Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

The Determinants of GATS Commitment Coverage

Peter Egger[1] and Rainer Lanz[2]

PRELIMINARY DRAFT – PLEASE DO NOT QUOTE WITHOUT PERMISSION

Abstract

This paper investigates hypotheses about the determinants of trade and investment liberalization with a particular focus on the market access commitments under the General Agreement on Trade in Services (GATS). We identify a positive impact of country size on the absolute coverage ratio, i.e. the ratio of the sum of weighted commitments to the number of possible commitments. Contrary to our theoretical expectations, 'richer' countries – i.e., ones with a higher capital-labor ratio – are also more liberal in terms of the absolute coverage ratio. As a further result, we find significant positive spatial interdependence between the coverage ratios of countries.

Keywords: GATS; Trade liberalization; Investment liberalization; Services

JEL-code: F14, F15

[1] *Affiliation:* Ifo Institute, CESifo, University of Munich, and Center for Globalisation and Economic Policy at the University of Nottingham. *Address:* Ifo Institute, Poschingerstrasse 5, 81679 Munich, Germany. *E-mail:* egger@ifo.de.

[2] *Affiliation:* Munich Graduate School of Economics at the University of Munich. *Address:* Munich Graduate School of Economics, Kaulbachstrasse 45, 80539 Munich, Germany. *E-mail:* rainer.lanz@lrz.uni-muenchen.de. *Acknowledgements:* To be added.

1. Introduction

The General Agreement on Trade in Services (GATS) launched in 1995 is considered to be the major outcome of the Uruguay Round (see Hoekman, 1996, for a first rigorous treatment). The agreement establishes a catalogue of rules and disciplines addressing commercial presence (such as foreign direct investment) in the service sector, trade in services, and even cross-border factor movements (such as the activity of expatriates). These rules and disciplines are targeted towards liberalizing trade in services, thereby paralleling the objectives of the General Agreement on Trade and Tariffs (GATT) which were meant for goods trade only. The GATS introduces the following key concepts of rules and disciplines:

- **Horizontal commitments** are general (or default) rules which have been notified by the member countries to the World Trade Organization (WTO) to apply to all sectors listed by a country as long as no sector-specific exceptions from this general rule are made (see the next point).

- **Specific commitments** are the country-and-sector-specific exceptions from horizontal commitments notified to the WTO. These commitments address either *market access* or *national treatment*. And for either of these principles the agreement distinguishes among four modes of supplying a service:
  - *Mode 1 – cross-border supply* (classical trade in services such as bank transfer or telephone calls)
  - *Mode 2 – consumption abroad* (e.g., tourism)
  - *Mode 3 – commercial presence;* (e.g., through foreign direct investment)
  - *Mode 4 – movement of natural persons* (e.g., the activity of expatriates)

- **Most favored nation (MFN) clause** ensures that member countries may not be selectively discriminated.

While MFN follows a negative list approach (the MFN principle applies as long as no exemptions are notified to and applied under the auspices of the WTO), horizontal as well as specific commitments follow a 'conditional' positive list approach. The latter means that horizontal commitments are effective only for the sectors listed (and as long as no specific commitments/exemptions apply). Restrictions about market access and/or national treatment become transparent only for the listed sectors. For unlisted sectors, countries are not bound in the type of restrictions implemented. Hence, the rules and principles under GATS bring about *conditional transparency* regarding restrictions of service transactions. Unconditional transparency about restrictions is not reached, because the restrictions for unlisted sectors may be more or less severe than those of the actually listed ones. Accordingly, a longer list of

notified restrictions does not necessarily reflect a higher (maximum) level of impediments to service transactions. This is only true conditional on a sector's listing at all. In general, it is therefore unclear whether a longer list of sectors and partial commitments in GATS on average reflects an attitude towards liberalization (through transparency) or towards protection (through restrictions).

It is this paper's purpose to study the economic fundamentals behind the coverage ratio of commitments (i.e., a country-specific weighted share of restrictions across sectors). In particular, we aim at understanding the deterministic part of this coverage ratio by means of econometric analysis against the background of general equilibrium work on trade and investment liberalization. Given our theoretical motivation, we restrict our analysis on the determinants of commitments in commercial presence (mode 3) and cross-border supply (mode 1), since these two modes correspond most closely to foreign direct investment in services and "traditional" service trade, respectively. Among the four modes of supplying a service commercial presence is clearly the most important one to countries. Hoekman (2006) reports that service sales by US foreign affiliates were around 50% higher than US cross-border service exports in 2003. For the case of Tunisia Konan and Maskus (2005) estimate that 75% of potential service liberalization gains may be achieved through mode 3 liberalization. Furthermore, we investigate the determinants of market access commitments only, since these and national treatment commitments are highly correlated and the market access principle is typically considered as being more important in attract investment.

The structure of the paper is as follows. In the next section we shortly explain the extent of liberalization under the GATS. In section three we summarize general equilibrium theory on trade and multinational enterprises for services liberalization and provide hypotheses about the determinants of commitments. In the empirical part of the paper (section 4, with sub-sections) we provide a descriptive analysis of GATS commitments, explain our regression specifications and report estimation results. As extensions we compute sensitivity analyses using other potential explanatory candidates like political variables and investigate interdependencies in commitments between countries with the help of spatial econometrics.

2. Trade and investment liberalization under GATS?

While GATS introduces rules and disciplines on market access and national treatment related to service sector economic activity, it is not entirely clear how to think about its consequences in the context of trade and investment liberalization. In principle, there are two channels through which the introduction of rules and disciplines could have had liberalizing or quasi-liberalizing effects on service trade and investment. One is the greater transparency of actually applied (or applicable) restrictions by country and sector from an investor's or exporting firm's point of view – greater transparency may be viewed as a quasi-reduction of barriers to trade and investment. A second possible channel is the reduction of restrictions in the course of their explicit formulation under GATS – a sort of race to the bottom caused by the requirement to make restrictions transparent.

While the role of GATS in creating greater transparency for exporters and multinational firms is uncontroversial, the accepted view about the second channel is that countries did not use commitments to a major extent for considerable liberalization but mainly bound the status quo of their trade and investment regimes.[3] Hence, GATS mainly quasi-liberalizes trade and investment through greater transparency and legal security in the listed sectors at the country-level. However, the specific commitments in GATS reflect the restrictiveness of a country's trade and/or investment policy and, therefore, a country's general attitude towards liberalization in these regards. Consequently, we may argue that countries which benefit most in welfare terms from trade and investment liberalization should not only exhibit the lowest level of restrictions but also a high incentive to make this fact transparent under GATS by notifying liberal commitments.

Regarding the (quasi-)liberalizing nature of GATS it is useful to recall the nature of commitments. First, GATS is a multilateral agreement where commitments are made unilaterally by countries. Hence, there is no discrimination between partner countries. Accordingly, testable hypotheses about the determinants of GATS commitments (as quasi-liberalizing standards for service trade and investment) should be gathered from the literature on the welfare effects not only of bilateral, but also of unilateral trade and investment liberalization. In the next section theoretical predictions for welfare effects from unilateral and bilateral liberalization policies are reviewed.

---

[3] See Hoekman (1996) among others. A certain amount of liberalization was reached in the financial services and telecommunications sector as a result from after-1995 negotiations.

3. Theoretical background

In order to provide predictions about the determinants of the GATS specific commitments we rely on the general equilibrium theory of trade and multinational enterprises. In particular, guidance about a reduced-form relationship between economic fundamentals and the welfare effects of trade and/or investment liberalization can be gathered from Markusen (1997, 2002), Markusen, Rutherford and Tarr (2005), Markusen (2006), Markusen and Strand (2007), and Egger, Larch, and Pfaffermayr (2007).

Markusen and Strand (2007) compute simulations for bilateral service trade and investment liberalization policies in a two-final-good, two-factor, two-country general equilibrium model of trade and multinational enterprises. They put the emphasis of their analysis on the consequences of service trade/offshoring for industrialized countries and therefore solve the model for a world with a small and skilled labor-abundant and a large and skilled-labor scarce country. Services are modeled as intermediates in the production of a final manufacturing good and might be fragmented in two ways. First, the production of services might be geographically separated from the final goods production, leading to cross-border trade in service inputs (mode 1). Second, services themselves can be fragmented into an upstream headquarters activity and a downstream production activity, giving rise to foreign direct investment in services (mode 3). They compare welfare and equilibrium characteristics of four regimes (no trade and foreign investment allowed, only trade is feasible, only foreign investment is feasible and both trade and investment are allowed). In an extension they divide skilled labor in managers and routine skilled workers, with the latter working in the downstream service activities which may be offshored. Markusen and Strands (2007) work builds on Markusen (2006), who computes a series of different general equilibrium models in order to investigates the welfare consequence of service offshoring in a setting with an industrialized (skilled labor-abundant) and a developing (skilled labor-scarce) country.

Trade liberalization

Markusen and Strand (2007) find that for a small, skilled-labor abundant country a regime which allows only trade in services is preferable in welfare terms to a regime which bans trade and foreign investment. Furthermore, trade liberalization tends to bring at least the same welfare gains as investment liberalization in their simulations for the industrialized country.

In a two-good, two-factor and two-country knowledge capital model, Markusen (1997) finds that pure trade liberalization is preferable to pure investment liberalization for a developing country (small and skilled-labor scarce) if welfare is the policy criterion.

Investment liberalization

The findings in Markusen (2002) for the knowledge-capital model with goods production suggest that small countries almost always gain from investment liberalization while large countries may lose. The reason is that small and (unskilled) labor abundant countries' inward investments react more sensitively to investment liberalization than those in large and skilled labor (or capital) abundant ones. These results are confirmed also for unilateral investment liberalization in Egger, Larch and Pfaffermayr (2007): small and/or capital-scarce countries gain more from unilateral investment liberalization than large and/or capital-abundant ones.

Trade and investment liberalization

Markusen (1997) considers trade and investment liberalization in a model with goods (rather than service) production. He finds that trade and investment liberalization alone have quite different effects, but also that trade and investment liberalization together are in a sense complements. A developing country obtains the highest welfare gain if both trade and investment are liberalized. Markusen, Rutherford and Tarr (2005), built their analysis on a monopolistic competition model with producer services used as intermediate inputs. In the model they do not formally distinguish between service trade and foreign direct investment. Two goods are produced by two factors, skilled labor and a composite factor. However, one good requires additionally a service input in production. This service input might be provided by domestic or foreign firms. While domestic firms use the two domestic factors in the production of this service, foreign firms use additionally a composite imported factor, whose price might be driven up by investment barriers. Liberalization implies a fall in the cost of this imported factor. Markusen, Rutherford and Tarr (2005) conclude that trade and producer service investment liberalization increase aggregate welfare in a developing country, but are particularly beneficial for skilled workers. Even though foreign services and domestic skilled labor are substitutes in partial equilibrium (we might say, in the short run), they are complements in general equilibrium (we might say, in the long run): Foreign service providers substitute for domestic firms what then lowers demand for domestic skilled workers, since foreign service firms replace parts of the skilled labor with the imported foreign input. However, the resulting lower cost of service inputs leads to an expansion of the

final good sector, which uses skilled labor intensively. This increase in demand for domestic skilled labor more than outweighs the reduction in demand from substitution of domestic service firms. In a dynamic analysis they find that the greater the fraction of immobile skilled workers (experience earnings losses) the more severe is the transition to the new better equilibrium. Furthermore, the composite factor (including unskilled labor), which is used intensively in the contracting sector might not experience a real price decrease because the Stolper-Samuelson effect (price of skilled labor increases relative to the price of composite factor) is offset by the Dixit-Stiglitz price index effect (price of skilled labor intensive good falls). Markusen and Strand (2007) find that combined trade and investment liberalization is equally desirable to trade or investment liberalization alone a two-factor model with skilled and unskilled labor. However, in a three-factor model with two types of skilled workers, the combined trade and investment liberalization scenario brings the highest welfare gain for the small, skilled labor-abundant country. However, while managers gain much, routine skilled workers gain only few and the wage of unskilled labor is likely to fall.

Summarizing the general equilibrium models mentioned above we can provide predictions about which countries should benefit most from trade and investment liberalization in services and hence should have the highest coverage ratios in their commitments. The role of country size and relative endowments tends to be similar for trade and investment liberalization in the models mentioned above. Hence, predictions with respect to mode 1 and mode 3 are the same. Small countries typically gain more from trade and/or investment liberalization, and therefore we expect that the relative coverage of mode 1 and mode 3 commitments are higher for small countries. Hypotheses with respect to skilled-labor are less clear. Studies mentioned above promised welfare gains to both skilled labor-abundant countries (Markusen and Strand 2007) and developing countries (Markusen, Rutherford and Tarr 2005) from trade and investment liberalization in services. Markusen (2006) computes a series of different general equilibrium models with a skilled-labor abundant and a skilled-labor scarce country. While the developing country typically gains from fragmentation of service production, the skilled-labor abundant country gains if it is small and may loose if it is too large. Hence, skilled-labor scarce countries should be less restrictive in their GATS commitments for sectors listed. Egger, Larch and Pfaffermayr (2007) come to a closely related result, namely that capital scarce countries benefit more from investment liberalization. Their finding is especially interesting since it considers welfare consequences from unilateral investment liberalization. In the empirical analysis we use country size and the capital per capita ratio as explanatory variables

for GATS coverage. We employ the capital per capita instead of the skilled labor ratio, since empirical evidence suggests that they are highly correlated and the former is available for more countries.

4. Empirical analysis

4.1. Classification of specific commitments

The first and most comprehensive evaluation of the specific commitments in the GATS has been done by Hoekman (1996). A more recent evaluation covering newly acceded members, results from extended negotiations in the telecommunication and financial sector as well as current offers from countries in the Doha Development Round is made by Adlung and Roy (2005). However, different to us both studies provide only a descriptive analysis of the GATS specific commitments. We adopt the classification of Hoekman (1996) from the initial set of commitments that came into force on January 1, 1995.[4]

If a country lists a sector, it must make commitments for each mode of supply and with respect to the market access and national treatment principle. However, as mentioned in the introductory section we confine our analysis to market access commitments for mode 1 and mode 3. We distinguish three broad types of commitments, i.e. none (full commitment), bound (partial commitment) and unbound (no commitment/full discretion). An entry of none implies that the country guarantees full market access for a certain sector and mode of supply. The bound category comprises all the partial commitments, i.e. the country guarantees market access subject to the restrictions listed. If a country enters an unbound, it makes no market access commitment for a sector with respect to a certain mode. None, bound and unbound are assigned the values 1, 0.5 and 0 respectively, reflecting different degrees of restrictiveness. An important assumption in this modeling is that a partial commitment made by a country is always more liberal than no commitment (unbound), no matter how restrictive the commitment is. Different to Hoekman (1996) and Adlung and Roy (2005) but following Langhammer (2005) and Eschenbach and Hoekman (2006) we classify the EU countries separately, because the EU schedule displays a considerable variation in commitments for member states. Thereby, a single EU country is assigned a none if the EU lists a sector in its

---

[4]We are grateful to Bernard Hoekman for making us available his original classification list. Our analysis does not include changes in commitments for the telecommunications and the financial services sector, where extended negotiations led to increased commitments after 1995.

schedule but the country itself does not enter a commitment. Hence, the country has implicitly guaranteed full market access.

Previous attempts to explain the determinants of the GATS specific commitments are made only on a sector basis. Harms, Mattoo and Schuhknecht (2003) try to explain the determinants of the GATS commitments in the financial sector of the agreement achieved in 1997.[5] While our analysis is based on the theory of the multinational firm, Harms et al. motivate most of their explanatory variables using a political economy model. They find membership in a coalition group, unionisation, financial development and foreign presence as the main determinants for liberal GATS commitments in the financial sector. Different to us they construct a liberalization index out of the commitments by combining market access commitments for mode 1, mode 2 and mode 3 and by sub-dividing partial commitments into four restrictiveness levels. Valcx (2004) extended the analysis of Harms et al. with respect to the impact of commitments in the financial sector on financial crisis. He finds several macroeconomic variables to have some explanatory power for liberal commitments in the financial sector. Contrary to these two studies, we investigate the determinants of commitments in all sectors and base our classification on the commitments made when the GATS came into force in 1995. We do not consider results from extended negotiations after 1995 in the financial services and the telecommunications sector. A further distinction is that our study treats the EU countries separately.

4.2. Features of the coverage ratios

In summarizing the commitments we group countries into low, middle and high income countries according to the World Bank classification for 1995. 25 countries are classified as low income, 48 countries as middle income and 34 countries as high income. The detailed country composition of the three groups is shown in Annex I.[6] Table 1 reports summary statistics of commitments in mode 1 and mode 3 for the three country groups.

– Table 1 –

---

[5] Service negotiations continued in the financial sector after 1995 and were concluded in December 1997.
[6] We include the same 96 countries as Hoekman (1996) plus the 12 EU countries in our analysis. Thus, also countries which scheduled commitments by mid 1994 but became member of the WTO at a later point in time are included, i.e. China (2001), Congo (1997), and Algeria (not member yet).

Overall, countries listed on average only 41.1 sectors out of 155, which corresponds to a coverage of only 26.5%.[7] Richer countries listed on average more commitments. While high income countries have a coverage of 48.1%, middle and low income countries listed on average only 19.8% and 9.9% of all sectors respectively. For the calculation of the weighted absolute and relative coverage ratios, commitments are assigned a 1 for none, a 0.5 for bound and a 0 for unbound, reflecting different degrees of restrictiveness. The weighted absolute coverage is the ratio of the sum of weighted commitments to the number of possible commitments (155). If we interpret it in terms of restrictiveness of the trade/investment regime, we assume that sectors not listed are most restrictive, i.e. equally to unbound sectors. Differently, the weighted relative coverage is calculated by dividing the weighted sum with the number of commitments actually made. Therefore it considers the restrictiveness of commitments made, and disregards sectors not listed. The weighted absolute and relative coverage ratios show that mode 3 commitments tend to be more liberal than mode 1 commitments for middle and high income countries. However, a closer look at the relative coverage ratios of none, bound and unbound entries delivers more valuable insights regarding the differences in commitments between modes. For mode 1 the high share of full commitments (66.6%) and unbounds (24.9%) are remarkable. Surprising is the difference in the number of bound commitments between modes. While in mode 1 only 3.8% of a country's entries are partial commitments, in mode 3 the relative bound coverage is 43.1%. The reversed pattern can be observed for unbound entries, with a low share of unbounds in mode 3 (4.5%) and a higher share in mode 1 (24.9%). The low number of unbounds indicate the importance of mode 3 for countries. Since countries have to make a commitment for every mode if a sector is listed this might also play a role for the high number of unbounds in mode 1. Other reasons might be the non-tradability of some services in a cross-border sense or the uncertainty of legal implications (Adlung and Roy 2005). The weighted coverage ratios indicate that poorer countries committed themselves more restrictively than richer ones. However, the differences between income groups decrease with the weighted relative coverage compared to the weighted absolute coverage. In mode 3 the difference between low and high income countries decreases from about 35% for the weighted absolute coverage to nearly 17% for the weighted relative coverage. High income countries have the highest coverage of full commitments for both modes in their schedule.

---

[7] The number of commitments does not vary across modes since countries must make a commitment for every mode if a sector is listed. Hence, the number of commitments for a mode corresponds to the number of sectors listed by a country.

4.3. Specification

In the light of the theoretical hypotheses summarized in Section 2, we may specify the (absolute versus relative) coverage ratio of GATS commitments announced in 1995 under Modes 1 or 3 in the following way:[8]

$$\ln\left(\frac{\dfrac{\sum weightedcomm.s_{m,i}}{\#allsectors_{m,i}}}{1-\dfrac{\sum weightedcomm.s_{m,i}}{\#allsectors_{m,i}}}\right)=\alpha_{m,0}+\sum_{k=1}^{K}\alpha_{m,k}X_k+u_{m,i} \quad for\ m=1,3;\ i=1,\ldots,N, \quad (1)$$

and, alternatively,

$$\ln\left(\frac{\dfrac{\sum weightedcomm.s_{m,i}}{\#listedsectors_{m,i}}}{1-\dfrac{\sum weightedcomm.s_{m,i}}{\#listedsectors_{m,i}}}\right)=\beta_{m,0}+\sum_{k=1}^{K}\beta_{m,k}X_k+v_{m,i} \quad for\ m=1,3;\ i=1,\ldots,N, \quad (2)$$

K is the number of explanatory variables, M denotes the mode-specific index and i is a country index. Section 2 suggested using country size and (relative) factor endowments as determinants of trade and/or investment liberalization (X_k). $u_{m,i}$ and $v_{m,i}$ are stochastic error terms. Summary statistics of explanatory variables are shown in Table 2. We use the log of real GDP in US dollars for the year 1993 (from the World Bank's World Development Indicators) as a measure of country size to explain the coverage ratios announced in year 1995. Furthermore, we include the log of capital-per-worker of 1993 (from Baier, Dwyer, and Tamura, 2006; kindly made available by Scott Baier) as a measure of a country's capital-labor ratio.[9] Additionally, we use dumping and antidumping measures indicating barriers to goods trade (data are taken from Egger and Nelson, 2007) as additional controls.[10] Since these two variables are also an indicator for the degree of active trade policy of a country, both a negative or positive sign of the coefficient might be reasonable. Furthermore, we include a variable indicating the past amount of trade liberalization efforts (such as the fraction of countries an economy was engaged with in free trade agreements notified to the WTO between 1970 and 1990) in our regressions. We expect this variable to be positively related to the GATS coverage since countries, which have formed more free trade agreements (FTA) in

---

[8] We use a logistic transformation of the coverage ratio on the left-hand-side to make sure that the model predictions will lie in the interval [0,1].

[9] Some of the theoretical models referred to in Section 2 derive hypotheses about the skilled-to-unskilled labor ratio rather than the capital-labor ratio. However, the two relative endowment indicators are highly correlated and capital-labor ratios are available for a broader set of countries.

[10] We measure the use of *dumping measures* of country i as the total number of antidumping cases filed against country i by others since 1970 up to 1990. In contrast, the number of *antidumping measures* used by country i is the number of cases filed by country i against others since 1970 up to 1990. We do not consider cases later than 1990 to avoid any feedback effects from GATS on the use of dumping and antidumping measures.

the past should also be more inclined to liberalize service trade. This argument is supported by Ornelas (2005). He shows for a model of endogenous FTAs and endogenous external tariffs that FTAs tend to foster multilateral liberalization.

4.4. Regression results

In Table 3, we run a first set of regressions using the logistically transformed coverage ratio of Modes 1 and 3 (*absolute* versus *relative*) as in equations (1) and (2) on the left-hand-side and only size and capital per capita on the right-hand-side. In Table 4, we use the *full commitment coverage ratio* (i.e., the fraction of full commitments in the number of sectors listed in Mode *m* by country i). The results can be summarized as follows.[11]

– Tables 3 and 4 –

Table 3 indicates that the explanatory power of the models based on two explanatory variables is remarkable. However, it is much better for the absolute coverage ratio than for the relative one. An obvious reason for this result is that large countries have interest in and, hence, list more sectors than small ones (see the positive significant coefficient of GDP with the absolute coverage ratio).[12] If we use the relative coverage ratio as dependent variable, we obtain a coefficient for country size which is negative for Mode 1 and insignificant for Mode 3. Hence, large countries tend to be more restrictive in their commitments for listed sectors (Mode 1). By way of contrast, 'richer' or more developed countries in terms of the capital-labor ratio display higher coverage ratios, irrespective of whether Mode 1 or Mode 3 are concerned. Hence, rich countries tend to commit more /are more liberal not only with respect to all sectors (absolute coverage), but also relative to the sectors listed (relative coverage). These findings are also confirmed when using the relative *full commitment coverage ratio i*n Table 4 instead of the *commitment coverage ratios* in Table 3 (based on 'none' only instead of 'none' and 'bound'). There, we generally find that small and capital-abundant countries have a larger fraction of sectors with full commitments than others. Hence, the results obtained are somewhat 'sharper' than before once we restrict our interest on sectors with full commitment as compared to others with no and partial commitment.

---

[11] Some countries are lost with the logistic transformation, because their coverage ratios take the boundary values 0 and 1.

[12] We ran the regression with absolute coverage ratio also for a subset of 62 developing countries and came to the same results with respect to the influence of country size and capital per capita. This weakens a possible argument that the absolute coverage is driven the developing status of a country.

In Tables 5 and 6, we run similar regressions but using the aforementioned trade friction/liberalization indicators in addition to the size and factor endowment variables in the econometric models.

– Tables 5 and 6 –

Results regarding country size and capital per capita are confirmed in this extended specification. Table 5 shows that large countries have a higher weighted sectoral coverage (mode 3), but when looking only at the sectors listed large countries tend to commit less (mode 1). Also in this extended specification more capital abundant countries have significantly higher coverage ratios for mode 1 and mode 3 as can be seen in both tables. Table 6 confirms the finding that small and capital abundant countries tend to have a higher share of full commitments in their GATS schedule.

Table 5 shows that the variable indicating the average fraction of partner countries in free trade agreements from 1970-1990 has a significant positive impact on the absolute coverage ratio for both mode 1 and mode 3. However, its impact seems to vanish for the relative coverage (significant at 10% only for mode 1). The significant positive impact for the absolute coverage and no impact for the relative coverage indicate that countries more engaged in free trade agreements have more sectors or want more sectors to be regulated on a multilateral level respectively. The coefficients of the dumping and antidumping measures are positive, but significant only for the specification using the relative coverage ratio for mode 1 as dependent variable. The positive coefficient supports the argument that countries with an active trade policy are more committed to liberalization. However, the fact that these two variables are not robust across the regressions (and neither across specifications as we will see) cast doubts on their influence. Table 6 shows similar results for the share of full commitments as dependent variable. The coefficients of both the number of filed and accused dumping cases are significant and positive for full coverage in mode 1 and the fraction of partner countries a country is engaged with in free trade agreements has a significant positive impact in mode 1 only.

The finding that smaller countries tend to commit relatively more liberal is in line with our theoretical predictions from section two. While we could expect the relationship between capital per capita and the absolute coverage of commitments to be negative, it is surprising

that this is also the case with respect to the relative coverage of commitments. Theory predicts the opposite, in the sense that capital scarce (skilled labor-scarce) countries should gain most from liberalization. Hence, the liberality of commitments made should be higher for developing countries, which is not the case though. Reasons might be that developing countries display a larger share of infant industries and protect them from foreign competition. Another reason for the finding that capital-rich countries have a higher absolute coverage should be that they have more service sectors present in their economy driving up the coverage ratio relative capital-scarce countries, if these do not include underdeveloped sectors in the schedule. Apart from economic fundamentals, political interests or strategic considerations might have influenced countries in scheduling their commitments, which is going to be investigated in the next section.

4.5. Extensions and sensitivity analysis

Political determinants of commitments

Beside the general equilibrium models of trade and multinational enterprises other theory strands might be used to explain the commitments in the GATS. The political economy approach on the formation of free trade areas focuses on interest groups, i.e. lobbies, which try to influence politicians so that their business or interest is best served. In the political economics literature of free trade agreements (see Grossman and Helpman,1995, as main contribution) the contrary interests and strength of export an import competing sectors play an important role for the outcome of negotiations. However, we do not have data to evaluate lobby power at an industry level. Consequently, we try to capture the importance of lobbies in the overall economy of a country. By doing so, we implicitly make the assumption that greater power of interest groups in a country leads to higher protection and thus lower coverage ratios in commitments. This excludes the possibility that highly competitive industries in a country lobby for more openness world wide or do not lobby for increased protection at home. We use political variables from two sources, the Polity IV Project (Marshall and Jaggers, 2002) and a dataset on comparative economics from the World Bank (Beck, Clarke, Groffe, Keefer and Walsh, 2004). Biglaiser and Brown (2001) argue that lobbying is more difficult if the legislature has a higher degree of fractionalization. Hence, countries with more fractionalized political systems should have higher coverage ratios (*frac*). Another variable we include in our regressions is the quality of checks and balances (*checks*), which should hinder lobbying efforts (Persson, 1998). Another factor which might constrain

the effectiveness of lobby groups is the degree of polarization in the political system (*polariz*). The more parties are polarized the more they suffer in utility terms if the are not in government and so having their preferred policy not implemented. Hence, the more polarized political parties are, the lower should be the effectives of interest groups, since their interest tend to be in contrast to the interest of social welfare (Testa 2003). However, Biglaiser and Brown (2001) find some evidence that polarized legislatures render an agreement on policy reforms more difficult to achieve. Furthermore, we use a durability indicator (*durable*), which indicates the number of years since the last greater regime change had happened and a variable indicating the number of years the chief executive has been in office (*yrsoffc*). The political economy arguments would be that a regime change fosters the building of political institutions and consequently reforms and that newly elected governments are more likely to reform. Additionally, we control for the political orientation of a country's government including dummy variables indicating whether the government parties are left-wing or right-wing oriented (*execrlcR, execrlcL*).

We do not report regression tables because we could not find evidence that political variables matter for coverage ratios. We ran several regressions using subsets of the political variables mentioned above but could hardly find a political variable being significant in any specification. The variable *checks* was significant in one specification, but was not robust at all, i.e. it was insignificant in most other specifications. Furthermore, we tested the result obtained from Harms et .al. (2003) for the financial sector, namely that a country's affiliation to a coalition group influenced the coverage of commitments. Thereby, dummy variables indicating the membership in the Cairns group of agricultural exporting nations and a coalition group indicating strong interest in textile exports were included.[13] The two dummies were insignificant in our baseline specification with only real GDP and capital stock per capita as well as when they were included together with other political variables. When included in the extended regression together with the trade variables the cairns group dummy was positive and significant for the two regressions using mode 3 coverage ratios as dependent variable. However, given that this result is by far not robust and even contrary to

---

[13] Harms et. al. (2003) considered commitments in the financial sector only.
Cairns Group: Argentina, Australia, Brazil, Canada, Chile, Colombia, Indonesia, Malaysia, Paraguay, Peru, Philippines, South Africa, New Zealand, Thailand, Uruguay. Not included due to after-1995 joining: Bolivia, Costa Rica, Guatemala, Pakistan.
Textile group: Brazil, Egypt, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Turkey, Hungary and Poland, Bahrain, Bulgaria, Colombia, Costa Rica, Czech Republic, Dominican Republic, El Salvador, Haiti, Hong Kong, Jamaica, Kenya, Kuwait, Macao, Mauritius, Mexico, Romania, Singapore, Slovak Republic, Sri Lanka and Uruguay.

expectations, we think we can reject the influence of either of the two coalition groups on the outcome of service trade negotiations.

Spatial Analysis

If we estimate the determinants of GATS commitments by OLS we assume that there are no interdependencies between countries in setting their commitments. However, this i.i.d. assumption is likely to be inadequate. Since the GATS is based on multilateral negotiations, countries will condition their commitments on those made by other countries. We hypothesize that a country will commit to more liberal policies if other economies – especially those that are highly relevant to the country – will do so as well. In order to take account of this interdependence between countries we expand our analysis by means of spatial econometrics. Thereby, we introduce first order spatial autocorrelation in both the dependent variable and the error term in our model:

$$y = X\beta + \lambda_0 W y + u \qquad |\lambda_0| < 1$$
$$u = \rho_0 M u + \varepsilon$$

y is the nx1 vector of dependent variables, X is an nxk matrix of explanatory variables. The spatial autocorrelation is captured by the so-called spatial lags Wy and Mu. The nxn weighting matrices W and M consist of exogenous weights reflecting different degrees of spatial autocorrelation between the coverage ratios and the residuals respectively. Hence, the spatial lag Wy is a weighted average of the coverage ratios made by other countries. The parameters λ_0 and ρ_0 indicate the strength of the spatial relationships. The nx1 vector of error terms is generated by the spatial lag Mu and the nx1 vector ε_n of innovations. The reduced form model is then:

$$y = (I - \lambda_0 W)^{-1} X\beta + (I - \lambda_0 W)^{-1} u$$

$$u = (I - \rho_0 M)^{-1} \varepsilon$$

The variance-covariance matrix (VC) of u is

$$E[uu'] = \Omega_u = \sigma_\varepsilon^2 (I - \rho_0 M)^{-1} (I - \rho_0 M')^{-1}$$

It is relatively easy to show that the spatial lag is correlated with the error term:[14]

$$E[(Wy)u'] = W(I - \lambda W)^{-1} \Omega_u \neq 0$$

Since the endogeneity of the spatial lag term leads the OLS estimator to be biased and inconsistent, we estimate the model by two-stage-least squares (2SLS) using X and its spatial

---

[14] See Kelejian and Prucha (1998) for a detailed discussion.

lags WX as instruments for Wy. The estimation of the variance covariance (VC) matrix of coefficients requires the VC matrix of a vector of sample moments. In order to obtain efficient estimates, we use the non-parametric spatial heteroscedasticity and autocorrelation consistent (HAC) estimator by Kelejian and Prucha (2006) to estimate this latter VC matrix.[15]

The weights of the matrix W reflect the degree of interdependence in commitments between countries. We use geographic distance between the capitals of two countries as a weight for the autocorrelation between them. The closer countries are to each other in geographic terms the more they should influence each other and consequently, the more similar their commitments should be. The importance of distance for trade connectivity is supported theoretically and empirically by the gravity model (see Anderson and Wincoop, 2003). Furthermore, Baier and Bergstrand (2004) show empirically that distance is inversely related to the probability of two countries entering a free trade agreement. The weight elements w_{ij} are computed as $w_{ij} = e^{-\tilde{d}_{ij}}$, where $\tilde{d}_{ij}$ is the scaled distance between capital cities of countries. Hence, the farer away country j is from country i, the less is the weight w_{ij} assigned to its coverage ratio. Weights are further row normalized so that each row of W sums to unity.

Results for the spatial 2SLS estimation are reported in Table 7. The spatial lag term is significant at the 5% level in the regression with the absolute coverage of mode 1 as dependent variable, and significant at 10% for mode 3. In both regressions the coefficient of the spatial lag is as expected positive. Hence, we find support for the hypothesis that the coverage ratio of a country is influenced by the coverage ratios of other countries. In other words, a country will commit more liberal in the GATS if economically important partners (as captured by geographic distance) do so as well. Results for other explanatory variables are almost the same as in Table 5. For the absolute coverage in mode 1 real GDP is not significant anymore, compared to a significance level of 10% in Table 5.

---

[15] See Annex II for the formulation of the 2SLS and the HAC estimator.

5. Conclusions

Studies regarding the determinants of the specific commitments in GATS have so far been purely descriptive or limited to a sector basis, i.e., the financial sector. In this paper we provide the first rigorous assessment of the economic fundamentals, which determine the market access commitments of countries for cross-border trade and commercial presence in services. In general equilibrium models of trade and multinational enterprises welfare effects from liberalization depend on size and relative endowment ratios. We propose country size in terms of real GDP and the capital-labor ratio as economic determinants of the commitments of countries. Contrary to our theoretical expectations we find that capital-abundant countries are more liberal in terms of the absolute coverage ratio, i.e. ratio of the sum of weighted commitments to the number of possible commitments and also in terms of the relative coverage, i.e. the ratio of weighted commitments to the number of commitments listed. Large countries are found to have a higher absolute coverage ratio and a smaller relative coverage ratio, a result which might be explained by higher sectoral specialization of small countries. We also find evidence that previous efforts to liberalize goods trade as measured by free trade agreements are positively related to the coverage ratios of countries. A further result is that there is spatial autocorrelation between countries, i.e. a country will commit more liberally in terms of the absolute coverage if important partner countries - as captured by geographic distance - do so as well.

References

Adlung, Rudolf and Martin Roy (2005), Turning hills into mountains? Current commitments under the General Agreement on Trade in Services and prospects for change, *Journal of World Trade* **39**(6), 1161-1194.

Anderson, James E. and Eric van Wincoop (2003), Gravity with Gravitas: A solution to the Border Puzzle, *American Economic Review* **93** (1), 170-192

Baier, S.L., Bergstrand, J.H. (2004), Economic determinants of free trade agreements, *Journal of International Economics* **64**(1), 29-63.

Baier, S.L., G.P. Dwyer, and R. Tamura (2006), How important are capital and total factor productivity for economic growth?, *Economic Inquiry* **44**(1), 23-49.

Beck Thorsten, George Clarke, Alberto Groff, Philip Keefer, and Patrick Walsh, (2001). New tools in comparative political economy: The Database of Political Institutions., *World Bank Economic Review, 15*, 165-176.

Beck, Thorsten, George Clarke, Alberto Groffe, Philip Keefer, and Patrick Walsh (2004), Database on Political Institutions, *The World Bank*.

Bhattarai, Keshab and John Whalley (2006), The division and size of gains from liberalization in service networks, *Review of International Economics* **14**(3), 348–361.

Biglaiser, Glen and David S. Brown (2001), The Determinants of Economic Liberalization in Latin America, unpublished manuscript, The World Bank. A shorter version has been published in 2005, *Political Research Quarterly* **58**, 671-680

Country classification by income group, 1995, World Bank. http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls

Egger, Peter, Mario Larch, and Michael Pfaffermayr (2004), Multilateral trade and investment liberalization: Effects on welfare and GDP per capita convergence, *Economics Letters* **84**(1), 133-140.

Egger, Peter, Mario Larch, and Michael Pfaffermayr (2007), On the welfare effects of trade and investment liberalization, *European Economic Review* **51**(3), 669-694.

Eschenbach, Felix and Bernard Hoekman (2006), Services policies in transition economies: On the EU and WTO as commitment mechanisms, World Bank Policy Research Working Paper No. 3951.

Grossman, Gene, and Elhanan Helpman, 1995, Trade Wars and Trade Talks, *The Journal of Political Economy*, **104** (4), 675-708.

Harms, Philipp, Aaditya Mattoo, and Ludger Schuknecht, (2003), Explaining liberalization commitments in financial services trade, *Review of World Economics* **139**(1), 82-113.

Hoekman, Bernard (1996), Assessing the General Agreement on Trade in Services, in Will Martin and Alan L. Winters (eds.), *The Uruguay Round and the Developing Countries*, Cambridge: Cambridge University Press, 88-124.

Hoekman, Bernard (2006), Liberalizing trade in services: A survey, World Bank Policy Research Working Paper No. 4030.

Keefer, Philip and David Stasavage (2003). The Limits of Delegation: Veto Players, Central Bank Independence and the Credibility of Monetary Policy. *American Political Science Review* (August).

Kelejian, Harry.H., and Ingmar R. Prucha (1998), *Journal of Real Estate Finance and Economics*, **17** (1), 99-121.

Kelejian, Harry.H., and Ingmar R. Prucha (2006), HAC estimation in a spatial framework, *Journal of Econometrics*, in press

Konan, Denise Eby and Keith E Maskus, (2006), Quantifying the Impact of Services Liberalization in Tunisia, *Journal of Development Economics*, **81**

Langhammer, Rolf (2005), The EU offer for service trade liberalization in the Doha Round. Evidence for a not-yet-perfect customs union, *Journal of Common Market Studies* **43**(2), 311-325.

Markusen, James R. (1997), Trade versus investment liberalization, NBER Working Paper No. 6231.

Markusen, James R. (2002), *Multinational Firms and the Theory of International Trade*, MIT Press, Cambridge, MA.

Markusen, James R. (2006), Modeling the Offshoring of White-Collar Services: from comparative advantage to the new theories of trade and FDI, in S.Lael Brainard and Susan Collins, editors, *Brookings Trade Forum 2005: Offshoring White-Collar Work*, Washington: the Brookings Institution, 1-34.

Markusen, James, Thomas F. Rutherford, and David Tarr (2005), Trade and direct investment in producer services and the domestic market for expertise, *Canadian Journal of Economics* **38**(3), 758–777.

Markusen, James R. and Bridget Strand (2007), Trade in Business Services in General Equilibrium, *NBER Working Paper* 12816.

Marshall, Monty G. and Keith Jaggers (2002), Polity IV Project: Political Regime Characteristics and Transitions, 1800-2002, Dataset Users' Manual, Center for International Development and Conflict Management, University of Maryland.

Ornelas, Emanuel (2005), Endogenous free trade agreements and the multilateral trading system, *Journal of International Economics* **67**, 471-497.

Richard Snape, Reaching Effective Agreements Covering Services, in Anne O. Krueger, ed., The WTO as an International Organization (The University of Chicago Press, 1998), pp. 287-289

Testa, Cecilia (2003), Government Corruption and Legislative Procedures: Is One Chamber Better than Two?, *STICERD Development Economics Discussion Paper*.

Valckx, Nico (2004), WTO financial services commitments: Determinants and impact on financial stability, *International Review of Financial Analysis* **13**(4), 517-541.

Whalley, John (2004), Assessing the benefits to developing countries of liberalisation in services trade, *The World Economy* **27**(8), 1223–1253.

Table 1: Summary statistics for listed commitments in 107 countries in 1995 (Modes 1 and 3)

	Mode 1				Mode 3			
	All	Low	Middle	High	All	Low	Middle	High
Number of commitments	41.1	15.4	30.8	74.6	41.1	15.4	30.8	74.6
Coverage	26.5	9.9	19.8	48.1	26.5	9.9	19.8	48.1
Weighted absolute coverage	19.3	5.8	12.3	39.2	21.0	6.7	14.0	41.3
Weighted relative coverage	70.9	68.5	67.8	76.9	74.0	66.6	70.9	83.8
Relative none coverage	66.6	65.4	63.1	72.5	52.5	38.9	47.3	69.6
Relative bound coverage	3.8	2.0	3.6	5.5	43.1	55.3	47.1	28.4
Relative unbound coverage	24.9	28.4	27.5	18.6	4.5	5.7	5.5	2.0

Income groups according to World Bank 1995: Low, Middle, High

Weights: none - 1, bound - 0.5, unbound - 0

Coverage - Ratio of commitments made to number of possible commitments (155)

Weighted Absolute Coverage - Ratio of weighted commitments made to number of possible commitments (155)

Weighted Relative Coverage - Ratio of weighted commitments made to number of commitments made

Table 2: Summary statistics for explanatory variables used in regressions

Variable	Obs	Mean	Std. Dev.	Min	Max
Log real GDP (1993)	89	24.059	2.266	19.280	29.642
Log capital per capita (1993)	89	8.212	1.575	5.116	11.014
m_fta	87	0.014	0.029	0.000	0.080
s_adinit	87	47.621	121.467	0.000	704.000
s_adinitj	87	46.517	91.630	0.000	594.000

m_fta is the fraction of countries an economy was engaged with in free trade agreements notified to the WTO between 1970 and 1990

s_adinit is the number of cases filed by a country against others since 1970 up to 1990

s_adinitj is the number of antidumping cases filed against a country by others since 1970 up to 1990

Table 3: Baseline regression results for the determinants of GATS commitment coverage ratios[16]

| | Mode 1 | | Mode 3 | |
| | Type of weighted coverage ratio on left-hand-side | | | |
	absolute	relative	absolute	relative
Log GDP (1993)	0.231 ***	-0.180 **	0.345 ***	0.049
	(0.048)	(0.084)	(0.047)	(0.064)
Log capital per capita (1993)	0.526 ***	0.555 ***	0.473 ***	0.268 ***
	(0.083)	(0.121)	(0.083)	(0.071)
Constant	-11.807 ***	0.602	-14.054 ***	-2.276 *
	(1.033)	(1.985)	(1.036)	(1.336)
Countries	86	69	89	82
R^2	0.554	0.217	0.630	0.183

Robust standard errors in parenthesis
***significant at 1%, ** at 5%, * at 10%.

Table 4: Baseline regression results for the determinants of GATS full commitment coverage ratios

	Mode 1	Mode 3
Log GDP (1993)	-0.185 **	-0.232 **
	(0.077)	(0.104)
Log capital per capita (1993)	0.563 ***	0.520 ***
	(0.116)	(0.126)
Constant	0.344	1.857
	(1.813)	(1.973)
Countries	69	65
R^2	0.220	0.204

Robust standard errors in parenthesis
***significant at 1%, ** at 5%, * at 10%.

---

[16] If we use the share of population that attained higher schooling from the Barro-Lee dataset as a measure of skilled labor instead of capital p.c., we find that skilled-labor abundant countries have a higher absolute coverage. This finding confirms the argument that capital per capita and skilled labor abundance are complementary/highly correlated, but contrasts the theoretical argument that skilled-labor (capital) scarce countries would benefit more from liberalization and hence, should have a higher absolute coverage ratio.

Table 5: Extended regression results for the determinants of GATS commitment coverage ratios

	Mode 1		Mode 3	
	Type of weighted coverage ratio on left-hand-side			
	absolute	relative	absolute	relative
Log GDP (1993)	0.118 *	-0.426 ***	0.319 ***	0.032
	(0.068)	(0.095)	(0.066)	(0.084)
Log capital per capita (1993)	0.335 ***	0.327 **	0.367 ***	0.199 **
	(0.10)3	(0.152)	(0.098)	(0.099)
m_fta	17.636 ***	14.110 *	12.350 ***	5.863
	(4.409)	(7.517)	(3.708)	(4.623)
s_adinit	0.001	0.003 **	0.000	0.001
	(0.001)	(0.002)	(0.001)	(0.001)
s_adinitj	0.002	0.004 **	0.000	-0.001
	(0.001)	(0.002)	(0.001)	(0.001)
Constant	-7.884 ***	7.984 ***	-12.725 ***	-1.370
	(1.807)	(2.669)	(1.703)	(2.076)
Countries	84	68	87	82
R^2	0.608	0.344	0.649	0.216

Robust standard errors in parenthesis
***significant at 1%, ** at 5%, * at 10%.

Table 6: Extended regression results for the determinants of GATS full commitment coverage ratios

	Mode 1		Mode 3	
Log GDP (1993)	-0.417 ***		-0.335 **	
	(0.095)		(0.150)	
Log capital per capita (1993)	0.301 **		0.480 ***	
	(0.138)		(0.155)	
m_fta	16.683 **		1.004	
	(7.298)		(6.676)	
s_adinit	0.003 **		0.003 **	
	(0.001)		(0.001)	
s_adinitj	0.004 **		0.001	
	(0.002)		(0.002)	
Constant	7.658 **		4.531	
	(2.586)		(3.403)	
Countries	68		65	
R^2	0.362		0.249	

Robust standard errors in parenthesis
***significant at 1%, ** at 5%, * at 10%.

Table 7: Regression results for spatial 2SLS using geographic distance weights

	absolute coverage	
	Mode 1	Mode 3
Wy	0.346 **	0.236 *
	0.156	0.125
Log GDP (1993)	0.068	0.274 ***
	0.063	0.066
Log capital-labor ratio (1993)	0.289 ***	0.342 ***
	0.098	0.098
m_fta	11.115 ***	7.380 **
	4.074	3.109
s_adinit	0.001	0.000
	0.000	0.000
s_adinitj	0.002	0.000
	0.001	0.001
Constant	-5.505 ***	-10.872 ***
	1.945	1.924
Countries	80	82
Centered R^2	0.672	0.692
Shea Partial R^2	0.749	0.816

Standard errors in parenthesis, based on non-parametric HAC estimation of sample moments
***significant at 1%, ** at 5%, * at 10%.
Sargan overidentification test: H0 that instruments are valid is not rejected

Annex I: 107 Countries by income group according to World Bank 1995

Low income (25)	Middle Income (48)	High Income (34)
Bangladesh	Algeria	Aruba
Benin	Antigua and Barbuda	Australia
Burkina Faso	Argentina	Austria
Cameroon	Bahrain	Belgium
China	Barbados	Brunei
Congo, Rep.	Belize	Canada
Cote d'Ivoire	Bolivia	Cyprus
Ghana	Brazil	Denmark
Guyana	Chile	Finland
Honduras	Colombia	France
India	Costa Rica	Germany
Kenya	Cuba	Hong Kong, China
Madagascar	Czech Republic	Iceland
Mozambique	Dominica	Ireland
Myanmar	Dominican Republic	Israel
Nicaragua	Egypt, Arab Rep.	Italy
Niger	El Salvador	Japan
Nigeria	Fiji	Korea, Rep.
Pakistan	Gabon	Kuwait
Senegal	Greece	Liechtenstein
Sri Lanka	Grenada	Luxembourg
Tanzania	Guatemala	Macao, China
Uganda	Hungary	Netherlands
Zambia	Indonesia	Netherlands Antilles
Zimbabwe	Jamaica	New Caledonia
	Malaysia	New Zealand
	Malta	Norway
	Mauritius	Portugal
	Mexico	Singapore
	Morocco	Spain
	Namibia	Sweden
	Paraguay	Switzerland
	Peru	UK
	Philippines	United States
	Poland	
	Romania	
	Slovak Republic	
	South Africa	
	St. Lucia	
	St. Vincent and the Grenadines	
	Suriname	
	Swaziland	
	Thailand	
	Trinidad and Tobago	
	Tunisia	
	Turkey	
	Uruguay	
	Venezuela, RB	

Annex II

Following Kelejian and Prucha (2006), we write the model more compactly with $Z=(X,Wy)$, $\delta_0'=(\beta',\lambda_0)$ and define H as nxp non-stochastic matrix of instruments. If we furthermore write $\hat{Z}=H(H'H)^{-1}H'Z$, then we get for the spatial 2SLS estimator the following expression:

$$\hat{\delta}=(\hat{Z}'Z)^{-1}\hat{Z}'y .$$

Kelejian and Prucha (2006) show that a consistent estimator of the variance-covariance matrix of the parameter vector δ_0' is:

$$\hat{\Phi}=n(\hat{Z}'\hat{Z})^{-1}Z'H(H'H)^{-1}\hat{\Psi}(H'H)^{-1}H'Z(\hat{Z}'\hat{Z})^{-1} .$$

$\hat{\Psi}$ is the estimated VC matrix for the sample moment $\Psi=n^{-1}H'\Omega_u H$. The spatial HAC estimator for the (r,s) element of the true VC matrix Ψ is then:

$$\hat{\psi}_{r,s}=n^{-1}\sum_{i=1}^{N}\sum_{j=1}^{N}h_{ir}h_{js}\hat{u}_i\hat{u}_j K(w_{ij}) .$$

$K(w_{ij})$ is the Kernel weight with the weight w_{ij} based on the distance between country i and country j. The Kernel weight forms a bartlett window, i.e. it is set to zero if the bilateral distance is smaller than the average distance in our sample.