

[5]Cf. Spanos (1993, p. 21) who refers to an *estimable* model as a "particular form of the theoretical model which is potentially estimable in view of the actual data-generating process (DGP) and the observed data chosen" and explicitly distinguishes it from the theoretical model, the statistical model, and the empirical econometric model.

[6]I therefore follow a country-approach, i.e. the question is to measure from a country-perspective how relevant MNCs are in its economy. This will be largely but not perfectly identical with an aggregated firm approach to measure how relevant certain host country activities are from the firm's perspective. I do not discuss any disaggregated direct measures of MNCs at the micro level such as firm-level datasets, nor do I delve into cross-industry comparisons for the discussed measures. Although this might be interesting for future research, the industry re-classification of the BEA in 1999 poses a problem to such an investigation in the present framework. See also Lipsey (2007).

working on the nature of the multinational firm can potentially take away from this exercise.

2. Measuring Activities of Multinational Corporations

2.1. FDI Data

FDI data is an ad hoc candidate and widely used to quantify the relevance of multinational firms.[7] They either come as flow or as stock data and are recorded in a country's Financial Account of the Balance of Payments (BOP) or International Investment Position (IIP), respectively. A main reference manual on measuring FDI data is the IMF's "Balance of Payments and International Investment Position Manual" (BOPM), which defines FDI as a "category of cross-border investment with a resident in one economy *having control or a significant degree of influence* on the management of an enterprise that is resident in another economy" (emphasis added).

More precisely, FDI requires that a long-term relationship is established between a foreign direct investor (either a natural person or a corporate body in the 'source' or 'home' country) and a direct investment enterprise in the 'host' country, where the former has a lasting interest and a significant degree of influence in the latter.[8] Since it is too complex to evaluate this criterion on a case-by-case basis, the relevant criterion for an investment to be classified as FDI (as opposed to portfolio investment) is that the direct investor directly or indirectly[9] owns "equity that entitles it to 10 percent or more of the voting power [i.e. of ordinary or voting shares] in the direct investment enterprise." Once this direct investment relationship has been established, all subsequent capital transactions between direct investor and direct investment enterprise are considered to be direct investment. These transactions are recorded on a *net* basis within an existing direct investment relationship,[10] more precisely as assets for the economy of the direct investor and as liability for the economy of the direct investment enterprise (cf. IMF, 2004, pp. 5 and 19f).[11]

Based on this definition, three different forms of FDI can be distinguished, where only the first one can constitute a foreign direct investment relationship while the others are

[7]Examples of important studies using FDI data are Baltagi et al. (2007, 2008) and a sample of Blonigen et al. (2003) for stocks and Borensztein et al. (1998); Davies and Voy (2009) and Harding and Javorcik (2011) for flows.

[8]In accordance with the BOPM and current accounting practices, "foreign" refers to residence, not nationality or citizenship.

[9]In practice, this measurement of indirect ownership poses serious problems, see IMF (2004, box 5.1 on p. 21 and paragraphs 6.15 - 7.17).

[10]This shall not be confused with net capital flows between countries, where the net flow from country A to country B is calculated as the flow from A to B minus the flow from B to A and which is relevant for movements in a freely floating exchange rate, for example.

[11]Note that the 10 % criterion means that FDI does not necessarily imply full control of the direct investor over the direct investment enterprise. In practice, however, almost all affiliates under this criterion are majority-owned, see Graham and Krugman (1989, p. 10) or IMF (2004, p. 19).

characterized as FDI (and recorded as such in the BOP or the IIP) once a FDI relationship has been established:

1. *equity capital*, which makes up for the main part of FDI (cf. IMF, 2004, paragraph 3.4 or Lehmann et al., 2004, table 1 on p. 5);[12]
2. *reinvested earnings* are the direct investor's share of earnings not distributed as dividends by subsidiaries and associated enterprises and earnings of branches not remitted to the direct investor during the reporting period,[13] and
3. other capital, mainly *intercompany debt*.[14]

2.1.1. Stocks vs. Flows

Simply speaking, FDI stocks are the (revalued) cumulation of past flows, while flows are the current transactions taking place in a certain period t, most importantly within a year. The definition of what is characterized as FDI applies to both of them, though for stocks - which are recorded in the IIP - equity capital and reinvested earnings are combined into a single category because at the end of the period they both form equity capital holdings.

While the sum of transactions taking place throughout the period can be taken for flow data, stock data is more problematic because one is confronted with the question how to value assets of a multinational firm that were acquired in the past. Table 2 exemplifies the relation between FDI stocks and flows: throughout the year, the assets held by the direct investor in the host economy have to be revalued. This includes a valuation to market values (price change), changes in the assets' value due to exchange rate changes (values are finally mostly reported in US-$) and other changes such as write-downs and reclassifications. In the example in table 2, this leads to changes in the IIP of 5 Monetary Units before any flow has taken place. This highlights, that FDI flows are generally *not* equal to the first difference of FDI stocks.[15] Nevertheless, when stock data is missing, summing capital flow data can be used as approximations to fill the data gaps, although this does not take into

[12]This does *not* imply, that equity capital of foreign direct investors is the main source of finance for direct investment enterprises. The issue is addressed below. Also note that throughout this work, I do not refer to 'capital' in a colloquial way, i.e. I do refer to capital as a liability, not an asset. The term 'fixed capital' should make clear that it is the part of capital (liabilities) that - as a mirror image in the books - is fixed in assets (such as buildings, machines etc.). The issue should be more clear after consulting section 3.

[13]Reinvested earnings, together with dividends and distributed branch profits and interests on intercompany-debt FDI constitute FDI investment income flows, which are generally part of the Income Account of the BOP's Current Account, not of the Financial Account of the BOP (besides from reinvested earnings which is also part of the Financial Account). This makes sense once one understands that they are the income of an exported service. For the same reason, direct investors' incomes through management and other fees and charges levied on the direct investment enterprises which are recorded under 'business services transactions' are part of the Current Account, not the Financial Account.

[14]Note that this is a broad definition of 'capital' (for a primer about capital in the context of bank capital cf. Elliott, 2010, pp. 2ff) and that debt on its own cannot constitute a FDI relationship.

[15]An exception is the special case when there are no revaluations or, which is the same, the investment position is recorded at historical values.

account nontransaction changes arising from, for example, exchange rate and price changes (cf. IMF, 2004, p. 13).

IIP assets at the beginning of the period ("stock")	120
BOP transactions ("*flows*")	15
price changes plus	2
exchange rate changes plus	- 8
other adjustments plus	1
IIP assets at the end of the perios ("stock")	130

Table 2: FDI Stock Changes and the Relation to FDI Flows (fictive example)

2.1.2. FDI-specific Problems

In one of the rather scarce attempts in the literature to address the appropriateness of FDI data to measure MNCs' output, Lipsey (2007) raises serious concerns about the use of FDI data because of the valuation problem, the intangible nature of most production generated by MNCs and the fact that even for production of tangible products, important parts of the assets that enter production are intangible, especially financial assets.[16] Since firms can almost arbitrarily attribute these intangible assets among countries, this would lead firms to "internationally shift assets and sales nominally [i.e. without any counterpart in movements of production] to low-tax countries to minimize taxes" (p. 14). With regards to country-level data, however, his concerns seem somewhat excessive in light of his results which are discussed in section 5 below and lead him to the conclusion that "the country distribution of the [US] outward FDI stock is a fairly good representation of the distribution of employment" in both 1994 and 1999 (p. 11) while the industry distribution is not (p. 12).

Another potential problem with FDI data—which I consider more interesting from the economic perspective and hence exemplify in section 3 below—is the question which other sources of finance besides from FDI a direct investment enterprise acquires, i.e. the question of its capital structure. Markusen (2002, p. xii) already noted that "the sourcing of finances for direct investments are often geographically disjoint from the actual parent country."[17] In an interesting study on the determinants of these sources of finance, Lehmann et al. (2004) find that "for US affiliates in all countries, finance that can be attributed to US parents (that is, FDI stocks) represents no more than a third of total balance sheets" (p. 5). Probably

[16]His other main concern is the fact that the location of production associated with about a third of the total US outward stock is unknown. A similar issue applies to trade data, where global exports also do not balance global imports.

[17]Note that this issue is *not* resolved by the above-made argument that majority-owned subsidiaries are the main part of MNCs' affiliates because having knowledge about the foreign direct investor's holdings in the direct investment enterprise's (common or voting) shares does not tell us anything about the distribution between the shareholders and (long-term) creditors in the capital structure.

even more important, the share of affiliates' host-country finance is larger in industrialized than in developing countries, suggesting that FDI structurally underestimates the share of foreign-controlled assets in the former countries compared to the latter ones.

2.2. Other Operational Data

The Bureau of Economic Analysis (BEA) of the US Department of Commerce does not only offer BOP and IIP data but also financial and operating data of US MNCs and on the US operations of foreign MNCs, such as total assets, employment, employee compensation, sales, and net income.[18] These data are generally available from 1997 for almost all countries and to some extent allow an industry-level breakdown. However, much data are subject to disclosure and missing values pose another problem, as does the sectoral classification change in 1999 and the change from only including nonbank foreign affiliates up to 2008 to including all foreign affiliates thereafter.

Since these data are only available for US-related multinationals and since outward investment motives are not necessarily limited to conditions in the host country (pull factors), but also in the home country (push factors; see Calvo et al., 1993; Fernandez-Arias, 1996; Chuhan et al., 1998; Albuquerque et al., 2005; di Giovanni, 2005, and others) such as the Federal Reserve's policy of cheap money throughout most periods of the last decades, econometric studies using these data should give special emphasis to modeling all relevant push factors (a rather heroic claim) or, which comes down to the same, to include time dummies (a more pragmatic approach).[19]

To avoid the discussed problems of the direct investment enterprise's capital structure, using data on **total assets**, i.e. all owned physical objects or intangible rights with economic value to the firm, would be an option. While FDI is recorded as one component of the liabilities' side of the balance sheet of the host (direct investment) enterprise, total assets—by accounting identity (assets = liabilities)—are the mirror image of FDI and *all* other liabilities and typically include items such as cash, inventories, receivables, and property, plant, and equipment (PPE). It also includes equity investments in unconsolidated domestic and foreign businesses. However, the use of this data in the literature is not common, potentially because the gains are rather modest compared to using FDI data which provides a much larger availability. Also note that the data do not resolve the issue of intangible assets raised

[18]OECD (2007) also provides data on similar variables on the ISIC Rev. 3 level, but only for a very limited time period (1999/2000 - 2003/2004). At stats.oecd.org, some operational data range for longer time periods, sometimes even outnumbering the BEA observations. I limit my discussion here to the BEA data since they are the most-widely used operational data in the literature.

[19]While the same argument applies to the aggregate of all source countries, it is possible that such source-country effects cancel out at the aggregate level. In this case, however, I would still recommend the use of time dummies or to model 'global variables' such as the oil price and LIBOR when $T \to \infty$ and hence time dummies cannot be used.

by Lipsey (2007) because they are part of these assets as well.

One of the most commonly used measures for the activity of MNCs is **sales data** of MNCs' affiliates, which is the value of goods and services sold and, for financial firms, also includes investment income.[20] The data is net of returns, allowances, and discounts and excludes sale or consumption taxes levied directly on the consumer and excise taxes levied on manufacturers, wholesalers, and retailers. Accordingly, it includes intermediate inputs from other producers. To measure the extent of MNCs' output from its own production and to represent its contribution to GDP in the host country, it would hence be preferable to use value added data which would give a closer impression how much resources multinational firms directly command in an economy. Furthermore, the above-mentioned quote of Lipsey (2007, p. 14) makes clear that the problem of arbitrary international shifts of resources within a MNC also applies to sales data. This has to be the case because the corporation wants to realize the nominal profit where profit taxes are lowest. Therefore, the affiliates located in tax havens have to sell something in their books, most likely services (or intangibles). Problems with the data might also arise if the capital structure of the host producing the sales will change, depending on what is the purpose of measurement and the question under investigation. Therefore, note that sales data might remain unaffected (at least in the short run) while the share of FDI in the affiliate's equity might increase, giving the foreign direct investor other incentives to transfer technology or other intangibles, for example. Despite these and other potential problems, many of the most important studies in the literature on MNCs, such as Brainard (1997); Carr et al. (2001); Helpman et al. (2004); Blonigen et al. (2007); Ekholm et al. (2007); Davies (2008), use US affiliates' sales data for their empirical investigations. A potential reason is the fact that the literature on MNCs emerged widely from trade theory and is hence mainly concerned with the movement of goods across borders and potential substitutes, which is in fact best measured by sales data (but does not necessarily provide us a good picture of the multinational firm, especially when it comes to such important issues as corporate finance and corporate management).

Another common (descriptive) measure for MNCs' relevance is **employment data** of their affiliates, which is the number of full-time and part-time employees on the payroll at year-end in the BEA's accounts. The advantage of this data is the fact that it is a real variable, i.e. not expressed in monetary terms. However, this also is the data's main weakness because it bears few information about the economic value of these employees since both, a high-skilled and a low-skilled worker are recorded with the same real value though the former's productivity is expected to be higher. Hence, the number of employees in MNCs' affiliates relative to total employment over the long run *within a given economy* might be a rough descriptive measure for the development of the MNCs' relevance in that economy, however, as discussed in section 4 below, this will only be appropriate under rather strict assumptions, such as no factor bias in technological progress across industries/firms. Probably more accurate is the comparison of the MNCs' employees as a share of total employees

[20] Cf. footnote 13 on page 5.

across sectors at a given point in time to describe the degree of multinationality across sectors in a given country since then the assumption of economic homogeneity of workers (between domestic and foreign firms within a given sector) is more reliable. Another problem in practice is the fact that employment data is often missing or only given in (rather large) intervals which can pose a serious problem in fixed effects (FE) estimation because the interval-censoring will not leave enough variation over time.

To resolve the problem of economic value of workers in the firm, data on **compensation of employees** could be used. While this should also account for labour-saving technological progress in theory, because the increased marginal product due to the latter should be reflected in the worker's remuneration, this is very unlikely given the potentially strong bargaining power of MNCs.[21]

Finally, the BEA also provides **net income data**, that is the profit an affiliate earns in a given time period. It equals total sales or gross operating revenues and other income less total expenses. It is net of, i.e. after deduction of, income taxes and includes income from equity investments. While probably not an appropriate measure for the overall relevance of MNCs, it might be used in industrial analysis to address the issue if MNCs' affiliates produce more profitable, conditional on the factor inputs, for example, although multinational tax incentives will again pose a serious problem in this context.

3. An Accounting Example

To see how FDI stocks and affiliates' sales—the two central measures for MNCs' activities—can constitute different concepts, consider table 3 which depicts a fictive balance sheet of an (direct investment) enterprise A in country 1. In the narrowest sense, the capital stock of the enterprise is the sum of common stocks held by the investors that amounts to 490 Monetary Units (MUs). Furthermore, the firm has issued preferred stocks of 90 MUs to investor E as a dept instrument that can be classified as capital in the narrow sense because investor E has no legal claim to ever get back this investment (see below). Note that capital is found on the liability side of the balance sheet. The firm can use this capital to buy things like machines or land that will be summarized under "property and equity" (in the case of machines and land, this will be 'fixed capital'), it holds some money, "cash," to carry out its daily business, and has some goods on storage. Since some of these assets have a relatively stable market value, the enterprise can take loans against these assets because even in times of a crisis (e.g. when the value of property and equipment decreases significantly), the capital owners do not have a strict legal claim on these assets because capital is by definition the portion of assets which have no associated contractual commitment for repayment (Elliott, 2010, p. 1). In this case, the enterprise has taken total loans of 420 MUs. Since capital and loans

[21]For a discussion of the bargaining power of foreign portfolio and direct investors in the context of developing countries, see Trapp (2012).

sum up to 1,000 MUs and since assets and liabilities have to balance per definition,[22] the (direct investment) enterprise (or, its management, or, its common shareholders) commands an equivalent of 1,000 MUs. Suppose that this stock of assets produces goods that are sold during the year at a total of 700 MUs.

Balance Sheet of Enterprise A (country 1)

Assets		**Liabilities**	
Cash	50	Common Stock of Investor B in Country 1	400
Property and Equipment	600	Common Stock of Investor C in Country 2	70
Intangible Assets	300	Common Stock of Investor D in Country 2	20
Storaged Goods	50	Preferred Stock of Investor E in Country 2	90
		Long-term Loan from Bank in Country 1	250
		Long-term Loan from Bank in Country 2	70
		Short-term Loan from Bank in Country 2	100
Total	*1,000*	*Total*	*1,000*

Table 3: Fictive Balance Sheet of (Affiliate) Enterprise A in Country 1

In this example, the only foreign direct investor is investor C from country 2 because it is both *foreign* and its capital stock amounts to $70/490 = 1/7$ of the total voting shares which is clearly larger than the 10%-cut-off point defined in the BOPM. The capital stock of investor D amounts to $20/490 < 10\%$ of the relevant capital structure and is hence classified as portfolio investment in the IIP and the stock of investor B is domestic, not foreign. Preferred stock (under usual circumstances) carries no voting rights, investor E hence does neither have control nor a significant degree of influence on the management of company A. There are at least three important lessons depicted in the balance sheet in table 3:

1. The amount classified as FDI can by far underestimate the assets commanded by MNCs. In the present case, it may be questionable how much ownership and control investor C can really exercise, but assume that it would buy stocks from investor B worth 180 MUs. It will then hold $250/490 > 50\%$ of the firm and exercise full control over assets worth $1,000$ MUs with an investment worth 250 MUs. Since long-term debt and preferred stock can be classified as capital in the wider sense, it will command capital worth 900 MUs with an FDI equal to 250 MUs.

2. This illustrates that conclusions from using FDI data *can* vary significantly from those using sales data. In our case, the first amounts to 70 MUs (250 MUs after the purchase

[22]Of course, not the assets will balance the liabilities but it is rather the capital part of the liabilities that will take care that liabilities equal assets, i.e. capital is the residual category that ensures this identity. However, a part of the capital structure may be reflected on the asset side as part of intangible assets. In fact, this should be a mechanism that allows the book values of capital to approach market values of traded capital, i.e. to relate the future with the present. Therefore note that market values of stocks are a present value (hence, a representation of a future value), while tangible assets should be current values.

from investor B), the second one to 700 MUs.

3. Finally, the balance sheet in table 3 makes clear that it is somehow problematic to consider FDI as a simple capital flow. One well-known question is to what extent multinational firms replace domestic firms. However, even if they supplement domestic firms in the real production process, they may still detract capital from the domestic market to a considerable extent, hence crowd out domestic firms via a financial channel.[23]

These issues emphasize potential pitfalls of conventionally used measures to quantify MNCs' relevance. From this example, I now turn to a more systematic way of comparing the different measures by looking at conditions under which these measures should be tantamount to each other and which economic changes could lead to a divergence between the measures. Afterwards, I will present some figures that demonstrate that the empirical correlation between most of these measures is relatively strong.

4. The Relationship Between FDI Stocks, Flows and Other Operational Data

4.1. Stocks and Flows in the Steady State

Assuming that host and home economy and the MNC are in equilibrium and none of the variables underlying the FDI decision changes, the FDI stock should be in a steady state:

$$FDIstock_{it} \stackrel{!}{=} FDIstock_{i,t-1}. \tag{1}$$

This means that the multinational firm has no incentive to adjust its FDI stock. Does equation (3) imply that there is no FDI flow in the BOP? To assess this question, it is important to note that the capital stock in time t necessarily consists of the stock inherited from $t-1$, minus depreciations of this stock and plus (minus) changes due to flows:

$$FDIstock_{it} := FDIstock_{i,t-1} - \delta FDIstock_{i,t-1} + FDIflow_{it}, \tag{2}$$

which will be discussed in more detail below. If $\delta > 0$, i.e. a certain fraction of the capital stock depreciates and δ is fixed, i.e. does not change over time and countries, substituting the steady-state condition (1) into condition (2) implies

$$\delta FDIstock_{i,t} = FDIflow_{it} \qquad \forall\ i,t. \tag{3}$$

This is equivalent to the well-known steady-state condition in the neoclassical exogenous growth model and intuitively means that the multinational has to make up for the depreci-

[23] Vora (2001) and Harrison and McMillan (2003) provide evidence that foreign-owned affiliates' host country leverage aggravates credit constraints of domestic firms in Morocco and Ivory Coast, respectively.

ated stock by a FDI flow from the parent to the host of equal size as the depreciation.[24,25]

This trivial conclusion has a very practical implication: To estimate any equilibrium model for the multinational firm, it theoretically does not matter whether one uses FDI stocks or FDI flows because the latter is a (homogeneous) function of the former. I will show in section 5 below, that the correlation in the data can indeed be very high and will discuss the implications for applied research in the concluding section.[26]

4.2. The Production Process and its Reflection in the Data

FDI data are balance of payments statistics and as such "they do not purport to measure the size of multinational firms ... or their activities in their host countries" per se (Lipsey, 2001, p. 14). Lipsey (2007) therefore raises the skeptic question if we "wish to say that the location of output has changed because, for example, firms have chosen to place their holding of their affiliates' stock in their Irish subsidiaries? Do we wish to say that the location of output has changed because firms have chosen to place ownership of their patents or corporate logos, which they use all around the world, in Ireland or in some Caribbean Island?" (p. 20).

Such accounting issues are of course important questions and *can* result in misleading data as exemplified above. But are these problems only substantial for specific 'tax-haven' countries or do they cast general doubt on the practice of using FDI data to proxy for the extent of MNCs' economic activities in the host country? To address this issue, I first establish an analytical relationship between FDI data and other operational data of MNCs under some simplifying assumptions. In the next section, I then empirically investigate to what extent this stylized approach can describe the data. To work outward from the middle of the maze, let us start with the simple Cobb-Douglas production function

$$Y_t = A_t K_t^a L_t^b, \tag{4}$$

where Y is the real output (e.g. sales), K is the stock of fixed capital and current physical assets (especially intermediate inputs), which is probably proxied best by the category

[24]Note that reinvested profits should be part of the FDI flows as they are recorded in the home country's Financial Account as a debit entry under 'FDI abroad' with an offsetting credit entry in 'reinvested earnings' under 'FDI investment income' in the Current Account in order to ensure the BOP identity. Cf. footnote 13 on page 5.

[25]One could add ηt to the right hand side of equation (1) and hence the left hand side of equation (3) that might capture an underlying process such as the steady-state growth rate of total output (hence market size) or other trends such as political globalization that lead to a deterministic trend in FDI stocks, however, to emphasize the argument made here, I assume $\eta = 0$.

[26]An important technical caveat to the condition derived in equation (3) should be highlighted: throughout the last decade, more and more countries adopted the 'Current Operating Performance Concept' instead of the 'All-Inclusive Concept' to measure FDI earnings, as suggested by the BOPM (see IMF, 2004, p. 29). Under this practice, depreciations are subtracted from the investors' earnings, hence while the earnings of the affiliate still make up for the depreciation, this transaction is not recorded in the BOP. However, until the early 2000s, not even one third of national compilers fully applied the 'Current Operating Performance Concept' (cf. IMF, 2004, p. 29)

'plant, property and equity' (PPE), L is labour input and A is a technology parameter. t can be thought of indexing observations over time and/or over cross-sections, most importantly countries. Apparently, it is reasonable to assume $a, b > 0$ and for simplicity assume $a + b = 1$, which leads to constant returns to scale (CRTS). I will assume that production is both technologically and allocatively efficient.

For now, let us consider that factor prices are constant and technology is fixed and homogeneous across firms. This entails, that the K/L ratio will remain constant in the optimum and any increase in Y can only be achieved by an increase in K and L, both of the same proportion (under CRTS) and hence *it does not matter under these circumstances, if data on sales (Y), PPE (K) or employment (L) is used.*

But how does FDI relate to this? Therefore note that K has to be paid for in advance while L can principally be paid from current cash flows (or using short-term debt or financial instruments such as repos in case the period between production and sales lasts longer than from the beginning to the end of the payment period). Hence, capital in a wider sense is a manifest proxy for K and to the extent that FDI is part of capital, it will be a proxy for K[27] and due to the above relation with L and Y variation in FDI will not only capture changing financial stakes in affiliates but be an adequate proxy for the extent of MNCs' economic activities.

But this leads to a potential problem: It is quite realistic that the cost of capital is lower for multinational firms[28] due to reasons like easier access to different capital markets and because parents may provide contingent liabilities. This will lower the relative price of K vis-a-vis L and hence lead to a higher K/L ratio for MNCs when producing the same output as a domestic firm on the same isoquant. It hence follows that *employment data is likely to be a downward biased measure of MNCs' real economic relevance in a host economy, while data proxying for K is likely to be an upward biased measure* for MNCs' real economic relevance in the host economy.

This statement concerns the coordination function in a market economy. However, any market will also perform some degree of incentive function (cf. Roemer, 2011, pp. 12ff). This leads to the question of **technological progress** and the potential problems that arise under a **dynamic**[29] view of the production process.

Therefore, first make clear that a technological change of *general* nature which is Hicks-

[27]In fact, most of long-term financing of corporations comes from internal financing, i.e. retained profits (cf. e.g. Ross et al., 2007, p. 396). Note that this is also capital and, more importantly, reflected in FDI data.

[28]I deliberately use the term 'firm' here to emphasize the fact of multinationality, not the fact that being a corporation might lower capital costs.

[29]Since time is not conceptually different from space, 'dynamic' could not only be interpreted over time but also as indexing t across countries with different production technologies.

neutral will pose no problem as long as sales will be normalized by the respective measure for the total economy or domestic producers.[30] But since MNCs potentially face a permanently lower price for capital (as well as technology and learning-by-doing spillovers between affiliates or parent and affiliates) they might have a higher incentive to conduct more R & D and hence experience a faster rate of technological change, especially one that is labour-saving. Let us consider the substitution and the productivity effect of this technological progress separately.

As far as there is only a factor bias but no productivity change, we will obtain a similar result as above: To the extent that the bias is labour-saving, employment data is likely to be an understating (downward biased) measure and data proxying for K is likely to be an exaggerating (upward biased) measure for the change of the MNCs' real economic relevance in the host country. Since the latter (and hence output or sales) will remain unaffected (only substitution, no productivity effect takes place), this means: K will rise and L will fall (over time), leading to a negative correlation between the two.[31]

Things get more complicated when a MNC-specific productivity increase occurs. First of all, measures for L and direct measures for K are unlikely to capture this change in MNCs' relevance accurately because L and K may remain unchanged while the output, hence the market share, and hence the relevance of the MNC increases in the long run. Depending on the market form, however, the short-run response of the firm to the productivity change will differ from the long-run equilibrium and hence a discrepancy between the two as well as the prevailing price elasticity of demand might pose additional problems. The long-run impact should be quite clear: The MNC will gain market shares and pricing power and the increased relevance will be reflected in the real sales data in the new equilibrium, while both K and L are seemingly inaccurate measures. The way to get there, however, may include engagements in price wars or quantity competitions. Say, the MNC uses a predatory pricing strategy to drive competitors out of the market and that the price elasticity of demand is smaller than 1 (in absolute terms) - favorable long-run conditions for the MNC. In the short run, however, the price decrease will not be compensated by the increase in demand, meaning that the value of sales will *decrease* although the competitive position of the MNC and hence its relevance has *increased*.[32]

[30] This normalization is necessary because an absolute increase in real sales will occur without a change of the relative relevance of MNCs' activities. Note that K and L should remain unaffected as long as the technological progress is of general nature and hence no substitution between sectors takes place. If the latter would be the case and the sector with a productivity increase (which is assumed to be MNCs-intensive) would expand production, the increase in MNCs' real sales would correctly reflect its increased relevance in the *overall* economy but this might be achieved with K and L unaffected.

[31] Of course, one would not expect a negative correlation between K and L in the data, this statement is the outcome of a restrictive thought-experiment. However, it might explain why the empirical correlation between employment and assets is lower than one may expect (cf. table 5 on page 17).

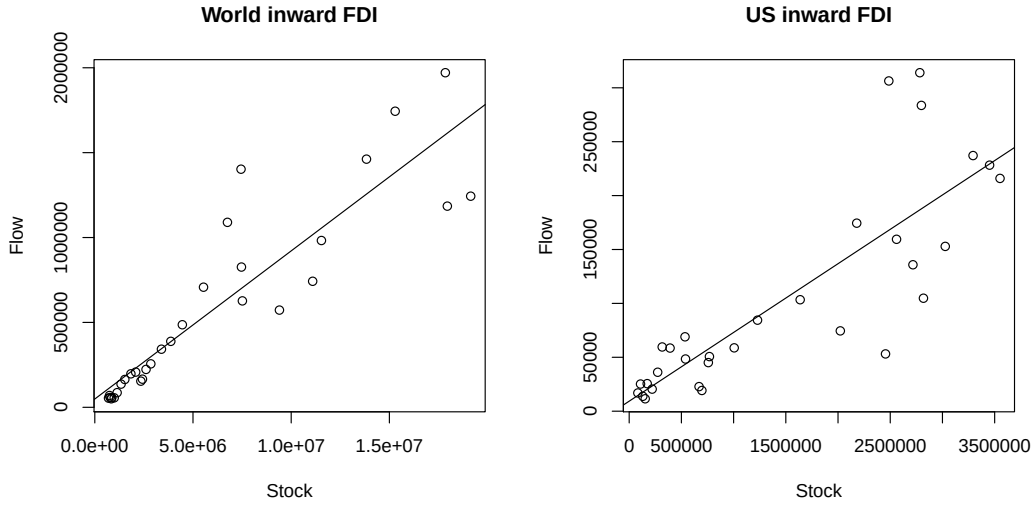
[32] It is assumed that the share of the MNC's products in the overall economy is small enough to not (considerably) influence the consumer price index that is used to deflate the sales series.

In a perfect world, we could compare the equilibrium before the technology change with the long-run equilibrium after the change. However, if we consider equilibrium not as a (comparative) static concept but as a gravitational center of the economy, we should prefer a real-time measure that captures the potential long-run changes ahead of time. Basically, this would just be the *price of the firm*, because any asset's current value should equal the present value of its future (net) cash flow. The economic agent who performs the task of valuing a (listed) firm is - the *stock market*. And the value of a firm's common stock to the investor is equal to the present value of the expected future dividends, i.e. distributed profits. Since changes in firms' market values (that should represent changes in the underlying fundamentals) should be reflected in the FDI stock data, I suggest that *FDI stock is a highly appropriate measure to value the relevance of MNCs* at any point in time.

Of course, some limitations to this view apply. First, one may argue that the value of the affiliate may be different for the direct investor than for the rest of the market because of intra-firm spillovers and other external effects. But if the goal is to proxy for the relevance in the host market, the pricing of the market is probably a preferable indicator over the pricing by the parent firm. The other problem is that this view requires at least some version of an Efficient Market Hypothesis (cf. e.g. Ross et al., 2007, p. 376) and correct compilation by national statistical authorities, that is, no market *and* no government failures - a pill that most economies might find hard to swallow. Admittedly, the Great Recession questions the proposition that stock markets get the pricing right and, as Krugman (2011, p. 308) points out, the real housing prices after 2002 were "the clearest market mispricing" in the last decades although houses differ from modern MNCs in the sense that they "have been with us for 7,000 years or so, and we should have a reasonable idea of what they're worth." Despite these concerns about the market's ability to get prices right, few economists would find it a theoretically appealing argument that stock markets get firm values systematically wrong and hence one could argue, that *on average* the market price will be a consistent statistic for the firm's economic value. Since it is a statistic and no parameter, this allows for a certain variability around the true value and it is reasonable to assume that this variability increases the less financially developed a country is (see e.g. Chang et al., 2000; Bhattacharya et al., 2000; Los, 2004, in this context).[33] But the advantage over other measures might be that it is finally consistent while other measures like PPE (for K) and employment (for L), as argued above, can be *systematically* biased and the response of sales data to changes might be severely delayed.

[33]Another relationship between the appropriateness of market valuation and financial development arises due to the fact that FDI can also come in the form of private equity, for example, where companies are not listed on stock markets. While a joint ECB/Eurostat task force proposed how to treat such cases (cf. IMF, 2004, §6.26), it is probable that there still remains a systematic difference between the valuation of listed and non-listed firms. To the extent that the fraction of the latter will be higher in developing countries, this may lead to a systematic difference in FDI data for developing, emerging, and industrialized countries.

Figure 2: Relationship Between FDI Stock and Flow Data



5. A Glance at the Data

After this discussion of technical concepts to measure MNCs and of potential relations and discrepancies between them, I provide a descriptive picture showing the extent to which common measures for MNCs in fact correlate with each other. I will start with the relationship between FDI stocks and FDI flows and therefore use UNCTAD annual FDI data in current US-$ and at current exchange rates in millions from 1980 to 2010 for the liabilities' side ('inward') of the US and the world as a whole (hence, the sample size is 31 in each case).[34]

Figure 2 and table 4 depict the relationship between FDI stocks and flows and show that it is indeed a tight one as we would expect from identity (3).[35] The right panel shows the US data, the left panel shows the data for the whole world. A strong positive relationship between the two series is visible, with a correlation coefficient $\hat{\rho}_{US} = 0.83$ for the US data. For the global data, the relationship is even stronger: $\hat{\rho}_{world} = 0.90$. OLS regression of flows on stocks for the US and global data leads to a (highly significant) parameter estimate $\hat{\beta}$ of 0.064 and 0.087, respectively.[36] If we assume no time trend in FDI stocks, $\eta t \stackrel{!}{=} 0$, this

[34]I picked the US as the single-country example because it is the world's largest economy and we would not expect cross-country heterogeneity in compiling inward FDI data from one host country.

[35]Note that there is no sense in empirically testing an identity or a theorem. The reason of this exercise is to investigate if the steady-state equilibrium assumption is an empirically valid generalization, so that flow and stock data can indeed be treated as substitutes, or not.

[36]One could argue that the identity (3) is homogeneous of degree 1 while the regression line in figure 2 does not go exactly through the origin and the underlying regression includes a constant (not listed in table 4). However, the parameter estimate of the constant ($\hat{\alpha}$) is not statistically different from 0 (t-statistic of 0.776 for the global data, 0.618 for the US data). Nevertheless, the model is not estimated under the

parameter can be interpreted as the depreciation rate, i.e. for every unit of FDI stock there has to be a corresponding flow of 0.06 or 0.09 units to replace the depreciated stock. More realistically, this figure should be interpreted as the depreciation plus a deterministic growth rate (which operates through flow data). The estimated parameter size makes sense from an economic perspective. The explanatory power of this simple regression is considerable: the variation in stocks explains 69 % of the variation of flows for the US and even 82 % for the world in total. The overall F-statistic for the US model is 64.56, for the global model it is 130.3. Since applied researchers consider instrumental variables to have reasonable predictive power with an F-statistic of 10 and above as a rule of thumb (cf. Staiger and Stock, 1997), it is hard to argue why one should not use FDI flow data instead of stock data in case one has specific reasons to do so.

	World	US
$\hat{\beta}$	0.087	0.064
t-stat of $\hat{\beta}$	11.414	8.035
R-squared	0.818	0.690
Correlation Coefficient	0.904	0.831

Table 4: Regression of UNCTAD FDI Flow on Stock

Table 5 shows the (estimated) correlation coefficient for different measures of US MNCs' outward activities, taken from BEA and compared over time and across host countries (hence incorporating both types of variation). The operational data are described in subsection 2.2 above. 'Stocks' are the US direct investment position abroad on a historical-cost basis (book values), 'flows' are financial outflows without current-cost adjustment, i.e. they consist of reinvested earnings without current-cost adjustment and equity and intercompany debt transactions. BEA provides current data, so all data (besides from employment) are deflated using the GDP deflator from IMF's WEO database. The main picture of the correlations is that that most measures, besides from flows and income, show a reasonably well correlation with all other measures. The highest single correlations are between sales and wages ($\hat{\rho} = 0.95$) and between stocks and assets ($\hat{\rho} = 0.93$). On average, stocks show the highest correlation with all other measures ($\overline{\hat{\rho}} = 0.82 = 4.89/6$), followed by sales ($\overline{\hat{\rho}} = 0.79$) and assets ($\overline{\hat{\rho}} = 0.77$). Although this is no indication that these measures are appropriate, it provides some evidence that one can hardly be wronger using them instead of the others and that one can generally treat them tantamount to each other (especially since the pairwise correlations are above 0.8 in each case).

constraint $\alpha \stackrel{!}{=} 0$ because in such a homogeneous model the decomposition of the TSS $:= \sum_{t=1}^{T} y_t^2$ into the ESS $:= \sum_{t=1}^{T} (y_t - \hat{y}_t)^2$ and the RSS $:= \sum_{t=1}^{T} \hat{\varepsilon}_t^2$ is not possible and hence no (meaningful) R-squared (=ESS/TSS) can be computed.

	stock	flows	assets	empl.	wages	sales	income
stock	1.00						
flows	0.77	1.00					
assets	0.93	0.67	1.00				
employment	0.71	0.51	0.69	1.00			
wages	0.80	0.54	0.83	0.89	1.00		
sales	0.87	0.62	0.84	0.88	0.95	1.00	
income	0.80	0.68	0.67	0.38	0.45	0.61	1.00
Σ	5.89	4.80	5.63	5.08	5.47	5.76	4.60

sample containing 913 observations over time (1997-2008) and host countries
Σ is the sum over *all* correlation coefficients of the measure,
not just the ones displayed.

Table 5: Correlation Coefficients between Different BEA Measures

Also note that the correlations provide some evidence for the theoretical considerations outlined above: I argued, to the extent that FDI is equity capital, it should be a good proxy for K, the latter being also captured well by 'assets.' Indeed, FDI 'stocks' show the highest correlation with 'assets' ($\hat{\rho} = 0.93$) and 'assets' show the highest correlation with 'stocks.' On the other hand, I argued, an increase in 'stocks' does not necessarily have to be accompanied by an increase in L if the increase in 'stock' (or K) is due to labour-saving technological progress. In fact, 'stocks' show the lowest correlation with 'employment' ($\hat{\rho} = 0.71$). Since workers in that case might somewhat gain from the increase in their marginal product despite being at a relatively weak bargaining power vis-a-vis the MNC, the correlation is stronger between 'stocks' and 'wages' ($\hat{\rho} = 0.8$). And as expected, the correlation between 'stocks' and 'sales' is in between these correlations ($\hat{\rho} = 0.87$).

Tables 7 to 10 in the appendix provide the same correlation coefficients limited to cross-country correlations in 1997 and 2008 and to correlations over time for Canada (as the main location of US outward FDI) and the aggregate of all countries. The main conclusions are that the average correlations of all measures across countries were higher in 1997 than in 2008. This is consistent with the finding of Lipsey (2007, p. 7) that the cross-country relationship of investment positions to factor inputs in US outward FDI were all weaker in 1999 than in 1994 and might be an indication that arbitrary financial shifts in the books increase over time (hence reducing the correlation of BOP data with operational data) and that technological progress has experienced an increasing factor bias (hence, for example, reducing the correlation between K and L). Overall, FDI stock seems to perform quite well, though better in the cross-country case (where no other measure has a higher average correlation) than in the case of correlation over time. Flows perform very poorly for correlations over time in case of US FDI in Canada, but do somewhat better for all countries. The reason may be that the relationship between stocks and flows in condition (3) is a steady-state, i.e. an equilibrium condition. In reality, however, FDI flows are very volatile, as shown

in figure 1 on page 2. Thus, if only one host country is considered over time, the 'noise' (i.e. volatility) in the data will be relatively large, while the mean over host countries of these flows will converge towards the true parameter (the 'equilibrium').[37] Accordingly, FDI flow data might be a particularly weak measure for MNCs' real economic activities for case studies at the country-level.

6. Estimating the Determinants of Multinational Corporations' Activities

A main application of the data discussed above is the estimation of location decisions of MNCs. The goal of such studies is to estimate what variables influence MNCs' decision of supplying certain markets in the form of local affiliates as opposed to exports, or why firms chose to produce downstream inputs in affiliates instead of outsourcing via arms length relations. Most empirical studies either use sales or FDI stock data. To illustrate my point of concern with this approach, I will discuss the firm's location decision based on FDI stock data (y) and market size (x). The goal of this exercise it not to come up with a precise point estimate for market size but to make a general statement concerning the functional form of estimation that is exemplified with only one explanatory variable in order to keep things easy. I will then argue that the problem I raise also prevails to sales data because sales can be seen as a function of stock, as discussed in equation (4) above. Econometrically, the issues I raise can be resolved, however, these solutions come at a cost as well. I will hence argue that flows can provide an alternative response variable that may be preferable under some circumstances.

For this example, assume that the activity of a MNC in a host market i at time t, denoted y_{it}, and measured by FDI stocks, is a function of the demand for products in that market, x_{it}.[38]

$$\mathbb{E}(y_{it}) = f_i(x_{it}). \tag{5}$$

For simplicity, I will first assume that this market size is perfectly flexible. Of course, there will be many relevant factors influencing MNCs' activities, such as the relative price of MNCs' production or the relative preference for foreign goods which are omitted here, but this is irrelevant to the point I want to highlight. The latter concerns the fact that when making its allocation decision based on x at time t, the firm has inherited y_{t-1} from the previous period, which has depreciated at a rate δ with $0 \leq \delta \leq 1$. In order to reach the new equilibrium stock y_t, the firm's additional FDI will hence be larger than the incremental change $\Delta y := y_t - y_{t-1}$ because it will also include the reproduction of depreciated stock, δy_{t-1}. Leaving besides exchange rate fluctuations, this is exactly why the first difference

[37] This is a result of the Chebyshev Inequality and the Law of Large Numbers, assuming that FDI data can be considered as i.i.d. random variable with finite first moment.

[38] For simplicity, I skip the subscript i in the remainder of the text if the interpretation is unambiguous.

of stocks is not equal to flows (compare table 2). The relevant quantity of decision for the MNC is hence

$$\begin{aligned} y_t^* &= y_t - (y_{t-1} - \delta y_{t-1}) && (6)\\ &= \Delta y_t + \delta y_{t-1} && (7)\\ &= y_t - (1-\delta) y_{t-1} && (8)\\ &\equiv y_t - \phi y_{t-1}. && (9) \end{aligned}$$

In accordance with the literature (e.g. Phillips and Sul, 2007), I will refer to expression (9) as the 'quasi-difference' of y. Note that one cannot observe this quasi-difference from FDI stock data in the IIP. The reason why the firm can only decide on the quantity $|y_{t-1}^*| \leq |y_t|$ is the fact that y_{t-1} and hence δy_{t-1} in y_t is predetermined in period t.

Economists attributing higher prior beliefs to the proper functioning of markets may object by emphasizing that firms will be able to sell the assets ϕy_{t-1} in period t. To some extent, this is a legitimate objection. However, as I will argue in the next pages, there are good economic reasons why the extent of these asset sales will be very limited in practice, especially for MNCs.

Macroeconomic research has a long tradition in modeling adjustment costs in investment that introduce frictional elements reducing, delaying or protracting changes in the investment allocation. The literature on convex adjustment costs (e.g. Eisner and Strotz, 1963; Lucas Jr., 1967; Sargent, 1978; see Khan and Thomas, 2008, and Caballero, 1999, for surveys) highlights that the very act of adjusting the capital stock causes real output costs and hence penalizes swift changes in aggregate variables such as the investment stock, which motivated the inclusion of lagged dependent variables in empirical models of factor demand to capture their gradual, partial adjustment towards the targeted investment equilibrium and hence introduced dynamic elements into the firm's (previously static) decision problem. Increasing microeconomic evidence, such as Doms and Dunne (1998); Cooper and Power (1999); Hamermesh and Pfann (1996); Hamermesh (1989), called such adjustment costs that were strictly increasing and convex in the distance between the equilibrium and the current level of the capital stock into question. They rather argued for lumpy investment such as the (S, s) stock adjustment model based on Scarf (1960), were firms face fixed adjustment costs and only invest (up to stock S) once the stock falls below the threshold (s). However, such non-convex adjustment costs also imply distributed lags in aggregate investment series (cf. King and Thomas, 2006), but would generally allow for aggregate nonlinearities when firms respond sharply to large shocks. Finally, piecewise-linear adjustment costs reviewed in Dixit and Pindyck (1994) lead to partial irreversibilities (but not lumpiness per se) since a decision rule similar to the (S, s) model is implied where the firm undertakes small adjustments to maintain the stock at its lower bound, once it is reached. See Sarkar and Zhang (2013) for a recent contribution.

Unfortunately, these contributions have found very little interest in the literature on foreign direct investment, which is surprising because irreversibility arguments are often highlighted in this research strand (e.g. Chisik and Davies, 2004; Daude and Fratzscher, 2008) and there are good reasons to expect frictions that result in sluggish responses of even higher magnitude for *foreign direct* than for domestic investment.

The first reason for this sluggishness stems from the *multinational* nature of the underlying direct investor parent enterprise. Since its investment income is potentially subject to double taxation in case of future profit repatriations, such firms can have tax 'incentives' to invest less than optimal in newly established subsidiaries and let them grow by self-financed, retained profits thereafter ('nucleus hypothesis', see especially Sinn, 1990, also Hartman, 1985), which will lead to a suppressed investment path.[39]

A second obvious reason concerns the fact that MNCs are usually technologically much more advanced than their domestic counterparts and are hence operating in a market environment that is not (perfectly) competitive. This implies that the market for its assets might be shallow, or even non-existent since the asset creates a firm-specific externality. This is probably most obvious in the case of complex vertical FDI where the MNC maintains a vertically integrated production chain that is scattered over some countries. A production facility in one country could then not simply be sold (without creating substantial hold-up costs). Similar to living organisms like cells that grow, divide, differentiate and die based on their specific role in the tissue they belong to, the fate of a MNCs asset is basically predetermined by its (economic) function in the (production) system and can hence not easily be disentangled from this process. Moreover, the technical state of the art and the highly complimentary nature of a MNCs production factors (e.g. human capital in management, marketing, and high-skilled labourers working with high-tech physical capital) cause especially high screening and matching costs for the latter so that firms might prefer not to sell down assets in face of a (potentially temporary) negative shock to the market environment.

'Rome was not built in a day,' and its imperial status made it special from others. Exactly this uniqueness also explains why the market for a MNC's assets may be imperfect and hence creates additional forces that prevent the firm from selling down certain assets when their profitability decays (see e.g. Blonigen, 1997, for the case of firm-specific assets and the returns it generates to the MNC).

In the attempt to cope with its daily business as efficient as possible, systems get more and more complex and develop some specifics (such as proprietary assets). However, since these specifics are special to time and space, such systems will find it difficult to adopt to

[39]Empirically, Foley et al. (2007) found that affiliates of US MNCs in countries with lower tax rates, which would face higher repatriation taxes, are more reluctant to bring back their foreign profits while Pinkowitz et al. (2012) challenge this view. The special case of progressive taxation for domestic investment pathways is investigated in Wong (2011).

a departure from 'business as usual' because every part and component in such an organic system requires the existence of every other part and component and takes it for granted. The bottom line is the argument that even if firms may be able and willing to sell down parts of ϕy_{t-1}, there will be a limit to this effort. Hence, although a MNC might influence the size of ϕ, it is nevertheless reasonable to assume $\phi > 0$ ($\leftrightarrow \ \delta < 1$) and that y_t^* is therefore (at least in the short run) bounded from below.

Accordingly, the behavioral relation in equation (5) should be rephrased as being conditional on y_{it-1} : $y_{it} = f_i(x_{it}|y_{it-1})$, or:

$$\mathbb{E}(y_{it}^*) = f_i(x_{it}). \tag{10}$$

Assuming a linear relationship, this can be modeled as

$$y_{it}^* = \alpha_i + x_{it}\beta + \varepsilon_{it}, \tag{11}$$

where y^* (nor δ, ϕ) cannot be observed from FDI stock data in the IIP. But one can instead rearrange equation (11) using expression (9) to obtain

$$\begin{aligned} y_{it}^* = y_{it} - \phi y_{it-1} &= \alpha_i + x_{it}\beta + \varepsilon_{it} \\ \Rightarrow y_{it} &= \phi y_{it-1} + \alpha_i + x_{it}\beta + \varepsilon_{it}, \end{aligned} \tag{12}$$

which is estimable since y_{it} and y_{it-1} can readily be observed from the IIP.[40] Note that an estimator $\hat{\beta}$ for β will in this case provide a short-run estimator while the long-run impact is obtained by $\hat{\beta}/(1-\hat{\phi})$.[41] Instead of the dynamic equation (12), most studies in the literature use a static model, hence estimate a model under the implicit assumption $\phi \overset{!}{=} 0$, that is a perfect (i.e. frictionless) adaption process.[42]

I will now discuss the consequences of such static estimation in the case of the **fixed effects** (FE) estimator because it should always provide a consistent estimates for β *if* the functional form of the model is correctly specified (i.e. the DGP is static and a static FE estimator is used) and the fact that it only exploits the variation within cross sections over time of a panel makes it intuitively easy.[43] I will then establish a relation to the (efficient

[40] In practice, estimation of such dynamic models pose some econometric problems that I will shortly mention in the application below.

[41] To see this, note that β will not only impact y_t but via ϕy_t also y_{t+1} and via $\phi^2 y_{t+1}$ also y_{t+2} etc., so after q periods the long-run impact β_{LR} will be $\beta_{LR} = \beta + \phi\beta + \phi^2\beta + ...\phi^q\beta = \beta(\phi^0 + \phi^1 + \phi^2 ... + \phi^q)$. Multiplying ϕ on both sides and subtracting the latter from the former gives $\beta_{LR}(1-\phi) = \beta(1-\phi^{q+1})$ and hence $\beta_{LR} = \beta(1-\phi^{q+1})/(1-\phi)$ and in the limit $\lim_{q\to\infty} \beta(1-\phi^{q+1})/(1-\phi) = \beta/(1-\phi)$. Apparently, this is simply the convergence of a geometric series.

[42] An exception worth noticing is Cheng and Kwan (2000), who motivate a similar dynamic model as above but against another background, i.e. agglomeration effects. In this context, ϕ is a positive parameter because past FDI attracts current FDI due to economic externalities.

[43] Accordingly, it is also often referred to as the 'within estimator.'

but probably inconsistent) random effects (RE) and pooled OLS (POLS) estimator as well as to the between effects (BE) estimator.

Estimating (12) under $\phi \stackrel{!}{=} 0$ with FE only allows for an influence of x_{it} on y_{it}, whereas (12) is a dynamic process in the sense that it allows x_{it} to influence not only y_{it} but also more future values y_{it+h} via the lagged dependent variables $\phi^h y_{it}$. Accordingly, FE estimation will only provide a short-run impact whereas a microeconomic analysis of the multinational firm is usually concerned about effects in equilibrium, that is the long run.

Besides from using a dynamic model like (12), what could one do? One approach would be modeling the lags explicitly:

$$y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it-1} + \beta_3 x_{it-2} + \beta_4 x_{it-3} + \beta_5 x_{it-4} + ... + \varepsilon_{it}. \tag{13}$$

Note that the restriction $\beta_{1+j} \stackrel{!}{=} \phi^j \beta_1$ leads to the dynamic model in (12). However, since the applied researcher is usually not interested in only one but more explanatory variables, this approach may quickly result in a shortage of degrees of freedom for estimation.[44]

A more pragmatic approach would be 'laissez-faire econometrics' and do nothing. To see why this might still lead to a reasonable long-run estimate in practice, assume that (13) is indeed the operating model but the researcher fits $y_{it} = \alpha_i + \beta_1 x_{it} + u_{it}$. $x_{t-l} \; \forall \; l \geq 1$ will then end up in the error term u, leading to an omitted variable problem. This will bias β_1 if x_{it} and u_{it} are correlated, for example when x_{it} is weakly dependent. For the OLS estimator (and hence LSDV[45] and FE), $\mathbb{E}(\hat{\beta}) = \mathbb{E}[(X'X)^{-1}X'y] = \beta + \mathbb{E}[(X'X)^{-1}X'u]$. The important part concerns the term $\mathbb{E}(X'u)$, in our case the covariance between x_{it} and u_{it}. Remember that $u_{it} = \beta_2 x_{it-1} + \beta_3 x_{it-2} + ... + \varepsilon_{it}$ and now assume that the x_{it} are positively serially correlated (which is realistic for many time series, especially in macroeconomics), for example in the form $x_{it} = \rho x_{it-1} + e, \; 0 < \rho < 1$. This will bias the estimator for β_1 upwards and hence into the direction of the long-run impact of X on y. Generally, the smaller the distance $\sum_{j=1}^{\infty}[\text{Cov}(x_{it}, x_{it-j}) - \text{Cov}(\beta_1, \beta_{1+j})]$ is, the closer will $\hat{\beta}_1$ be to the long-run estimate. A special case in this example of an AR(1) series with an operating model of the form described in (12) occurs when $\phi = \rho$ because then the bias of $\hat{\beta}_1$ is exactly large enough to mimic the long-run estimator. While this equality is certainly too restrictive in practice, the difference between the two may often not be all too large.[46]

[44] A potential solution to this problem would be using a shrinkage-type estimator like the LASSO (cf. Tibshirani, 1996 and Knight and Fu, 2000) that performs model selection to identify the relevant covariables even when the potential regressors outnumber the observations.

[45] Least Squares Dummy Variables

[46] Similarly, Baltagi and Griffin (1984) argue that the greater the correlation between the omitted lags and the current values of the covariables, the closer the static coefficients will be to the sum of the dynamic coefficients - i.e. the long-run effect. Monte Carlo studies by Egger and Pfaffermayr (2005) show that the static FE estimator is downward biased even compared to the short-run effects when the operating DGP is dynamic and explanatory variables are not serially correlated; but when the level of serial correlation is high, the FE estimator converges towards the long-run effects.

If one does not feel confident with this approach, taking averages of the data over longer periods would be an option, e.g. 5-year or 10-year averages. In the latter case and formulated in first-difference terms, this means that one estimates the impact of a change in the average of x over one decade on the change in the average of y over one decade. This will allow the response to take a longer time period and should converge towards the long-run impact. However, the method also calls for a longer T dimension of the panel.

A special case of this idea occurs when one averages over all T time periods. Then, of course one could not estimate a FE model (because de-meaning will make all data equal to 0) but one could take the remaining N averaged observations and simply run an OLS regression. This is called the **between effects** estimator (BE) because its coefficient estimates only exploit variation between countries and not within countries, though they use the entire dataset to construct the estimates.[47]

The use of dynamic models or BE estimation, however, is not very common in the applied economic literature on FDI determinants. Most important studies (e.g. Brainard, 1997; Carr et al., 2001; Ekholm et al., 2007; Davies, 2008) rather use a POLS or a GLS estimator such as random effects (RE) to estimate the determinants of MNCs' activities. The reason why I chose to discuss FE and BE first instead of RE, is the simple fact that RE is a (matrix-weighted) average of the former two estimators (Maddala, 1971). To the extent that RE is an efficient version of POLS, a similar conclusion applies to the latter. The intuition of this result is the fact that RE and POLS both consider variation between and within cross-sections. I will now exemplify which different parameter estimates can be obtained from using a dynamic specification, static FE, static RE and BE, how the results relate to the (analytically) expected values for these estimators, and how the dynamic adjustment process of FDI from one equilibrium to another might look like.

6.1. A Real-Data Example

The aim of this subsection is to exemplify with real-world data the discrepancies that can occur from fitting different models and/or from using the different estimators. Therefore, I use outward FDI stock, flow and sales data from US MNCs (as provided by BEA in US-$[48] and deflated using the US GDP deflator from WEO) as response variables. Since the only purpose of the exercise is to highlight the different impacts that can occur from choosing different econometric approaches, I limit the set of explanatory variables to market size of the host country which is proxied by GDP in US-$ and deflated using domestic GDP deflators, both taken from IMF WEO. First, FDI stock is regressed on its lagged value and

[47] On the—generally favorable—properties of the BE estimator, see e.g. Baltagi and Griffin (1984); Pesaran and Smith (1995); Pirotte (1999); Hauk and Wacziarg (2009); Stern (2010).

[48] The data are described in more detail in section 2. There are other data sources that provide longer series but the advantage of BEA data is that it provides a consistent data set covering BOP *and* operational data.

on GDP for all cross-sections where neither flows nor stocks nor sales data are missing at any year under consideration. The subsequent analysis is then restricted to the subsample of these 297 observations ($N = 27,\ T = 11$).[49]

I start by using a dynamic model with one lagged dependent variable, as described in equation (12). To tackle the well-known Nickell (1981) bias in such lagged dependent variable (LDV) models, I use the bias correction of Bun and Kiviet (2003) in the extension to unbalanced panels derived by Bruno (2005a).[50] I then calculate the long-run effect of market size (in line a of table 6) and compare this to the estimated parameters for a static FE (line b), a static RE (line c) and a BE model (line d). All (but the BE) models are estimated using time dummies. Note that asterisks for standard errors are omitted because no analytical standard errors are computed by Bruno (2005b). While this could be resolved in principle (e.g. by bootstrapping), statistical inference is secondary in the present exercise.[51]

The results are displayed in table 6, for linear models in columns (1) to (3) and for log-log models in columns (4) to (6). I will focus on the latter because the fact that the results can be interpreted as elasticities is easier for comparison across different response variables. However, in both the linear and the log-log models it is obvious that stocks and sales are very persistent series with a high parameter estimate for the LDV indicating a slow response speed while $\hat{\phi}$ for the flow series is rather low (and statistically not different from 0 when analytical standard errors under FE are used).[52] This is an outcome from relation (10) leading to equation (11) and generally indicates that the researcher is rather on the safe side when estimating a static model to FDI flow data. It can reduce econometric problems arising from dynamic models, though it causes a trade-off against other potential problems discussed below. Note that the linear results for the market size are negative (and far from significant when considering analytical FE standard errors) for flow data, indicating a potential misspecification that is ironed out in the log-log model.

There is strong evidence that a static model is not appropriate for the sales and FDI stock series. As a consequence, the corresponding FE estimates of the log-log models in line b) are below the BE estimates that serves as a long-run estimate and also below the long-run estimate one obtains from the dynamic model by $\hat{\beta}/(1-\hat{\phi})$ and depicted in line

[49]Note that there are nevertheless slight discrepancies in sample size, e.g. because flows could be negative and hence drop out in the log-log model.

[50]This is motivated by Judson and Owen (1997) who find a substantial bias for FE in typical macro panels with relatively large $T = 30$ and recommend a corrected FE estimator proposed by Kiviet (1995) when T is small and the IV estimator developed by Anderson and Hsiao (1981) when $T > 10$. The Bruno (2005a) estimator is based on Kiviet (1995) and should hence work well considering the small T dimension of the panel. The consistent estimator of Anderson and Hsiao (1981) is used to initialize the bias correction. The accuracy of approximation is up to order $O(1/NT^2)$.

[51]Test statistics for the LDV model are derived analytically from LSDV regressions to allow the reader to compare different model specifications.

[52]The estimates in columns (1) and (3) are even close to a unit root. Accordingly, no long-run effects are calculated.

model	(1)	(2)	(3)	(4)	(5)	(6)
dep. var.	stock	flow	sales	log(stock)	log(flow)	log(sales)
specification	lin-lin	lin-lin	lin-lin	log-log	log-log	log-log
LDV	1.0358	0.3119	0.9657	0.7367	0.1550	0.8927
	[35.11]	[1.45]	[28.93]	[15.60]	[0.58]	[22.62]
real GDP	0.0014	-0.0006	0.0226			
log(real GDP)				0.1093	0.5019	0.0765
	[1.08]	[-0.55]	[5.90]	[1.57]	[1.73]	[2.49]
a) long-run coef.	n.a.	-0.0009	n.a.	0.4150	0.5940	0.7132
b) static FE coef.	0.0437	-0.0015	0.0800	0.3573	0.6996	0.4537
	[1.83]	[-0.68]	[3.24]	[1.19]	[1.61]	[2.14]
c) static RE coef.	0.0405	0.0017	0.0824	0.4158	0.5231	0.4782
	[1.78]	[1.30]	[3.39]	[1.95]	[2.69]	[2.95]
d) BE coef.	0.0320	0.0025	0.0960	0.5171	0.4929	0.5367
	[2.08]	[1.63]	[4.34]	[3.77]	[3.65]	[4.77]

Note: Asterisks on parameters indicating statistical significance omitted. Numbers in [parentheses] are z/t statistics. For FE/RE, they are robust to heteroscedasticity and serial correlation; for dynamic models, z/t statistics are taken from LSDV estimation.

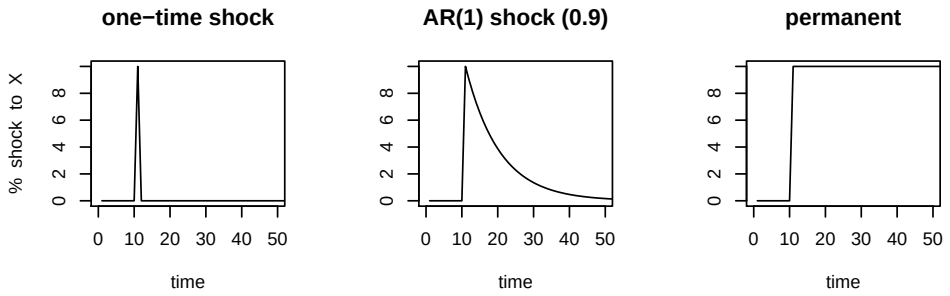
Table 6: Different Parameter Estimates for DifferentEstimators and Functional Forms

a). To see what is going on, I simulated three different scenarios to the market size variable and depict the resulting responses of the three dependent variables under the assumption that the estimated dynamic model is the operating model. The scenarios are depicted in figure 3. In all three of them, the market size x is stable in the first 10 time periods and calibrated to $100 \times (1-\hat{\phi})/\hat{\beta}$ so that y equals 100 for comparison.[53] In period $t = 11$ a shock of magnitude 10 % occurs to x in all three scenarios. The scenarios differ in the periods thereafter. While it is a one-time shock in the first scenario depicted in the left panel, the shock to x in the middle panel is an AR(1) shock with an autocorrelation coefficient of 0.9. In the last and rightmost scenario it is a permanent shock (i.e. an AR(1) shock with autocorrelation coefficient 1).

Figure 4 shows how the series respond to these shocks. A striking result is the quick and large response by logged FDI flows (in the second line). They increase by more than 12 % in the shock period and under the first scenario they are almost down to the level of 100 thereafter.[54] This is the optimal response and it can be observed because the quasi-difference in (10) is the multinational's quantity of immediate response to the shock in market size. The statement related to equation (11) that y^* cannot be observed from the IIP is correct but the careful reader might have noticed: it can be observed from the BOP since it is - FDI flows. The response of logged FDI stocks and logged sales is much more sluggish, although

[53]Note that the 10 % shock occurs to x, that is to log(real GDP) in this example, not to GDP.
[54]The precise value is 101.9.

Figure 3: Shock Types



the overall effect in the long-run is similar if the shock is permanent (roughly 10 % or above). The rightmost panel for FDI stocks and sales also makes clear why a FE estimator under this DGP will tend to underestimate the impact of X on y: Although the long-run impact is a change of 10 % or more in logs,[55] the response is below 3 % in the first year. However, this is the year where FE under $\phi \stackrel{!}{=} 0$ explicitly models the impact. But to the extent that the xs are (positively) serially correlated to each other, parts of the long-run effect will be captured by the misspecified FE estimation.

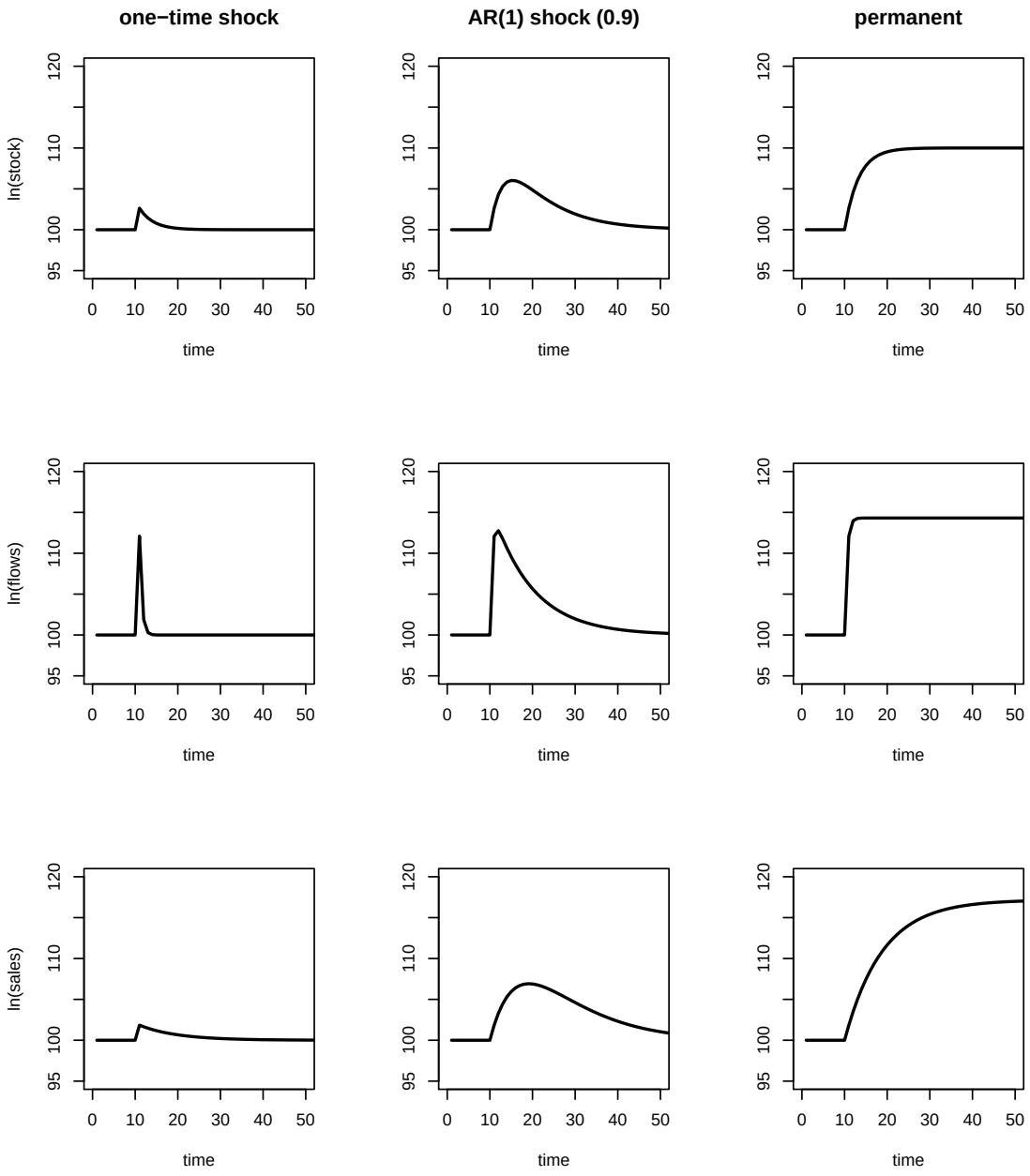
Table 6 shows at least three other important features. First, RE always lies between FE and BE (note that an estimator is a random variable and this hence does not have to be the case but we would *expect* it to be the case according to Maddala, 1971). From this perspective, RE (and POLS) is a 'better' estimator (than FE) for estimating long-run effects in partial or general equilibrium approaches, however, it is hard to argue why preference should be given to the RE vs. the BE estimator. Certainly, it is good to know that RE converges to an average of short and long run but, to quote a recent statement of 'Apple' CEO Tim Cook, "anything can be forced to converge. You can converge a toaster and a refrigerator, but you know those things are probably not going to be pleasing to the user. ... The problem is ... about tradeoffs. You begin to make tradeoffs to the point that what you have left at the end of the day doesn't please anyone."[56]

In that sense, FE and BE have the advantage that they can be helpful for different purposes: If one is interested in the short-run impact of x on y, e.g. in case one has to design a policy to prevent the exchange rate from appreciating, static FE using flows as the response might serve as a reasonable estimator, maybe with some lagged covariables added. In this special case one is more concerned about flows and can hence do well with the static model. In case one is more interested in the equilibrium effect of x on a MNC's activities, BE

[55]Remember that the 10 % shock occurs to log(GDP), not to GDP. Hence, one should not confuse it with the elasticity of over 40 % in line a) of table 6 which refers to a shock to GDP.

[56]Tim Cook about Windows 8 on a press conference, April 2012.

Figure 4: Response of the Dynamic Model to a Shock



estimation of a (static) model using FDI stocks or sales data is appropriate. One could also estimate a dynamic model, however, the potential econometric problems should be taken serious, while the BE is straightforward to implement since it only requires least squares estimation on the cross-sectional means. An optimal investigation will compare BE and a dynamic estimator and probably also distinguish between long run and short run effects and discuss the adjustment speed. For example, in the case of a LDV of 0.97 as for sales in table 6, this translates into a half-life[57] of almost 20 periods, meaning that the MNC needs on average 20 years to adjust half of its sales in the transition from one equilibrium to another.

The next point worth mentioning in table 6 is the fact that the BE (i.e. long-run) elasticities for stocks', flows' and sales' responses to market size are almost identical.[58] And from the above discussion one would expect exactly this outcome. The similarity between FDI stocks and sales is probably more intuitive. The similarity with FDI flows follows directly from equation (3): Since flows are a homogeneous function of stocks, their elasticity in response to x should be the same.

Finally, table 6 also raises some caution about the depiction of FDI flows' response in figure 4: This follows from the observation that the short-run effect in line b) is larger than the long run effect in line d). This may be surprising on a first view but should be clear from equation (7): y_t^* will first respond to the larger market size by expanding the stock via Δy_t. This will raise y_{t-1} and hence δy_{t-1} in the next period. However, after the new equilibrium is reached, $\Delta y_t = 0$ and the increased y_{t-1} and hence δy_{t-1} will not make up for this. These dynamics would require an even more complex model such as an AR(2) model of the form $y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + X\beta + \varepsilon$ with $\phi_1 > 0$, $\phi_2 < 0$ and $\phi_1 > |\phi_2|$. Nevertheless, I would argue that a static FE model for flows can be an adequate model, especially for short-run open macro dynamics and for evaluating a policy change when the observation period is truncated. To see why this should be preferable, look at the rightmost column of figure 4 and suppose the researcher has a panel which only lasts until $T = 13$. At that point, the increase was only about 5-6 % for ln(stocks) and ln(sales) but more than 14 % for ln(flows). It will hence be easier to find a statistically significant impact when using flows although this has to be balanced against the fact that FDI flows are usually measured with more noise than stocks and sales data. In any case, it can be helpful to also address the dynamics in this case. An example is given in Hashimoto and Wacker (2012, V).

Of course, there are also other potential estimators that can be used.[59] However, there

[57] estimated as $\hat{\text{half life}} := \ln(0.5)/\ln(\hat{\phi})$

[58] The same does not hold for the long-run effect of the dynamic model, highlighting the potential problems with estimation of dynamic models.

[59] Examples in the FDI literature are model averaging applications such as Blonigen and Piger (2011); Eicher et al. (2011); Antonakakis and Tondl (2012), or the application of the Plümper and Troeger (2007) estimator by Davies et al. (2008). In my personal opinion, non-parametric approaches to model-selection (cf. Henderson et al., 2012, for growth theories) seem the most promising due to their flexibility and the conclusions that can be drawn about the functional form of the operating model for economic theory.

might be serious drawbacks of such estimators, although they have not yet been studied as extensively as the estimators mentioned before.[60] Hence, vogue and computational convenience should not substitute economic reasoning and striving for consistency between arguments, data and model specification (as pointed out by Blonigen et al., 2003, for educational variables in the knowledge-capital model, for example).[61]

7. Discussion and Conclusion

The aim of this paper was to discuss the measurement of foreign direct investment and how it relates to other measures of MNCs' activities, to highlight their advantages and disadvantages, the economic relations between them, and to give an overview about the different parametric panel data models to estimate the determinants of MNCs' activities. Real data was used to to investigate and exemplify the considerations. They lead to some implications for applied researchers.

Not surprisingly, there is no a priori "best" way to measure MNCs' activities or to estimate its determinants. The choice rather depends on the circumstances. Nevertheless, my investigation shows that one usually does not too wrong using FDI stock data which has the main attractiveness of large availability over both countries and time (compared to operational data). There are certain caveats discussed in this paper and to some extent by Lipsey (2007), that have to do with accounting creativity of MNCs. However, in order to benefit from the intended shift of profits, sales data will also be shifted arbitrarily between host countries so that their use should not considerably help solving the problem. Since the issue is concentrated in a small number of countries (some small islands and to a milder degree Ireland and potentially also Switzerland), they can easily be excluded from investigations or assumed to be a constant number (and hence a decreasing fraction) in case $N \to \infty$.

Besides availability, a main difference between FDI and operational data is the degree of ownership it reflects: While operational data is based on an 'all or nothing' principle (extensive measurement), FDI data more appropriately reflects the degree of ownership (intensive measurement). If a researcher is concerned about the multinational influence on industrial

[60] For the case of BMA see the (largely ignored) result by Pötscher (2006) that it is impossible to construct an estimator whose finite-sample cumulative density function converges uniformly (with respect to the parameters to be estimated) towards their asymptotic counterpart over compact subsets of the parameter space and the (probably related and generally more known) finding of Ciccone and Jarocinski (2010) that 'robust' growth determinants obtained by BMA are not so robust after all. Furthermore, BMA does not resolve functional misspecification. For the statistically worrisome properties of the mentioned Plümper and Troeger (2007) estimator see the discussion between Greene (2011a,b); Plümper and Troeger (2011a,b).

[61] Another problem in the FDI literature is the fact that conventional statistical inference is derived under the assumption that the researcher explores the data set for the first and only time (cf. Pötscher, 1991). This is certainly not the case in most empirical applications and in the case of FDI, for example, the data set by Carr et al. (2001) has been explored several times.

and labour relations (as in Wacker and Vadlamannati, 2011, for example), FDI data may be more appropriate than operational data since it more explicitly quantifies the MNCs' degree of influence in the host country affiliate (i.e. the 'financial stake') and hence the degree to which it shapes the industrial and labour relations.

Another issue this paper has addressed are the dynamics of the MNC's decision and the use of appropriate econometric techniques to identify the quantitative impact of certain variables on MNCs' activities, especially since the long-run impact might be different from the short-run impact. I have outlined that FDI stock and sales data are relatively persistent and will hence need more time to completely adjust to a changing market environment. I have argued and exemplified that static FE (and, to a lesser extent POLS and RE) estimation can result in misleading conclusions in case one is interested in the long-run equilibrium impact, and that BE estimation or using a dynamic model is a more appropriate way to address the issue.

However, I have also shown that using FDI flows can be an option. Since they are far less persistent than other data, using a static model is more appropriate for FDI flows and the fast response makes it a powerful measure to evaluate quick changes in covariables such as a policy change, especially when the time dimension of the panel is truncated and the stock and sales data have not completely responded to the shock yet. One can then use a FE estimator (if one is concerned about unobserved cross-country heterogeneity which is correlated with the covariables) because the within-variation will be strong. However, this strong signal has to be balanced against the higher noise in flow data compared to stocks and most operational data, as discussed at the end of section 5.[62] Furthermore, quantitative conclusions about the level of MNCs' activities should be treated with care: as explained and exemplified above, flows will 'overreact' as a first impulse to a changing environment.

On the other hand, using flow data instead of stock or operational data has the advantage that the high persistence in the latter raises the concern that these series contain a unit root. Since they are often regressed on other series that are suspicious of being I(1), conventional techniques such as LSDV may produce spurious inference (Kao, 1999). The problem is growing with the increasing T dimension of these panels (Entorf, 1997). Alternatively, BE estimation using FDI stock or sales data seems appropriate for long-run effects and should provide consistent estimates even in the presence of powers of unit root variables.

Finally, the obtained results emphasize to pay more attention to the relationship between the short and the long run for both a policy reason and a reason related to the economic theory of the MNC. As highlighted by the IMF (Ostry et al., 2011, p.8), it is important to have "appropriate quantitative metrics to guide policies" managing capital inflows. For a policy maker, it might be helpful to expect that increasing corporate taxation by 10 per-

[62]For the same reason, FDI flows should be a rather poor right hand side variable capturing MNCs' activities, especially if one mis-specifies the dynamics in the lag structure.

centage points will, in equilibrium, lead to a decrease in FDI of magnitude β. However, probably even more important is some knowledge about the speed at which this change occurs. It certainly makes a difference for the design of policy if the half-life or the mean lag ($\phi/(1-\phi)$ in the dynamic model) of the impact is one year or ten years. In the latter case, the tax might be an option for temporary fiscal consolidation. More knowledge about these dynamics would help provide more solid economic grounds for the public discussions about national business locations in the globalization context.

As far as our theoretical understanding of multinational corporations is concerned, the adjustment speed ϕ^{-1} also tells us something about the efficiency of a firm (or of an aggregate of firms) in adjusting to changes in the economic environment. Multinationals are usually perceived as the most productive and the most efficient firms. Without prejudice to this viewpoint, this distinguishes them from being just one in an infinite continuum of firms and this status might give them the possibility to externalize some opportunity or transaction costs that might result from a protracted adjustment process . The firm's situation is similar to an organism, where the amount of energy necessary for reproduction, the metabolic rate, is a (sub-linearly) increasing function of its mass: the need for finance and hence the claims of creditors and shareholders are increasing in the firm's assets. The described obstacles to selling off these assets quickly and/or profitable enough in the face of a negative shock demands a cautious business strategy. However, the largest firms might be able to roll over this 'mass' (i.e. fixed asset costs) to the public - an externality potentially lowering social welfare. This problem of soft-budget constraints of large corporations in 'market economies' has become apparent in recent years and is known in the public debate as being "too big to fail."[63] Currently, we are becoming eye-witnesses to the slow adjustment speed ϕ^{-1} in the form of long-lasting deleveraging processes, reductions in 'mass.'

This does not mean that MNCs allocation will not be efficient in the long run, although they may be in the short run - *un jour tout sera bien, voila notre esperance; tout est bien aujoud'hui, voila l'illusion.*[64] My point concerns the question how long this long run takes and if MNCs face incentives that extend their long run. If so, we should ask for the precise transmission channel in the Keynesian dictum that 'in the long run we are all dead.' For a bluebell and a rose it is the fact that the metabolic rate becomes unsustainable against the organism's mass at some point. The master of equations might have had something in mind when specifying that not all of her equations lead to infinities.

[63] Note that this argument does not strictly apply to MNCs but 'large' corporations. However, most companies that are considered 'too large to fail' are operating multinationally and it may be argued that this multinational activity is an important factor in making them distinct from the continuum of homogeneous firms.

[64] *'One day everything will be well, that is our hope. Everything's fine today, that is our illusion.'* F.M.A. de Voltaire, Poème sur le désastre de Lisbonne, 1756

Appendix

	stock	flows	assets	empl.	wages	sales	income
stock	1.00						
flows	0.83	1.00					
assets	0.97	0.78	1.00				
employees	0.58	0.28	0.59	1.00			
wages	0.72	0.33	0.77	0.84	1.00		
sales	0.80	0.51	0.82	0.80	0.92	1.00	
income	0.74	0.84	0.69	0.13	0.23	0.43	1.00
Σ	5.64	4.58	5.63	4.23	4.82	5.29	4.05

sample containing 47 different host countries in year 2008
Σ is the sum over *all* correlation coefficients of the measure,
not just the ones displayed.

Table 7: Correlation Coefficients Between Different BEA Measures, 2008

	stock	flows	assets	empl.	wages	sales	income
stock	1.00						
flows	0.89	1.00					
assets	0.94	0.86	1.00				
employees	0.84	0.72	0.79	1.00			
wages	0.86	0.68	0.86	0.92	1.00		
sales	0.91	0.75	0.89	0.91	0.98	1.00	
income	0.92	0.84	0.82	0.77	0.77	0.86	1.00
Σ	6.37	5.74	6.16	5.95	6.07	6.29	5.98

sample containing 90 different host countries in year 1997
Σ is the sum over *all* correlation coefficients of the measure,
not just the ones displayed.

Table 8: Correlation Coefficients Between Different BEA Measures, 1997

	stock	flows	assets	empl.	wages	sales	income
stock	1.00						
flows	0.10	1.00					
assets	0.92	-0.09	1.00				
employment	0.59	0.38	0.50	1.00			
wages	0.90	-0.04	0.97	0.53	1.00		
sales	0.92	-0.06	0.96	0.54	0.98	1.00	
income	0.83	-0.21	0.92	0.29	0.95	0.95	1.00
Σ	5.25	1.09	5.19	3.83	5.29	5.28	4.73

sample containing 12 observations over time (1997-2008)
Σ is the sum over *all* correlation coefficients of the measure,
not just the ones displayed.

Table 9: Correlation Coefficients Between Different BEA Measures, Canada

	stock	flows	assets	empl.	wages	sales	income
stock	1.00						
flows	0.54	1.00					
assets	0.97	0.50	1.00				
employment	0.96	0.49	0.94	1.00			
wages	0.98	0.54	0.97	0.96	1.00		
sales	0.98	0.52	0.94	0.94	0.99	1.00	
income	0.96	0.47	0.95	0.91	0.98	0.99	1.00
Σ	6.39	4.06	6.28	6.21	6.41	6.36	6.26

sample containing 12 observations over time (1997-2008) for the aggregate of
all host countries, Σ is the sum over *all* correlation
coefficients of the measure, not just the ones displayed.

Table 10: Correlation Coefficients Between Different BEA Measures, 'All Countries Total'

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