Multinational Production: Data and Stylized Facts

Natalia Ramondo (the corresponding author), University of California at San Diego, School of International Relation and Pacific Studies, 9500 Gilman Dr, La Jolla, CA, 92093-0519, Phone: 858-534-2660. Fax: 858-534-3939.

E-mail: nramondo@ucsd.edu.

Andrés Rodríguez-Clare, University of California at Berkeley and NBER, Department of Economics, 549 Evans Hall 3880, Berkeley, CA, 94720-3880. Phone: 510-643-1654. Fax: 510-642-6615.

E-mail: andres@econ.berkeley.edu.

Felix Tintelnot, University of Chicago, Department of Economics, 5757 S. University Avenue, Chicago, IL, 60637. Phone: 773-702-5403. Fax: 773-702-8490.

E-mail: tintelnot@uchicago.edu

Session Title: Measuring the Multinational Economy

Session Chair: Kim Ruhl, New York University-Stern

Discussant: Vanessa Alviarez, University of British Columbia

Multinational Production: Data and Stylized Facts

Natalia Ramondo, Andrés Rodríguez-Clare, and Felix Tintelnot

Globalization is a phenomenon of many dimensions: international trade and migration, financial integration, multinational production, international knowledge flows, etc. We are concerned here with multinational production (MP), defined as production that is carried out by firms outside of their country of origin. There are several important questions associated with MP: To what extent are firms becoming multinational? How is this affecting worldwide efficiency? What are the effects on home and host country welfare? Is this trend facilitating income convergence across countries? What are the effects on inequality within and across countries?

There is, of course, a large theoretical and empirical literature tackling these questions (e.g., Antras and Yeaple, 2014 [5]). On the empirical side, most of the work has been done with data on foreign direct investment (FDI). To some extent, the reliance on FDI data comes from the fact that early theorizing focused on the transfer of capital associated with FDI. For the most part, however, it comes from the fact that FDI data is readily available, while more direct measures of MP are much scarcer. In this paper we introduce a new dataset on MP and present a series of stylized facts motivated by recent quantitative models of trade and MP (e.g., Ramondo and Rodríguez-Clare, 2013, [17] Arkolakis, Ramondo, Rodríguez-Clare, and Yeaple, 2013, [7] and Tintelnot, 2014, [20]). For many of the questions above, MP flows are a more appropriate empirical object than FDI.[1] This is because the importance of a subsidiary depends on the magnitude of its production activity (which we proxy by sales) rather than the way in which it was financed. For example, if the investment to open a subsidiary is financed from local sources, this would not show up as FDI, but it would appear in our MP data.

Our analysis of the MP data emphasizes the parallels between MP and international trade because these two flows are intimately related. On the one hand, trade and MP are substitutes in that they are alternative ways through which firms can serve foreign markets or take advantage of low priced factors of production in foreign countries. On the other

---

[1]There are some papers that explicitly distinguish between FDI and MP – see for example Antras, Desai, and Foley (2009) [4] and McGrattan and Prescott (2009) [16].

hand, trade and MP are complements in that foreign subsidiaries of multinational firms are intensively engaged in both imports (for inputs) and exports to third countries. We measure bilateral MP flows from country i to country j by the sales of foreign affiliates in country j that belong to country i multinationals. This is analogous to bilateral trade flows. More formally, think of X_{iln} as the sales to market n by subsidiaries in location l that belong to multinationals from country i. Bilateral MP flows from i to l result when we sum X_{iln} over n (i.e., we do not care about the destination of the sales), while bilateral trade flows from l to n result when we sum X_{iln} over i (i.e., we do not care about the country of origin of the firms that do the sales).

Our dataset is a cross-section of aggregate bilateral MP flows and counts (i.e., number of affiliates) across 59 countries for the end of the 1990s. As far as we know, there are three alternative datasets on bilateral MP. Alfaro and Charlton (2009) [1] use firm-level data provided by Dun & Bradstreet. These are registry data, so while there is useful information at the firm level, there is a concern about accuracy in the aggregation to the country level.[2] Despite using smaller samples of countries, Fukui and Lakatos (2012) [12] and Alviarez (2014) [2] take important steps in assembling bilateral MP data disaggregated by sectors. Fukui and Lakatos (2012) use Eurostat FATS data and extrapolates missing values from a gravity regression. Alviarez (2014) uses unpublished OECD data, complemented with Eurostats, to assemble a dataset for the activity of affiliates of multinational firms, in terms of revenues and employment, for 35 countries and ten sectors as an average over the 2003-2007 period.[3]

I   Data

The construction of the MP database combines several sources, the main one being published and unpublished data by UNCTAD. The UNCTAD dataset includes the sales by affiliates of foreign firms, the number of local affiliates owned by foreign firms, as well as their employ-

---

[2]Figure 1a in Alfaro and Charlton (2009) [1] indicates that poorer countries have less coverage in terms of affiliates' sales.

[3]One obvious concern is the pervasiveness of missing values: three quarters of the source-host-sector relationships are zeros or missing. While not perfect, the author tries to address the problem using ORBIS and BEA data as additional sources.

ment and asset value.[4] Of the 151 countries available at UNCTAD, we restrict our attention to the countries with a real GDP per capita above 5,000 US dollars (PPP-adjusted) or a population of more than three million.[5] We end up with a sample of 59 countries which entails 3,422 (58×59) possible observations. Each observation is an aggregate over non-financial sectors constructed as an average over the period 1996-2001.

A problem with the UNCTAD data for MP is the large number of missing values. We use data on the value and count of mergers and acquisitions (M&A) from Thomson and Reuters to fill in some of the missing observations.[6] M&A data is highly informative about bilateral MP. For the set of country pairs for which we have both variables, the correlation between the bilateral number of M&A transactions and bilateral MP is 0.82 (in logs), while for the bilateral number of affiliates is 0.87 (in logs). Our extrapolation procedure brings down the number of missing values for bilateral MP and bilateral number of affiliates from 1,111 and 1,190 observations to 728 and 692, respectively. The resulting dataset has a large number of zeros: of a total of 2,694 observations with non-missing values, 1,215 present some MP activity, while the rest has zero MP.

Finally, it is worth mentioning that FDI stocks, a commonly used bilateral measure of MP activity, have a strong correlation with our measure of MP: the elasticity of MP sales to FDI stocks is 0.56 (s.e. 0.029) with an R-squared of 0.87.[7] Nonetheless, the levels for the two variables are different: as a share of (non-financial) gross production in the host country, our measure of MP activity entails an average inward MP flow of 17 percent, while FDI stocks represent ten percent. Inference on the openness of a country using stocks would lead one to think that some countries are less open that they are if openness were measured by MP activity.

The supplemental online material presents a detailed description of the data and the

---

[4]Bilateral FDI flows and stocks from the Balance of Payments are also included.

[5]We exclude Puerto Rico and Taiwan for lack of data, and add China, India, and Indonesia.

[6]As an alternative extrapolation procedure for affiliate sales, we use (bilateral) Foreign Direct Investment (FDI) stocks from the balance of payment of countries (international investment position). Most countries record this variable, so the number of missing observations is substantially lower for FDI stocks than for MP flows.

[7]In this Ordinary Least Squared (OLS) regression, we include source- and destination-country fixed effects, and robust standard errors.

extrapolation procedure.

II   Gravity and the Extensive and Intensive Margins of MP

In this section, we revise the evidence on MP gravity, including the extensive and intensive margins of MP, and we compare it with trade gravity, using bilateral trade flows in goods from Feenstra and Lipsey (2005) [11]. The extensive margin of MP refers to (1) the presence or not of affiliates from i in country n; and (2), given that country i has MP presence in n, the number of affiliates of firms from i in n.[8] The extensive margin of trade simply refers to the presence or nor of trade flows from country i in to n—we do not have the analogous of (2) for the trade data (e.g., the number of exporters from i into n).

Table 1 shows the results for gravity for trade and MP. In columns 1 and 2, we estimate a linear probability specification for the extensive margin of trade and MP. In doing so, for MP, we exploit our data that indicate the presence of MP activity from country i in l: the dependent variable in column 1 is a dummy that takes the value of one when we observe a positive or missing value in our data, and zero otherwise. For trade, in column 2, the dependent variable is a similar dummy.[9] Columns 3 to 6 show the results of a log-linear specification for the intensive margins of trade and MP. In column 3, the dependent variable is (log) exports from i to n, as a share of gross production in n. In column 4, the analogous dependent variable is constructed for MP, that is, revenues of affiliates of firms from i in n, as a share of gross production in n. We further can decompose this aggregate MP share into the number of affiliates (column 5) and revenues per affiliate (column 6). In all cases, regressors are geographical distance and dummies indicating common border, common language, and colonial ties, from CEPII.

---

[8]The relation between MP volumes and gravity has been largely documented, among others, by Carr, Markusen, and Maskus (2001) [9], who uses affiliates' sales, and Razin, Rubinstein, and Sadka (2003) [19], and Head and Ries (2008) [15], who uses FDI stocks. None of these papers distinguish between the two margins of MP; the exception is Ramondo (2014) [18].

[9]For trade, results are unchanged whether we assume that the few missing values are zeros, positive missing values, or we drop them altogether from the regression.

Table 1: **Gravity: Extensive and intensive margins. Trade and MP.**

Dep var	$D(Y_{il})$	$D(X_{in})$	$\log \lambda_{in}^T$	$\log \lambda_{il}^M$	$\log M_{il}$	$\log y_{il}$
	(1)	(2)	(3)	(4)	(5)	(6)
log of distance	-0.122***	0.006	-1.082***	-0.917***	-0.767***	-0.119***
	(0.009)	(0.005)	(0.034)	(0.051)	(0.042)	(0.033)
common border	-0.046	-0.007	0.314**	0.129	0.23**	-0.09
	(0.035)	(0.012)	(0.134)	(0.167)	(0.117)	(0.098)
colonial ties	0.082**	0.014**	0.70***	0.865***	0.718***	0.139*
	(0.035)	(0.007)	(0.128)	(0.165)	(0.131)	(0.084)
common language	0.082***	0.0002	0.407***	0.597***	0.502***	0.110*
	(0.022)	(0.012)	(0.086)	(0.112)	(0.084)	(0.065)
Obs	3,417	3,417	3,211	1,212	1,202	1,163
R-squared	0.82	0.98	0.98	0.98	0.95	0.99

Notes: The operator $D(Z)$ takes the value of one if $Z > 0$ and zero otherwise. Y_{il} denotes revenues of affiliates from i in l, while X_{in} denotes trade flows from i in n. Trade shares are $\lambda_{in}^T \equiv X_{in}/Y_n$, while MP shares are $\lambda_{il}^M \equiv Y_{il}/Y_l$. Y_l denotes gross production in non-financial sectors. M_{il} denotes number of affiliates from i in l, while $y_{il} \equiv Y_{il}/M_{il}$. All regressions with source and destination country fixed effects. Robust standard errors are in parentheses. Levels of significance are denoted ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$

The effects of distance on the country-level extensive margin are large and significant: doubling distance decreases the probability of observing MP activity between two countries by 12 percentage points (column 1). In contrast, we do not find any effect of distance on the extensive margin of trade (column 2). The difference in the results between MP and trade arises because zeros are way more prevalent in MP than trade. Restricting our attention to the countries in our MP dataset, we find that 50 percent of all ordered country pairs have zero MP while only 3 percent have zero trade. It is then not surprising that we find no impact of distance on zeros in bilateral trade flows.[10]

Conditional on observing some MP activity, the effects of distance on MP shares (λ_{il}^M) are rather similar to the ones found for trade shares, and close to minus one (0.91 vs 1.08, respectively). Sharing a border does not have a significant impact on the magnitude of MP, while it has a positive and significant effect on the magnitude of trade.

The last two columns in Table 1 decompose the effects of geographical variables on aggregate MP flows into the extensive (number of affiliates M_{il}) and intensive (sales per affiliate, y_{il}) margins, given that we observe some MP activity by country i in l. The extensive margin of MP is much more elastic to changes in each of the covariates included in the regression than the intensive margin: for instance, a ten-percent increase in distance decreases the number of affiliates from i to l by almost eight percent, while sales per affiliate only decrease by 1.2 percent.

To explore the relative importance of the extensive and intensive margins of MP, we perform an analysis similar to that in Eaton, Kortum, and Kramarz (2011) [10]. In figure 1a, we show the bilateral number of affiliates against the size of the receiving market, measured as gross production. Similarly to the analysis in Eaton et al. (2011) [10] for the number of French exporters in each importing country, the relation is increasing, but cloudy. Once we normalized the extensive margin of MP for firms from i in l by the share of revenues of those affiliates in l, the relation becomes tighter: fitting a linear relation in figure 1b (with a constant) delivers a coefficient of 0.61 (s.e 0.03), virtually identically to the elasticity reported by Eaton et al. (2011) [10] for French exporters. Including source fixed effects

[10]Helpman, Melitz, and Rubinstein (2008) [13] find an effect of distance on the extensive margin of trade: since their sample of countries is much larger (158), the fraction of country-pairs with zero trade is of around 50 percent.

brings the size-elasticity down from 0.61 to 0.51.

Figure 1: Market Size, and the Extensive and Intensive Margins of MP.

(a) Number of Affiliates — level

(b) Number of Affiliates — normalized
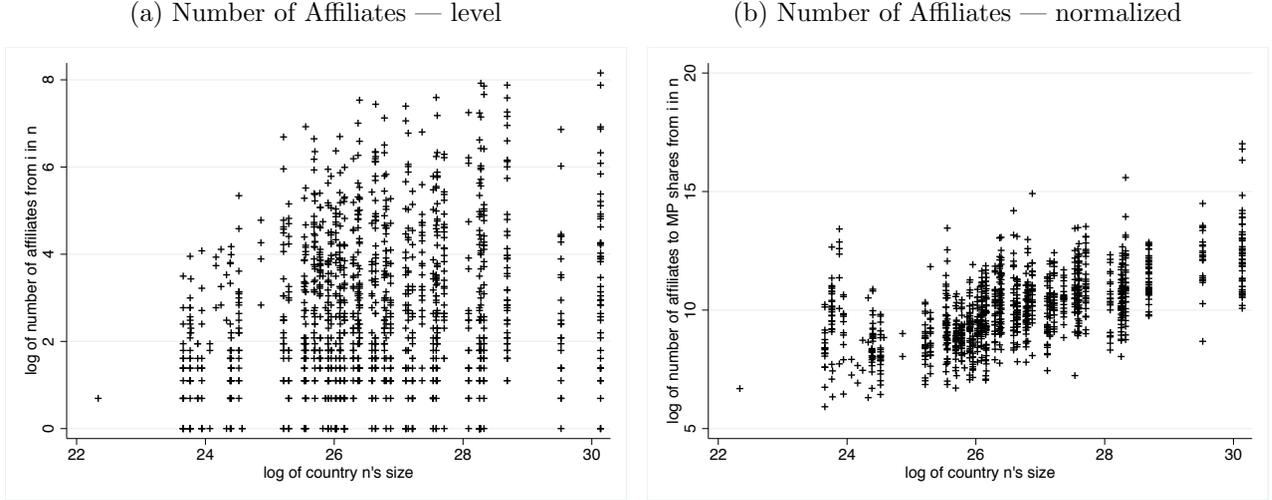
Notes: The y-axis is: in figure 1a, the (log) number of affiliates of firms from country i in l, M_{il}; in figure 1b, the (log) number of affiliates from i in l, normalized by the MP share, $\lambda_{il}^M \equiv Y_{il}/Y_l$. Market size refers to gross production in non-financial sectors, Y_l.

Figure 1b reveals that the number of MP sellers increases with market size but less than proportionally, meaning that the average sales per seller are also increasing by 1 - 0.61 = 0.39 (and 1 - 0.51 = 0.49 when source fixed effects are included). Eaton et al. (2011) [10] had only one source country for exporters, France. Since we have many source countries, we can further see how much of the variation in bilateral MP flows, Y_{il}, are explained by the extensive (M_{il}) and intensive (y_{il}) margins of MP, respectively, controlling for source and host country fixed effects. Results from OLS reveal that: $\log M_{il} = 0.66^{***} \log Y_{il} + S_i + H_l$ (with $1,166$ observations and R-squared of 0.98), indicating that two thirds of the increase in MP flows are through an increase in the number of affiliates; only a third of the increase is an increase in the amount of sales per affiliate.

III   Trade and MP Openness

As shown by Arkolakis, Costinot, and Rodriguez-Clare (2012) [6], given a trade elasticity ε, a sufficient statistic to compute the gains from trade for a country (i.e., the proportional increase in its real income as it moves from autarky to the trade equilibrium) is its domestic

trade share, $GT_l = (\lambda_{ll}^T)^{-\epsilon}$, where $\lambda_{ll}^T = 1 - \sum_{j \neq l} \lambda_{jl}^T$. Ramondo and Rodríguez-Clare (2013) [17] show that under some conditions that imply that trade and MP are neither substitutes nor complements, this formula for the gains from trade continues to be valid in a model that allows for both trade and MP, while an analogous formula holds for the gains from MP. In such a model, the definition of the gains from trade is the proportional increase in real income as the country moves from no trade (but with MP) to the equilibrium with both trade and MP, while the gains from MP are the proportional increase in real income as the country moves from no MP (but with trade) to an equilibrium with both trade and MP. The gains from MP in this case are given analogously to the gains from trade: $GMP_l = (\lambda_{ll}^M)^{-\epsilon}$, where $\lambda_{ll}^M = 1 - \sum_{j \neq l} \lambda_{jl}^M$. [11] In this particular case of independence of trade and MP, the gains from openness are given by $GO_n = GT_n \cdot GMP_n$.

Domestic trade and MP shares are then the base to calculate the gains from openness. Figure 2 shows those shares calculated as one minus imports (for trade) and one minus inward MP flows (for MP), as a share of gross production in non-financial sectors.[12] It is also obvious from the figure that domestic trade and MP shares are positively associated (correlation of 0.63). Roughly half the countries are more open to MP than trade. A good benchmark to compare these two measures of openness is a frictionless world. In such scenario, domestic trade and MP shares should be the same and equal to the share of the country in world output. The United States, for instance, have an MP domestic share of 0.84, while their domestic trade share is 0.93, but according to their size in world production, their domestic share should be 0.30. A small and open economy like Belgium has domestic MP and trade shares of 0.53 and 0.63, respectively, while, because of its size, under frictionless these shares should be of one percent. These discrepancies are simply an indication of the presence of cost of movement of goods and ideas across countries. In Table 2, we explore more formally the relation between domestic shares, country size, and income. Our measure of country size is gross production in non-financial sectors, while income per capita is measure as real GDP per capita, PPP-adjusted, from the Penn World Tables 8.1 (PWT). Domestic trade

---

[11]This formula is also valid for the models with only MP in Burstein and Monge-Naranjo (2009) [8], McGrattan and Prescott (2009) [16], and Ramondo (2014) [18].

[12]We consider here trade in all goods, not only manufacturing; that is why the magnitudes of domestic trade shares are slightly different from the ones in the literature.

Figure 2: MP and Trade Domestic Shares.
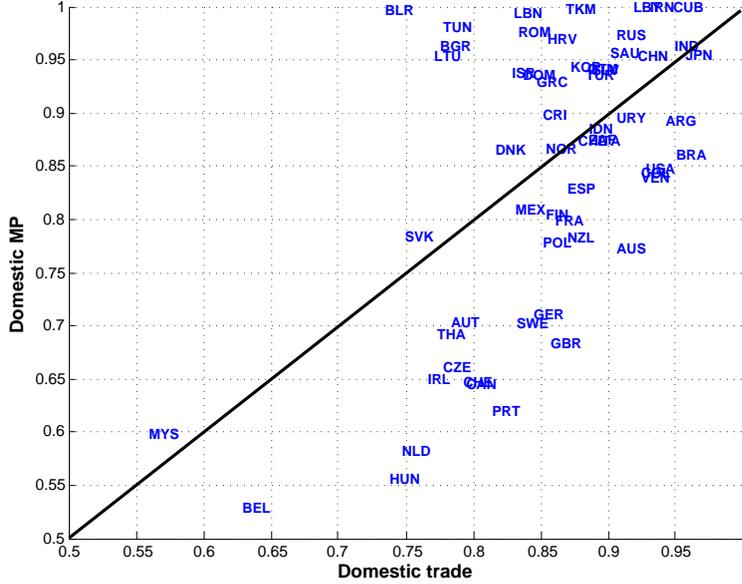
Notes: Domestic MP (trade) refers to Y_{ll} (X_{ll}), normalized by gross production in non-financial sectors, Y_l.

Table 2: **Openness, Size, and Income per Capita.**

Dep var	$\log \lambda_{ll}^T$	$\log \lambda_{ll}^M$
	(1)	(2)
$\log y_l$	-0.099*	-0.104***
	(0.055)	(0.027)
$\log Y_l$	0.041**	-0.007
	(0.017)	(0.013)
constant	-0.31	0.988***
	(0.211)	(0.307)
Obs.	59	58
R-squared	0.12	0.24

Notes: $\lambda_{ll}^M \equiv Y_{ll}/Y_l$ with Y_{ll} denoting revenues of affiliates from l in l. $\lambda_{ll}^T \equiv X_{ll}/Y_l$ with X_{ll} denoting trade flows from l in l. Y_l is gross production in non-financial sectors. y_l is real GDP per capita, PPP-adjusted. from PWT 8.1. Robust standard errors are in parentheses. Levels of significance are denoted ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$

and MP shares, in columns 1 and 2, respectively, present an elasticity to real GDP per capita of around -0.1: A country with half the income per capita presents domestic shares that are around ten percent higher, meaning that poorer countries are less open to trade and foreign firms. Turning to the variation of openness with country size, we see that domestic trade shares show a size-elasticity of 0.05, indicating that larger countries are less open to trade, while domestic MP shares do not seem to be responsive to country size. In a frictionless world, this coefficient should be one.

As mentioned above, deviations from the frictionless benchmark should be related to trade and MP costs. We explore the magnitude of such costs by applying the approach in Head and Ries (2001) [14], both for trade and MP. Let τ_{ln} be the iceberg trade cost from l to n, and let be an analogous iceberg productivity loss for multinationals from country i that produce in l. Under symmetry (i.e., $\tau_{ln} = \tau_{nl}$ and $\gamma_{il} = \gamma_{li}$) and assuming that there are no domestic trade and MP costs (i.e., $\tau_{ll} = \gamma_{ll} = 1$ for all l), then we can compute trade and MP costs from the observed flows: $\tau_{ln} = \left(\frac{X_{ln}X_{nl}}{X_{nn}X_{ll}}\right)^{-\frac{1}{2\epsilon}}$ and $\gamma_{il} = \left(\frac{Y_{il}Y_{li}}{Y_{ll}Y_{ii}}\right)^{-\frac{1}{2\epsilon}}$. The broad class of trade models that satisfy the standard gravity equation satisfy the conditions needed for the validity of the Head-Ries index for trade costs. For MP, we need to restrict the model of trade and MP to the case in which those flows are independent—or use a model with only MP—as shown in Arkolakis et al. (2013) [7].[13] One remark is in order: the pervasive presence of very low shares of zeros in the bilateral MP data makes it more of a challenge to apply these indices; the class of models for which the Head and Ries index can be applied do not deliver zero flows at the aggregate bilateral level. Nonetheless, we calculate such indices restricting the sample to pairs of countries with positive MP flows both ways. With $\epsilon = 4$, the median country pair has an iceberg-type cost of 6.6 for trade, and 6.5 for MP (with $\epsilon = 5$, the median costs are 4.5 for both flows), with $\tau_{ll} = \gamma_{ll} = 1$. These results are in line with the ones in the gravity literature (see Anderson and van Wincoop, 2004 [3]).

---

[13]Arkolakis et al. (2013) [7] show how to compute Head-Ries-type index in a set up where trade and MP are not independent.

IV MP, Trade, and the Current Account

Arkolakis et al. (2013) [7] present a trade and MP model that extends the Melitz model by allowing firms to produce outside of their home country. The model implies that foreign subsidiaries earn profits (net of market costs but gross of firm-entry costs) equal to a constant share η of their sales, so that profits made by subsidiaries of firms from country i in country l are simply $\Pi_{il} = \eta Y_{il}$. Of course, these profits are not necessarily repatriated back to the home country, since firms often use those funds for foreign investments or keep them away for tax reasons. But as a matter of accounting, one could use this result to see how net MP flows may be compensating for trade imbalances. In a model of trade and MP, current account balance for country l entails

$$(1) \qquad \left(\sum_{n \neq l} X_{ln} - \sum_{j \neq l} X_{jl} \right) + \eta \left(\sum_{j \neq l} Y_{lj} - \sum_{i \neq l} Y_{il} \right) = 0.$$

The first term is the trade surplus while the second term is the MP surplus. Figure 3 plots the two term in (1), for $\eta = 0.187$, as calibrated by Arkolakis et al. (2013) [7], as share of a country's GDP. The figure shows that the United States have a trade deficit that is more than compensated with a large surplus due to MP profits: The sum of the two terms in (1) gives a deficit in the current account of 1.5 percent of U.S. GDP, for the late nineties. The opposite is the case for China: according to our accounting, the current account would have a surplus of 7.4 percent, as a share of GDP, mainly coming from a large trade surplus. The other two countries that clearly experience a current account surplus are Netherlands and Switzerland, with surpluses of 21 and 14 percent of their GDP, respectively. The prediction for Japan is a current account surplus of around five percent of its GDP, for the late nineties, coming from a 2-3 percent surpluses in both terms of (1).

References

[1] **Alfaro, Laura, and Andrew Charlton.** 2009. "Intra-industry Foreign Direct Investment." *American Economic Review* 99(5): 2096—2119.

[2] **Alviarez, Vanessa**. 2014. "Multinational Production and Comparative Advantage." Mimeo University of Michigan.

Figure 3: Net MP, Net Trade, and the Current Account.
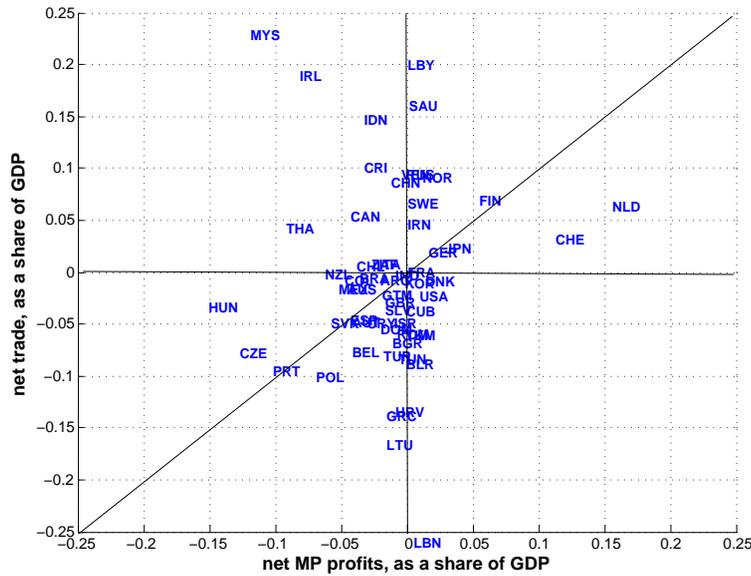
Notes: The y-axis shows total exports minus imports in goods, as share of GDP. The x-axis shows total profits of affiliates abroad of firms from n minus total profits of foreign affiliates of foreign firms in n, as share of n's GDP. Profits are calculated as a share η of affiliates' sales, with $\eta = 0.187$. GDP data are from the World Development Indicators.

[3] **Anderson, James E., and Eric van Wincoop.** 2004. "Trade Costs." *Journal of Economic Literature* 42(3): 691—751.

[4] **Antrs, Pol, Mihir Desai, and Fritz Foley.** 2009. "Multinational Firms, FDI Flows and Imperfect Capital Markets." *Quarterly Journal of Economics*, 124(3): 1171—1219.

[5] **Antrs, Pol, and Stephen R. Yeaple**. 2014. "Multinational Firms and the Structure of International Trade", in the Handbook of International Economics, 4: 55—130.

[6] **Arkolakis, Costas, Arnaud Costinot, and Andres Rodriguez-Clare**. 2012. "New Trade Models, Same Old Gains?" *American Economic Review* 102(1): 94—130.

[7] **Arkolakis, Costas, Natalia Ramondo, Andres Rodriguez-Clare, and Stephen R. Yeaple**. 2013. "Innovation and Production in the Global Economy," NBER Working Paper No. 18792.

[8] *Burstein, Ariel, and Alex Monger-Naranjo.* 2009. "Foreign know-how, firm control, and the income of developing countries". *Quarterly Journal of Economics* 124 (1): 149—195.

[9] **Carr, David, James Markusen, and Keith Maskus.** 2001. "Estimating the knowledge-capital model of the multinational enterprise." *American Economics Review* 91: 693—708.

[10] **Eaton, Jonathan, Samuel Kortum, and Francis Kramarz.** 2011. "An Anatomy of International Trade: Evidence From French Firms". Econometrica 9(5): 14538.

[11] **Robert C. Feenstra, Robert E. Lipsey, Haiyan Deng, Alyson C. Ma, and Hengyong Mo**. 2005. "World Trade Flows: 1962-2000." NBER Working Paper No. 11040.

[12] **Fukui, Tani and Csilla Lakatos**. 2012. "A Global Database of Foreign Affiliate Sales." USITC Working paper No. 2012-08A

[13] **Helpman, Elhanan, Marc Melitz, and Yona Rubinstein**. 2008. "Estimating trade flows: trading partners and trading volumes." *Quarterly Journal of Economics* 123(2): 441—487.

[14] **Head, Keith, and John Ries.** 2001. Increasing Returns versus National Product Differentiation as an Explanation for the Pattern of U.S.-Canada Trade *American Economic Review* 91(4): 85876.

[15] **Head, Keith, and John Ries.** 2008. FDI as an outcome of the market for corporate control: theory and evidence." *Journal of International Economics* 74 (1): 2—20.

[16] **McGrattan, Ellen, and Prescott, Edward.** 2009. "Openness, technology capital, and development." *Journal of Economic Theory* 144 (6): 2454—2476.

[17] **Ramondo, Natalia and Andres Rodriguez-Clare.** 2013. "Trade, Multinational Production, and the Gains from Openness, " *Journal of Political Economy* 121(2).

[18] **Ramondo, Natalia.** 2014. "A quantitative Approach to Multinational Production." *Journal of International Economics* 93(1): 108—122.

[19] **Razin, Assaf, Yona Rubinstein, and Efraim Sadka.** 2003. "Which countries export FDI, and how much?" NBER Working Paper No. 10145.

[20] **Tintelnot, Felix.** 2014. "Global Production with Export Platforms." Mimeo Pennsylvania State University.