Peterson Institute for International Economics

Prospects for Greater Global and Regional Integration in the Maghreb

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Gravity Model Analysis

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Gravity Model Analysis [1]

In recent years, the gravity model has become a "work horse" of quantitative studies of international trade and investment policy.[2] Essentially, the model uses econometric techniques to evaluate thousands of individual observations on trade and investment between countries over time, against the gravitational "mass" of explanatory variables that describe the characteristics of bilateral trade and investment partners. Two familiar explanatory variables are the joint real GDP levels of partners and the distance between them. But numerous other explanatory variables are frequently specified as well, including geographic, political, and institutional factors that either augment or diminish the gravitational forces giving rise to commerce between countries. Most important, recent gravity models incorporate indicators for bilateral and regional free trade agreements (FTAs), enabling the models to assess the contribution of FTAs to international commerce.

The Gravity Model and Data Set

The Peterson Institute gravity model (DeRosa 2007) is based on bilateral merchandise trade flows and inward stocks of foreign direct investment (FDI) among approximately 170 countries from 1976 to 2005 (with numerous gaps, mainly in the observations of bilateral FDI stocks), as compiled from the UN COMTRADE database (using the World Integrated Trade Solution of the World Bank)[3] and the UN Conference on Trade and Development FDISTAT database.[4] In the main, the numerous explanatory variables of the model, identified in Table 1, are taken from an extensive data set for gravity models compiled by Rose (2004).

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[1] Dean A. DeRosa was the principal author of this section
[2] Eichengreen and Irwin (1998).
[3] http://wits.worldbank.org.
[4] http://www.unctad.org/Templates/StartPage.asp?intItemID=2921&lang=1. Note that the UNCTAD FDI data stock figures are inward FDI stocks, not outward FDI stocks. However, for convenience in our descriptive text and tables, we refer to inward FDI stocks in country B from country A as outward FDI stocks from country A.

Finally, the Peterson Institute gravity model incorporates indicator variables for over 500 FTAs, based on historical notifications of the dates on which the trade agreements entered into force and their contemporary participants. These indicators are dichotomous (0, 1) variables – sometimes called "dummy" variables. They take on the value of 1 if trade or investment partner countries are FTA members and their mutual trade agreement is in force, and a value of zero otherwise.[5] The FTA indicators are grouped into nine prominent individual FTAs and groups of FTAs worldwide, including the European Union and NAFTA.[6] Related indicator variables are included in the gravity model to assess the effect of the FTAs on the trade and investment of members with non-member countries.[7]

Notwithstanding the large number of explanatory variables already specified in most gravity models (including our own), the common practice is to take into consideration any missing or unobservable explanatory variables. This is done in two ways. To account for systemic global influences on trade, we additionally specify "year-effect" variables that essentially are indicator variables representing episodic global influences on international trade and investment. More important, however, we also specify indicator variables for each ordered country pair in the data set. This technique minimizes any

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[5] To illustrate, the NAFTA indicator variable for US-Mexican trade would not take on a value of 1 until 1994.

[6] The free trade agreements and preferential trade agreements are grouped as follows: European Union (EU), European Free Trade Area (EFTA), EU bilateral free trade agreements (EU FTAs), North American Free Trade Agreement (NAFTA), Southern Common Market (Mercosur), Chile, Mexico, Australia, and Singapore bilateral free trade agreements (CMAS FTAs—separately distinguished because these are truly free trade countries), ASEAN Free Trade Area (AFTA), South Asia Free Trade Agreement (SAFTA), and all other customs unions and free trade agreements.

[7] The change in trade or investment between FTA members is most often measured in percentage terms. Given the log-linear specification of the gravity model, the impact of a free trade agreement on bilateral trade or inward FDI stocks can be computed in percentage terms as $100*[\exp(b_{fta}) – 1.00]$. In this expression, b_{fta} is the estimated coefficient for the dummy variable representing the presence of a free trade agreement, and $\exp(b_{fta})$ is the value of the natural number e raised to the exponent b_{fta}. For example, if the coefficient b_{fta} is 0.50, then the value of $\exp(b_{fta})$ is 1.65, and the percentage expansion in bilateral commerce is estimated as $100*[1.65 – 1.00]$, which equals 65 percent.

possible bias in the estimated coefficients of the gravity model that arises from missing or unobservable explanatory variables. Finally, we estimate the parameters of our gravity model, separately for bilateral trade and inward FDI stocks, using a multi-step, fixed-effects method for panel data sets developed recently by Plumper and Troeger (2007). This approach yields reliable coefficient estimates for both time-invariant and time-varying explanatory variables.

Estimation Results

The estimation results for our gravity model are presented in Table 1, for both bilateral trade flows and inward FDI stocks. A number of regularities are discernible in the results. Broadly speaking, these regularities match the findings of other gravity models. Above all, the specified explanatory variables predominantly contribute significantly to explaining variations in bilateral trade flows and inward FDI stocks, as indicated by the high R-squared statistics for the two gravity model equations.[8]

As expected, the distance between partners reduces bilateral trade and investment, while the joint GDP of partners, expressed in either level or per capita form, expands bilateral commerce in the model (holding other factors constant).[9] The individual influences of the other "core" explanatory variables are also sensible, and generally conform to the results of other gravity model analyses. A common language and border between countries tends to expand bilateral commerce. So too does being an island economy, having had a colonial relationship with a trading partner, or being a recipient of trade preferences

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[8] Although the R-squared statistic is greater than 0.90 for both equations, the reported value of the statistic may be somewhat inflated by the Plumper-Troeger multi-stage estimation procedure, which measures the statistic only in the last stage of the procedure.

[9] The economic theory underlying the gravity model suggests that the estimated coefficient of the joint GDP level variable should approximate unity when the dependent variable of the estimating equation is bilateral trade. The expected sign of the joint GDP per capita variable is uncertain, but in our estimation results it appears to vie with the joint GDP level variable for statistical significance in explaining both bilateral trade flows and FDI stocks.

under the generalized system of preferences (GSP).[10] In addition to distance, the principal "resistance factors" identified by the gravity model are the status of being a landlocked country or being a member of a country pair with a common colonizer (e.g., India and Kenya -- former UK colonies).

The significant inter-relationships between trade and foreign investment are also important to note in the estimation results. The greater is the joint stock of foreign investment in partner countries, the greater is their mutual trade. Analogously, the greater is the joint trade of partner countries with the world, the greater the level of investment of the two countries in each other's economy, presumably attracted both by their mutual trade and by their general openness to the global economy.

Finally, as a stylistic device in Table 1, the coefficient estimates for the FTA indicator variables are "framed" for emphasis. Like the estimates for the other explanatory variables, they are statistically significant in most instances and predominantly bear the anticipated positive sign. The significant negative coefficient estimated for the NAFTA indicator variable in the inward FDI stocks equation is the most important anomaly. Possibly this coefficient reflects appreciable tariff-jumping investment between the United States and Canada before the NAFTA was established in 1994, and then some natural "unwinding" of investment positions between the two NAFTA partners after 1994.[11]

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[10] Under the generalized system of preferences, a number of advanced countries extend trade preferences to less developed countries on a nonreciprocal basis. The GSP programs of major industrial and other countries are monitored by the UN Conference on Trade and Development, including through a series of manuals describing the individual programs (UNCTAD 2005).

[11] Not reported individually in Table 1 are estimated year-effects representing global influences on trade and investment over the estimation period 1976-2005, and "cross" FTA indicators that indicate the influence of the FTAs on trade and investment by member countries with non-member countries. However, it is interesting to note that estimated coefficients for cross-FTA indicators in the gravity model equation for bilateral trade are widely positive and significant. In other words, the FTAs appear to stimulate not only intra-bloc trade but also trade with countries outside the trading blocs – an unexpected form of "trade diversion". For further discussion, see DeRosa and Hufbauer (2007).

Table 2 summarizes the bilateral trade and investment impact percentages implied by the FTA coefficients estimates in Table 1. In some cases, the implied, medium-to-long term trade and investment impacts are substantially greater than 100 percent. In general, however, the positive impact effects (measured by an elasticity percentage) range between 15 percent and 100 percent.

The prospective impacts on trade and foreign investment resulting from greater economic integration may be simulated using our gravity model estimations, once we choose appropriate FTA coefficients for application to the Maghreb scenarios. In fact, the nature of the FTAs underlying the various FTA coefficient estimates in Table 1 and Table 2 differ importantly. The EU and NAFTA coefficients should be regarded as representing the potential impacts of the deepest, most thoroughgoing economic integration schemes, followed by the coefficients for the EU FTAs and CMAS FTAs which are representative of the recent burgeoning crop of high-standard FTAs established with emerging market countries. At the other end of the FTA spectrum are a large number of early, and frequently unsuccessful, bilateral and regional FTAs among less developed countries, a description that includes the Arab Maghreb Union (AMU). Notably, however, two prominent developing country FTAs shown in Table 2 – the Mercosur in Latin America and the AFTA in Southeast Asia – evidence some of the largest trade and investment impact coefficients estimated for the several groups of FTAs identified in the model. These considerations play a prominent role in our selection of FTA coefficients for application to the Maghreb economic integration scenarios.

Maghreb Integration Scenarios

Established in 1989 by Algeria, Libya, Mauritania, Morocco and Tunisia, the Arab Maghreb Union (AMU) began with the principal objective of creating a free trade area in goods, services, and factors of production by 1992, and a common market by 2000. To

date, however, the free trade area is yet to be fully established, and economic integration between countries in the region remains weak at best.[12]

Efforts to advance and strengthen the Maghreb Union have been attempted in recent years, including prominently by the World Bank and the International Monetary Fund.[13] Beyond simply reinvigorating the original AMU plan, these proposals have emphasized initiatives to build greater private sector support in the Maghreb region for completing the Maghreb Union, to accelerate and deepen EU plans for widely establishing bilateral FTAs with the Maghreb countries (culminating in the envisioned Euro-Mediterranean free trade area), and, more generally, to increase integration of the Maghreb countries with the world economy.

To this mix of recommendations, we add consideration of the US plan announced by President George W. Bush in (2003), namely, to establish high-standard US bilateral FTAs with the countries of the Middle East and North Africa (MENA), and eventually to establish a US-MENA free trade area.[14]

Using the Peterson Institute gravity model, we carry out three basic sets of scenarios for achieving greater economic integration of the Maghreb countries that yield estimates of the impacts of the integration schemes on aggregate merchandise trade and inward FDI stocks for the individual Maghreb countries, the European Union, and the United States:

1. Arab Maghreb Union Free Trade Area
2. EU and US Bilateral FTAs with Algeria, Morocco, and Tunisia
   - EU-Algeria FTA, EU-Morocco FTA, EU-Tunisia FTA

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[12] See Dennis (2006). For in-depth analysis, see the examination by Brunel in chapter XX of this report, and see Brenton, Baroncelli, and Malouche (2006).

[13] See, among others, World Bank (2006) Allain and Loko (2007), and Tahari et al. (2007).

[14] To date, the United States has signed FTAs with Israel, Jordan, Morocco, and Bahrain in the MENA region. Additionally, it has begun FTA negotiations with Oman and the UAE. See
http://www.ustr.gov/Trade_Agreements/Regional/MEFTA/Section_Index.html.

- EU-Algeria+ FTA, EU-Morocco+ FTA, EU-Tunisia+ FTA
- US-Algeria FTA, US-Morocco FTA, US-Tunisia FTA
- US-Algeria+ FTA, US-Morocco+ FTA, US-Tunisia+ FTA

3. EU and US Regional FTAs with the Maghreb Countries
    - EU-Maghreb Free Trade Area
    - US-Maghreb Free Trade Area
    - EU-US-Maghreb Free Trade Area

The first scenario represents a meaningful free trade and investment area among the five AMU countries, largely as envisioned by the current Maghreb Union plan for regional economic integration.

In the second set, the integration scenarios depict arguably less ambitious, but potentially more outward-oriented bilateral FTAs by the European Union and United States with the three major Maghreb countries, Algeria, Morocco, and Tunisia, individually. These scenarios are regarded as the most politically feasible approaches to establishing and deepening Maghreb integration in the near future. They are also regarded as potential instruments for encouraging the Maghreb countries to reach out gradually to one another and liberalize intra-regional economic relations, in part to offset the distortions to foreign trade and especially investment that can emerge from the hub-and-spoke design of EU and US bilateral FTAs.[15] The implications of this sort of regional outreach are illustrated by hypothesized "plus" scenarios for EU and US bilateral FTAs with the three major Maghreb countries. In the "plus" scenarios, the European Union and United States strike bilateral FTAs with the three individual Maghreb countries as before, but additionally the three countries simultaneously eliminate barriers to trade and investment with their Maghreb Union partners, thereby widening the liberalization of their markets vis-à-vis the entire Maghreb region.

The third and last set of scenarios depicts the establishment of full-fledged EU and US regional free trade areas with the Maghreb countries, individually by the European Union

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[15] Wonnacott (1996).

and the United States, and on a combined basis. These scenarios envision the widest possible liberalization of the Maghreb countries vis-à-vis one another and the global economy (through their integration with either the European Union or the United States).

The final element of the scenarios is the selection of appropriate gravity model FTA coefficients for the simulation analysis. Our choice of coefficient estimates for the Maghreb Union scenario and EU-Maghreb FTA scenarios is straightforward. We assume that the trade and investment impacts of the hypothesized AMU free trade area will be governed by the gravity model coefficient estimates for the group of Other FTAs (Tables 1 and 2), whereas those of the hypothesized EU bilateral and regional FTAs will be governed by the coefficient estimates for the group of EU FTAs.

Choosing estimates for the US bilateral and regional FTA scenarios is more difficult. In particular, we are hesitant to specify the NAFTA coefficients estimated by our gravity model. The anomaly of the negative coefficient estimated for NAFTA in the gravity model for inward FDI stocks has already been mentioned. Additionally, the estimated coefficient for NAFTA in the gravity model for merchandise trade is the largest estimated FTA coefficient in our gravity model (implying a trade impact elasticity of 123 percent in Table 2). To avoid these extremes, and the uncertainties that underlie them, we have decided to represent the trade and investment impacts of the bilateral and regional FTAs between the United States and Maghreb countries by the average of the estimated coefficients for the CMAS FTAs and AFTA. This assumption essentially balances the experience of recent high-standard FTAs between the United States and advanced countries, such as Australia and Singapore, against the experience of the relatively dynamic ASEAN developing countries with regional free trade. The assumption implies an average impact of US-Maghreb FTAs on bilateral trade of about 55 percent and on bilateral inward FDI stocks of about 85 percent.

Finally, in the enhanced EU and US FTA scenarios, we assume that, by extending some preferences to Libya and Mauritania, and among themselves, the three major Maghreb countries (Algeria, Morocco and Tunisia) will achieve only half of the percentage gains

in trade and investment that the European Union and United States achieve in expanding their economic relations with the three major Maghreb countries. Essentially, this assumption recognizes the reality of current intra-Maghreb relations, which since the adoption of the Arab Maghreb Union have been slow to move forward decisively and quickly to open Maghreb borders to greater regional trade and investment.

Simulation Results

The gravity model simulation results for merchandise trade and inward stocks of foreign direct investment of the Maghreb countries, the European Union, and the United States under the three sets of Maghreb integration scenarios are reported in Tables 3 and 4, respectively. To facilitate comparison of the results, the two tables also report the base levels of Maghreb, EU, and US trade and FDI stocks in the gravity model, and the simulated trade and investment impacts of the integration scenarios expressed as percentages of the base level of trade and investment vis-à-vis the world for each of the countries.

The impacts of the integration scenarios were obtained by first predicting trade and investment outcomes in the gravity model over the period 2001-2005, assuming that the relevant FTA indicator (for example, the EU FTAs variable in the case of the EU bilateral and regional FTAs) was zero. Then, the FTA variable was replaced by an FTA indicator tailored specifically to the individual scenario, and the gravity model was re-solved to predict the new trade and investment outcomes over the same period. Finally, the difference between the second and the first values predicted by the gravity model were averaged over the five period (at 2005 prices) to determine the average annual impacts for trade and investment under each scenario reported in Tables 3 and 4.

It is important to note that, through this methodology, the gravity model provides estimates of the bilateral impacts of the different Maghreb integration scenarios even where no underlying trade or investment may be reported. In other words, impacts are

computed on the basis of the predictions of the gravity model assuming that the trade or investment levels of the partner countries conform to the norms estimated by the model for other country pairs with similar characteristics. In those cases where no trade or investment is reported, the estimated impacts are substantial ***underestimates*** because they ascribe base levels of trade or investment predicted by the gravity model where in fact no trade and or investment may actually take place.[16]

Trade Impacts. Consider first the trade impacts of the three sets of Maghreb integration scenarios summarized in Table 3. Before turning to the results, it should be emphasized that all the calculations refer to merchandise trade. At this time, gravity model data sets do not cover service trade flows.

Given the small economic size of the Maghreb Union and the limited diversity of endowments among its members, a full-fledged free trade area among the Maghreb countries yields a gain in total trade (merchandise exports plus imports) of only about $1 billion (or about 1 percent of base total trade). Notwithstanding this modest impact for the AMU bloc as a whole, the impacts on the total trade of Mauritania ($122 million or 8.7 percent) and the total imports of Libya ($122 million or 2.2 percent) are significant, and would substantially improve general welfare in both countries.

As emphasized previously, fully establishing the Maghreb Union has not proven politically feasible to date, owing to deep-seated rivalries. More feasible may be the establishment of FTAs between the European Union or the United States, on the one hand, and the major Maghreb countries on the other (Algeria, Morocco, and Tunisia). The simulation results in Table 3 support this view, although the economic benefits are clearly concentrated in the combined imports of the three Maghreb partner countries ($2-to-$3 billion or about 5-to-6 percent of combined base imports of the three Maghreb countries). Although the European Union trades more extensively than the United States with the Maghreb countries, the US FTA impacts on Maghreb Union trade are somewhat

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[16] These instances arise in the simulation results mainly for inward FDI stocks (Table 4), where the percentage impacts are reported to be greater than 999 percent.

greater than the impacts of the EU FTA because the assumed gravity model coefficients for US FTAs are larger in value.

Interestingly, the "plus" integration scenarios involving the extension of trade and investment preferences under the EU and US FTAs by Algeria, Morocco, and Tunisia both to one another and to Libya and Mauritania yield only modest trade gains to the latter two countries. Yet such an approach to leveraging wider liberalization in the Maghreb might still represent the most feasible path for spreading globalization more widely and quickly in the region.[17]

While the bilateral EU and US FTAs with the three major Maghreb countries are probably the most politically feasible route in the near-term, and would yield substantial economic benefits to the Maghreb partners, still of interest are the potential economic gains from true globalization of the AMU countries. That scenario is represented by the hypothesized EU and US regional FTAs in the third and last set of Maghreb integration calculations in Table 3.

As expected, the simulated trade gains under the regional FTA scenarios are the largest of all, for the Maghreb countries considered individually and as a bloc. Total Maghreb trade expands by $4-to-$5 billion (3.0-to-4.5 percent) when the European Union and the United States separately establish free trade areas with the Maghreb countries, and it expands by nearly $9 billion (nearly 8 percent) when both the European Union and the United States establish regional FTAs with the AMU countries (Table 3).

The estimated impacts on Maghreb imports are especially strong. Under a combined EU-US-Maghreb FTA, total Maghreb imports expand by $6.7 billion or nearly 14 percent. Moreover, the stimulus to the imports of the individual Maghreb countries ranges

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[17] Macroeconomic benefits to EU and US economies are clear not appreciable in percentage terms from the simulation results presented in Table 3. EU and US trade with the Maghreb countries does expand, however, and to the individual EU and US exporters and importers involved in the expansion of trade, the gains from trade may well be substantial and significant.

between about 10 percent (Tunisia) and 45 percent (Mauritania). At the same time, total Maghreb exports expand substantially less, $2.1 billion or 3.2 percent. Yet the export gains are significant in percentage terms for Mauritania (35 percent) and for Morocco and Tunisia (4 percent). Moreover, if Maghreb imports expanded as much as the models suggest, it seems likely that greater efficiencies would stimulate exports in ways not covered – for example larger service exports. Furthermore, the potential trade gains could create considerable incentives for the Maghreb countries to build on the foundations of either EU or US FTAs, through a process of competitive liberalization, to embrace a wide range of economic reforms.

FDI Impacts. In recent years it has become widely accepted that trade and FDI are closely linked, with worldwide investment by multinational firms importantly motivating trade flows and guiding their directions. The limited inward stock of FDI in the Maghreb countries, especially small outside the energy sector, reflects the region's failure to keep pace in today's world economy.

The FDI impacts of the three sets of Maghreb integration scenarios resented in Table 4 provide an indication of the extent to which greater openness might boost foreign investment in the Maghreb region. Broadly speaking, the FDI impacts are similar to the trade impacts. They indicate that inward FDI stocks are increased substantially more when closer economic ties are pursued with either the European Union or the United States rather than simply on a Maghreb Union basis.[18] Closer Maghreb economic ties with the European Union and the United States tend to result in greater impacts on inward FDI stocks than outward FDI stocks. The FDI impacts for EU bilateral and regional FTAs are larger than those for US FTAs because the gravity model predicts substantially greater base period investment between the Maghreb countries and the European Union, than between the Maghreb countries and the United States.

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[18] EU and US bilateral and regional FTAs with the Maghreb imply very little change in inward FDI for either the European Union or the United States.

In the most ambitious case of the hypothesized EU-US-Maghreb free trade area, total Maghreb inward FDI stocks would increase by $5.8 billion (75 percent), compared to the simulated increase in total Maghreb outward FDI stocks amounting to $3.9 billion. These potential impacts of Maghreb integration scenarios on foreign direct investment reinforce the conclusions of the previous discussion of trade flows. In their own right, the FDI calculations add significantly to the potential gains that the Maghreb countries might enjoy by forging closer economic relations with the European Union and the United States, through competitive liberalization and other strategies to engage the Maghreb region with the world economy.

Box 1. Trade and FDI Linkages in the Gravity Model

The impacts on Maghreb trade and investment of proposed EU and US bilateral and regional FTAs with the countries of the region should be determined simultaneously in the Peterson Institute gravity model. This is because the separate gravity model equations for bilateral trade and inward FDI stocks are interrelated by the inclusion of the joint FDI variable and the joint trade variable, respectively, as explanatory variables in the two equations. Thus, an initial expansion of either bilateral trade or FDI under an EU or US FTA with one or more Maghreb countries should lead to additional rounds of increases in bilateral trade and stocks of FDI for the FTA partners until a final equilibrium is reached at levels greater than those reported in Tables 3 and 4.

Algebraically determining the appropriate adjustment of the two "right-hand side" variables -- joint trade with the world and joint total inward FDI stocks -- to changes in the two "left-hand side" (or predicted) variables in the gravity model -- bilateral trade and bilateral FDI stocks -- reveals that the relationships involve calculations of changes in two-way trade and FDI stock holdings weighted by baseline shares of both FTA partners and non-FTA partners that are too extensive to be computed readily in successive simulations of the Peterson gravity model.

Nonetheless, we can take advantage of the fact that initial bilateral impacts of FTAs on bilateral trade and inward FDI stocks in the gravity model are highly symmetric when measured in proportional changes. Then, the adjustment in two right-hand side variables can be approximated by a simple linear relationship. Specifically, based on baseline shares of country pairs in their joint trade with the world and their joint inward FDI stocks in the gravity model, we assume that the proportional change in the joint trade variable is equal to 0.10 times the corresponding proportional change in the predicted level of bilateral exports, and that the proportional change in the joint inward FDI stocks variable is equal to 0.15 times the corresponding proportional change in the predicted bilateral level of "outward" FDI stocks.

The results of incorporating these linkages in the gravity model and then applying the model to the case (chosen for illustration) of the enhanced ("plus") EU FTAs with Algeria, Morocco, and Tunisia are presented in Table 5, along side the results for the same Maghreb integration scenario without linking trade and FDI first reported in Tables 3 and 4. In the simultaneous gravity model, "general equilibrium" is effectively reached after five successive iterations of the model after the establishment of the enhanced EU FTAs with the three major Maghreb countries.

In Table 5, the results of incorporating the trade-FDI linkages are fairly straightforward. The simulated trade impacts of the enhanced EU FTAs are greater than found without the trade-FDI linkages, but only marginally so (about 2 percent across the board). Thus, total Maghreb trade expands by nearly $2.9 billion when the trade-FDI linkages are built into the model, compared to $2.8 billion without the linkages.

The "general equilibrium" impacts on FDI stocks, however, are substantially greater than those found without the trade-FDI linkages. In fact, they are over 5 percent greater across the board. Total outward and inward Maghreb FDI stocks expand by nearly $4.1 billion, compared to $3.9 billion without taking into account the linkages. The substantially greater impacts on FDI stocks when the trade-FDI linkages are included in the model are

the consequence of the relatively large estimated coefficient (0.54) in Table 1 for the joint trade explanatory variable in the gravity model equation for FDI stocks.

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Table 1. Gravity Model Estimates for Trade and Inward FDI Stocks Specifying Major Customs Unions and Free Trade Agreements, 1976-2005

	Merchandise Trade	Inward FDI Stocks
Distance	-0.91 ***	-0.50 ***
Joint GDP	0.03 ***	-0.10 ***
Joint GDP per capita	0.04 ***	0.22 ***
Common language	-0.03 ***	0.98 ***
Common border	0.40 ***	0.62 ***
Landlocked	-0.82 ***	-0.35 ***
Island	0.48 ***	0.59 ***
Land area	0.26 ***	0.16 ***
Common colonizer	-0.64 ***	-0.34 ***
Current colony	0.42 ***	-0.37
Ever a colony	1.06 ***	1.74 ***
Common country	1.11 ***	2.09 ***
GSP	0.37 ***	0.19 ***
Joint FDI stocks	0.11 ***	…
Joint trade with all partners	…	0.54 ***
EU	0.25 ***	0.62 ***
EU FTAs	0.15 ***	0.17 ***
NAFTA	0.80 ***	-0.37 ***
Mercosur	0.69 ***	1.25 ***
CMAS FTAs	0.08 ***	0.52 ***
AFTA	0.69 ***	0.80 ***
Other FTAs	0.34 ***	0.07 **
Constant	7.67 ***	-7.94 ***
R-squared	0.96	0.92
Observations (thousands)	36	36
Clusters (thousands)	4	4

Source and Notes: Fixed-effects estimates obtained by a multi-step method developed by Plumper and Troeger (2007). Dependent variables are bilateral trade and bilateral inward FDI stocks, both measured in log real terms. Distance, joint real GDP, joint real GDP per capita, joint land area, joint real FDI stocks, and joint real trade with all partners are measured in log terms. Estimates for year-effects and indicators of FTA members' trade and investment with non-member countries are not reported. *,**,*** denote statistical significance at the 10, 5, and 1 percent levels.

Trade agreements represented by indicator variables are: European Union (EU), European Free Trade Area (EFTA, not reported), EU bilateral free trade agreements (EU FTAs), North American Free Trade Area (NAFTA), Southern Common Market (Mercosur), Chile, Mexico, Australia, and Singapore bilateral free trade agreements (CMAS FTAs), ASEAN Free Trade Area (AFTA), South Asia Free Trade Agreement (SAFTA, not reported), and all other customs unions and free trade agreements (Other FTAs).

Clusters are the number of ordered country pairs in the panel data set.

Table 2. Gravity Model Estimates for FTA Indicator Variables and Implied Impact Elasticities

	Merchandise Trade			Inward FDI Stocks	
	Coefficient Estimate	Impact Elasticity		Coefficient Estimate	Impact Elasticity
EU	0.25	29%		0.62	85%
EU FTAs	0.15	16%		0.17	18%
NAFTA	0.80	123%		-0.37	-31%
Mercosur	0.69	98%		1.25	247%
CMAS FTAs	0.08	9%		0.52	68%
AFTA	0.69	99%		0.80	123%
Other FTAs	0.34	41%		0.07	7%

Source: Table 1 and author's calculations.

Table 3. Average Impacts on Merchandise Trade of Maghreb Economic Integration Scenarios, 2001-2005
(Millions of US Dollars at 2005 prices; percentages)

	Base	AMU	EU & US Bilateral FTAs				EU & US Regional FTAs			AMU	EU & US Bilateral FTAs				EU & US Regional FTAs		
	Trade with the World	Arab Maghreb Union	EU-Alg Eu-Mor EU-Tun	EU-Alg+ Eu-Mor+ EU-Tun+	US-Alg US-Mor US-Tun	US-Alg+ US-Mor+ US-Tun+	EU-Maghreb	US-Maghreb	EU-US-Maghreb	Arab Maghreb Union	EU-Alg Eu-Mor EU-Tun	EU-Alg+ Eu-Mor+ EU-Tun+	US-Alg US-Mor US-Tun	US-Alg+ US-Mor+ US-Tun+	EU-Maghreb	US-Maghreb	EU-US-Maghreb
Total Trade (X+M)										**Total Trade (X+M, Percentages)**							
Maghreb	115,130	893	2,654	2,793	3,110	3,534	3,604	5,216	8,820	0.8	2.3	2.4	2.7	3.1	3.1	4.5	7.7
Algeria	42,410	254	469	518	1,734	1,885	620	2,258	2,878	0.6	1.1	1.2	4.1	4.4	1.5	5.3	6.8
Libya	24,073	242	0	32	0	95	429	703	1,133	1.0	0.0	0.1	0.0	0.4	1.8	2.9	4.7
Mauritania	1,406	122	0	9	0	26	217	340	558	8.7	0.0	0.6	0.0	1.9	15.5	24.2	39.7
Morocco	26,738	138	1,770	1,792	793	862	1,846	1,061	2,907	0.5	6.6	6.7	3.0	3.2	6.9	4.0	10.9
Tunisia	20,504	136	415	442	583	665	492	853	1,345	0.7	2.0	2.2	2.8	3.2	2.4	4.2	6.6
EU	6,182,919	0	2,654	2,654	0	0	3,086	0	3,086	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
US	2,285,789	0	0	0	3,110	3,110	0	3,411	3,411	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
World	16,407,561	893	5,308	5,447	6,219	6,643	6,691	8,627	15,318	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Exports (X)										**Exports (X, Percentages)**							
Maghreb	66,296	446	461	531	198	410	934	1,194	2,128	0.7	0.7	0.8	0.3	0.6	1.4	1.8	3.2
Algeria	26,952	136	170	186	32	81	251	313	564	0.5	0.6	0.7	0.1	0.3	0.9	1.2	2.1
Libya	18,506	120	0	32	0	95	213	271	485	0.6	0.0	0.2	0.0	0.5	1.2	1.5	2.6
Mauritania	755	46	0	9	0	26	100	166	265	6.1	0.0	1.2	0.0	3.5	13.2	21.9	35.2
Morocco	11,031	73	172	177	105	121	211	245	456	0.7	1.6	1.6	1.0	1.1	1.9	2.2	4.1
Tunisia	9,053	70	119	128	61	88	158	199	357	0.8	1.3	1.4	0.7	1.0	1.7	2.2	3.9
EU	3,025,399	0	2,192	2,192	0	0	2,412	0	2,412	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.1
US	842,357	0	0	0	2,911	2,911	0	3,120	3,120	0.0	0.0	0.0	0.3	0.3	0.0	0.4	0.4
World	8,203,780	446	2,654	2,724	3,110	3,322	3,345	4,313	7,659	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Imports (M)										**Imports (M, Percentages)**							
Maghreb	48,834	446	2,192	2,262	2,911	3,123	2,671	4,022	6,692	0.9	4.5	4.6	6.0	6.4	5.5	8.2	13.7
Algeria	15,458	118	298	332	1,701	1,804	368	1,945	2,314	0.8	1.9	2.1	11.0	11.7	2.4	12.6	15.0
Libya	5,567	122	0	0	0	0	216	432	648	2.2	0.0	0.0	0.0	0.0	3.9	7.8	11.6
Mauritania	651	75	0	0	0	0	118	175	292	11.6	0.0	0.0	0.0	0.0	18.1	26.8	44.9
Morocco	15,707	65	1,598	1,616	688	742	1,635	816	2,451	0.4	10.2	10.3	4.4	4.7	10.4	5.2	15.6
Tunisia	11,451	66	296	314	522	577	334	654	988	0.6	2.6	2.7	4.6	5.0	2.9	5.7	8.6
EU	3,157,520	0	461	461	0	0	675	0	675	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
US	1,443,433	0	0	0	198	198	0	292	292	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
World	8,203,780	446	2,654	2,724	3,110	3,322	3,345	4,313	7,659	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

Source: Peterson Institute gravity model.

Table 4. Average Impacts on Inward FDI Stocks of Maghreb Economic Integration Scenarios, 2001-2005
(Millions of US Dollars at 2005 prices; percentages)

	Base	AMU	EU & US Bilateral FTAs				EU & US Regional FTAs			AMU	EU & US Bilateral FTAs				EU & US Regional FTAs		
	Inward FDI Stocks	Arab Maghreb Union	EU-Alg Eu-Mor EU-Tun	EU-Alg+ Eu-Mor+ EU-Tun+	US-Alg US-Mor US-Tun	US-Alg+ US-Mor+ US-Tun+	EU-Maghreb	US-Maghreb	EU-US-Maghreb	Arab Maghreb Union	EU-Alg Eu-Mor EU-Tun	EU-Alg+ Eu-Mor+ EU-Tun+	US-Alg US-Mor US-Tun	US-Alg+ US-Mor+ US-Tun+	EU-Maghreb	US-Maghreb	EU-US-Maghreb
Total Outward and Inward FDI Stocks										**Total Ouward and Inward FDI Stocks (Percentages)**							
Maghreb	8,096	156	3,719	3,859	1,366	1,996	5,376	4,356	9,732	1.9	45.9	47.7	16.9	24.6	66.4	53.8	120.2
Algeria	4,827	54	1,370	1,423	779	1,013	1,524	1,563	3,087	1.1	28.4	29.5	16.1	21.0	31.6	32.4	64.0
Libya	458	50	0	33	0	155	1,197	1,436	2,633	11.0	0.0	7.2	0.0	33.8	261.2	313.6	574.7
Mauritania	35	2	0	1	0	5	161	50	212	6.3	0.0	3.2	0.0	15.2	455.8	142.1	597.9
Morocco	2,286	20	1,506	1,528	268	367	1,563	555	2,118	0.9	65.9	66.8	11.7	16.0	68.4	24.3	92.6
Tunisia	489	30	842	874	318	455	931	751	1,682	6.1	172.2	178.6	65.1	93.1	190.2	153.6	343.8
EU	7,478,118	0	3,719	3,719	0	0	4,926	0	4,926	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
US	3,286,223	0	0	0	1,366	1,366	0	2,081	2,081	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
World	14,881,710	156	7,437	7,578	2,731	3,361	10,301	6,437	16,738	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Outward FDI Stocks										**Outward FDI Stocks (Percentages)**							
Maghreb	397	78	1,393	1,463	254	569	2,190	1,736	3,926	19.7	351.2	368.9	64.0	143.4	552.0	437.5	989.5
Algeria	0	30	643	662	169	255	726	595	1,321	6,584.4	>999.9	>999.9	>999.9	>999.9	>999.9	>999.9	>999.9
Libya	71	27	0	33	0	155	566	709	1,275	37.9	0.0	46.4	0.0	218.9	801.2	>999.9	>999.9
Mauritania	2	1	0	1	0	5	78	32	110	72.3	0.0	70.6	0.0	331.9	>999.9	>999.9	>999.9
Morocco	323	7	388	394	23	44	410	123	533	2.1	120.1	121.8	7.0	13.7	127.0	38.0	164.9
Tunisia	1	14	362	374	62	109	410	278	687	1,801.8	>999.9	>999.9	>999.9	>999.9	>999.9	>999.9	>999.9
EU	3,875,859	0	2,325	2,325	0	0	2,961	0	2,961	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.1
US	1,781,483	0	0	0	1,112	1,112	0	1,483	1,483	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
World	7,440,855	78	3,719	3,789	1,366	1,681	5,151	3,219	8,369	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Inward FDI Stocks										**Inward FDI Stocks (Percentages)**							
Maghreb	7,699	78	2,325	2,396	1,112	1,427	3,186	2,621	5,806	1.0	30.2	31.1	14.4	18.5	41.4	34.0	75.4
Algeria	4,826	24	727	761	610	758	798	968	1,766	0.5	15.1	15.8	12.6	15.7	16.5	20.1	36.6
Libya	387	23	0	0	0	0	630	728	1,358	6.0	0.0	0.0	0.0	0.0	162.7	187.9	350.5
Mauritania	34	1	0	0	0	0	83	19	102	3.2	0.0	0.0	0.0	0.0	247.1	55.2	302.3
Morocco	1,963	14	1,118	1,135	246	323	1,153	432	1,585	0.7	56.9	57.8	12.5	16.4	58.7	22.0	80.7
Tunisia	488	16	481	500	256	346	521	474	995	3.3	98.4	102.4	52.5	70.9	106.7	97.0	203.7
EU	3,602,259	0	1,393	1,393	0	0	1,965	0	1,965	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
US	1,504,740	0	0	0	254	254	0	598	598	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
World	7,440,855	78	3,719	3,789	1,366	1,681	5,151	3,219	8,369	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1

Source: Peterson Institute gravity model.