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The Geography of Trade in Goods and Asset Holdings

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Abstract:

Gravity models have been widely used to describe bilateral trade in goods. Recently, Portes and Rey [1999] applied this framework to cross border equity flows and found that distance, which proxies information asymmetries in financial markets, is a surprisingly very large barrier to cross-border asset trade. We adopt here a different point of view and explore the complementarity between bilateral trade in goods and bilateral asset holdings. We jointly study trade in goods and banking assets in a simultaneous gravity equations framework using different instruments for both endogenous variables. To instrument trade in goods, we choose geographical variables (excluding distance) and data on bilateral transport costs. For asset holdings, we use legal similarities between countries and data on the international taxation of withheld capital. We find that the strong correlation between bilateral trade in goods and asset holdings is not simply due to distance: bilateral trade in goods generates bilateral asset holdings and *vice versa*. Those effects are of first order magnitude: a 10% increase in trade generates a 6 to 7% increase of asset holdings, and a 10% increase in banking claims induces a 2 to 3% increase in trade. Finally, we investigate the question of the remaining impact of distance. We find out that the impact of distance on trade in goods is only slightly reduced, while for asset holdings, a large part of the effect of distance is going through trade.

Keywords: Gravity Models, International Finance, International Trade, Simultaneous Equations

Résumé:

Nous explorons la complémentarité entre commerce de biens et détentions internationales d'actifs financiers. Dans un système d'équations de gravité simultanées, nous montrons que le commerce de biens accroît les échanges financiers (et vice-versa) et que ces effets sont de premier ordre. Une hausse de 10% du commerce bilatéral accroît les échanges financiers bilatéraux de 6-7%. Réciproquement, une hausse de 10% des échanges financiers induit une hausse du commerce de 2-3%.

Mots-clés: Commerce international, Équations simultanées, Finance internationale, Gravité

JEL Classification: F36, F10, C31

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Abstract

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Keywords: gravity models, international finance, international trade, simultaneous equations.
Jel Classification: F36, F10, C31.

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1 Introduction

The determinants of international asset holdings have recently received renewed attention. Existing theories are mostly based on portfolio choice models and put forward risk-sharing as the main motive for cross-border asset trade. However, this literature has been empirically extremely disappointing. Indeed, Capital Asset Pricing Models predictions do not fit data on international portfolios for two main reasons. First, those models were unable to replicate the size of the "home bias" in country portfolios. If twenty years ago the segmentation of financial markets could well explain the "home bias puzzle", it is not likely to be the case today. Second, countries seem to invest much more in geographically close economies. Portes and Rey [1999] highlight the very large impact of geography on cross-border equity flows: when the physical distance is doubled, capital flows are at least divided by two. To explain this surprising result, they argue that informational asymmetries lead to higher transaction costs between distant economies. Moreover, as they point out, since distant economies should be a better hedge for regional risk, this result is hard to justify in a world where investors want to diversify their risk. Those results suggest that barriers to international investment are still large, which is at odds with the popular view of intense and widespread financial globalization.

This puzzling effect of distance on capital flows leads to the following question: does distance directly affect international financial investment or does the negative impact of distance go through another feature of globalization? In this paper, we argue that distance affects bilateral asset holdings mainly through its impact on trade in goods. The argument is the following: assume that trade in goods is a powerful determinant of asset portfolios. In that case, since distance, understood as transport costs, reduces international trade in goods, it is likely to also reduce bilateral asset holdings. Indeed, we show that the "distance puzzle" documented by Portes and Rey is drastically reduced once we control for trade in goods. We find that the distance effect on asset holdings is at least divided by two. The remaining challenge is to explain why asset portfolios are induced by trade in goods.

Thus the second motivation of this paper is to analyze the complementarity between bilateral trade in goods and bilateral financial claims. Indeed, there are good reasons to think that trade in goods and trade in assets are closely related[1]. First, due to information asymmetries, entrepreneurs may learn about each other by trading goods and this information facilitates trade in financial assets (and vice versa). Second, in the complete markets model developed by Obstfeld and Rogoff [2000], trade costs (transportation costs or other barriers to international trade) induce a bias in investors portfolios towards domestic securities and securities of their trading partners. As a consequence, country portfolios would reflect trade patterns. Lane and Milesi–Feretti [2003] test this model in a N–countries set–up and find the expected effects. However, the argument can easily be reversed: it may be that transaction costs in financial markets (pure transaction costs or informational costs) make agents exchange goods with countries with whom

[1] Obstfeld and Rogoff [2000], Rose [2000], Rose and Spiegel [2002] and Serrat [2001] provide theoretical arguments for such a complementarity between trade in goods and asset holdings.

they can easily exchange securities. As a consequence, international investment patterns would impact trade flows.

Are those relations between trade and finance of first–order magnitude: in other words, can we still model international trade and international investment separately ? We investigate this question empirically and the answer is an unambiguous no: we find a very robust and significant effect of trade on financial asset holdings. Moreover, the causality runs significantly in both ways although the impact of asset holdings on trade in goods is smaller.

In line with Portes and Rey [1999], we consider the "home bias" as given and focus on the determinants of geographical asset holdings using a "gravity equation" set-up[2]. We use a dataset[3] which breaks down international banking assets by countries[4]. We find that informational frictions decrease bilateral financial claims, institutional and cultural proximity affect positively international asset holdings and standard financial motives have marginal effects. Those results are consistent with the findings of Portes and Rey. However, we also show that bilateral trade patterns are a very strong determinant of bilateral asset holdings.

In order to address the issue of reverse causality (between bilateral trade and bilateral asset holdings), the use of good instruments is crucial. We use some geographical variables (excluding distance[5]) and data on bilateral transport costs to instrument bilateral trade in goods. Another set of instruments for bilateral financial asset holdings is required: using data on bilateral tax treaties (fiscal taxation of foreign capital and bilateral agreements on double–taxation) and some institutional proximity variables, we provide reasonable instruments which allow us to properly address the reverse causality issue. We estimate that a 10% increase in bilateral trade induces a 6 to 7% increase in bilateral financial assets holdings so that the effect of trade in goods on asset portfolios is quantitatively important. Conversely, a 10% increase in bilateral financial asset holdings induces a 2,5% increase in bilateral trade. This empirical methodology also allows us to identify the channel through which some variables affect bilateral trade (resp. bilateral holdings of financial assets): as mentioned before, we find that distance affects country portfolios mainly through its impact on trade. This suggests that globalization has gone much further on the financial side than on the real side. Finally, as a by-product, we find some interesting results on the "distance puzzle"[6] in the gravity equation of international trade: depending on the methodology, we reduce the impact of distance on trade in goods by around 20 percents. In order to test the robustness of our findings, we reestimated our gravity models using the same empirical methodology but with a different dataset (the "Coordinated Portfolio Investment Survey") which breaks down securities holdings

[2] "Gravity models" in which bilateral trade flows are explained by the size of the two partners and the distance between them, have been used since the 1960s and have provided a powerful predictor of bilateral trade flows.

[3] The Bank for International Settlements (BIS) consolidated International Banking Statistics.

[4] We use stock data whereas Portes and Rey use equity flow data.

[5] Since distance is likely to affect both endogenous variables

[6] What we call the "distance puzzle" is the fact that the negative impact of distance on bilateral trade is very large relative to transport costs (see Grossmann [1998]).

by countries[7]. All our results are confirmed qualitatively and quantitatively.

In section 2, we give some insights on the standard gravity models in international trade in goods and international asset portfolios : although it is not the main point of the paper, we reestimate the standard "gravity equations" for comparison purposes. In section 3, we properly address the question of the complementarity between international financial asset holdings and trade flows and give the estimates for the system of two simultaneous gravity equations. We analyze our main results and comment on the "correlation puzzle" that emerges from the empirics: we find that, even after controlling for trade and distance, investors still hold more financial assets from countries whose returns are positively correlated with their domestic stock market[8]. We also discuss the links between our empirical results and the existing theory on the complementarity between trade in goods and trade in assets. In section 4, we conclude.

2 Gravity Models and the Distance Puzzle

The "gravity equation" has been extensively used in the international trade literature from both a theoretical and an empirical point of view. The idea is very simple: import flows from country j to country i (Import_{ij}) are explained by countries sizes (GDP) and bilateral physical distance (Dist_{ij}). This simple rule leads to the following regression (where λ and μ should be close to one):

$$\log(\text{Import}_{ij}) = \alpha + \lambda \log(\text{GDP}_i) + \mu \log(\text{GDP}_j) - \beta \log(\text{Dist}_{ij}) + \varepsilon_{ij}$$

Portes and Rey [1999] apply this rule to asset trade and show that bilateral cross-border equity flows can also be described by market size and physical distance. From now on, a "gravity equation" refers to this type of rule.

2.1 Gravity Models for International Trade in Goods

There is a huge literature on international trade based on a "gravity equation" framework. We first briefly give the theoretical underpinnings that will motivate our empirical specifications.

2.1.1 Theoretical Background

We assume an exogenous number of varieties n_i produced in each country i ($1 \le i \le N$). A representative consumer in country i maximises its utility which depends on the flow of consumption c_{ijh} of all varieties h produced in country j (the elasticity of substitution across goods is assumed to be constant equal to $\sigma > 1$). We assume symmetry among varieties within a country such that $c_{ijh} = c_{ij}$ for all h.

$$C_i = \left(\sum_{j=1}^{N} \sum_{h=1}^{n_j} c_{ijh}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} = \left(\sum_{j=1}^{N} n_j c_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

[7] This dataset is quite different from the BIS dataset as it includes a larger part of securities and excludes cross-border bank lending.

[8] This surprising effect of the correlation also appeared in Portes and Rey [1999].

A good imported from country j is bought by an agent in country i at price $p_{ij} = (1+\tau_{ij})p_j$ where τ_{ij} is an iceberg-cost that features trade costs on international goods markets[9].

The budget constraint of agent i is then: $\sum_{j=1}^{N}(1+\tau_{ij})p_j n_j c_{ij} = Y_i = P_i C_i$ (where Y_i denotes the aggregate revenues of agent i and $P_i = \left[\sum_{j=1}^{N} n_j(1+\tau_{ij})^{1-\sigma} p_j^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$ is the aggregate price index in country i).

This leads to the following demand function for goods produced in country j:

$$c_{ij} = C_i \left(\frac{p_j(1+\tau_{ij})}{P_i}\right)^{-\sigma}$$

We deduce the bilateral value of imports from country j to country i:

$$\text{Import}_{ij} = Y_i P_i^{\sigma-1} n_j p_j^{1-\sigma}(1+\tau_{ij})^{1-\sigma}$$

Taking logs-:

$$\log(\text{Import}_{ij}) = \log(Y_i) + \log(n_j) + (\sigma-1)\log(P_i) + (1-\sigma)\log(p_j) + (1-\sigma)\log(1+\tau_{ij})$$

Once we suppose that trade costs are positively related with physical distance (Dist_{ij}) and some other control variables Z_{ij}^T, we easily deduce the standard "gravity equation" model:

$$\log(\text{Import}_{ij}) = \alpha + \log(Y_i) + \log(n_j) + (\sigma-1)\log(P_i) + (1-\sigma)\log(p_j) - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^T + \varepsilon_{ij}^T$$

Previous works on "gravity equation" have shown some relevant determinants of trade costs: Frankel *et al.* [1995] and Frankel and Rose [2002] show that Trade Agreements and Currency Unions boost trade. Rauch [1999,2001] puts forward the informational content of international trade costs. In other words, trade between people who know each other is less costly and as a consequence people who belong to the same social networks trade more. For example, countries which share a common language or had colonial links should trade more: the data confirm his argument. Combes *et al.* [2004] also provide some insights about the informational content of trade costs using French data. Anderson and Marcouiller [1999] show the importance of the contractual environment and find that "trade is reduced in response to hidden transaction costs associated with the insecurity of international exchange and a lack of contract enforcement".

2.1.2 Estimation strategies

Following our theoretical model, we propose three estimation strategies:

- **Specification (1)**

We proxy market sizes variables (Y_i) and (n_j) by countries GDP and leave price indices in the error term to estimate:

$$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j}\right) = \alpha - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{1T} + \varepsilon_{ij}^{1T}$$

[9] Where τ_{ii} is assumed to be zero.

We decide to normalize bilateral imports by the product of countries GDPs instead of putting market sizes as explanatory variables as it is usually done: this avoid eventual misspecification due to the endogeneity of GDPs[10]; however none of the following results depend on this choice.

This specification has the main advantage to keep variability in the three dimensions (country i, country j and bilateral dimension). However, as underlined by Anderson and Van Wincoop [2003], trade costs do matter for consumption prices P_i which might affect the estimated coefficient on trade cost variables.

- **Specification (2)**

We add importer country fixed-effects (and drop importer specific factors) to estimate:

$$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_i - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{2T} + \varepsilon_{ij}^{2T}$$

This is our preferred estimation since the number of parameters to estimate is reasonable according to the size of our dataset and allows us to control for trade costs appearing in the price index of the importer.

- **Specification (3)**

We control for fixed-effects in both dimensions (as recommended by Hummels [1999], Feenstra [2003]).

$$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_i + \alpha_j - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{3T} + \varepsilon_{ij}^{3T}$$

This estimation is fully consistent with the theoretical model and control for "multilateral resistance factors" (Anderson and Van Wincoop [2003]). However, the number of coefficients is very large which raises multicollinearity issues[11].

The "Distance Puzzle"

The "gravity equation" has been extensively estimated with different sets of regressors; however the coefficient on physical distance is systematically very high (β between 0.8 and 1.2 in many regressions): therefore, everything else equal, trade drops sharply with distance (a 10% increase in distance reduces trade by 8%). This estimate is huge compared to what transport costs would suggest (see Grossman [1998] or Anderson et al. [2003]) and has not decreased over time (although transportation costs have diminished). One can argue that the "gravity model" might be misspecified: an omitted variable (correlated with physical distance) might lead to an overestimation of β but the difficulty consists in finding the missing variable. The right one has not been found yet. Empirical works based on network effects (Rauch [1999,2001]) or informational asymmetries (Portes and Rey [1999])[12] help to solve the "Distance Puzzle" but β remains very high.

[10] This is equivalent to an estimation where the elasticity of bilateral imports with respect to market sizes are constrained to one. We thank an anonymous referee for this suggestion.

[11] Indeed, the number of importers is restricted by our dataset on financial assets, so that our fixed-effects α_j are estimated over at most 19 points.

[12] Portes and Rey reduce significantly the puzzle for a sample of industrialized countries: their estimate of β ranges from 0.3 to 0.55.

2.2 Gravity Models for International Financial Claims

The adaptation of the "gravity equation" framework to describe international trade in assets is much more recent. The seminal paper is Portes and Rey [1999][13] which shows that a "gravity equation" explains cross-border equity transactions at least as well as trade in goods transactions. They find that physical distance is also strongly negatively correlated with asset trade flows and argue that distance is a proxy for some informational costs. Using some proxies for information flows (telephone traffic between countries, newspaper circulation, bank branches), they confirm that informational flows enhance significantly asset trade. Although those information variables reduce the coefficient on distance, the latter remains high and very significant[14]: β is around 0.7 in most specifications which makes the "distance puzzle" even worse than for trade in goods. As underlined by Portes and Rey, financial assets are "weightless" and are not subject to transportation costs. Moreover, if investors want to diversify their risk, they should bias their portfolio towards distant countries assets as returns in those countries should be less correlated with domestic returns.

Some other papers use the "gravity equation" framework to describe bilateral foreign direct investment (Buch [2003], Mody *et al.* [2002,2003]): such a model accounts well for bilateral FDI flows. However, we think that the determinants of bilateral FDI flows are quite different from those of portfolio and debt flows. Especially, we should be very cautious with the impact of distance on FDI flows as FDI can be seen as a substitute of trade flows.

2.2.1 Theoretical Background

From a theoretical standpoint, Martin and Rey [2000] propose a model where a "gravity equation" of international trade in assets emerges. In their set-up, international trade in assets and international stock holdings coincide. We think that it is more natural to theoretically derive a "gravity equation" of stock holdings and the transposition to asset flows is not obvious. However, as underlined by Portes and Rey, when data on bilateral stocks and flows exist, it is easy to check that they are highly correlated.

We simplifiy Martin and Rey [2000] modelling by assuming an exogenous number of projects in each country[15]. Each country i $(0 \leq i \leq N)$ is populated with n_i risk averse agents. In the first period, agent h in country i (denoted h_i) is endowed with y_i units of traded goods (the numeraire) and a risky project. She consumes part of her endowment, sell shares of her project and buy shares of other agents projects in the first period. The number of shares for each project is normalized to one. Agents in country i pay $p_j(1 + \tau_{ij})$ for a share of a project run in country j (τ_{ij} is an iceberg cost that features the frictions on international financial markets)[16].

[13] Buch[2002] and Papaionnaou [2004] test a Gravity Model for Bilateral Banking Flows and Lane and Milesi-Feretti [2003] for Bilateral Equity Holdings.

[14] β is decreasing from 0.88 to 0.67.

[15] which equals the number of agents-investors.

[16] We assume: $\tau_{ii} = 0$. As shown by Martin and Rey, we also could apply the cost of holding foreign securities on the dividend stream without affecting the results as long as frictions are iceberg-type.

There are L equally likely states of nature in the second period. One project in country i run by agent h pays $\delta_{mh_i} d_{h_i} = \delta_{mh_i} d_i$ in state $m \in \{1, ..., L\}$ where $\delta_{mh_i} = 1$ if $h_i = m$ and zero otherwise. This stochastic environment makes assets imperfect substitutes and will create a demand for other agents' assets in order to diversify their risks.

The total number of projects is $M = \sum_{j=1}^{N} n_j$. We assume $M < L$, so that markets are incomplete.

Agent h in country i maximises the following two-period utility subject to a budget constraint (where $x_{k_j}^{h_i}$ is the number of shares bought by agent h in country i to agent k in country j):

$$\max_{\left\{c_{1,h_i},\ x_{k_j}^{h_i} \quad 1 \leq j \leq N,\ 1 \leq k_j \leq n_j\right\}} \left\{ c_{1,h_i} + \beta E \left(\frac{c_{2,h_i}^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} \right) \right\}$$
$$s.t \quad : \quad c_{1,h_i} + \sum_{j=1}^{N} \sum_{k_j=1}^{n_j} p_j (1+\tau_{ij}) x_{k_j}^{h_i} = y_i + p_i$$

Symmetry insures $x_{k_j} = x_j$, and we can rewrite the maximisation as:

$$\max_{c_{1,h_i},\ x_j^{h_i} \quad 1 \leq j \leq N} \left\{ c_{1,h_i} + \frac{\beta}{\left(1-\frac{1}{\sigma}\right) L} \left(\sum_{j=1}^{N} n_j \left(d_j x_j^{h_i} \right)^{1-\frac{1}{\sigma}} \right) \right\}$$
$$s.t \quad : \quad c_{1,h_i} + \sum_{j=1}^{N} n_j p_j (1+\tau_{ij}) x_j^{h_i} = y_i + p_i$$

Agent h_i in country i has the following asset demand for shares on individual projects in country j[17]:

$$\left(x_j^{h_i} \right) = \kappa \frac{(d_j)^{\sigma-1}}{[p_j(1+\tau_{ij})]^{\sigma}}$$

This gives the following aggregate asset holdings (Asset_{ij}) of country i from country j:

$$\begin{aligned} \text{Asset}_{ij} &= n_i \left(p_j n_j x_j^{h_i} \right) \\ &= \kappa \frac{n_i n_j}{(1+\tau_{ij})^{\sigma}} \left(\frac{d_j}{p_j} \right)^{\sigma-1} \end{aligned}$$

Introducing the gross return (R_j) on assets in country j: $R_j = \frac{d_j}{p_j}$, this naturally leads to the following "gravity equation":

$$\log(\text{Asset}_{ij}) = \log(n_i n_j) - \sigma \log(1+\tau_{ij}) + (\sigma - 1)\log(R_j) + \log(\kappa) + \varepsilon_{ij}^{A}$$

The first-term reflect market sizes of both countries, the second term is related to trading costs in financial markets and the third term is a "return chasing" component.

Of course, the main question remains to exhibit determinants of transaction costs (τ_{ij}) on financial markets (pure transaction costs, taxes on the repatriation of dividends, informational costs, foreign-exchange costs...). Like Portes and Rey [1999], we use bilateral distance and other proxies for those bilateral frictions:

$$\log(1+\tau_{ij}) = \alpha + \rho \log(\text{Dist}_{ij}) + \phi Z_{ij}^{A} + \nu_{ij}$$

[17]Where $\kappa = \frac{\beta}{L}^{\sigma}$ is a constant.

2.2.2 Estimation strategies

Following our estimation strategy for international trade in goods, we propose three identification strategies:

- **Specification (1)**

We proxy market size n_i (*i.e* the number of projects in country i) by the GDP of country i (GDP_i) and returns in country j by the log of the average gross return in US$ over the period 1990-2001 (Ret_j) and estimate[18]:

$$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha - \beta\log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{1A} + \delta\text{Ret}_j + \varepsilon_{ij}^{1A}$$

- **Specification (2)**

We control for country i fixed-effects: indeed, in the model the number of investors is equal to the number of projects but it is likely that some discrepancy exist between those two terms such that GDP_i is not a convenient proxy for market size of the capital exporter[19].

$$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_i - \beta\log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{2A} + \delta\text{Ret}_j + \varepsilon_{ij}^{2A}$$

- **Specification (3)**

We add fixed-effects in both dimensions:

$$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_i + \alpha_j - \beta\log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{3A} + \varepsilon_{ij}^{3A}$$

2.3 Empirics

2.3.1 Data Presentation

Our dataset concerns the year 2001[20].

In order to estimate a "gravity equation" of international trade, we use data on bilateral trade flows from the dataset CHELEM (CEPII, Paris). The dependent variable ($\log(\text{Import}_{ij})$) is the log of imports from country j to country i. Because of sample restrictions in our dataset of country financial assets, we restrict our dataset on trade flows to 19 importers countries (i) and 62 exporters countries (j)[21]. Using worldwide data, trade flows are usually found to be zero for an important number of country pairs, which makes interesting to consider fixed cost in international trade in addition to marginal effects of iceberg-type costs; however, because of our sample restrictions in our data on financial assets, we are considering only imports towards relatively rich countries and we do not have zeroes in our dataset. As

[18] Like for bilateral imports, we normalize our asset holdings by the product of market sizes. However our results do no not depend on this normalization choice.

[19] Financial wealth of country i would be a better proxy but it is unfortunately non-observable.

[20] Although using panel data would be more appropriate, we are restricted by our dataset on international financial claims. Testing the robustness of our result using panel data is left for future work.

[21] For a country list, see Appendix.

a consequence, we are not able to model the effect of fixed cost on international trade and restrict our attention on the intensive margin of trade due to iceberg-type trade costs.

For the "gravity equation" of bilateral international asset holdings, we use data on bilateral banking financial assets in 2001: the Bank of International Settlements issues quarterly the international claims of its reporting banks on individual countries, geographically broken down by nationality of reporting banks[22]. The dependant variable ($\log(\text{Asset}_{ij})$) is the log of financial claims in country (j) of banks of country (i) (expressed in US dollars). It might be surprising to use data on the banking sector to estimate our "gravity model". However we can justify our choice with three main arguments: first, the reliability of the dataset since it is often a very difficult task to collect data on stocks; second, banking financial assets do not include Foreign Direct Investment and as we said before there are good reasons to think that FDI does not obey the same determinant as a standard geographical portfolio[23]; finally, to explain portfolio flows, we have to consider borrowing and lending since it is the main part of international investment (see Kraay *et al.* [2000])[24]. The main drawback of our dataset is that we cannot distinguish different types of assets (especially between equities, bonds and cross-border bank lending): indeed, it could be that informational costs differ for different types of assets (see Portes *et al.* [2001])[25]. In the appendix, table A.2 gives some insights on the nature of international banking assets: a disaggregation by sector shows that banking assets are for half interbank assets, the rest being corporate sector financing (35%) and public sector financing (15%). A disaggregation by types of assets show that a big part is loan and deposit (around two thirds) but a non-negligible part consist in negotiable securities (bonds and equities[26]). Unfortunately such a disaggregation is not available in the bilateral dimension.

We use "importer" and "exporter" countries' GDPs (GDP_i and GDP_j) to correct for markets sizes[27]. The product of GDPs will be used to normalize our dependent variables[28].

The distance between the two main cities is used for bilateral distance (Dist_{ij})[29]. In the Gravity Model of Trade in Goods, we add other geographical variables: Border_{ij}, which is unity if country i and j have a common border and zero otherwise, Islands_{ij} which is the number of islands in the country pair, $\text{Area}_i\text{Area}_j$, the (log of the) product of the countries' areas, and LandLock_{ij} the number of landlocked countries in the country pair.

[22]See http://www.bis.org/statistics/histstats10.htm. To get more robust results, we average quarterly data for portfolio stocks in 2001. We do not exploit the time series aspect of this dataset because there is too much variations in the reporting conventions. In particular the dataset was initially built to monitor risks due to emerging economies and the claims held on developed countries are only reported since 1999, which makes a rather short time span for a stocks dataset.

[23]Moreover, banking assets include a marginal part of trade credit (as it is mainly inter-firm finance) which avoid any spurious relationship between asset holdings and goods trade. For France, we have a disaggregation of foreign banking assets by types of assets: the share of trade credit is 0.05% of total foreign banking assets.

[24]Especially in developing countries where bond and equity markets are underdeveloped, see table A.2.

[25]However, we have for some countries (namely France and UK) a certain level of disaggregation between bonds & equities and cross-border lending. Geographical allocation of different types of assets have very similar patterns.

[26]For some countries, namely France and UK, we know that around half of total securities are equities.

[27]Some might argue that market capitalization could be a better proxy for the Gravity Model of Asset Trade but no one of our results were affected by this choice. Moreover the choice of GDPs is more consistent with theoretical foundations.

[28]We first added GDP/Capita in the Asset Trade Regression to control for the development of financial markets but the results were mixed because of interaction with our corruption variable. However, no one of our results depend on this specification.

[29]We first added a "Time Difference" variable to control for different working hours of stock markets but we dropped it because it did not modify any of the results.

We construct Trade Zone dummies when both countries belong to a Trade agreement in 2001. We have three dummy variables: NAFTA_{ij} for the NAFTA Agreement, EC_{ij} for the European Community and APEC_{ij} for the Asia-Pacific Economic Cooperation. We do not consider currency unions because the Euro Zone is the only one in our dataset and the effect is already captured by the European Community dummy.

To take into account the informational determinants of trade in goods and assets, we use a "Common Language" dummy (Language_{ij}) if country i and country j share the same language and a "Colonial Link" dummy (ColonialDep_{ij}) if country j has been a colony of country i (or vice versa).

Following Anderson *et al.* [1999] and Papaioannou [2004][30], we use an index of corruption for the "importer" and the "exporter" countries (Corruption_i and Corruption_j) since it is likely that hidden bribes reduce transactions in international markets. This index is developed by *Transparency International*[31] and gives some insights on the degree of corruption as seen by business people, academics and risk analysts.

We also add some fiscal and legal determinants of transaction costs in financial markets:

- First, we use a dummy for the proximity of legal systems from La Porta *et al.* [1997,1998]. We distinguish between "common law" systems (or "English law"), "French law", "German law" and "Swedish law". The dummy variable Legal_{ij} equals one when source and destination countries have the same legal system. Indeed, legal system similarities might also reduce information asymmetries and contracting costs.

- Second, we use bilateral tax treaties[32] to describe the taxation of foreign capital. Although most of the countries we study have a residence–based tax system, they charge withholding taxes when foreigners repatriate dividends, capital gains or interests. To limit double–taxation, several bilateral tax treaties regulate those withholding taxes. We built two different variables that describe bilateral tax on dividends (and capital gains) and on interests (from loans, deposits or debt securities), resp. DividendTax_{ij} and InterestTax_{ij}, in percents. Both of them should affect banking assets[33]. When such tax treaty does not exist, we use the regulatory tax rate applied to foreigners.

- Third, we suppose that countries that have old fiscal agreements should exchange more in financial markets for historical reasons. We add the age of the fiscal treaty (if there is one, zero otherwise) to catch this effect (FiscalTreaty_{ij}). We also add a variable TaxHaven_j to control for capital recipient countries with very favourable fiscal treatment. We consider three Tax Havens in our sample, namely Switzerland, Luxembourg and Panama.

[30] Papaionnou [2004] finds a large impact of institutional quality on cross-border bank flows.

[31] http://www.transparency.org, "Corruption Perception Index"

[32] http://www.ibfd.org

[33] Those taxes are far from being negligible, ranging from 0% for some agreements to 40%, and as we mentioned before, equity shares are a non–negligible part of banking assets.

Finally, we use stock market data (monthly stock prices in US $ from 1990 to 2001 of the main stock market index of the country[34]) to compute the log of the average gross stock returns of country j (Ret_j) and the empirical correlation over the period between the stock returns of the country pair (Correlation_{ij}). If we assume that diversification motives matter for asset allocations, we might expect that countries would hold a higher share of assets with respect to countries whose assets are poor substitutes of the domestic ones (*i.e* whose stock returns are weakly correlated with domestic returns).

2.3.2 Estimation of a Gravity Model for Trade in Goods

	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$							
Spec. # [abc]	1[a]			2[b]			3[c]	
$\log(\text{Dist}_{ij})$	−0.751*** (0.038)	−0.743*** (0.037)	−0.744*** (0.041)	−0.746*** (0.038)	−0.747*** (0.038)	−0.717*** (0.041)	−1.045*** (0.048)	−0.826*** (0.055)
Border_{ij}	0.451 ** (0.184)	0.236 (0.189)	0.193 (0.189)	0.52 *** (0.176)	0.35 * (0.181)	0.36 ** (0.179)	0.299 ** (0.15)	0.247 (0.152)
$\text{Area}_i\text{Area}_j$	−0.083*** (0.015)	−0.09 *** (0.016)	−0.106*** (0.016)	−0.045** (0.018)	−0.046** (0.019)	−0.064*** (0.018)	−0.052 (0.161)	−0.061 (0.155)
Islands_{ij}	0.133 * (0.071)	0.109 (0.071)	−0.005 (0.073)	0.605 *** (0.098)	0.593 *** (0.098)	0.465 *** (0.096)		
LandLock_{ij}	−0.326*** (0.087)	−0.34 *** (0.086)	−0.336*** (0.087)	−0.048 (0.119)	−0.039 (0.118)	0.018 (0.118)	0.009 (0.481)	0.103 (0.463)
ColonialDep_{ij}		0.545 *** (0.171)	0.602 *** (0.169)		0.666 *** (0.17)	0.701 *** (0.166)		0.459 *** (0.137)
Language_{ij}		0.43 *** (0.135)	0.366 *** (0.134)		0.207 (0.135)	0.107 (0.131)		0.276 ** (0.112)
Corruption_j		0 (0.016)	0.001 (0.016)		0.001 (0.016)	0.005 (0.016)		
Corruption_i		−0.031 (0.027)	−0.048 * (0.027)					
EC_{ij}			0.005 (0.112)			0.023 (0.11)		0.021 (0.138)
NAFTA_{ij}			0.369 (0.558)			−0.006 (0.527)		0.752 * (0.444)
APEC_{ij}			0.986 *** (0.173)			1.432 *** (0.176)		1.198 *** (0.17)
N. Obs.	977	977	977	977	977	977	977	977
R^2	0.426	0.446	0.465	0.497	0.511	0.543	0.704	0.728

Table 1: Gravity Models for Bilateral Imports.

Standard errors in parentheses.
Statistical significance at the 10% (resp. 5% and 1%) level are denoted by * (resp. ** and ***).

[a]Specification # 1: $\log\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{1T} + \varepsilon_{ij}^{1T}$

[b]Specification # 2: $\log\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha_i - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{2T} + \varepsilon_{ij}^{2T}$

[c]Specification # 3: $\log\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha_i + \alpha_j - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{3T} + \varepsilon_{ij}^{3T}$

[34]Most data on stock returns are from Martin and Rey [2002].

Depending on the specification used, we estimate the following regressions where Z_{ij}^{kT} are sets of control variables[35]:

$$\textbf{(1)}: \qquad \log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{1T} + \varepsilon_{ij}^{1T}$$

$$\textbf{(2)}: \qquad \log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_i - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{2T} + \varepsilon_{ij}^{2T}$$

$$\textbf{(3)}: \qquad \log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_i + \alpha_j - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{3T} + \varepsilon_{ij}^{3T}$$

Our estimates of the usual "gravity models" of trade are shown in table 1. They support the consensus view of a strong and significant impact of physical distance on trade in goods; β is estimated between 0.7 and 0.8 depending on the specification: this figure is in line with previous studies and as we already mentioned surprisingly high. Adding "Language", "Colonial Link" and "Trade Zone" dummies does not solve the "distance puzzle" although those variables are significant[36].

2.3.3 Estimation of a Gravity Model for Trade in Assets

We estimate the following regression where Z_{ij}^{kA} is a set of control variables:

$$\textbf{(1)}: \qquad \log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha - \beta\log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{1A} + \delta\text{Ret}_j + \varepsilon_{ij}^{1A}$$

$$\textbf{(2)}: \qquad \log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_i - \beta\log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{2A} + \delta\text{Ret}_j + \varepsilon_{ij}^{2A}$$

$$\textbf{(3)}: \qquad \log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_i + \alpha_j - \beta\log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{3A} + \varepsilon_{ij}^{3A}$$

Our estimation of the standard "gravity equation" is presented in table 2.

As in Portes and Rey, we find a strong negative impact of physical distance on asset trade; β is estimated between 0.4 and 0.7 depending on the specification[37] and the "distance puzzle" is worse than for trade flows. Adding "Language", "Colonial Link" and "Legal System" dummies as proxies for information flows helps to solve the puzzle (in our most complete specification, β is equal to 0.45) but β remains very high and significant. We confirm here the importance of information as our three variables boost significantly international asset holdings (more than goods trade) and help to reduce the impact of distance.

Our fiscal variables are significant with the expected contribution[38]: the effects of fiscality are statistically significant and strong. Indeed, a 10 percentage points increase of bilateral dividend withholding tax leads to a 20% decrease in bilateral banking claims.

As expected, our measure of returns affects positively portfolio shares[39] and corruption reduces significantly asset holdings (probably by reducing returns or by increasing risks).

[35] Z_{ij}^{1T} includes both importers and exporters fixed factors that might affect international trade in goods, whereas we drop importers fixed factors in the set Z_{ij}^{2T} and both importers and exporters fixed factors in the set Z_{ij}^{3T} to keep only dyadic variables.

[36] Surprisingly, trade zone dummies are not very robust, the APEC effect being the only robust (and positive) effect; β is consistently estimated around $0.7 - 0.8$.

[37] For comparison, in Portes and Rey, β is around 0.6 in most specifications.

[38] The age of the fiscal treaty is the less robust one.

[39] According to the theoretical model, this means that the asset demand elasticity with respect to asset prices σ is greater than one. Throughout the paper, our estimates suggest a σ between 2 and 3, depending on the specification.

The "Correlation Puzzle"

More surprisingly, even when we control for distance and informational variables[40], we find that a country will hold more financial assets from a country whose stock market is highly correlated with his own one. This effect is quite large, very significant and absolutely at odds with the finance literature predictions. Portes and Rey [1999] also found that diversification motives do not play a large role in explaining asset trade beween industrialized countries and we confirm their results using a larger sample of countries[41]. We refer to this result as the "Correlation Puzzle".

	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j}\right)$							
Spec. # abc	1[a]			2[b]			3[c]	
$\log(\text{Dist}_{ij})$	−0.753*** (0.047)	−0.477*** (0.047)	−0.445*** (0.048)	−0.661*** (0.046)	−0.448*** (0.045)	−0.4*** (0.045)	−0.891*** (0.061)	−0.733*** (0.065)
Ret_j	2.347*** (0.564)	0.878* (0.51)	0.905* (0.506)	2.266*** (0.508)	0.648 (0.461)	0.695 (0.453)		
ColonialDep_{ij}		1.486*** (0.232)	1.495*** (0.23)		1.641*** (0.216)	1.655*** (0.212)		1.453*** (0.185)
Language_{ij}		0.353* (0.183)	0.316* (0.182)		0.286* (0.172)	0.257 (0.169)		0.27* (0.154)
Corruption_j		−0.142*** (0.022)	−0.09*** (0.026)		−0.193*** (0.021)	−0.123*** (0.023)		
Corruption_i		−0.091** (0.037)	−0.082** (0.037)					
Legal_{ij}		0.647*** (0.115)	0.628*** (0.114)		0.547*** (0.108)	0.527*** (0.106)		0.457*** (0.092)
FiscalTreaty_{ij}		0.006* (0.003)	0.001 (0.004)		−0.003 (0.003)	−0.011*** (0.003)		−0.003 (0.004)
DividendTax_{ij}		−0.023*** (0.006)	−0.021*** (0.006)		−0.024*** (0.005)	−0.022*** (0.005)		−0.025*** (0.009)
InterestTax_{ij}		−0.018** (0.007)	−0.019*** (0.007)		−0.012* (0.007)	−0.013** (0.007)		0.005 (0.01)
TaxHaven_j		1.495*** (0.15)	1.497*** (0.149)		1.473*** (0.199)	1.447*** (0.195)		
Correlation_{ij}			1.127*** (0.299)			1.628*** (0.275)		−0.019 (0.473)
N. Obs.	977	977	977	977	977	977	977	977
R^2	0.209	0.408	0.416	0.373	0.536	0.553	0.648	0.702

Table 2: Gravity Models for Bilateral Banking Claims.

Standard errors in parentheses.
Statistical significance at the 10% (resp. 5% and 1%) level are denoted by * (resp. ** and ***).

[a] Specification # 1: $\log \frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{1T} + \varepsilon_{ij}^{1T}$
[b] Specification # 2: $\log \frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha_i - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{2T} + \varepsilon_{ij}^{2T}$
[c] Specification # 3: $\log \frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha_i + \alpha_j - \beta\log(\text{Dist}_{ij}) + \gamma Z_{ij}^{3T} + \varepsilon_{ij}^{3T}$

[40] We also tried to control for GDP/Capita to be sure that this result was not just catching the fact that rich countries have higher correlations and higher trading volumes.
[41] Everything else equal, diversification should be a larger motive for asset trade once we include emerging countries since they provide larger diversification opportunities.

3 Asset Portfolios and Trade in Goods Complementarity ?

3.1 A misspecified regression ?

Our previous results and especially the strong impact of distance let us think that both "gravity equations" might be misspecified. The idea is very simple: let us suppose that for any reason trade in goods enhances asset trade (and *vice versa*). Then, omitting bilateral trade in goods in the "gravity equation" for international asset holdings is likely to lead to a bias in the estimates of some coefficients. Especially, we might expect that the coefficient β on distance in the "Asset Regression" is biased upwards as distance affects negatively bilateral trade in goods. Put differently, part of the effect of distance on international banking portfolios might go through trade. On the other hand, in the "gravity model" for trade in goods, there is no reason to exclude bilateral banking claims.

Figure 1 showing the strong correlation between Asset Holdings and Goods Trade is in line with this argument.

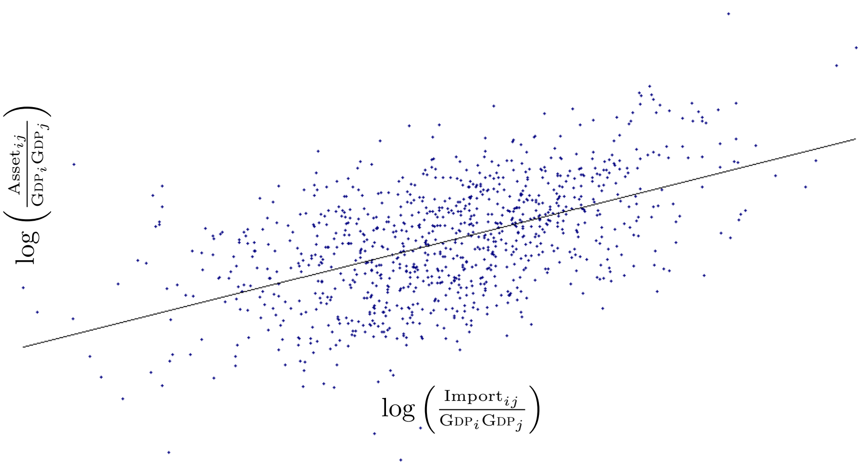

Figure 1: $\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$ versus $\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$.

In other words, if trade in goods and asset holdings are complementary, estimating independently the previous gravity models is not appropriate. The OLS estimator of the gravity models including financial asset holdings in the "trade in goods model" (resp. trade in the "financial assets model") confirms this intuition (see table 3, first column): trade seems to affect positively geographical portfolios (and respectively countries that have bilateral financial relationships trade more). These are first–order effects since for example, a 10% increase in bilateral trade leads to a 3% increase in bilateral banking claims. We get that a large part of the impact of physical distance on bilateral asset holdings goes through its impact on trade. On the other hand, its impact on trade in goods is a bit smaller.

Of course the variables we consider in those estimations are jointly determined and the estimation may suffer from an endogeneity bias. Especially, if both types of trade are reinforcing each other, we expect a downward bias on the OLS estimates, which will be confirmed. Still, what we show here is that we should take into account the complementarity of asset holdings and trade in goods in our gravity modelling.

3.2 Theoretical Motivation

From a theoretical point of view, the channel through which bilateral trade affects country portfolios is not clear. We propose to give some insights on the theoretical explanation. Obstfeld and Rogoff [2000] and Spiegel and Rose [2002] provide two different channels through which barriers to international trade in goods would reduce bilateral asset holdings[42].

Obstfeld and Rogoff [2000]: "The Consumption Hedging Story"

Obstfeld and Rogoff [2000] argue that adding trade costs into a complete markets model with two countries (where agents can insure their consumption basket with Arrow–Debreu Securities) helps to explain the "home bias" puzzle. In their model, trade costs imply a bias towards domestic securities since trade costs reduce investors incentives to repatriate their dividends from foreign assets. They provide their model to solve the "home bias puzzle"[43]. However, a simple extension with many countries (and bilateral trade costs) would lead to a bias towards securities of trading partners (relative to other countries). Lane and Milesi–Feretti [2003] provide a N–country generalization of Obstfeld and Rogoff's model. In their model, trade in goods enhances asset portfolios as equity biases reflect in large measure goods market biases.

Rose and Spiegel [2002]: "The Sovereign Risk Story"

Rose and Spiegel [2002] propose a model of international lending where bilateral lending is sustainable because of bilateral trade in goods. Their paper is in line with the "sovereign debt" literature (for a survey, see Eaton and Fernandez [1995]). Because debt contract cannot be enforced internationally, creditors lend to foreign countries only when they can threaten the debtor with a credible sanction in case of default[44]. In their model, penalties go through trade: creditors exclude their defaulting partners from trade relationship (cutting trade credits for example). In a sense, trade is a collateral which relaxes partly borrowing constraints. As a consequence, bilateral trade affects bilateral lending[45].

Possible common frictions on goods and financial markets?

We could also argue that some costs on international markets affect simultaneously bilateral trade in goods and bilateral asset holdings. In line with Portes and Rey [1999], a simple story could be

[42] We are aware that there is an extensive literature on FDI that shows that it might be either complementary to or substitute for Trade but we do not want to go much into it as we consider FDI as a very different type of asset (for a survey see Venables [1999,2000]).

[43] In a dynamic set-up, Serrat [2001] also provides theoretical evidence that frictions in goods market lead to home bias in portfolios: frictions are captured by the existence of non-traded goods but this delivers the same kind of predictions for portfolios.

[44] In those models, the maximum sustainable lending is exactly the sanction value.

[45] The reverse causality is not considered.

based on information asymmetries: because trading partners share information, the information flows through trade will enhance asset stocks (and *vice versa*). In other words, because information flows (or social networks) positively affect both cross–border finance and trade, trade in goods and trade in assets become in a sense complementary: firm managers learn about each other by trading goods and/or securities. Therefore, trading in the goods market reduces informational asymmetries in the financial markets (and vice versa). We have plenty of anecdotal evidence where an exporting firm brings its financial intermediary to help financing an investment plan of a potential client. We guess that the financial intermediary can propose better credit terms because it can get private information from its exporting client. As a consequence trade in goods enhances corporate financing. The apparent gravity structure of asset trade would therefore rely mainly on information flows induced by trade in goods.

A competing story based on transaction costs on the cross–country foreign exchange markets could also potentially justify this complementarity between asset holdings and trade in goods. Indeed, the larger the volume of trade between two countries, the more liquid and efficient are foreign exchange markets and consequently the more attractive the financial transactions between the two. The appealing part of such an assumption is that it also explains the reverse causality. Frankel and Rose [2002] reveal a surprisingly large effect of currency unions on trade[46], which is consistent with our assumption since a common currency reduces transaction costs on both markets. Thus, the increase in bilateral trade in goods is reinforced by an increase in bilateral asset holdings (and vice-versa), leading to a kind of "accelerator effect". One would argue that transaction costs are rather small especially between developed countries[47]: however if those costs are negatively related to the volume of transactions, it is not surprising that those costs are small between countries that trade a lot in international markets.

But whatever the story, we need to confirm our empirical result and especially address the endogeneity problem to provide a precise quantification of those effects.

3.3 Instrumental Variables Estimation

3.3.1 Estimation strategy

To confirm the strength of the reciprocal effect of bilateral trade in goods on bilateral asset holdings, we need to correct for endogeneity.

The empirical model we have to estimate is now the following simultaneous equations system where international banking assets and international trade in goods are mutually determined[48]:

$$(*)\begin{cases} \log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_A + \phi_A \log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) - \beta_A \log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{1A} + \delta_A \text{Ret}_j + \varepsilon_{ij}^{1A} \\ \\ \log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) = \alpha_T + \phi_T \log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) - \beta_T \log(\text{Dist}_{ij}) + \gamma_T Z_{ij}^{1T} + \varepsilon_{ij}^{1T} \end{cases}$$

[46]We are not able replicate those results because of sample limitation.
[47]Transaction costs with developing countries are difficult to estimate.
[48]Under specification (1).

Two different empirical questions arise from this estimation:

- first, what is the effect of trade in goods on international banking claims (and *vice versa)?* In other words, what are the elasticities ϕ_A and ϕ_T?
- second, once we have taken into account the endogeneity of trade in goods and international banking assets, what is the independent effect of the geographical distance on international asset portfolios and international trade in goods (*i.e* what are the values of β_A and β_T)?

We will consider those two questions separately.

3.3.2 What are the effect of trade in goods on international banking claims (and *vice versa)*?

Instrumentation methodology

In order to estimate the impact of trade in goods on international asset holdings (and *vice versa*), we have to provide instruments for both dependent variables. We do not need completely different instruments but at least a set of instruments that affect both differently (or better: instruments that affect only one of our endogenous variables). Indeed, the estimates of ϕ_A and ϕ_T should not depend on the instruments used as long as they are valid instruments.

To instrument trade in goods, we could use distance and some other geographical variables that are known to matter for bilateral trade in goods. However, since we do not know *a priori* if distance matters for international portfolio allocation, we are exposed to multicollinearity issues in the second stage regression for asset holdings (remind that distance is a very powerful determinant of trade in goods). We propose another identification based on transport costs data: indeed, transport costs certainly affect trade in goods but should not affect international asset holdings. Providing data on transport costs is a very difficult task[49] but we actually built a dataset on bilateral transport costs, looking at the bilateral cost of shipping a ton between the two main cities of the country pair using UPS services[50]. We are aware that this variable is no more than an estimate of transport costs as it is only airline freight (whereas the biggest part of goods transportation is sea freight or truck freight). However, we argue that this variable is a good instrument since it is actually a good predictor of goods trade and, which is the most important for our purpose, should be independent of bilateral asset holdings. We finally restrict our set of instruments for bilateral trade in goods to some geographical variables (excluding distance) and transport costs data.

We now have to provide variables that affect international asset holdings independently of bilateral trade in goods. We argue that the fiscal and legal variables will provide reasonable instruments for international banking claims (*i.e* LegalSystem_{ij}, InterestTax_{ij}, DividendTax_{ij}, FiscalTreaty_{ij}).

We decide to drop distance from both set of instruments to avoid multicollinearity problems in the second stage but we will see that this choice has some consequence on the estimated remaining impact

[49] Hummels [1999] gives estimates of transport costs but unfortunately only from the US point of view.
[50] We compute the (log of the) cost per kg in USD.

of distance.

If I_{ij}^{A} (resp. I_{ij}^{T}) are the instruments for banking claims (resp. trade in goods), the First-Stage Regression is the following:

$$\begin{aligned} \log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) &= \sigma_A + \varphi_A I_{ij}^{A} + \xi_{ij}^{A} \\ \log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right) &= \sigma_T + \varphi_T I_{ij}^{T} + \xi_{ij}^{T} \end{aligned}$$

ϕ_A and ϕ_T are then estimated simply by plugging the predicted value of trade in goods (resp. banking claims) in the second-stage regression.

Results

In our first specification (table 3, Specification (1), third column)[51], trade in goods is instrumented by variables that we expect to be independent of banking assets, *i.e* geographical variables (excluding distance) and transport costs[52]:

$$I_{ij}^{T} = \left\{\text{TransportCost}_{ij},\ (\text{TransportCost}_{ij})^2,\ \text{Area}_i\text{Area}_j,\ \text{LandLock}_{ij}\right\}$$

Respectively, banking assets are instrumented using fiscal and legal variables:

$$I_{ij}^{A} = \left\{\text{LegalSystem}_{ij},\ \text{InterestTax}_{ij},\ \text{DividendTax}_{ij},\ \text{FiscalTreaty}_{ij}\right\}$$

The First-Stage regressions perform reasonably well suggesting that we do not have "weak" instruments problems[53]. We provide exclusion tests (Sargan Tests) confirming the validity of our instruments: our instruments for trade in goods are affecting asset holdings only through their impact on trade in goods (and vice versa our instruments for asset holdings are not affecting independently trade in goods).

ϕ_A and ϕ_T are found to be significant at standard levels. Trade patterns affect strongly international asset holdings: the estimates of ϕ_A is remarkably high (around 0.7), which means that a 10% increase in bilateral trade in goods induces a 7% increase in bilateral asset holdings. Reciprocally, cross-border asset holdings between two countries affect positively their bilateral trade although the effect is less strong (ϕ_T is estimated to 0.24).

Robustness checks using different sets of instruments

In the previous specification, we have estimated ϕ_A and ϕ_T using instruments that only affect one of the two endogenous variables[54]; this specification is probably the most convincing although it is possible to use a larger set of instruments and "exogenous" variables that might affect both endogenous variables. We do it as a robustness check. We expand the set of instruments including all our set of exogenous variable

[51]Estimates of control variables other than distance are not reported but available on request.

[52]To take into account some non-linearities in the transport costs, we also use its square as an instrument.

[53]The First–SLS gives an R^2 of 0.29 for $\text{Trade}_{ij}/[\text{GDP}_i\text{GDP}_j]$ and 0.14 for $\text{Asset}_{ij}/[\text{GDP}_i\text{GDP}_j]$. First–SLS are not reported but available on request.

[54]There is no variable that is common instrument for both types of trade.

except bilateral distance[55] This specification allows us to catch a larger variablility of asset holdings and trade in goods in the first-stage regression[56]. The estimates of ϕ_A and ϕ_T should not depend on the set of instruments, which is confirmed by our estimates (see table 3, Specification (1), fourth column). Our estimated elasticities are roughly identical, highly significant, which confirms the two-way causality between financial portfolios and trade in goods.

Robustness checks with country fixed-effects

Controlling for importer-country fixed effects almost does not change the estimated value of ϕ_A and ϕ_T[57] (specification (2)). ϕ_A is still remarkably high (around 0.6) and ϕ_T is consistently estimated between 0.2 and 0.3, which is consistent with the previous estimates. Again, expanding the set of instruments does not change the results (see table (3), Specification (2), third and fourth column).

Specification (3) raises some estimations difficulties due to the important number of parameters that have to be estimated. Indeed, our main instrument for bilateral trade in goods *i.e* data on bilateral transport costs is almost fully explained by exporter-country fixed effects and bilateral distance[58] which raises multicollinearity issues in the second step. To avoid this problem, we propose to keep country i and country j fixed-effect in the trade regression since the country j specific factors that matters for international trade in goods in the theoretical model are indeed unobservable. In the asset regression where the multicollinearity problem is the most stringent, we just keep country i fixed-effect and the observable variable that is found to matter in the theoretical model (*i.e* Ret_j). We also add a full set of regional dummies for capital recipient countries in order to control as much as possible for unobservable regional factors of capital importing countries. Again, our estimates confirm the previous results (see Appendix, table A.3).

Robustness checks using Securities Holdings

We propose exactly the same identification methodology using a different dataset on bilateral portfolio holdings: this dataset[59] provided by the IMF geographically breaks down securities holdings. It gives the aggregate bilateral portfolio stocks (including Equities, Long–Term Debt Securities and Short–Term Debt Securities) in USD for a large sample of countries in 2001; we restrict this dataset to our sample of importing countries (excluding Taiwan) and exporting countries. Those data include a larger part of negotiable securities than the BIS database but exclude bank lending.

We redo the same regressions with this new dataset on foreign capital stocks, using exactly the same simultaneous equation set–up (and the same instrumentation methodology): the results confirm our

[55]We still exclude distance from the set of instruments although including distance gives very comparable estimates. The full set of instruments is then $I_{ij}^T = I_{ij}^A \bigcup \left\{ \text{TransportCost}_{ij},\ (\text{TransportCost}_{ij})^2 \right\}$ where

$$I_{ij}^A = \left\{ \begin{array}{c} \text{Corruption}_i, \text{Corruption}_j, \text{Language}_{ij}, \text{ColonialDep}_{ij}, \text{Landlock}_{ij}, \\ \text{LegalSystem}_{ij}, \text{InterestTax}_{ij}, \text{DividendTax}_{ij}, \text{FiscalTreaty}_{ij}, \text{Area}_i\text{Area}_j \end{array} \right\}.$$

[56]The First–SLS gives an R^2 of 0.35 for $\text{Trade}_{ij}/\left[\text{GDP}_i\text{GDP}_j\right]$ and 0.32 for $\text{Asset}_{ij}/\left[\text{GDP}_i\text{GDP}_j\right]$.

[57]Although ϕ_A is a bit smaller

[58]Indeed, 90% of the variance of our transport cost variable is explained by country j fixed-effects and bilateral distance.

[59]Coordinated Portfolio Investment Survey Data, http://www.imf.org/external/np/sta/pi/datarsl.htm

		Naive Ols		System Ols		Instrument Set # 1		Instrument Set # 2	
		Asset	Trade	Asset	Trade	Asset	Trade	Asset	Trade
Specification # 1 [a]	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$			0.333 *** (0.042)		0.732 *** (0.082)		0.755 *** (0.085)	
	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$				0.149 *** (0.022)		0.239 *** (0.055)		0.378 *** (0.081)
	$\log(\text{Dist}_{ij})$	−0.477 *** (0.047)	−0.741 *** (0.041)	−0.229 *** (0.055)	−0.68 *** (0.041)	−0.202 *** (0.055)	−0.698 *** (0.042)	−0.212 *** (0.054)	−0.703 *** (0.042)
	Expected Bias					−0.254	−0.125	−0.319	−0.245
	Sargan Stat. [c]					1.067 (0.587)	3.651 (0.302)	0.514 (0.773)	2.052 (0.562)
	N. Obs.	977	977	977	977	977	977	977	977
	R^2	0.408	0.466	0.444	0.489	0.452	0.476	0.453	0.477
Specification # 2 [b]	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$			0.279 *** (0.04)		0.599 *** (0.099)		0.631 *** (0.103)	
	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$				0.134 *** (0.024)		0.234 *** (0.053)		0.355 *** (0.078)
	$\log(\text{Dist}_{ij})$	−0.448 *** (0.045)	−0.72 *** (0.041)	−0.253 *** (0.052)	−0.67 *** (0.041)	−0.24 *** (0.056)	−0.684 *** (0.041)	−0.247 *** (0.055)	−0.69 *** (0.041)
	Expected Bias					−0.208	−0.122	−0.267	−0.23
	Sargan Stat. [c]					3.078 (0.215)	1.006 (0.8)	1.959 (0.375)	0.541 (0.91)
	N. Obs.	977	977	977	977	977	977	977	977
	R^2	0.536	0.543	0.559	0.558	0.553	0.552	0.554	0.553

Table 3: Simultaneous Gravity Models for Bilateral Imports and Bilateral Banking Claims.

Standard errors in parentheses.
Statistical significance at the 10% (resp. 5% and 1%) level are denoted by * (resp. ** and ***).

[a] Specification # 1:

$$\begin{cases} \log \frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha^T + \phi_T \log \widehat{\frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_T \log(\text{Dist}_{ij}) + \gamma_T Z_{ij}^{3T} + \varepsilon_{ij}^{1,T} \\ \log \frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha^A + \phi_A \log \widehat{\frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_A \log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{3A} + \delta_A \text{Ret}_j + \varepsilon_{ij}^{1,A} \end{cases}$$

[b] Specification # 2:

$$\begin{cases} \log \frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha_i^T + \phi_T \log \widehat{\frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_T \log(\text{Dist}_{ij}) + \gamma_T Z_{ij}^{3T} + \varepsilon_{ij}^{2,T} \\ \log \frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha_i^A + \phi_A \log \widehat{\frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_A \log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{3A} + \delta_A \text{Ret}_j + \varepsilon_{ij}^{2,A} \end{cases}$$

[c] P–values in parentheses.

previous findings since we get remarkably similar estimates (see Appendix, table A.4). Asset Holdings and Goods Trade are enhancing each other and the elasticities we have estimated with banking assets are very stable. Those results with a different dataset show the robustness of our findings.

3.3.3 What is the independent effect of the geographical distance on international asset portfolios and international trade in goods?

At this point, we are confident that bilateral asset holdings and bilateral trade in goods are reinforcing each other. We are also reasonably convinced given the different robustness checks that ϕ_A and ϕ_T are fairly well estimated.

We want to raise another issue: how does this misspecification in the standard gravity equation bias the estimates of the control variables? Indeed, given the fact that distance might affect trade in goods through transport costs (resp. asset holdings through information costs), we expect the impact of distance to be reduced once we control for the endogeneity of trade in goods and asset holdings. But how large is the remaining impact of geographical distance on asset holdings and trade in goods once endogeneity is controlled for? Especially, we would like to know whether physical distance affects international portfolios *on the top of* its effect through trade in goods. Technically, this is equivalent to give an estimate of β_A (resp. β_T) in the model $(*)$.

Estimating an upper-bound for the effect of distance on asset holdings (resp. on trade in goods)[60]

It is important to consider that looking at the estimates of β_A (resp. β_T) in the second-stage regression once we have instrumented trade in goods (resp. asset holdings) might be misleading. Indeed, the estimates of β_A and β_T are not independent of the instruments used in the first-stage regression (contrary to ϕ_A and ϕ_T). Assume for instance that trade in goods is instrumented by a variable that is orthogonal to distance (and to asset holdings): in the Second-Stage regression, β_A will still be catching the effect of physical distance going through trade in goods (actually β_A will exactly estimate the global effect of distance on asset holdings whatever its cause).

The instruments we use are not orthogonal to distance but still looking at the estimate of β_A in the second-stage regression will just provide an upper-bound for the independent effect of distance on asset holdings (as long as distance is not included in the set of instruments, see appendix for a technical proof). Intuitively, when we drop distance from the set of instruments, we give it the maximum chance to show up in the second stage regression [61].

Table (3) gives the estimates of β_A (resp. β_T) for the different sets of instruments[62]. The independent effect of distance on bilateral asset holdings is at most a reduction of 2% of banking claims when distance increases by 10%: we reduce dramatically the effect of distance on asset portfolios (the magnitude of the

[60] Technically, this is equivalent to estimate a upper-bound for β_A (resp. β_T)

[61] Adding distance in the set of instruments raises multicollinearity issues in the second stage regression that cast doubt on our estimate of β_A and β_T.

[62] Under specifications (1) and (2). Spec. (3) is available in Table A.3.

"distance puzzle" has been reduced by 60%) although such an elasticity is far from being negligible. For trade in goods, we find an upper-bound for β_T that is equal to 0.69. We also provide estimates of the size of the bias on β_A (resp. β_T)[63]. Those estimates provide evidence that the effect of distance on asset holdings might be rather small whereas its effect on bilateral imports remains quite large. According to the estimated size of the bias, the "independent" effect of distance on asset holdings should be close to zero whereas its "independent" effect on trade flows is at most reduced by around 20% compared to the OLS estimates of previous section.

Our robustness checks using country fixed-effects confirms those estimates. Moreover, when we consider securities holdings instead of banking assets, we reproduce very similar estimates (see table (3), Specification (2) and Appendix tables (A.3) and (A.4)). Using securities holdings, we find that the remaining effect of distance on asset portfolios is slightly higher than for banking claims, indicating that information costs might be larger for equities and corporate bonds than for bank lending.

In short, we get that an exogenous increase in bilateral trade in goods has a strong impact on asset portfolios: a 10% leads to a 6 to 7% increase in bilateral asset holdings. This effect is robust to many specifications and to the use of different types of assets (banking assets versus negotiable securities). The reverse causality is also true but of a smaller magnitude. Once we control for trade costs in goods markets, the remaining impact of geographical distance on asset holdings is much smaller: the elasticity of distance with respect to asset holdings is estimated between 0 and 0.2. The distance–effect on bilateral imports has been slightly reduced but remains high and undisputable.

3.4 Back to the "correlation puzzle"

Adding trade in the regression does not solve the "correlation puzzle" we mentioned in the first section. Indeed, we could have expected that this "correlation puzzle" was due to a misspecification of the regression. Because business cycles are more correlated between trading partners (see Frankel and Rose [1998], Imbs [1999]), we could have expected that the correlation variable was spuriously catching the effect of trade on cross–border asset holdings. As the "puzzle" remains once we control for trade, this intuition is not confirmed by the data. Indeed, we still find that portfolios are biased towards countries whose assets are close substitutes to the domestic ones and the estimated impact of the bilateral correlation on bilateral asset holdings is close to the previous OLS-estimates[64].

We think that the "correlation puzzle" comes from an estimation bias in the regression. Indeed, stock market correlation may be endogenous, and adding it roughly in the regression may be inappropriate. There is very few empirical (and theoretical) work that takes the correlation of returns[65] as endogenous. However we have good reasons to think that it is the case: with "dynamic portfolio rebalancing", Coeur-

[63]See technical appendix for the derivations of the bias on β_A (resp. β_T).

[64]The effect is slightly lower: the coefficient is estimated between 0.6 and 1.2 and significant at standard levels. Estimates available on request.

[65]Imbs [1999] is a notable exception even if he does not consider the impact of the correlation on effective bilateral flows.

dacier and Guibaud [2004] generates endogenous comovements of stock prices between markets and those comovements are more pronounced when financial frictions between markets are low. In other words, well integrated financial markets should exhibit higher correlation of their stock markets, which enhances the probability of simultaneously observing high correlations of returns and high levels of cross-border asset holdings. To correct for this endogeneity bias, one should be able to find an instrument of the correlation of stock markets that is exogenous to the degree of integration between financial markets. Since we are not able to provide such a valid instrument, we must admit that, at this point, there is no evidence that diversification matters for asset allocation and restoring the standard predictions of the portfolio choice literature is left for future research.

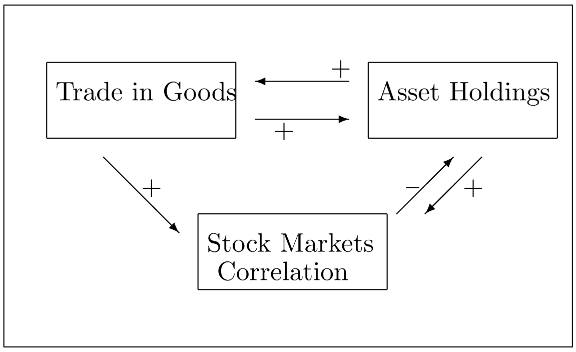

Figure 2: A way to solve the "Correlation Puzzle".

3.5 Testing competing theories?

We provide convincing empirical results arguing that a reduction of frictions on international goods markets enhances bilateral asset holdings (and *vice versa*). One can see our empirical results on the two–way relationship between asset holdings and trade in goods as a necessity to consider the interaction between trade and finance in a common theoretical set–up. We do not pretend to submit a full theory explaining what we observed in the data but we try to give some new empirical results that might be an helpful guidance for future theoretical works on this issue.

Even if it is difficult to test properly with our data the different stories we gave in section 3.2, one way to confirm Obstfeld and Rogoff [2000] theory would be based on the different roles played by imports and exports in their model; indeed, only trade costs on imports matter for bilateral asset stocks: agents want to hedge their consumption basket and bias their portfolio towards securities of countries from which they import goods. Then, as long as bilateral imports and bilateral exports are not completely symmetrical (which is the case)[66], we should expect that import patterns are the main determinant of geographical portfolio holdings.

We do a regression for bilateral financial assets including bilateral imports and bilateral exports and, surprisingly, exports are the main determinant of portfolio holdings (see Appendix, table A.5): of course,

[66] Trade Costs might not be symmetrical either!

we should be cautious with this result as we cannot address the endogeneity problem with those two variables (because we do not have different instruments). However, the results are quite appealing and reveal that their story might not be the whole story.

Rose and Spiegel [2002] story is very attractive, but it is hard to believe that sovereign risk is a major concern for industrialized countries. Indeed, we find that the effect of bilateral trade on asset holdings is even larger for rich countries than for emerging countries (see Appendix, table A.6).

4 Conclusion

We bridge two strands of literature: international trade in goods on the one hand and international asset portfolios on the other. Numerous papers have shown that international trade in goods can be very well described by gravity models and some recent papers have pointed out that international asset portfolios could also be described by this kind of models: if the distance between two countries doubles, bilateral asset holdings are almost divided by two. This far from negligible impact seems somewhat puzzling, since geography should not shape asset trade in a globalized world.

Portes and Rey [1999] justifies the impact of distance on asset flows by information costs, distance acting as a proxy for the informational asymmetries. We chose here to investigate another idea, namely that trade in goods and asset holdings are mutually reinforcing. The strong impact of distance on asset holdings is the consequence of the complementarity between trade in goods and trade in assets.

Using bilateral data on international trade flows and international banking claims, we have examined what remained of the effect of distance once we take into account the fact that trade in goods and bilateral financial claims are mutually determined. The set of instruments we use to identify the system is a crucial aspect of this study. We have used geographical variables and new data on transport costs to instrument trade in goods. To instrument asset holdings, we followed LaPorta *et al.* [1997,1998] and used data on legal environments; to the standard legal environment data, we added a set of variables we built, which describe some aspects of the bilateral fiscal relationships between countries (bilateral withholding taxes on dividends and interests, and fiscal agreements). This methodology allows us to estimate precisely the effect of bilateral trade in goods on bilateral asset holdings: this effect is found to be quantitatively important since a 10% increase in bilateral imports lead to a 6 to 7% increase in bilateral asset holdings. Bilateral asset holdings also enhance trade in goods but the latter effect is found to be much smaller.

Our results show that only trade in goods has an undisputable gravity structure, *i.e.* a structure in which distance (understood as a proxy for transportation and transaction costs) is a major determinant. The system we have estimated shows that distance affects asset holdings mainly through its impact on trade in goods: in the asset part of the system, the magnitude of the distance puzzle is at least reduced by 60%.

The existing scenarios (Obstfeld and Rogoff's consumption hedging, Rose's sovereign risk) cannot be formally eliminated so far, even if we have shown that some of our results cast doubt on each one of them. Another story based on common transaction costs on financial markets and goods markets could be a more natural match to our result. For example, in line with Portes and Rey's paper, it might be that both trade in assets and trade in goods are subject to some common information costs making trade in goods and trade in assets complementary. Those information spillovers (from goods markets to financial markets) would need to be very large to have the observed effects but we do think that this explanation is a large part of the story. However, we do not pretend to provide a full-fletched theory of what we point out in the data. The robustness and the strength of our empirical results shed light on the necessity to model trade and financial linkages together. It is a new challenge for the economic theory.

Furthermore, our framework leads to an other puzzle: the higher the correlation between two countries stock returns, the larger the volume of asset trading between the two. This result still holds true once we control for trade in goods. This reinforces the need for a theoretical study on the interactions between trade in goods, trade in assets and diversification.

Finally, these results raise some interesting questions about the coherence of liberalization policies. We show in this paper that trade in goods and in assets reinforce each other. Trade policies and capital account liberalization cannot be considered independently. Therefore, these policies should be thought of by policymakers in a common and single perspective.

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5 Appendix

5.1 Data

5.1.1 Data Sources

- **Bilateral Exports and Imports**: in 2001, in US Dollars from the Chelem dataset (Centres d'Etudes Prospectives et d'Informations Internationales, Cepii, Paris).

- **Bilateral Financial Banking Assets**: in US dollars, average over quaterly data in 2001, from the Bank of International Settlements.

- **Bilateral Securities Holdings**: in US dollars, in 2001, from the Coordinated Portfolio Investment Survey, http://www.imf.org/external/np/sta/pi/datarsl.htm

- **Gdp and Population**: from the International Financial Statistics.(Gdp in US dollars in 2001, exchange rates used are also from the Ifs).

- **Bilateral Distance**: in km, from S–J Wei's website and from various sources ("How far is it ?", http://www.indo.com/distance)

- **Transportation Costs**: cost of shipping a ton between the two main cities of two countries (in USD, per kg) with Ups. From Ups websites of the different source countries.

- **Other Geography Variables:** various sources (especially A. Rose's website)

- **Trade Agreements** : various sources (especially A. Rose's website)

- **Corruption**: "Corruption Perception Index" from *Transparency International*[67] ranking from 0 to 10 (actually we use the opposite of the standard index to have the maximum value for the most corrupted country)

- **Common Language and Colonial Link**: various sources (for colonial link, mainly summaries of country history in Encyclopædias.)

- **Legal Variable**: mainly La Porta *et al.* [1998], various sources for missing countries [68].

- **Fiscal Variables:** Ibfd online products (http://www.ibfd.org); Latin American Taxation Database, European Taxation Database, Asia–Pacific Taxation Database, Tax Treaties Database.

- **Stock Market Returns**: monthly data from 1990 to 2000 in USD Dollars from Martin and Rey [2002] (World Bank and Bloomberg) and *Global Financial Data*.

[67] http://www.transparency.org
[68] http://www.llrx.com

5.1.2 Geographical Sample

- **Importer Countries**: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Taiwan, United Kingdom, United States;
- **Exporter Countries**:
  - **Europe**: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland,United Kingdom, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Israel, Lithuania, Poland, Russia, Slovakia, Slovenia, Turkey;
  - **Asia & Oceania**: China, Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand;
  - **Oceania**: Australia, New Zealand;
  - **North America**: Canada, United States;
  - **South America**: Argentina, Brazil, Chile, Colombia, Peru, Uruguay, Venezuela;
  - **Central America**: Costa Rica, Mexico, Panama;
  - **Africa**: Algeria, Côte d'Ivoire, Egypt, Morocco, Nigeria, South Africa, Tunisia.

5.2 Empirical Results

	Mean	Std	Median	Min	Max	N
$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$	–18.662	0.059	–18.597	–24.931	–12.658	987
$\log\left(\frac{\text{CPIAsset}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$	–19.36	2.39	–19.10	–27.73	–11.42	1005
$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$	–18.954	1.512	–18.885	–24.848	–13.598	1152
$\log\left(\frac{\text{Exports}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$	–18.791	1.336	–18.780	–23.605	–13.678	1152
$\log(\text{Distance}_{ij})$	8.249	0.032	8.693	4.025	9.884	1159
TranspCost_{ij}	1.150	0.23	1.156	0.134	1.571	1098
$(\text{TranspCost}_{ij})^2$	1.382	0.496	1.352	0.018	2.470	1098
$\text{Area}_i\text{Area}_j$	24.738	0.077	24.550	16.840	32.956	1159
Ret_j	0.027	0.099	0.040	–0.314	0.274	1159
Correlation_{ij}	0.311	0.219	0.313	–0.269	0.872	1159
Corruption_i	–7.716	0.038	–7.7	–5.2	–9.7	1159
Corruption_j	–5.595	0.07	–4.9	–1.6	–9.7	1140
InterestTax_{ij}	8.505	0.217	10	0	40	1155
DividendTax_{ij}	13.429	0.237	15	0	40	1155
FiscalTreaty_{ij}	15.862	0.450	14	0	76	1159

Table A. 1: Descriptive Statistics

Table A. 2: International Banking Assets Breakdown by Types of Assets and Sectors (in Billions USD, 2001)

		Total Assets	Loans and Deposits	Bonds and Equities	Loans and Deposits (%)	Bonds and Equities (%)
Developed	Europe[a]	3487.3	2363.0	1124.2	67	33
	North–America	2387.5	1684.9	702.5	70	30
	Asia–Oceania	632.0	519.0	113.0	82	18
Emerging	Africa	42.6	37.3	5.4	87	13
	Asia[b]	255.4	213.6	41.7	83	17
	Eastern Europe	142.2	114.2	28.1	80	20
	South America[c]	259.0	193.3	65.7	74	26
Financial Centers[d]		1086.2	965.8	120.5	89	11
Total		8292.3	6091.1	2201.2	73	27

Disaggregation by sector (%)	Banking Sector	Public Sector	Corporate Sector	Unallocated
	48	16	35	1

[a]Excluding Luxembourg, Switzerland and United Kingdom.
[b]Excluding Hong–Kong and Singapore.
[c]Excluding Panama.
[d]Hong–Kong, Luxembourg, Panama, Singapore, Switzerland and United Kingdom.

		Naive OLS		System OLS		Instrument Set # 1		Instrument Set # 2	
		Asset	Trade	Asset	Trade	Asset	Trade	Asset	Trade
Specification # 3 [a]	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$			0.305 *** (0.044)		0.592 *** (0.111)		0.65 *** (0.116)	
	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$				0.186 *** (0.024)		0.341 *** (0.059)		0.492 *** (0.081)
	$\log(\text{Dist}_{ij})$	−0.732 *** (0.058)	−0.823 *** (0.056)	−0.426 *** (0.072)	−0.687 *** (0.056)	−0.37 *** (0.072)	−0.8 *** (0.055)	−0.369 *** (0.071)	−0.807 *** (0.055)
	Expected Bias	.	.	.	.	−0.208	−0.18	−0.275	−0.319
	Sargan Stat. [d]					2.753 (0.252)	2.114 (0.348)	4.432 (0.109)	0.635 (0.888)
	N. Obs.	977	977	977	977	977	977	977	977
	R^2	0.702	0.728	0.717	0.746	0.581	0.738	0.583	0.739

Table A. 3: Simultaneous Gravity Model for Bilateral Imports and Banking Assets under Spec. # 3.

Standard errors in parentheses.
Statistical significance at the 10% (resp. 5% and 1%) level are denoted by * (resp. ** and ***).
Specification # 3:

$$\begin{cases} \log \frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha_i^T + \alpha_j^T + \phi_T \log \widehat{\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j}} - \beta_T \log(\text{Dist}_{ij}) + \gamma_T Z_{ij}^{3T} + \varepsilon_{ij}^T \\ \log \frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha_i^A + \zeta \text{Reg}_j + \phi_A \log \widehat{\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}} - \beta_A \log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{3A} + \delta_A \text{Ret}_j + \varepsilon_{ij}^A \end{cases}$$

[a] The Instrument Set of Imports over GDPs has been reduced from the standard one: the exogeneity of $\text{TransportCost}_{ij}^{\ 2}$ in this dimension was rejected by the Overidentifying Restrictions Test. The remaining instruments for Imports are then LandLock_{ij}, $\text{TransportCost}_{ij}$ and $\text{Area}_i\text{Area}_j$.

[d] P–values in parentheses.

		Naive Ols		System Ols		Instrument Set # 1		Instrument Set # 2	
		Asset	Trade	Asset	Trade	Asset	Trade	Asset	Trade
Specification # 1[a]	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$			0.321 *** (0.06)		0.672 *** (0.091)		0.669 *** (0.094)	
	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$				0.082 *** (0.015)		0.068 ** (0.031)		0.149 *** (0.052)
	$\log(\text{Dist}_{ij})$	−0.583 *** (0.057)	−0.678 *** (0.034)	−0.334 *** (0.073)	−0.633 *** (0.034)	−0.304 *** (0.067)	−0.653 *** (0.036)	−0.325 *** (0.066)	−0.651 *** (0.035)
	Expected Bias					−0.246	−0.036	−0.307	−0.097
	N. Obs.	999	999	999	999	999	999	999	999
	R^2	0.464	0.595	0.479	0.606	0.492	0.597	0.49	0.598
Specification # 2[b]	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$			0.268 *** (0.063)		0.745 *** (0.109)		0.714 *** (0.112)	
	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$				0.072 *** (0.015)		0.084 *** (0.029)		0.175 *** (0.049)
	$\log(\text{Dist}_{ij})$	−0.564 *** (0.055)	−0.657 *** (0.032)	−0.383 *** (0.069)	−0.626 *** (0.032)	−0.304 *** (0.065)	−0.631 *** (0.033)	−0.337 *** (0.064)	−0.63 *** (0.033)
	Expected Bias					−0.273	−0.045	−0.328	−0.113
	N. Obs.	999	999	999	999	999	999	999	999
	R^2	0.567	0.677	0.575	0.685	0.587	0.68	0.584	0.681
Specification # 3[c]	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$			0.362 *** (0.061)		0.808 *** (0.121)		0.811 *** (0.126)	
	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i \cdot \text{GDP}_j}\right)$				0.112 *** (0.017)		0.171 *** (0.035)		0.307 *** (0.058)
	$\log(\text{Dist}_{ij})$	−0.703 *** (0.075)	−0.88 *** (0.051)	−0.355 *** (0.094)	−0.799 *** (0.052)	−0.172 * (0.089)	−0.86 *** (0.051)	−0.202 ** (0.088)	−0.862 *** (0.05)
	Expected Bias					−0.296	−0.092	−0.373	−0.199
	N. Obs.	999	999	999	999	999	999	999	999
	R^2	0.755	0.771	0.764	0.781	0.63	0.777	0.629	0.778

Table A. 4: Simultaneous Gravity Model for Bilateral Imports and Bilateral Cpi Assets.

Standard errors in parentheses.
Statistical significance at the 10% (resp. 5% and 1%) level are denoted by * (resp. ** and ***).

[a]Specification # 1:

$$\begin{cases} \log \frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha^T + \phi_T \log \widehat{\frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_T \log(\text{Dist}_{ij}) + \gamma_T Z_{ij}^{3T} + \varepsilon_{ij}^{1,T} \\ \log \frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha^A + \phi_A \log \widehat{\frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_A \log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{3A} + \delta_A \text{Ret}_j + \varepsilon_{ij}^{1,A} \end{cases}$$

[b]Specification # 2:

$$\begin{cases} \log \frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha_i^T + \phi_T \log \widehat{\frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_T \log(\text{Dist}_{ij}) + \gamma_T Z_{ij}^{3T} + \varepsilon_{ij}^{2,T} \\ \log \frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha_i^A + \phi_A \log \widehat{\frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_A \log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{3A} + \delta_A \text{Ret}_j + \varepsilon_{ij}^{2,A} \end{cases}$$

[c]Specification # 3:

$$\begin{cases} \log \frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha_i^T + \alpha_j^T + \phi_T \log \widehat{\frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_T \log(\text{Dist}_{ij}) + \gamma_T Z_{ij}^{3T} + \varepsilon_{ij}^{3,T} \\ \log \frac{\text{Asset}_{ij}}{\text{GDP}_i \text{GDP}_j} = \alpha_i^A + \zeta \text{Reg}_j + \phi_A \log \widehat{\frac{\text{Import}_{ij}}{\text{GDP}_i \text{GDP}_j}} - \beta_A \log(\text{Dist}_{ij}) + \gamma_A Z_{ij}^{3A} + \delta_A \text{Ret}_j + \varepsilon_{ij}^{3,A} \end{cases}$$

	Assets$_{ij}$		
Spec. #[a]	1	2	3
$\log\left(\frac{\text{Export}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$	0.369 *** (0.056)	0.459 *** (0.06)	0.421 *** (0.062)
$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j}\right)$	0.174 *** (0.047)	0.104 *** (0.045)	0.177 *** (0.047)
Dist$_{ij}$	−0.06 (0.06)	−0.056 (0.056)	−0.157 * (0.081)
N. Obs.	977	977	977
R^2	0.468	0.585	0.731

Table A. 5: Gravity Models for Banking Claims, including Bilateral Exports and Imports.
Standard errors in parentheses. Statistical significance at the 10% (resp. 5% and 1%) level are denoted by * (resp. ** and ***).

[a] $\log\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha^A + \phi_{imp}\log\frac{\widehat{\text{Import}_{ij}}}{\text{GDP}_i\text{GDP}_j} + \phi_{exp}\log\frac{\widehat{\text{Export}_{ij}}}{\text{GDP}_i\text{GDP}_j} - \beta_A\log(\text{Dist}_{ij}) + \gamma_A Z^{3A}_{ij} + \delta_A\text{Ret}_j + \varepsilon^A_{ij}$

		Naive OLS		System OLS		Instrument Set # 1		Instrument Set # 2	
		Asset	Trade	Asset	Trade	Asset	Trade	Asset	Trade
Developed Countries	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\cdot\text{GDP}_j}\right)$			0.488 *** (0.068)		0.615 *** (0.098)		0.664 *** (0.098)	
	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\cdot\text{GDP}_j}\right)$				0.151 *** (0.027)		0.035 (0.051)		0.109 (0.073)
	$\log(\text{Dist}_{ij})$	−0.58 *** (0.056)	−0.707 *** (0.049)	−0.164 ** (0.078)	−0.623 *** (0.049)	−0.206 ** (0.08)	−0.704 *** (0.049)	−0.213 *** (0.076)	−0.698 *** (0.049)
	Expected Bias					−0.132	−0.017	−0.198	−0.077
	N. Obs.	452	452	452	452	452	452	452	452
	R^2	0.513	0.661	0.564	0.683	0.553	0.662	0.559	0.663
Emerging Countries	$\log\left(\frac{\text{Import}_{ij}}{\text{GDP}_i\cdot\text{GDP}_j}\right)$			0.318 *** (0.054)		0.545 *** (0.107)		0.586 *** (0.119)	
	$\log\left(\frac{\text{Asset}_{ij}}{\text{GDP}_i\cdot\text{GDP}_j}\right)$				0.193 *** (0.033)		0.503 *** (0.129)		0.684 *** (0.163)
	$\log(\text{Dist}_{ij})$	−0.328 *** (0.076)	−0.714 *** (0.063)	−0.128 (0.081)	−0.647 *** (0.062)	−0.177 ** (0.08)	−0.655 *** (0.064)	−0.185 ** (0.08)	−0.656 *** (0.063)
	Expected Bias					−0.223	−0.245	−0.294	−0.398
	N. Obs.	525	525	525	525	525	525	525	525
	R^2	0.271	0.369	0.317	0.409	0.306	0.387	0.304	0.39

Table A. 6: Simultaneous Gravity Model for Bilateral Imports and Bilateral Banking Claims, Emerging Vs. Developed Countries.
Standard errors in parentheses.
Statistical significance at the 10% (resp. 5% and 1%) level are denoted by * (resp. ** and ***).
Specification # 1:

$$\begin{cases} \log\frac{\text{Import}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha^T + \phi_T\log\frac{\widehat{\text{Asset}_{ij}}}{\text{GDP}_i\text{GDP}_j} - \beta_T\log(\text{Dist}_{ij}) + \gamma_T Z^{3T}_{ij} + \varepsilon^T_{ij} \\ \log\frac{\text{Asset}_{ij}}{\text{GDP}_i\text{GDP}_j} = \alpha^A + \phi_A\log\frac{\widehat{\text{Import}_{ij}}}{\text{GDP}_i\text{GDP}_j} - \beta_A\log(\text{Dist}_{ij}) + \gamma_A Z^{3A}_{ij} + \delta_A\text{Ret}_j + \varepsilon^A_{ij} \end{cases}$$

5.3 Estimating an upper-bound for the effect of distance on asset holdings (resp. on trade in goods)

Let us consider the following model where $\{A, T, D\}$ means respectively bilateral Asset Holdings, bilateral Import of Goods and bilateral Distance:

$$\begin{aligned} A &= \phi_A T + \beta_A D + \varepsilon_A \\ T &= \phi_T A + \beta_T D + \varepsilon_T \end{aligned}$$

We refer to this model as the "true model". For sake of clarity in the demonstration, we drop the other control variables from this model but a similar reasoning can be made when other covariates are included (see below).

The First-Stage regressions are the following:

$$\begin{aligned} A &= \sigma_A + \varphi_A I_A + \xi_A = \widehat{A} + \xi_A \\ T &= \sigma_T + \varphi_T I_T + \xi_T = \widehat{T} + \xi_T \end{aligned}$$

where I_A and I_T are the set of instruments for A and T , $\widehat{A}$ and $\widehat{T}$ are the predicted value of A and T.

Let us consider the "true model" for Asset Holdings and its 2SLS–estimated counterpart.

$$\begin{aligned} A &= \phi_A T + \beta_A D + u_A \\ A &= \widehat{\phi_A}\widehat{T} + \widehat{\beta_A} D + \widehat{u}_A \end{aligned}$$

Taking the covariance with Distance leads to[69]:

$$cov(A, D) = \phi_A cov(T, D) + \beta_A V(D) + cov(u_A, D) = \widehat{\phi_A} cov(\widehat{T}, D) + \widehat{\beta_A} V(D) + cov(\widehat{u}_A, D)$$

As far as D is "exogenous" and then orthogonal to the structural disturbances u_A (and $\widehat{u}_A$), one gets the expected bias of the estimated $\widehat{\beta_A}$:

$$E(\widehat{\beta_A} - \beta_A) = E\left(\frac{\phi_A cov(\xi_T, D) - (\widehat{\phi}_A - \phi_A) cov(\widehat{T}, D)}{V(D)}\right)$$

the instrumental variable estimator is asymptotically convergent, thus the expected asymptotical bias of the second stage estimate of β_A is:

$$E(\widehat{\beta_A} - \beta_A) = E\left(\frac{\phi_A cov(\xi_T, D)}{V(D)}\right) = E\left(\phi_A corr(\xi_T, D) V(\xi_T)\right)$$

Respectively, the bias on the estimate of β_T is:

$$E(\widehat{\beta_T} - \beta_T) = E\left(\frac{\phi_T cov(\xi_A, D)}{V(D)}\right) = E\left(\phi_T corr(\xi_A, D) V(\xi_A)\right)$$

This procedure is valid for any proper instrument I_T. A simple calculus of the right hand side of those expressions gives an estimate of the magnitude of the bias.

Note that when distance is included in the set of instruments: $cov(\xi_T, D) = 0$ and the bias is expected to be zero.

[69] The operator cov is for the covariance and V for the variance.

However, given the strong predictive power of bilateral distance on goods trade, adding distance in the set of instruments raises multicollinearity issues in the second step.

Theoretically, these expressions of the bias do not give information on its sign but empirically $corr(\xi_i, D)$ is found to be negative: then $\widehat{\beta_A}$ (resp. $\widehat{\beta_T}$) gives an **upper-bound** of the true effect of distance on asset holdings (resp. trade in goods).

We can estimate the bias in presence of control variables; we just have to redo the same reasoning in the orthogonal of those control variables :

$$\begin{aligned} A &= \phi_A T + \beta_A D + \gamma_A Z_A + \varepsilon_A \\ T &= \phi_T A + \beta_T D + \gamma_T Z_T + \varepsilon_T \end{aligned}$$

$$\begin{aligned} A &= \widehat{A} + \xi_A \\ T &= \widehat{T} + \xi_T \end{aligned}$$

$$\begin{aligned} A &= \phi_A T + \beta_A D + \gamma_A Z_A + u_A \\ A &= \widehat{\phi_A}\widehat{T} + \widehat{\beta_A} D + \widehat{\gamma_A} Z_A + \widehat{u}_A \end{aligned}$$

We introduce $P^{\perp}_{Z_A}$ the projector on the orthogonal of the vectorial space generated by Z_A[70]:

$$\phi_A P^{\perp}_{Z_A} T + \beta_A P^{\perp}_{Z_A} D + u_A = \widehat{\phi_A} P^{\perp}_{Z_A} \widehat{T} + \widehat{\beta_A} P^{\perp}_{Z_A} D + \widehat{u}_A$$

since $P^{\perp}_{Z_A} u_A = u_A$ (resp. $P^{\perp}_{Z_A} \widehat{u}_A = \widehat{u}_A$)

Taking the covariance with D leads to:

$$\phi_A cov(P^{\perp}_{Z_A} T, D) + \beta_A cov(P^{\perp}_{Z_A} D, D) = \widehat{\phi_A} cov(P^{\perp}_{Z_A} \widehat{T}, D) + \widehat{\beta_A} cov(P^{\perp}_{Z_A} D, D)$$

since u_A (resp. $\widehat{u}_A$) is orthogonal to D.

Rewriting this expression and taking expectations (using $\phi_A = E(\widehat{\phi_A})$) gives the expression of the bias in presence of control variables:

$$E\left(\widehat{\beta_A} - \beta_A\right) = E\left(\frac{\phi_A cov(P^{\perp}_{Z_A} \xi_T, D)}{cov(P^{\perp}_{Z_A} D, D)}\right)$$

This expression is similar to the previous one; the only difference is that we have project on the orhogonal of the set of control variables. We also have:

$$E\left(\widehat{\beta_T} - \beta_T\right) = E\left(\frac{\phi_T cov(P^{\perp}_{Z_T} \xi_A, D)}{cov(P^{\perp}_{Z_T} D, D)}\right)$$

This procedure is valid for any proper instrument I_T. A simple calculus of the right hand side of those expressions gives an estimate of the magnitude of the bias.

If $\{Z_A, D\}$ is included in the set of instrument, then: $P^{\perp}_{Z_T} \xi_A = \xi_A$ is orthogonal to D and $E\left(\widehat{\beta_A}\right) = \beta_A$ (resp. $E\left(\widehat{\beta_T}\right) = \beta_T$)

[70]Strictly speaking, $P^{\perp}_{Z_A} U$ is hte residual of the OLS-regression of U on Z_A.

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