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# Landlocked or Policy Locked? How Services Trade Protection Deepens Economic Isolation

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**Abstract.** A new cross-country database on services policy reveals a perverse pattern: many landlocked countries restrict trade in the very services that connect them with the rest of the world. On average, telecommunications and air-transport policies are significantly more restrictive in landlocked countries than elsewhere. The phenomenon is most starkly visible in Sub-Saharan Africa and is associated with lower levels of political accountability. We find evidence that these policies lead to more concentrated market structures and more limited access to services than these countries would otherwise have, even after taking into account the influence of geography and incomes, and the possibility that policy is endogenous. Even moderate liberalization in these sectors could lead to an increase of cellular subscriptions by 7 percentage points and a 20 percent increase in the number of flights. Policies in other countries, industrial and developing alike, also limit competition in international transport services. Hence, "trade-facilitating" investments under various "aid-for-trade" initiatives are likely to earn a low return unless they are accompanied by meaningful reform in these services sectors.

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## 1. Introduction

Landlocked countries are seen as victims of geography, insulated from beneficial flows of trade, tourism and knowledge. But are these countries choosing policies to offset the handicap of location and improve connectivity with the rest of the world? Surprisingly, many are not. Drawing upon a new services policy database, we show that the policies of landlocked countries in key "linking" services like transport and telecommunications are on average significantly more restrictive than elsewhere. We also show that these policies lead to more concentrated market structures and more limited access to services than these countries would otherwise have, even taking into account the constraining influences of geography and low incomes, and the possibility that policies are endogenous.

To motivate the analysis, consider three landlocked countries, Laos, Nepal and Zambia, on which we provide more detailed information in Section 2. In terms of policy, each country has stifled competition in telecommunications – primarily by restricting the conditions for new entry – and in air transport – primarily by negotiating restrictive BASAs on key routes. In terms of access and quality of services, each of the three countries fairs poorly. In, Nepal the number of telephone mainlines per 100 people is 2.5, half the regional average for South Asia; in Laos 1.5, one-seventh the regional average for East Asia; and in Zambia 0.75, one-fourth of the regional average for Sub-Saharan Africa. In mobile telephony, the gaps are slightly less stark but still significant; for example, Nepal had a mobile teledensity (subscriptions per 100 people) of 12, which is about one-third of the South Asian regional average. In terms of lead time to import and export, in all three countries goods move slowly compared to their respective regional averages. For example, in Laos, shipments take twice as long for the average East Asian country (50 vs 25 days). The World Bank's logistics performance index for the quality of logistics services is also below the regional average in all three countries.

Can concentrated markets and poor performance be attributed to poor policy? Or are they primarily attributable to other disadvantages? It is not easy to provide a convincing answer to these questions because the policy information we have collected is only for a single time period, making it difficult to control for all the possible sources of heterogeneous performance across countries. Nevertheless, we are able to control for the most likely determinants of poor performance: the adverse influences of geography and low incomes. We also address the possibility that policy itself is endogenously determined – e.g. through successful lobbying for protection by concentrated industries – by using an instrumental variable strategy that relies on the association between poor policy and weak governance. Using these strategies, we show that there is evidence that poor policies lead to more concentrated market structures and more limited access to services than these countries would otherwise have. At this stage, we seek primarily to document the unexpected patterns of policy, and demonstrate, to the limited extent allowed by available data, that these patterns matter.

The policies of landlocked countries are not the only problem. In international transport, it takes two to liberalize. Zambia cannot unilaterally introduce greater competition on the Lusaka-London or Lusaka-Johannesburg air routes. Both the United Kingdom and South Africa also need to agree to allow entry by third country airlines on each route. Our database shows that industrial and developing country

policies in international transport tend to be more restrictive than in other services sectors. Traffic on many air routes continues to be subject to restrictive bilateral air service agreements (BASAs) that fragment the international market into a series of route-specific duopolies. Ironically, industrial countries that are willing to provide "aid for trade" to landlocked countries to improve their ports, airports and customs, neither seek nor initiate the liberalization of air transport services that would greatly enhance the impact of this aid.

Previous studies have looked at possible reasons for the transport sector's poor performance in landlocked countries. Limao and Venables (2001) highlight the effect of infrastructure on landlocked countries' trade costs and trade flows but do not consider policy choices. Other studies recognize the role of policy, particularly in trucking. Raballand and Macchi (2009) find that market regulation is a critical determinant of the price of trucking services, while market access restrictions and freight sharing schemes hinder competitiveness and raise trade costs especially for landlocked countries of Africa. The paper suggests that the donor community should support transport market liberalization because investments in roads alone would not reduce the cost of transportation for end-users. Indeed, Hallaert et al. (2011) do not find domestic transportation infrastructure to be an important determinant of landlocked countries' trade performance, pointing instead to the importance of regulatory issues in the transport sector. Arvis, Raballand and Marteau (2010) discuss not only the trucking regulations in landlocked countries but draw attention to the fact that corresponding regulations in transit countries are also essential to reducing the cost of trade. Raballand, Kunaka and Giersing (2008) argue that regional liberalization of trucking services in Southern Africa has had an important effect on transport costs and tariffs for Zambia. Lall, Wang, and Munthali (2009) demonstrate that both improved infrastructure and increased competition among transport service providers are important in lowering transport cost in Malawi, another landlocked country in Africa.

The present study builds on this earlier work but is broader in scope, both in terms of the range of countries and types of sectors and policies covered. We focus on air transport and telecommunications, both because they are vital for connectivity, but also because landlocked countries have a smaller if any inherent disadvantage in these services. While previous studies acknowledge the importance of market structure, this paper adds to that literature by illustrating how specific policies contribute to a concentrated market structure. The dominant trend in trade facilitation projects under the new "aid for trade" initiatives is increased investment in infrastructure, but this paper shows how such investments alone will yield a low return if policies that restrict competition among service providers remain in place.

## 2. Policy data and patterns

A range of services link a country to the rest of the world. We focus on air transport and telecommunications, first, because they are vital for connectivity. Second, the availability of these services is influenced at least in part by landlocked countries own policies, rather than just geography. Third, better policy data is available for these services than for other relevant services sectors, such as road transport.

We focus on policies that affect market structure, particularly by influencing foreign entry. The policy data comes from a new World Bank project that has for the first time compiled data on actual or *applied* policies affecting foreign presence in a number of services sectors.[1] Thanks to this database it is possible to investigate the implications of differences in services policies across sectors and countries.[2] In the telecommunications sector, relevant policies include limits on the number of licenses issued, restrictions on the extent of foreign ownership in firms, nationality requirement for board of directors, restrictions on establishing an international gateway (IG) and the use of voice over IP (VOIP) technology. In the air transport sector, relevant policies include not just those affecting the ability of foreign airlines to establish a local commercial presence, but also the bilateral air service agreements (BASAs) that govern international transport. To capture the restrictiveness of BASAs, we draw on the WTO's "Quantitative Air Services Agreements Review"(QUASAR) database which represents the most comprehensive source currently available on bilateral air services agreements, covering over 2000 such agreements.

### *2.1 A qualitative picture of policy in selected countries*

To provide a country-face to the subsequent empirical analysis, consider examples of the policies of three landlocked countries: Nepal, Laos and Zambia[3]. In telecommunications, as much of the world is being transformed by the interplay between competition and new technologies, each of these countries has stifled competition in its own unique way. Nepal granted exclusive licenses in the fixed line segment until 2009 to United Telecommunications Limited (with majority Indian Government ownership) and in mobile to Spice Telecom (with majority Kazakh ownership), effectively creating duopolies in each segment between these firms and the state-owned firm. Zambia set a prohibitively high license fee ($12 million) for establishing an independent international gateway market (IGW), in order to give the incumbent state-owned operator, Zamtel, a d*e facto* monopoly in the international segment. Monopoly profits enabled Zamtel to inhibit competition in other segments of the market through cross-subsidization rather than to finance expansion of the rural network. In Laos, new entry is possible only through direct negotiation with the government, and to date the government has in all cases reserved its right to be a partial owner of the new undertakings (Millicom, Shinawatra, Sky Communications and Veittel). In each of these countries, the regulatory authority is not really independent and is widely reported to favor state-owned incumbent operators. For example, in Laos, since the regulator was unable or unwilling to induce the incumbent firm to share its fiber-optic "backbone" cable with rival firms, one of them has chosen to create at significant cost a parallel fiber-optic backbone.

[1] The main sectors are financial, telecommunications, retailing, transportation, and professional services sectors, further disaggregated into banking (retail), insurance (life, non-life, and reinsurance), road freight transport, railway freight, maritime shipping and auxiliary services, air transport (freight and passengers), accounting, auditing, and legal services.

[2] To date surveys have been conducted in 78 developing and transition countries and comparable information obtained for 24 OECD countries. Among the countries covered in the paper, only Laos was not covered by the survey, and the data for Laos came from a country study by one of the authors. In an effort to ensure data accuracy, the policy information was subjected to review by government officials, which led to a confirmation and/or update of the data for most of the OECD countries and a number of developing countries. The country coverage is representative of all world regions and income levels.

[3] For an in-depth study of services sectors in Zambia, see Mattoo and Payton (2007).

In air transport, the restrictions are less original, and resemble the pattern in the rest of the world. In Laos, the government-owned airline, Lao Aviation, has a quasi-monopoly on the domestic air transport market, and the only competition comes from a privately-owned helicopter-charter service, which is used to reach remote areas. On international routes, Lao Aviation operates flights covered by a series of restrictive bilateral air service agreements (BASAs) on routes to their respective countries with Thai Airways International, Viet Nam Airlines, and China (Yunnan) Airlines. For example, the agreement with Thailand limits capacity on the vital Bangkok-Vientiane route to 2,100 seats per week. Nepal Airlines, plagued by poor management and political interference, has seen its financial situation weakened and its fleet shrunk to two Boeing 757s and four twin otters. By virtue of being the designated airline, it occupies crucial space in BASAs, which it is incapable of exploiting. One of the key hubs is Delhi, where the number of seats is limited to 6000 per week for each side, but Nepal Airlines uses only 1,300 seats of the Nepali quota. Japan has refused to grant fifth freedom rights on the Kathmandu-Shanghai-Osaka route, and China may be restricting flights on the Kathmandu-Lhasa route.

Zambia's case has broader significance because it is part of a regional agreement that ostensibly liberalized air transport and is one of the rare countries that allowed its loss-making national airline to be liquidated, in the mid 1990s. The implementation of up to fifth freedom liberalization in the African Union was agreed in the Yamoussoukro Decision (YD) which became fully binding in 2002. However, years later, the Agreement has had little impact on Zambia and its neighbors. Given the failure of YD, the Common Market for Eastern and Southern Africa (COMESA) agreed to liberalize air transport services among its member states with regulations and a mechanism similar to the YD. But here too implementation has been partial at best. As a consequence, Zambia's international air transport remains based on restrictive bilateral air service agreements (BASA). Schlumberger (2007) has shown how both Zambia and South Africa have in the past denied Fifth Freedom rights to other countries.[4] Another policy aspect inhibiting Zambia's air connectivity are jet fuel prices which are reported to be about 50 percent higher in Lusaka than in neighboring countries (see Schlumberger 2007, p. 192).

### *2.2 Quantification of survey policy information*

The techniques used to measure barriers to services trade are still relatively primitive.[5] Existing estimation methods range from simple counts of restrictive policies to more complex weighted averages, where weights reflect prior assessments of the relatively restrictiveness of specific policy barriers. There is, however, a potentially serious problem with methods that treat all restrictions (entry, operational, regulatory) as additive. For instance, if foreign suppliers are not allowed to enter in the first place, then the restrictions on operations and regulatory environment simply do not matter. Similarly, a

[4] Even though Zambia no longer has a national airline, it has denied Fifth Freedom rights to Ethiopia to fly the Addis Ababa-Lusaka-Johannesburg route, to Nigeria on the Lagos-Lusaka-Johannesburg route, and to Kenya on the Nairobi-Lusaka-Harare route. At the same time South Africa, keen to protect its national airline's interests on routes between Zambia and South Africa, has also denied Fifth Freedom rights to other countries like Egypt to fly the vital Cairo-Lusaka-Johannesburg route.

[5] Non-tariff barriers, which are pervasive in services, have proved hard to measure even in goods trade. Existing methods in goods rely on inferring restrictiveness on the basis of the impact on trade flows (Kee, Nicita and Olarreaga 2009), but the absence of disaggregated services trade data especially for developing countries rules out such techniques.

foreign equity limit of 49 percent already precludes foreign corporate control and so adding to it a further (frequently encountered) requirement that the majority of board of directors be nationals would amount to double counting.

It seems more appropriate econometrically to estimate the restrictiveness of policies based on their impact on some outcome variable – such as the price of the service (Fink et al., 2002). Where feasible, several policy variables could be included separately as explanatory variables, either as directly measured (e.g. the number of licenses or the percentage share of foreign ownership allowed) or as a binary indicator variable (e.g. whether voice over internet protocol is allowed). The impact on the outcome variable, controlling for other non-policy influences, then serves as a means of comparing the relative impact of different policies. The use of such techniques depends on whether the number of observations is large enough to accommodate the range of policy variables being considered, whether policies can be represented quantitatively, whether relevant outcomes can be measured and whether the required data is available.

We choose to use a combination of methods. To the extent feasible, we assess the impact of policy variables individually in ordinary least squares regressions. However, it is also useful to construct a single measure of overall openness in specific sectors to facilitate graphic depiction, but more importantly to conserve degrees of freedom in estimation and to address concerns about the possible endogeneity of policy. The measure of openness we construct is relatively transparent and avoids the pitfalls of the additive approaches mentioned above. Essentially, we assess policy regimes in their entirety and assign them into five broad categories: completely open, i.e. no restrictions at all; completely closed, i.e. no entry allowed at all; virtually open but with minor restrictions; virtually closed but with very limited opportunities to enter and operate; and a final residual "middle" category of regimes which allow entry and operations but impose restrictions that are neither trivial nor virtually prohibitive. We either represent each of these regimes by a dummy variable, or when required for graphic illustration or instrumental variable estimation, the regimes are assigned a services trade restrictiveness index (STRI) on an openness scale from 0 to 1 with intervals of 0.25. When two or more measures are in place, the regime assignment reflects the overall restrictiveness of the measures.[6] More details about the methodology can be found in Borchert et al. (2011).

For cross-border trade in air transport, we used the Air liberalization index (ALI) of the QUASAR database, created by the WTO Secretariat. The ALI ranges from 0 to 50 with zero being the most restrictive. The ALI is calculated by selecting the provisions of bilateral ASAs deemed to be particularly important for market access and assigning a score between zero (most restrictive) and 8 (least restrictive) to each restriction. These scores are then averaged in consultation with a group of experts, using weights intended to reflect the relative importance of each restriction. The scores attributed can

[6] Measures covered can be divided in two tiers. The first tier measures include those that affect market entry decisions most significantly, such as the limit on foreign ownership and the number of licenses allowed. The second tier measures are those that affect operations of service providers, such as the board of directors and repatriation of earnings etc. If the first tier measures are prohibitive, the second tier measures are not considered. But if the first tier measures are not prohibitive, then the second tier measures are also considered to determine of overall restrictiveness.

also be altered to take into account the specific situation of a country pair, in particular by giving more weight to: fifth freedom traffic rights (e.g. for geographically remote countries such as Australia and New Zealand); withholding, in particular, community of interest and principal place of business; and multiple designation. For comparability, the scale of ALI is converted to the STRI scale.[7]

We recognize the subjectivity of our approach. Yet there is no obviously superior, feasible method of quantification.[8] The subjectivity is somewhat mitigated by the extensive consultations we have conducted with the private sector and regulators to make the assignments to specific categories. We also checked the robustness of the assignments by moving border-line policies regimes across categories. We believe that the adopted approach is better equipped than any fixed algorithm to turn the rich and difficult-to-quantify aspects of policy information into broadly plausible restrictiveness scores. In Krugman's words, it has the virtue of being "roughly right rather than precisely wrong."

### *2.3 The patterns of policy*

Figure 1 compares the average overall Services Trade Restrictiveness Index (STRI) of 22 landlocked countries[9] to the average STRI of non-landlocked countries. The STRI ranges from 0 (fully open) to 100 (sector closed to foreign entry).[10] In both sectors the average restrictiveness index for landlocked countries is significantly higher as compared to average restrictiveness in coastal countries. The gap is larger in telecommunications than in air transport, reflecting the fact that the rest of the world has moved faster to liberalize telecommunications than air transport.

Within the air transport, the difference is primarily driven by considerably tougher policies on cross-border trade of air transport services in landlocked countries. In fact, policies governing commercial presence in air transport are slightly more liberal in landlocked countries (STRI of 32 vs 39). Nonetheless, foreign investors might not be able to take advantage of the relative openness in Mode 3 (FDI) due to the withholding and designation provisions of the Bilateral Air Services Agreements (BASAs). More specifically, the designation policy of BASAs allows countries to designate one or more airlines to exercise the right to operate the agreed air services. In most developing countries, the designated airlines are the state-owned incumbents. The withholding policy specifies the ownership conditions for the designated airlines of the other party. In the majority of countries, the withholding rights require

[7] ALI values are first sorted to increase in restrictiveness, divided into quartiles, and countries within each quartile are then associated with STRI scores equal to 0, 25, 50 and 75, respectively. In Figure 1 presenting the overall STRI in air transport, the STRI for cross-border trade (BASAs) is combined with the STRI for commercial presence using a weight of 0.7 and 0.3, respectively, because cross-border supply is the primary mode of supply for air transport.

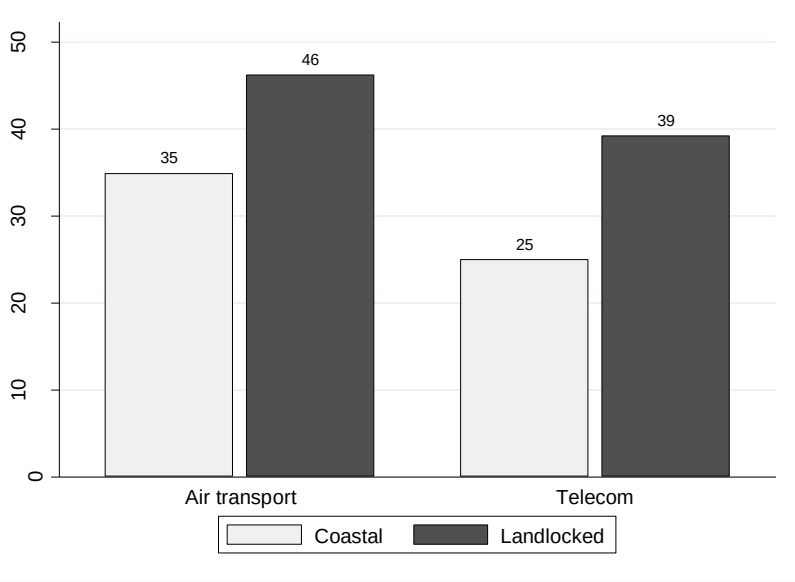
[8] Notice that when the goal is to demonstrate how policies matter for outcome variables of interest, as we endeavor in this paper, the restrictiveness of certain measures cannot be quantified econometrically in a first step by estimating their effect on some outcome variable. In this case, the restrictiveness score needs to be exogenous and must not be derived in a way that involves the quantity to be explained.

[9] The 22 landlocked countries, grouped by region, are: Africa – Botswana, Ethiopia, Lesotho, Mali, Malawi, Rwanda, Uganda, Zambia, Zimbabwe; Asia – Mongolia, Nepal, and Lao, PDR; Eastern and Central Asia – Armenia, Belarus, Kazakhstan, Kyrgyz Republic, Uzbekistan; Latin America – Bolivia, Paraguay; OECD – Austria, Czech Republic, Hungary.

[10] Later in regression analysis, the scores are in decimals. In the figure, these decimal indices are multiplied by 100.

substantial ownership and effective control by the nationals of the designated party. Hence, liberal FDI policies regarding the establishment of, say, a majority-owned subsidiary by a foreign airline have limited impact if this affiliate company is prevented from offering international services.

**Figure 1: Overall STRI for Air Transport and Telecommunications**




Note: Air transport comprises mode 1 and mode 3 and telecom comprises fixed and mobile telecom; The difference in means is significant at the 5 percent level in both sectors.

Within the telecom sector, policies applied by landlocked countries to the fixed line segment are more restrictive than those governing mobile telephony. This feature of policy is shared with most other countries, especially in Africa where the 'mobile revolution' emerged as a way to bypass the stalemate in the fixed line sector. For example, in Zambia and Belarus a state-owned monopolist provides fixed line services but in both countries the mobile market is at least partially open to foreign investment. However, within both sub-sectors landlocked countries have markedly more restrictive policies in place. The wedge is slightly higher in fixed line, where the average STRI is 43 in landlocked countries and 27 for other countries, than in mobile telecom, where averages are 35 and 23, respectively. Annex 3 and Annex Table 5 provide more detail on the pattern of policy at the individual country level.

## 3. The political economy of services policies

Before proceeding to the empirical analysis of how (and how much) policy measures affect outcome variables of interest, we wish to better understand the factors underlying policy choices; in particular, we propose a theoretical rationale for the stylized fact that, on average, landlocked countries choose to adopt more restrictive policies than coastal countries. This section also creates the basis for our empirical analysis.

We begin by adding a political economy dimension to an otherwise standard oligopoly model in which a suppliers compete in quantities to provide a homogenous service. The key modification consists of relaxing the assumption that the government maximizes the 'social surplus,' in which equal weights are attached to consumer surplus and profits. Instead, we explicitly allow for the government to attach a higher weight to profits, as in the well-known Grossman Helpman framework.[11] We assume that, through policy measures such as license limits, the government is able to directly control the number of active providers in the market, but the price and quantities are determined by the market.[12] We will use this model to show how the optimal number of providers the government would want to allow in the market depends on country characteristics.

Let $Q=\Sigma(q)$ denote aggregate output, $P(Q)$ the inverse demand function, $C(q)$ a provider's cost function, CS consumer surplus and $\pi$ profits, $W(n,q)$ the government's objective function, $\gamma$ the relative weight attached to profits, n the number of providers, and $\varepsilon$ the price elasticity of demand. In addition, we make the following assumptions:

(A1) The inverse demand function satisfies $P'(Q) < 0$ for all $Q > 0$.

(A2) (i) The cost function is the same for all firms, $C_i(q) = C(q)$, and satisfies $C'(q) > 0$ and $C''(q) > 0$.[13] (ii) The average cost schedule, $AC(q) = C(q)/q$, is downward sloping and thus satisfies $AC'(q) < 0$.

(A3) A provider's marginal revenue must not rise with its rivals' output, i.e. $\partial\pi^2/\partial q_i \partial q_j = P'(Q) + q_i P''(Q) < 0$ (the Hahn condition).[14] $P''(Q) < 0$ for all Q, i.e. a concave demand function, is sufficient for the Hahn condition to hold with strict inequality.

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[11] We adopt a notation that puts a relative weight on profits because the socially efficient outcome in an oligopoly model, which is a natural starting point for our analysis, would set profits to zero so that there is no point in attaching any non-degenerate weight to consumer surplus without violating the firms' financial viability constraint.

[12] Suzumura and Kiyono (1987) have also focused on the number of firms but studied the "excess entry theorem" under alternative pricing conditions rather than the government's optimal choice. Zhao (2009) explores necessary and sufficient conditions regarding cost functions under which a social planer's search for the optimal number of firms will yield an interior solution. This work highlights the important role of scale economies in shaping the social welfare function but does not explore deviations from a set of equal weights on consumer surplus and profits.

[13] The latter condition $C''(q) > 0$ is stronger than necessary and may be replaced by the weaker assumption that the marginal cost schedule decrease, if ever it does, at a slower rate than the perceived demand curve, i.e. $P'(Q) - C''(q) < 0$.

[14] This assumption ensures that providers' reaction curves are downward sloping and thus rules out "strategic complementarity" (Shapiro 1989, p.337).

(A4) A symmetric equilibrium uniquely exists and is defined as a triplet of q*(n), Q*(n) and P*(Q), with Q(n)=nq(n) and P(nq*) + q*P'(Q*) – C'(q*) = 0.

(A5) (i) The inverse demand elasticity $\eta$ can be written as $\eta \equiv P'(Q)Q/P = 1/\varepsilon$.[15] (ii) The demand elasticity $\varepsilon$ is bounded from above according to $\varepsilon < \frac{(1-\gamma)}{\gamma} < 0$.

The government's objective function, W(n,q), is a weighted average of consumer surplus and profits. With oligopolistic pricing, the government will take into account that in equilibrium q(n) will adjust to the number of providers. Thus the government will maximize the following objective function with respect to n:

$$\boldsymbol{W(n,q(n)) = CS + \gamma\Sigma\pi = \int_0^{nq(n)} P(z)dz - P(nq(n))nq(n) + \gamma\{P(nq(n))nq(n) - nC(q(n))\}}$$

Setting W'(n) = 0 leads to the following first-order condition

$$\gamma P\{q + nq'(n)\} + (\gamma - 1)P'(Q)\{q + nq'(n)\}nq(n) - \gamma C(q) - \gamma nC'(q)q'(n) = 0$$

The first-order condition also includes the indirect effect of n through induced output changes, $q^*(n)'$, which is negative, i.e. firm output falls when more providers are allowed to enter the market. As in Zhao (2009), $q^*(n)'$ can be compactly expressed as a function of $\alpha \equiv P'(Q) + qP''(Q)$ and $\beta \equiv P'(Q) - C''(q)$, both of which are strictly negative (see Annex 1 for full details). Making use of this simplification and rearranging yields the optimality condition for the number of firms

$$P(n^*q^*(n^*)) = \frac{\gamma\varepsilon}{\gamma(\varepsilon+1)-1} \cdot \left[\frac{C(q^*)}{q^*} - \frac{n^*\alpha}{\beta}\{AC'(q^*)q^*\}\right]$$

In addition, we may define the factor of proportionality which depends on the country characteristics $\gamma$ and $\varepsilon$:

$$\kappa(\gamma,\varepsilon) \equiv \frac{\gamma\varepsilon}{\gamma(\varepsilon+1)-1}$$

Notice that when the relative weight on profits, $\gamma = 1$, this factor of proportionality is reduced to unity. However, with $\gamma > 1$ (and $\varepsilon$ negative) it is easily verified that $\kappa(\gamma,\varepsilon) > 1$, demonstrating how the added weight on profits drives a wedge between price and marginal cost. Using this notation, and recalling that C(q*)/q* denotes average cost (AC), the optimal number of providers, n*, is the fixed point of this optimality condition that expresses price as a function of average costs:

$$P(n^*q^*(n^*)) = \kappa(\gamma,\varepsilon) \cdot \left[\frac{C(q^*)}{q^*} - \frac{\alpha}{\beta}\{AC'(q^*)Q^*\}\right]$$

[15] Shapiro (1989, p.334) assumes this to hold without further qualification but the second equality is only satisfied when the inverse of the first derivative of the demand function equals the first derivate of the inverse. Let Q = f(P), then we must have that 1/f'(P) = [f-1(P)]'. This condition is satisfied, for instance, for the class of constant elasticity of demand functions.

Against the benchmark of the efficient outcome, i.e. price equal to average cost, this condition reveals two principle sources of inefficiency. First, the term in squared brackets exceeds average costs due to oligopolistic pricing on the part of the firms ($AC'(q^*) < 0$ because Assumption A2(ii) requires the average cost schedule to be downward sloping[16]). Secondly, this expression is then multiplied by a factor $\kappa(\gamma, \varepsilon)$ which captures the influence of country characteristics. That is, in addition to the distortion introduced by strategic interaction, the government will find it optimal to admit an even lower number of firms as $\kappa(\gamma, \varepsilon)$ widens the wedge between price and average cost.[17] Recall that the effect exerted by the demand elasticity disappears only in the special case of equal weights given to consumer surplus and profits. Since there is no particular reason to believe that this is case in reality, the general prediction delivered by this model may be useful for empirical work. Notice that the relationship between both effects—oligopolistic behavior and country characteristics—is not additive but rather multiplicative. As a result, we find that the adverse effect of less elastic demand and less welfare-oriented decision makers on the optimal number of providers is amplified by the strategic interaction typically prevalent in oligopolistic markets.

We are particularly interested in the way in which the parameters $\gamma$ and $\varepsilon$ affect the government's choice of n. The factor $\kappa(\gamma, \varepsilon)$ will be higher in countries in which the demand for the service under consideration is less elastic ($\kappa'(\varepsilon) > 0$, recall $\varepsilon$ is negative), whereas for any given demand elasticity, a stronger government weight on rents will also increase the factor of proportionality ($\kappa'(\gamma) > 0$); for details see Annex 1. In both cases the implication is a lower optimal number of providers. In order to derive the main result of this section, totally differentiate the optimality condition to obtain

$$\frac{dn^*}{d\varepsilon} = \frac{\kappa'(\varepsilon) \cdot \left[\frac{C(q^*)}{q^*} - \frac{\alpha}{\beta}\{AC'(q^*)Q^*\}\right]}{\kappa \cdot \frac{\alpha}{\beta} AC'(q^*)q^*} < 0$$

$$\frac{dn^*}{d\gamma} = \frac{\kappa'(\gamma) \cdot \left[\frac{C(q^*)}{q^*} - \frac{\alpha}{\beta}\{AC'(q^*)Q^*\}\right]}{\kappa \cdot \frac{\alpha}{\beta} AC'(q^*)q^*} < 0$$

$$\frac{d(n^*)^2}{d\varepsilon d\gamma} = \frac{\left[\frac{C(q^*)}{q^*} - \frac{\alpha}{\beta}\{AC'(q^*)Q^*\}\right]}{[\gamma(\varepsilon+1)-1]^2 \cdot \left[\frac{\alpha}{\beta} AC'(q^*)q^*\right]} < 0$$

[16] See Zhao (2009). The presence of economies of scale is a necessary condition for obtaining an interior solution on n*. To see this, consider the two corner solutions: under constant or diseconomies of scale overall welfare always improves as the number of providers grows large, whereas under strong economies of scale welfare is maximized by having production concentrated in a single firm.

[17] It has long been recognized that the standard Cournot oligopoly equilibrium, in which there are likewise positive profits, can conversely be seen as the outcome attained by a social planer which maximizes an aggregate welfare function in which profits are valued relatively more than consumer surplus (Bergstrom and Varian 1985).

Given Assumptions (A1)—(A5), the optimal number of providers is lower in markets characterized by more inelastic demand for the service under consideration. The optimal number of providers is also lower in countries in which the government attaches a higher relative weight to providers' aggregate profit compared to consumer surplus. Lastly, examining the cross-derivative reveals again how the two parameters reinforce each other in determining the government's choice. Specifically, the optimal number of providers shrinks more rapidly with lower demand elasticity the less welfare-oriented the government.

## 4. Market Structure and Performance – An Econometric Analysis

Having described the incidence of services policy measures across countries, with a particular focus on landlocked countries' policy choices, we now investigate whether policy restrictiveness matters for market structure and performance in the telecommunication and transportation sector, respectively. The effects of services policy measures are not well studied especially in developing countries due to the scarcity of data on policy restrictiveness. One of the few studies to venture into this area is Fink et al. (2003) who analyze the impact of policy reform in basic telecommunications across 86 developing countries and find that both privatization and competition lead to significant improvements in performance.[18] However, as far as we know, previous studies have not addressed the possibility that services policy in endogenous. In Section 4.1, we discuss a possible approach to this problem, which then provides the basis for the econometric analyses in Sections 4.2 and 4.3.

### 4.1 *Addressing the possible endogeneity of policy*

Trade openness is unlikely to be an exogenous variable; in particular, standard political economy arguments would suggest that policy choices depend at least in part on local market structure and the sector's performance, precisely the aspects we seek to explain. For instance, supplier concentration confers political clout that can be used to resist liberalization which would dissipate the rents emanating from the incumbents' market power.[19] To the extent that these rents can be shared with policy makers,

[18] A study by the OECD (2009) is closest to ours, finding that countries' restrictiveness in telecommunications, as measured by a similar index, significantly impedes inward foreign direct investment (FDI) as well as domestic sales by foreign affiliates (FATS). Some studies provide index-type descriptive evidence on regulatory barriers in the telecom sector but do not proceed to a quantitative impact analysis, e.g. Holmes and Hardin (2000) on APEC countries, Koyama and Golub (2006) on OECD and 13 non-OECD countries, Marouani and Munro (2009) on Egypt, Jordan and Morocco, and Golub (2009) on 73 developing and developed countries across the globe. The latter focuses on a narrower definition of restrictiveness (only barriers to FDI) but demonstrates how FDI per capita decreases as the FDI restrictions index increases.

[19] There is empirical evidence (Goldberg and Maggi 1999, Gawande and Bandyopadhyay 2000) that policy makers respond to pressures by granting protection in sectors with low demand elasticities, implying that sectors receive higher protection when there are fewer opportunities for consumers to substitute away. This might provide one rationale for policies being more restrictive in landlocked countries because demand e.g. for transportation services is less elastic due to the absence of maritime shipping as an alternative mode of transportation.

as the `protection for sale' literature assumes (Grossman and Helpman 1994), an oligopolistic market structure *ceteris paribus* provides incentives for retaining a more restrictive policy stance.[20]

The theoretical analysis above suggests that the restrictiveness of policy can be related to two country attributes: elasticity of demand and the government's welfare-orientation. While we have argued that landlocked countries tend to have a lower elasticity of demand for certain services, we cannot rule out the possibility that the fact of being landlocked per se affects market structure and performance independently of policy. Therefore, in our search for a suitable instrument for policy, we focus on the government's welfare-orientation. The inclination of policy makers to favor vested interests at the expense of public welfare is constrained by the extent to which policy makers will be held accountable for their decisions. In short, political institutions that shape governance and democracy appear to be an important factor when policy makers decide on the level of openness.[21] This suggests a strategy for addressing the endogeneity problem using a measure of pre-determined political institutions.

We use the Polity IV Project's political regime indicator to instrument for potentially endogenous trade restrictiveness. Ranging from +10 (strongly democratic) to -10 (strongly autocratic), the Polity IV score summarizes the opportunities available to citizens to express their preferences over alternative policies and leaders, the existence of institutionalized constraints on the exercise of power by the executive branch, and the guarantee of civil liberties in acts of political participation.[22] This indicator appears to be a suitable instrument for the purposes at hand because it can be treated as exogenous to our outcome measures of interest and, most importantly, overall democratic accountability is not likely to have a direct effect on market structure and performance other than through the choice of regulatory measures.

Empirical evidence provides support for the two-step process by which prevailing political institutions matter for the government's 'welfare-mindedness', i.e. its relative valuation of public welfare versus rents, and how this measure of welfare valuation affects the choice of services policies. With regard to the first step, Mitra, Thomakos and Ulubaşoğlu (2002) estimate the Grossman-Helpman model for Turkey at four different points in time over the period 1983 to 1990, during which Turkey transitioned from a dictatorship to a democracy, thereby offering an opportunity to observe the same country's

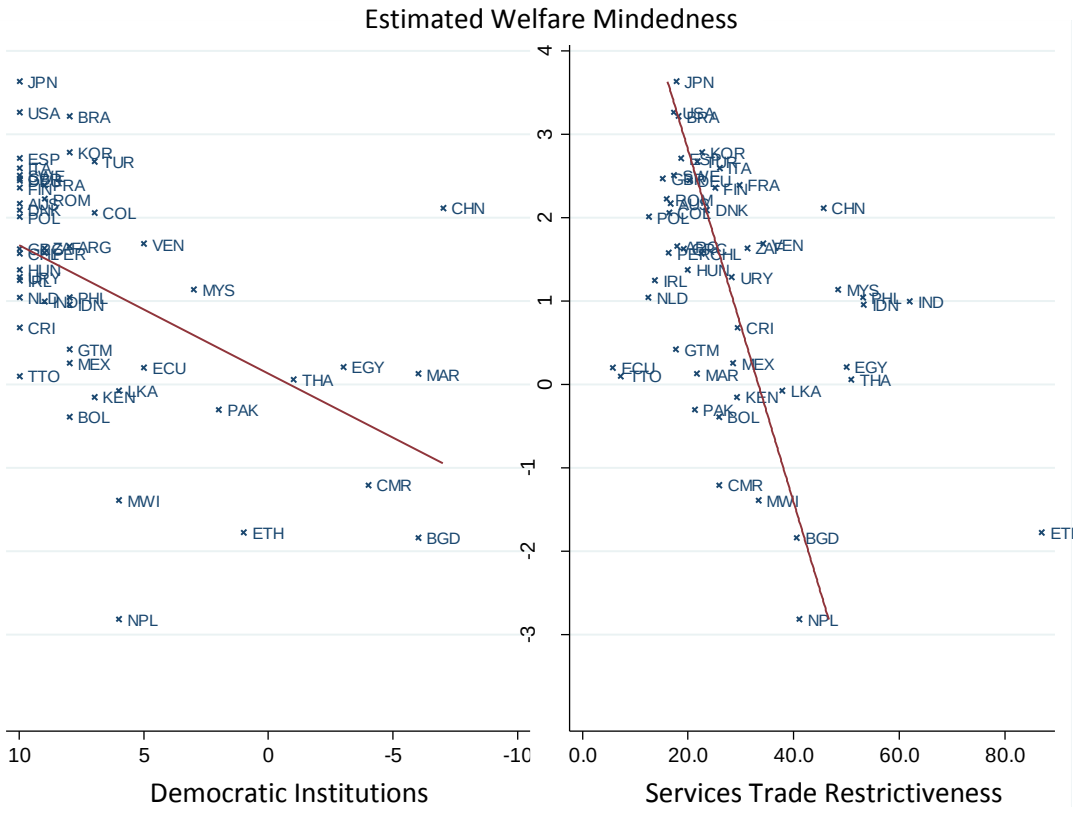
[20] Dihel and Shepherd (2007) show how policy barriers inflate firms' price-cost margins. E.g. for commercial presence in fixed line telecom, these estimates mostly range between 50-130% while the tax equivalents for the mobile segment in mode 3 are mostly in the single-digit range.

[21] Gasmi, Noumba Um and Recuero Virto (2009) find that in developing countries the quality of the political process has a favorable impact on performance in the telecom industry, though their measure of 'accountability' captures institutions ranging from corruption to currency risk and is thus not directly comparable to our notion of this term. Gual and Trillas's (2006) search for determinants of telecom policy is inconclusive; they find that entry barriers are mainly a function of the inherited legal system while the other institutional variables are insignificant. In addition the size of the incumbent telecom firm, supposedly reflecting its political clout, is positively associated with the decision to create an independent regulator, a fact the authors themselves call 'surprising.' (p.263).

[22] Gasmi and Recuero Virto (2010) report that a prior change in the democracy variable over time is negatively related to competition in the fixed line and mobile sectors, respectively, which is tantamount to an improvement in democracy being associated with fewer telecom operators. No rationale is offered for this result.

political economy forces at work under two different institutional settings. Reassuringly, Mitra et al. find the government's weight on welfare to be generally higher for the democratic regime as compared to dictatorship.

**Figure 2**




For the second conceptual step that links welfare valuation to policy choices, we draw on Gawande, Krishna and Olarreaga's (2009) study estimating government's welfare-mindedness for a broad cross-section of countries to show that policy openness increases the more governments care about public welfare. Using their estimates[23], Figure 2 presents an integrated picture of the political economy mechanism at work. To the left the horizontal axis is increasing in democratic accountability and to the right the horizontal axis is increasing in overall policy restrictiveness whereas the vertical axis in the middle measures governments' relative welfare weight. Because a country's institutional setup is pre-determined, reading this graph from left to right illustrates the systematic relationship between institutions and the choice of policies. In a nutshell, for the roughly 50 countries for which all the requisite data are available, there is evidence of a positive relationship between institutions and welfare weight such that more democratic countries put larger weight on social welfare, and evidence of a

[23] We are able to match 49 countries, i.e. about half of our sample, to the data set of Gawande, Krishna and Olarreaga (2009) who estimated welfare weight parameters for 54 countries.

positive relationship between welfare weight and openness.[24] The idea that a country's political institutions limit policy-makers' susceptibility to lobbying efforts applies to every sector. Thus we employ the same accountability indicator to instrument for our measure of policy restrictiveness in telecom and transport, respectively.

### *4.2 Telecommunications*

In the absence of an established unified estimation framework for such diverse variables as market structure and connectivity (in both telecom and transport sectors), we estimate a reduced-form equation for each outcome variable of interest. Across our analyses we will consider a core set of covariates as fundamental determinants of market structure and connectivity, which reflect a country's attractiveness to investors in telecom and transport services sectors. These variables include GDP, GDP per capita, the percentage of urban population and population density. We also include a dummy variable for landlocked and for African countries, respectively, thus accounting for geography. The Africa dummy is important to ensure that results regarding policy choices are not driven solely by this region: not only are 9 of the 22 landlocked countries in our sample located in Africa, but some parts of Africa may also be especially vulnerable to governance problems. All these determinants are closely related to gravity model variables that are known to affect goods trade flows. In addition, the distribution and 'lumpiness' of demand, as proxied by the two population variables, is important in services sectors because the fixed (often sunk) costs of sizable investments in both telecommunications and transport must be covered by sufficiently high (localized) demand.

We start by looking at market structure in telecommunications, using data on the Herfindahl index (HHI) of market concentration in the fixed line and mobile segment.[25] The reduced-form estimable equation is given by

$$HHI_i = \phi_0 + \phi_1 Policy_i + \phi_2 Fundamentals_i + \phi_3 Geography_i + \varepsilon_i$$

The specific variables and the results are displayed in Table 1. Policy variables are first treated as exogenous (columns labeled 'OLS') and then, following the previous section's discussion, we instrument for the STRI with the Polity IV variable in columns labeled `IV'.[26] Before summarizing a country's policies

[24] The Spearman rank correlation coefficient between the institutions and the welfare variable is +0.56 whereas the correlation between the welfare and the policy variable (STRI) is –0.40, both highly significant. The first-stage estimation results of policy restrictiveness on political accountability are presented in Appendix A.1.

[25] We compute the HHI based on TeleGeography's GlobalComms database as the sum of squared market shares of all firms in a market. A taxonomy commonly used by competition authorities would call a market with HHI < 1,000 "unconcentrated", 1,000 ≤ HHI < 1,800 "moderately concentrated", and with HHI ≥ 1,800 "concentrated". In the latter case a market is usually no longer assumed to be competitive. A value of 10,000 would indicate a monopoly.

[26] Based on its constituent elements, the Polity IV score seems to come closest to capturing the institutional arrangements that are relevant for shaping trade policies. To check robustness, we have run the same analyses with other indicators measuring institutions, namely the EIU's democracy index, the World Bank's Worldwide Governance Indicators, and the score of political freedom from Freedom House. All these variables are highly correlated (the Polity and EIU score 0.84, Polity and WGI

in a single index (see section 2.2 on quantification), we explore directly the effects of individual elements of policy. The relatively small sample size does not allow us to identify separately the effects of the entire range of policy measures. We therefore focus on four aspects of the regulatory regime, identified as salient in discussions with industry stakeholders and regulators: the existence of a limit on the number of licenses awarded, the public availability of licensing criteria, the maximum equity share permitted to be held by foreign investors, and the existence of a regulatory authority that is independent of the sector ministry.

**Table 1: Fixed Line Telecommunications Market Structure**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Fixed line | | | Mobile | | |
| | OLS | OLS | IV | OLS | OLS | IV |
| Log GDP (2007) | -743.4872*** | -798.2878*** | -809.0922*** | -375.9854*** | -430.3521*** | -434.3159*** |
| | (144.0017) | (133.2533) | (144.2164) | (108.2153) | (116.0360) | (113.7538) |
| Log GDP p.c. (2007) | 337.5251 | 408.2233 | 594.7895* | 453.5335** | 583.2758*** | 658.5521*** |
| | (290.1874) | (261.1358) | (309.7016) | (173.6483) | (182.1849) | (184.0177) |
| Urban population (% of total) | -4.6006 | -4.2191 | -10.0375 | -3.3924 | -6.7183 | -7.4386 |
| | (13.5589) | (14.1653) | (15.8076) | (8.1750) | (8.6059) | (9.6040) |
| Population Density (people/sqkm) | -0.4287 | -0.2019 | -0.7863 | -0.1279 | -0.3848 | -0.5329 |
| | (0.8240) | (0.6933) | (0.9776) | (0.4793) | (0.5504) | (0.6303) |
| LLC Dummy | -1209.7363*** | -728.4651 | -1042.8145** | 281.7894 | -10.0693 | -101.0782 |
| | (455.2252) | (465.9156) | (495.3117) | (336.2588) | (377.2240) | (389.1188) |
| Africa Dummy | 851.3010 | 909.5038* | 741.3573 | 674.7607* | 632.0786 | 434.1480 |
| | (553.7653) | (526.0141) | (572.6307) | (398.9616) | (438.5653) | (504.4995) |
| License Limit | 1636.2611*** | | | 494.1309 | | |
| | (454.2623) | | | (408.7319) | | |
| Public Lic Criteria | -948.1628* | | | -2543.2939*** | | |
| | (485.0377) | | | (810.1150) | | |
| Foreign Ownership Limit | -15.1185* | | | -15.4296** | | |
| | (7.6787) | | | (6.7105) | | |
| Indep Regulator | 552.6018 | | | -125.5950 | | |
| | (477.1015) | | | (335.9401) | | |
| STRI Fixed Line | | 1338.7055** | 3787.6651*** | | | |
| | | (564.5126) | (1.4e+03) | | | |
| STRI Mobile | | | | | 2830.4262*** | 4434.4475*** |
| | | | | | (798.9577) | (1.6e+03) |
| Constant | 10423.0639*** | 8018.9008*** | 6199.9453*** | 6154.8811*** | 1099.5716 | 165.6405 |
| | (1.9e+03) | (1.8e+03) | (2.2e+03) | (1.5e+03) | (1.5e+03) | (1.7e+03) |
| Obs | 101 | 103 | 103 | 100 | 103 | 103 |
| Log L | -899.7253 | -922.0859 | -928.9106 | -850.1660 | -886.8009 | -890.2658 |
| R-sq | 0.4240 | 0.3598 | 0.2691 | 0.5019 | 0.3649 | 0.3207 |
| H0: exogenous reg | | | 0.0379 | | | 0.2638 |
| H0: under-ident | | | 0.0029 | | | 0.0098 |
| Kleibergen-Paap F | | | 17.4368 | | | 10.3548 |

Dependent variable: Hirschman concentration index in fixed and mobile market
Excluded instruments: p4_polity2

accountability 0.83, Polity and Freedom House 0.84), thus employing either one of those indicators delivers qualitatively similar results.

The main result is a significant and quantitatively important effect of services policy restrictiveness, suggesting that—conditional on relevant country characteristics—less open countries are on average characterized by a more concentrated market structure. The policy effect remains strong and significant even after controlling for African and landlocked countries.[27] Once we account for the endogeneity of policy choices (columns 3 and 6), the unbiased impact of restrictive policies on market concentration is even larger in magnitude.[28]

Based on the presumption that concentrated markets (and the associated rents) tend to perpetuate restrictive policies, we would expect the OLS coefficient to be biased upward compared to the IV estimate. Yet we find that instrumenting raises the magnitude of the positive coefficient. One explanation could be that the STRI variable is afflicted with measurement error.[29] The 'classical errors-in-variables' assumption implies the well-known attenuation bias, leading to a downward bias if the OLS coefficient is positive (and an upward bias if it happens to be negative as is the case in other models further below). Even though the STRI score captures the latent concept of policy restrictiveness only imperfectly, note that the IV estimator will remedy both problems. Specifically, as long as the excluded instrument is uncorrelated with the measurement error, the IV procedure will remove both the endogeneity and the attenuation bias. Since those effects are biasing the OLS estimate in opposite directions, it is quite conceivable for IV estimates to increase once the attenuation bias is removed.

In terms of individual policies, the existence of a license limit has a strong effect on fixed line operators and results in an average increase in market concentration by 1,636 index points. Transparency about the licensing process and the criteria applied work to reduce concentration, and the same is true with respect to more liberal ownership rules. Overall, when all these (and more) policies are encapsulated in a single index, a more restrictive policy stance—reflected in a higher STRI score—is associated with a significantly higher market concentration. Since fixed line policy is most likely not exogenous with respect to market structure (p-value = .0379), we interpret the STRI coefficient from column 3 to find that a change in the index score by 25 points (which corresponds to one increment) would on average be associated with a market that is less concentrated by about 947 HHI points. This effect is quite sizable. The presence of a quota-like limit on licenses would *ceteris paribus* change a country's STRI by

[27] We always present robust standard errors which, in addition, include a correction for small sample size. The findings are therefore designed to provide a conservative lower bound, in spite of the larger standard errors associated with two-stage IV estimation.

[28] The IV estimation's first-stage regression results are presented in Annex 1. The coefficient on the excluded instrument, the Polity IV score, is highly significant at the 1% level and carries a negative sign, confirming that countries with more democratic institutions tend to employ more liberal policies (low STRI values). In those first-stage regressions, Shea's (1997) partial $R^2$ with respect to the Polity IV score equals 22 percent. We are therefore confident that we have a strong and relevant instrument.

[29] The phenomenon of OLS and IV coefficients diverging in an unexpected way has been a persistent feature in the literature on returns to education/schooling; see Card (2001) for an in-depth treatment of potential explanations. Among these, measurement error is likely to be an important problem when studying trade policy openness. We do not exclude the possibility, for instance, that underlying heterogeneity in treatment effects also plays a part in explaining the wedge, such that countries differ in the way trade restrictiveness affects their market structure or outcome, and that political institutions constrain some countries more than others. However, the data do not allow us to explore these aspects further.

50 points, which corresponds to a higher market concentration by 1,894 index points; this is the same order of magnitude as the effect inferred from the model in column 1.

Apart from the main variables of interest, we also see that larger countries are characterized by lower concentration; presumably because larger economies can sustain more operators.[30] Similar findings emerge from the mobile telecommunications market, except that here transparency of licensing criteria turns out to be more important than license limits. This result is not surprising since the availability of radio spectrum imposes in principle exogenous limits on the number of mobile providers, and telecommunication authorities have often used discretion to set licensing conditions rather than explicit license limits.

The effect of restrictive telecom policies on the sector's market structure is robust to other measures as well. In the Appendix we present estimation results on how restrictive policies affect the number of telecom operators active in a country, which yield qualitatively the same results. Likewise, more restrictive policies are also associated with a significantly higher market share of the largest provider in a given country, both in the fixed line and the mobile market.

Next we turn to an analysis of access to telecom services, for which we look at the number of telephone main lines per hundred inhabitants (in fixed line) and the number of cellular subscriptions per hundred inhabitants (in mobile). Estimating performance in the telecom sector follows the approach taken in Fink et al. (2003), Boylaud and Nicoletti (2000) and Ros (1999). We include the familiar set of covariates controlling for market attractiveness. In addition, the observed market structure—itself a result of policy's first-round impact on entry decisions—can be expected to influence performance. Therefore, in this performance specification we also include, for each segment, the residual from the previous market structure estimation, i.e. that part of market structure that is left unexplained by policy and other covariates, and estimate the following equation.

$$\log_e\left(Access\ to\ Telecom\ Service_i\right) = \gamma_0 + \gamma_1 Policy_i + \gamma_2\ Fundamentals_i + \gamma_3 Geography_i + \gamma_4\ Market\ Structure_i + \xi_i$$

Table 2 presents the results for the mobile and fixed telecom sector, respectively. Columns 1/2 and 4/5 estimate an exogenous policy model, first by representing stages of restrictiveness by a set of dummy variables and second by treating the STRI as a continuous variable.[31] Columns 3/6 then apply a two-step IV procedure to the STRI variable. In general the results show a significant negative impact of restrictive policies on a country's teledensity. Using an instrument is essential to obtain unbiased results, for reasons of endogeneity and measurement error, even though the substantially larger standard errors associated with IV estimation render the mobile STRI coefficient insignificant as compared to OLS.

[30] This is confirmed by estimating the determinants of the number of operators with a Poisson model, the results of which can be found in the Appendix.

[31] Employing a set of dummy variables to represent policy relaxes the assumption that there is one linear partial effect of policy that is uniform across all values of restrictiveness, which is assumed when the STRI score is treated as a continuous variable.

**Table 2: Cellular Subscriptions**

| | (1) F-OLS | (2) F-OLS | (3) F-IV | (4) M-OLS | (5) M-OLS | (6) M-IV |
|---|---|---|---|---|---|---|
| Log GDP (2007) | 2.4746*** | 2.3557*** | 2.4097*** | -2.1839 | -2.2545 | -2.2555 |
| | (0.6573) | (0.6778) | (0.6719) | (1.5264) | (1.4774) | (1.4775) |
| Log GDP p.c. (2007) | 9.6955*** | 10.0248*** | 9.0947*** | 23.0129*** | 24.1328*** | 24.1509*** |
| | (1.7905) | (1.8087) | (1.7524) | (2.9013) | (2.6189) | (2.7118) |
| Urban population (% of total) | 0.0085 | -0.0024 | 0.0267 | 0.1778 | 0.1558 | 0.1556 |
| | (0.0647) | (0.0714) | (0.0799) | (0.1331) | (0.1372) | (0.1379) |
| Population Density (people/sqkm) | 0.0032 | 0.0052 | 0.0082** | 0.0072 | 0.0072 | 0.0071 |
| | (0.0035) | (0.0038) | (0.0038) | (0.0121) | (0.0120) | (0.0120) |
| Africa Dummy | 3.4644 | 2.5261 | 3.3690 | 0.0528 | -0.4793 | -0.5268 |
| | (2.7466) | (2.8603) | (3.0360) | (4.9500) | (4.6949) | (5.0101) |
| LLC Dummy | 2.3882 | 4.6915* | 6.3080** | -2.0470 | -0.4325 | -0.4543 |
| | (2.4563) | (2.3725) | (2.9229) | (3.9509) | (4.1121) | (4.2005) |
| Log HHI residual | 0.0002 | -0.0001 | -0.0007 | -0.0041*** | -0.0036** | -0.0036** |
| | (0.0004) | (0.0005) | (0.0006) | (0.0015) | (0.0015) | (0.0016) |
| STRI = 0.25 | -5.5564** | | | -12.9708** | | |
| | (2.4903) | | | (5.6347) | | |
| STRI = 0.50 | -1.1689 | | | -16.2788*** | | |
| | (2.5797) | | | (5.5890) | | |
| STRI = 0.75 | 2.5276 | | | -28.9742*** | | |
| | (8.2894) | | | (10.4050) | | |
| STRI = 1.00 | -5.7834 | | | -17.3247** | | |
| | (4.5554) | | | (8.3479) | | |
| STRI Fixed Line | | -4.0226 | -16.4599** | | | |
| | | (4.0397) | (7.8692) | | | |
| STRI Mobile | | | | | -27.9711*** | -27.5863 |
| | | | | | (7.8014) | (18.7148) |
| Constant | -77.6332*** | -80.8423*** | -71.7368*** | -124.8579*** | -135.9442*** | -136.1684*** |
| | (13.7494) | (13.2233) | (13.0698) | (22.2814) | (19.7363) | (21.7501) |
| Obs | 102.0000 | 102.0000 | 102.0000 | 102.0000 | 102.0000 | 102.0000 |
| Log L | -369.6457 | -372.6347 | -378.8429 | -436.8189 | -438.2601 | -438.2612 |
| R-sq | 0.7233 | 0.7066 | 0.6686 | 0.7941 | 0.7881 | 0.7881 |
| H0: exogenous reg | | | 0.0439 | | | 0.9821 |
| H0: under-ident | | | 0.0012 | | | 0.0118 |
| Kleibergen-Paap F | | | 24.0848 | | | 10.1268 |

Dependent variable: Number of mainlines/cellular subscriptions per 100 people
Excluded instruments: p4_polity2

Estimation results for the fixed line market (columns 1-3) show that the effect of policies on teledensity is not as strong as on cellular subscriptions, in terms of both magnitude and significance of coefficients. It appears, though, that conditional on size and per capita income, both of which are strong predictors of teledensity, countries with moderate restrictions (STRI = 25) have lower accessibility to landlines. When policies are considered one by one, it is again the prohibition of VoIP and operation of own international gateways that stifles access to mainlines (see Appendix Table A.3). Once accounting for policy endogeneity, though, the adverse effect of the fixed line STRI is significant at the 5% level (column 3). The coefficient estimate suggests that liberalizing policies by one index increment, which would correspond to a change from the 75$^{th}$ percentile (STRI = 75) to the median (STRI = 50), would on average be associated with an increase in mainlines by 4 percentage points.

Looking at the results for the mobile segment in Table 2, we find all four dummy variables negative and significant, i.e. conditional on market structure, progressively higher levels of restrictiveness are associated with fewer numbers of cellular subscriptions. The mobile STRI in column 5 also exhibits a highly negative effect. This result suggests that liberalizing policies equivalent to one incremental change in the telecom STRI, e.g. an easing of foreign equity limitations from 49 to 70 percent so as to lower the STRI score from 50 to 25, would on average be associated with an increase in cellular subscriptions by 7 percentage points.[32] In terms of individual policy measures, the measure of prohibiting VoIP routing and operation of international gateways by foreign providers has a strong negative impact, as have equity limits on acquiring public enterprises, while publicly available licensing criteria is associated with higher levels per capita subscriptions. The latter finding relates to the positive effect of transparency already found in the mobile segment's market structure model.[33]

Apart from the strong effect of policies, market structure in the mobile sector also affects performance in a way we would expect. In particular, across all three specifications, a more concentrated market (higher Herfindahl index) is associated with fewer cellular subscriptions per capita. This is the part of cross-country variation in market concentration that is not already explained by policy and the set of usual covariates, all of which are also in the performance equation. Amongst the other covariates, in the mobile market the effect of income per capita trumps any other variable such as size, geography or population.

In the fixed line segment it is likewise true that larger and richer countries have more mainlines per capita, as should be expected. In addition, there is some evidence that more densely populated countries have on average better access. There is also a minor positive effect of landlocked countries, which is best understood as conditional on size and income. Since many landlocked countries are small and poor, this effect indicates that access to telephone mainlines in these countries is on average not as low as would be predicted based on other covariates.

As was previously the case in the market structure regressions, measurement error appears to be a pervasive phenomenon afflicting the coefficient on policy restrictiveness. If we presume, however, that the measurement error is roughly the same for the fixed line and mobile STRI, then the comparison of OLS and IV coefficients in the two markets would imply that reverse causality is stronger in the mobile segment than in fixed line (because it fully offsets the attenuation bias in Table 2). This is somewhat surprising; the more concentrated market structure in the fixed line sector could have pointed at this sector being better 'organized.' In any case the results underscore the adverse effect of more restrictive policies on accessibility in both markets.

[32] The array of STRI dummy variables suggest, though, that the effect might not be linear; in particular, moving from the 75th percentile to the median, and from the 25th percentile to fully open policies, is each associated with an increase of about 12 percentage points in coverage, whereas the partial effect of reducing restrictions from 'major' (STRI = 50) to 'minor' (STRI = 25), respectively, raises cellular subscriptions by 3.3 percentage points.

[33] It has proved difficult, though, to include several policy measures simultaneously, which appears to be a problem of insufficient degrees of freedom; estimation results are presented in Appendix Table A.4.

### *4.3 Transportation*

Let us now turn to connectivity in the air transportation sector. The number of international flights (both inbound and outbound) as well as total seat capacity serve as indicators for how well a country is connected in terms of air transport. We continue to use the core set of gravity-type variables that determine a market's attractiveness to foreign providers, in this case airlines. GDP as a measure of economic size will control for the scale effect inherent in both variables. In the following analysis we limit our attention to air passenger transportation[34] but we note that approximately fifty percent of global airborne cargo is transported in the belly of passenger aircraft. The results in this section may therefore assume some significance beyond the narrowly defined air passenger sector (see also World Bank 2009).

Air passenger transport services are almost exclusively traded on a cross-border basis, for airlines do not need to establish a commercial presence in order to fly to a specific country. While a national investment regime, i.e. a set of rules for FDI in the airline sector, does exist, the key policy instruments are Bilateral Air Service Agreements (BASAs) which stipulate conditions under which international flights might be provided between the two contracting parties. [35] We will return to the type and scope of BASA provisions in greater detail below. It is clear, though, that due to the predominance of cross-border trade in air services the number of airlines established in a country is not a meaningful metric of market structure; airlines would rather compete for providing flights between specific country pairs, or even between cities, i.e. competition on a route-specific basis. We therefore focus directly on the impact of air transport policies on the availability of air transport services, for which the number of airlines flying to a given country matters as well.[36]

Information on the number of airlines, the number of international flights, and available seat kilometers for each country are obtained from Air Transport Intelligence's (ATI) Flight Global database. We consider the total number of international flights (or, alternatively, the total seat capacity of such flights) as the dependent variable. In addition to the core set of gravity-type variables already introduced, the provision of flights is innately linked to two additional characteristics. From a supply side perspective, airport infrastructure matters and is, at least in the short run, exogenous to the number of flights. Second, from the demand side, a country's attractiveness to tourism is an important determinant of

[34] The chief reason is data availability, both in terms of policies that specifically apply to air cargo transportation as well as cargo volume, some of which travels as belly cargo in scheduled passenger flights and some on dedicated cargo flights. One would need to concord the fraction of belly cargo to the corresponding BASA provisions applicable to passenger traffic, and the remainder to specific provisions governing dedicated cargo traffic, which may be scheduled or charter flights. Current data availability does not allow for this matching.

[35] As has been explained in section 2.3 above, the provisions of a country's national investment regime in the air transport sector may have little bearing on openness, for the privileges it affords will interact, and often be superseded, by whatever rights and obligations are stipulated by the relevant BASA.

[36] We regard the evidence of policy impact on air movements offered in this paper as complementary to related work that has studied the effect of aviation policies on bilateral goods trade flows. For example, Geloso Grosso (2008), Piermartini and Rousova (2008), and Geloso Grosso and Shepherd (2010) have directly included the ALI in the trade cost function of gravity model of goods trade.

flights and seats offered. Therefore, we also control for the number of airports with a paved runway per country and for tourist arrivals as a share of domestic population (see Annex 4).[37]

In terms of policies affecting air connectivity, the appropriate measure of policy restrictiveness needs to take into account both air traffic rights and foreign investment rules. The former is summarized by the WTO's Air Liberalization Index (ALI) whereas information on the latter comes from the World Bank's newly developed policy database (see footnote 5 above on the construction of the combined STRI). We estimate the following reduced-form model:

$$Log(No.of\ Flights_i) = \beta_0 + \beta_1\, Policy_i + \beta_2 Infrastr_i + \beta_3 Tourism_i + \beta_4 Fundamentals_i + \beta_5\, Geography_i + \xi_i$$

Table 3 presents results for the number of flights per country. Column 1 includes a set of dummy variables for countries with intermediate and highly restrictive policies, whereas column 2 treats the STRI as a continuous, exogenous variable. Column 3 then instruments for policies with institutional accountability in the same way as in the previous section (the IV estimation's first-stage regression results are presented in Annex 2).

We find again that policy choices matter for air transport connectivity. Across 100 countries, policies restricting the cross-border trade of air passenger transport services as well as the establishment of commercial presence are associated with significantly fewer flights offered to and from such countries.[38] Based on the estimated coefficient from the air passenger STRI in column 2, liberalizing aviation policies such that the index score falls from 50 to 25 is associated with a 20 percent increase in the number of flights.[39] Looking at the set of conditioning variables, attractiveness as a tourist destination, economic size and income per capita all exert a positive and significant effect of flights, as expected. Overall the model fits the data very well, explaining about 86 percent of the cross-country variation in the number of international flights. When we instrument for aviation policies with institutional accountability, the magnitude of the coefficient on policy increases substantially. The partial effect of liberalization, as inferred from the model in column 3, such that the index score falls from 50 to 25 would increase the total number of flights by some 42 percent.

The same qualitative results obtain when we look at total seat capacity rather than flights. These estimations are therefore not shown to conserve space but are available upon request. In both cases—

[37] For instance, Dresner et al. (2002) show that constrained access to gates may constitute a barrier to entry (and increase the cost of airline service for incumbents). Similarly, Brueckner (2002) uses a Cournot duopoly model to show how incumbent duopolists may restrict runway capacity such that no third party can enter the market. These studies strongly suggest that airport infrastructure matters.

[38] The results are robust to alternative weights with which the cross-border and commercial presence part are combined in the STRI; specifically, the ALI component (i.e. BASA provisions) may assume any weight in the 60-90% band without materially affecting the results.

[39] Following the log-linear functional form, $\exp\{(-.70)\times(-.25)\} = 1.1912$.

number of flights and seat capacity as dependent variables—the results are robust to using the ALI alone as a measure of policy openness.

**Table 3: Air Transport Performance**

| | (1) OLS-STRI | (2) OLS-STRI | (3) IV-STRI |
|---|---|---|---|
| Log GDP (2007) | 0.5804*** | 0.5903*** | 0.6033*** |
| | (0.0381) | (0.0393) | (0.0460) |
| Log GDP p.c. (2007) | 0.2824** | 0.2757** | 0.2510** |
| | (0.1255) | (0.1224) | (0.1233) |
| Urban population (% of total) | -0.0056 | -0.0056 | -0.0063 |
| | (0.0049) | (0.0049) | (0.0053) |
| Population Density (people/sqkm) | -0.0000 | -0.0001 | -0.0001 |
| | (0.0003) | (0.0003) | (0.0002) |
| Percent Tourists/Population | 0.3151** | 0.3282** | 0.3313** |
| | (0.1359) | (0.1325) | (0.1321) |
| LLC Dummy | -0.1526 | -0.1657 | -0.1075 |
| | (0.1602) | (0.1585) | (0.1655) |
| Africa Dummy | 0.1004 | 0.0885 | 0.1161 |
| | (0.1666) | (0.1673) | (0.1702) |
| airports paved runways | 0.0000 | 0.0000 | 0.0000 |
| | (0.0001) | (0.0001) | (0.0001) |
| STRI intermed | -0.1486 | | |
| | (0.1319) | | |
| STRI high | -0.4234*** | | |
| | (0.1317) | | |
| STRI AirPass M0 | | -0.7003** | -1.4157* |
| | | (0.2738) | (0.8168) |
| Constant | 5.8828*** | 5.9809*** | 6.4229*** |
| | (0.9141) | (0.8780) | (0.9164) |
| Obs | 100.0000 | 100.0000 | 100.0000 |
| Log L | -77.0324 | -77.9991 | -80.9988 |
| R-sq | 0.8634 | 0.8607 | 0.8521 |
| H0: exogenous reg | | | 0.3097 |
| H0: under-ident | | | 0.0039 |
| Kleibergen-Paap F | | | 11.8571 |

Dependent variable: Log Total Number of Flights
Excluded instruments: p4_polity2

In Table 3, the number of flights is an 'absolute' measure of connectivity in that it is not scale-invariant (the same is true for total seat capacity). As such, a given number of flights, say 400, could be the result of 40 airlines offering 10 flights each or a single airline only offering 400 flights, or of course anything in between these two polar cases. In analogy to the trade in goods literature, in which a distinction is commonly made between 'trade in more product categories' and 'more trade of a given product,' we may think of more airlines serving a country as the 'extensive margin' and of the number of flights per airline as the 'intensive margin.' We are interested in the relevant margin of adjustment, i.e. whether aviation policies primarily affect the number of airlines, the frequency of flights, or both. Individual

BASA provisions may either primarily affect the number of airlines or the frequency and/or size of carriers' operations, respectively.[40] On the one hand, air traffic rights, in particular 5th and higher freedom rights, as well as the type of designation and withholding clauses likely affect the number of airlines being able (or willing) to service a country. On the other hand, the range of provisions relating to airfares, number of flights per route and maximum seat capacity directly affect the frequency and capacity of flights for a given (designated) airline.

In order to disentangle the channel through which aviation rules affect air connectivity, we split the total number of flights (F) into the average number of flights per airline (F/A) and the number of airlines (A), which allows us to study the intensive and extensive margin separately. We take advantage of the property of OLS estimation that under these circumstances, the estimated coefficients on the policy variable in the flights-per-airline and in the number-of-airline estimations will exactly add up to the policy coefficient in the total number of flights regression. This allows for a convenient decomposition of the overall policy effect into one working through the intensive and extensive margin, respectively.

$$
\begin{aligned}
F_i &= (F/A)_i \times A_i \\
\log(F_i) &= \log(F/A)_i + \log(A_i) \\
&\Downarrow \\
\hat{\beta}^{F}_{STRI} &= \hat{\beta}^{(F/A)}_{STRI} + \hat{\beta}^{A}_{STRI}
\end{aligned}
$$

Table 4 presents the decomposition results; the first three columns refer to OLS estimations assuming the STRI is an exogenous variable whereas the last three columns employ IV estimation. Looking at the STRI coefficients, it is evident that aviation policies affect predominantly the average number of flights per airline. Looking at the column (2), the effect of policy is highly significant at the 1 percent level and increasing in magnitude as restrictiveness moves from an intermediate to a high level. The partial effect of an intermediate STRI value is a reduction in the number of flights per airline by 25 percent, whereas highly restrictive polices reduce flights per airline by another 14 percent, i.e. by almost 40 percent compared to the references point of liberal policies.[41] The decomposition thus reveals that the number of flights per airline is the primary margin of adjustment in response to restrictive aviation policies.

Apart from the main findings pertaining to policy, results for other covariates are also of interest. For instance, and unlike aviation policies, tourist attractiveness increases the number of flights mainly through more airlines (two-thirds of the effect) and only to a smaller but still significant extent through more flights. Given that different airlines bring in tourists from their national markets, this result and the relative size of both margins is quite plausible. Likewise, a country's 'absorptive capacity' as

[40] Bilateral Air Service Agreements contain four principal areas of provisions that regulate the possibility and the extent of bilateral flight connections: (1) traffic rights, (2) ownership rules, (3) fares/tariffs, and (4) capacity. For a comprehensive overview of regulatory aspects of the air transport services sector, and how the restrictiveness of market access provisions is quantified in the QUASAR database, see WTO document S/C/W/270/Add.1, Volume I, of November 2006. A detailed exposition of the 'Freedoms of the Skies' can be found on page I.15.

[41] Using the coefficient estimates of column (2), one obtains exp{-.2907} – 1 = -0.2523 and exp{-.4941} – 1 = -0.3899, respectively, the difference of which is -0.1376.

measured by airports with paved runways affects the number of flights per airline rather than the number of airlines.

The findings in Table 4 suggest that the adverse impact on air transport connectivity is mainly driven by BASA provisions that affect frequency and capacity of air traffic, e.g. designation clauses, weekly flight limitations, and perhaps also traffic rights. A more detailed analysis of the differential impact of various BASA provisions is data demanding and is beyond the scope of the present paper. We leave this task for future research.

**Table 4: Air Transport Performance – Number of Flights, Flights per Airline, and Number of Airlines**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | | OLS | | | IV | |
| | F-STRI | F/A-STRI | A-STRI | F-STRI | F/A-STRI | A-STRI |
| Log GDP (2007) | 0.5804*** | 0.2000*** | 0.3804*** | 0.6033*** | 0.2208*** | 0.3825*** |
| | (0.0381) | (0.0328) | (0.0346) | (0.0460) | (0.0346) | (0.0355) |
| Log GDP p.c. (2007) | 0.2824** | 0.2427*** | 0.0397 | 0.2510** | 0.2178*** | 0.0332 |
| | (0.1255) | (0.0723) | (0.0866) | (0.1233) | (0.0756) | (0.0826) |
| Urban population (% of total) | -0.0056 | -0.0039 | -0.0017 | -0.0063 | -0.0044 | -0.0020 |
| | (0.0049) | (0.0030) | (0.0033) | (0.0053) | (0.0033) | (0.0033) |
| Population Density (people/sqkm) | -0.0000 | -0.0001 | 0.0000 | -0.0001 | -0.0001 | 0.0000 |
| | (0.0003) | (0.0002) | (0.0003) | (0.0002) | (0.0002) | (0.0003) |
| Percent Tourists/Population | 0.3151** | 0.1126* | 0.2026* | 0.3313** | 0.1113** | 0.2200** |
| | (0.1359) | (0.0570) | (0.1042) | (0.1321) | (0.0546) | (0.1012) |
| LLC Dummy | -0.1526 | 0.0443 | -0.1967 | -0.1075 | 0.0927 | -0.2001 |
| | (0.1602) | (0.1269) | (0.1590) | (0.1655) | (0.1269) | (0.1738) |
| Africa Dummy | 0.1004 | 0.2669* | -0.1667 | 0.1161 | 0.2607* | -0.1448 |
| | (0.1666) | (0.1468) | (0.1771) | (0.1702) | (0.1525) | (0.1795) |
| airports paved runways | 0.0000 | 0.0001** | -0.0001 | 0.0000 | 0.0001** | -0.0001 |
| | (0.0001) | (0.0000) | (0.0000) | (0.0001) | (0.0000) | (0.0000) |
| STRI intermed | -0.1486 | -0.2907*** | 0.1420 | | | |
| | (0.1319) | (0.0961) | (0.1127) | | | |
| STRI high | -0.4234*** | -0.4941*** | 0.0707 | | | |
| | (0.1317) | (0.1106) | (0.1346) | | | |
| STRI AirPass M0 | | | | -1.4157* | -1.3665** | -0.0494 |
| | | | | (0.8168) | (0.6279) | (0.5799) |
| Constant | 5.8828*** | 4.6283*** | 1.2547* | 6.4229*** | 5.0128*** | 1.4104** |
| | (0.9141) | (0.5329) | (0.6592) | (0.9164) | (0.5996) | (0.6581) |
| Obs | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 |
| Log L | -77.0324 | -43.2276 | -60.6725 | -80.9988 | -48.3405 | -61.6434 |
| R-sq | 0.8634 | 0.7180 | 0.7466 | 0.8521 | 0.6877 | 0.7416 |

Dependent variable: flights
Excluded instruments: p4_polity2

## 5. Conclusions and Policy Implications

Drawing on a new dataset of applied policies affecting services trade, we are able to isolate the effect of regulatory policies on market structure and performance from other country characteristics. Our results illustrate that a country's own policy reform can also contribute to a more competitive market structure, and improved access to telecommunications and air transport services. We find that in the telecommunications sector, liberalizing policies from the level of the median country (STRI = 50) to the level of first quartile (STRI = 25) would on average result in an increase of cellular subscriptions by 7 percentage points and an increase in mainlines by 4 percentage points. Within the STRI scoring framework applied in this paper, such a step could for instance be achieved by increasing the maximum foreign capital participation limit from a minority to a majority stake. In the air transport sector, a reform of aviation policies with similar impact, such that the STRI score would fall from 50 to 25, is estimated to be associated with a 20 percent increase in the number of flights. The effect of aviation policies works mainly through reducing the average number of flights per airline, rather than reducing the number of airlines flying to and from a country. Countries with highly restrictive aviation policies have on average 39 percent fewer flights per airline than liberal countries.

The importance of services policies for market structure and performance has two implications for policy-making. First, international assistance for transport and telecommunications infrastructure needs to be complemented by policy reform. Second, in transport services, there is a strong case for multilateral negotiations because there are limits to what unilateral reform can achieve. We address each aspect in turn.

Our results suggest that access to key "linking" services is determined not only by the state of infra-structure (see Portugal-Perez and Wilson 2008; Francois and Manchin 2007) but also by competitive pressure in those sectors. However, current trade facilitation and trade-related aid have placed a heavy emphasis on infrastructure projects, especially so in transportation but also in telecommunication. Also, studies which evaluate the effectiveness of aid for trade (see e.g. Cali and Te Velde 2010) do not explicitly specify the role of restrictive policies as alternative constraints to trade performance. Our findings indicate that international assistance for infrastructure investment is likely to earn a low return where policies restrict competition between service providers.

Apart from policy reform within a country, progress in transport liberalization requires stronger inter-national cooperation. The reason is that a particularly country, say Zambia, is limited in what it can achieve on its own in the air transport sector because introducing competition on any international route requires the consent of other countries involved. Borchert et al. (2011) show that air transport services are also restricted in other developing and industrial countries, many of which are either important destination and source countries, or transit or hub countries for connecting flights to landlocked economies.

Engaging in international negotiations on services sector liberalization is important for at least two reasons. Even though the mercantilistic 'quid pro quo' logic may not be particularly suited to services

negotiations, regional or multilateral negotiations with strong *demandeurs* may sometimes help overcome entrenched domestic interests, as the example of Costa Rica shows, which opened one of its most sensitive services sectors (telecommunications) under the auspices of the CAFTA-DR agreement (Robert and Stephenson 2008). Secondly, the beneficial effect on landlocked countries' connectivity of policy reforms in other (transit or final destination) countries constitutes a positive externality that is unlikely to be fully internalized by policy makers in those partner countries. This externality could be addressed in international negotiations. The WTO would be a natural platform for multilateral negotiations but its contribution to liberalizing the transport sector has so far been limited. Air traffic rights are explicitly excluded from the scope of services negotiations, and maritime transport has never been seriously negotiated. In the Uruguay Round many countries, including OECD countries, did not make full commitments on cross-border road and rail transport services. Regional agreements like the Yamoussoukro Decision, which entered into force in 2000, also offer scope for regional policy reform but they have, however, so far seen only limited implementation.

Transport and telecommunications services are critical to a country's overall economic performance. Connectivity requires good infrastructure, an appropriate policy regime, and international regulatory cooperation. Our paper suggests that international assistance for infrastructure investment needs to be complemented by national and multilateral reform in order to yield full benefits. To insist on such reform as a condition for assistance is now anathema. At the same time, participative mechanisms are noticeably short on reform proposals and long on lists of required investments. Perhaps the way forward is to ask countries to present proposals that specify both intended reforms and required investments, and to allocate assistance competitively to maximize the expected social rate of return.

**References**


Arvis, Jean-Francois, Gaël Raballand and Jean-Francois Marteau (2010), "The Cost of Being Landlocked: Logistics Costs and Supply Chain Reliability", Directions in Development – Trade No. 55837, Washington DC: The World Bank.

Borchert, Ingo, Batshur Gootiiz and Aaditya Mattoo (2011), "Policy Barriers To International Trade In Services: New Empirical Evidence", World Bank: forthcoming.

Boylaud, Olivier and Giuseppe Nicoletti. 2000. " Regulation, Market Structure and Performance in Telecommunications," OECD Economics Department Working Paper No. 237.

Brueckner, Jan K. (2002), "Airport congestion when carriers have market power", *American Economic Review* 92, pp. 1357-1375.

Cali, Massimiliano and Dirk Willem Te Velde (2010), "Does Aid for Trade Really Improve Trade Performance?", *World Development*, forthcoming.

Dihel, Nora and Ben Shepherd (2007), "Modal Estimates of Services Barriers", OECD Trade Policy Working Paper No. 51, TD/TC/WP(2005)36/FINAL.

Dresner, Martin, Robert Windle and Yuliang Yao (2002), "Airport Barriers to Entry in the US", *Journal of Transport Economics and Policy* 36 (2), pp. 389-405.

Fink, Carsten, Aaditya Mattoo and Ileana Cristina Neagu (2002), Trade in international maritime services: how much does policy matter, *World Bank Economic Review* 16 (1), pp. 81-108.

Fink, Carsten, Aaditya Mattoo and Randeep Rathindran (2003), "An assessment of telecommunications reform in developing countries," *Information Economics and Policy* 15 (4), pp. 443-466.

Francois, Joseph and Miriam Manchin (2007), "Institutions, Infrastructure, and Trade", World Bank Policy Research Working Paper # 4152.

Gasmi, Farid, Paul Noumba Um and Laura Recuero Virto (2009), "Political Accountability and Regulatory Performance in Infrastructure Industries: An Empirical Analysis", *World Bank Economic Review* 23 (3), pp. 509-531.

Gasmi, Farid and Laura Recuero Virto (2010), "The determinants and impact of telecommunications reforms in developing countries", *Journal of Development Economics* 93, pp. 275-286.

Gawande, Kishore and Usree Bandyopadhyay (2000), "Is Protection for Sale? Evidence on the Grossman-Helpman Theory of Endogenous Protection", *Review of Economics and Statistics* 82 (1), pp. 139-152.

Gawande, Kishore, Pravin Krishna and Marcelo Olarreaga (2009), "What Governments Maximize and Why: The View from Trade", NBER Working Paper # 14953.

Geloso Grosso, Massimo and Ben Shepherd (2008), "Liberalising Air Cargo Services in APEC", MPRA Paper Working Paper No. 17781, University Library of Munich, Germany.

Goldberg, Pinelopi K. and Giovanni Maggi (1999), "Protection for Sale: An Empirical Investigation", *American Economic Review* 89 (5), pp. 1135-1155.

Golub, Stephen S. (2009), "Openness to Foreign Direct Investment in Services: An International Comparative Analysis", *The World Economy* 32 (8), pp. 1245-1268.

Grossman, Gene M. and Elhanan Helpman (1994), "Protection for Sale", *American Economic Review* 84 (4), pp. 833-850.

Gual, Jordi and Francesc Trillas (2006), "Telecommunications Policies: Measurement and Determinants", *Review of Network Economics* 5 (2), pp. 249-272.

Hallaert, Jean-Jacques, Ricardo Cavazos Cepeda and Gimin Kang (2011), "Estimating the Constraints to Trade of Developing Countries", OECD Trade Policy Working Paper No. 116, Paris: OECD.

Holmes, Leanne and Alexis Hardin (2000), "Assessing barriers to services sector investment", in: Christopher Findlay and Tony Warren (eds.), Impediments to Trade in Services – Measurements and Policy Implications, Routledge, London and New York, pp. 52-70.

Kee, Hiau Looi, Alessandro Nicita and Marcelo Olarreaga, (2009), "Estimating trade restrictiveness indices", *Economic Journal* 119, pp. 172-199.

Kessides, Ioannis N. and Li Tang (2011), "Sunk costs, Market Contestability, and the Size Distribution of Firms," World Bank Policy Research Working Paper #5540, forthcoming in the Review of Industrial Organization.

Koyama, Takeshi and Stephen Golup (2006), "OECD's FDI Regulatory Restrictiveness Index: Revision and Extension to More Economies", OECD Working Papers on International Investment No. 2006/4.

Lall, Somik V., Hyoung Wang and Thomas Munthali (2009), "Explaining High Transport Costs within Malawi", World Bank Policy Research Working Paper No. 5133.

Limao, Nuno and Anthony J. Venables (2001), "Infrastructure, Geographical Disadvantage, Transport Costs and Trade", *World Bank Economic Review* 15, pp. 451-479.

Marouani, Mohamed Ali and Laura Munro (2009), "Assessing Barriers to Trade in Services in the MENA Region", OECD Trade Policy Working Paper No. 84, TAD/TC/WP(2008)25/FINAL.

Mattoo, Aaditya and Lucy Payton (ed) (2007), "Services Trade and Development: The experience of Zambia", co-publication of Palgrave Macmillan and the World Bank.

Mitra, Devashish, Dimitrios D. Thomakos and Mehmet A. Ulubaşoğlu (2002), "`Protection for Sale' in a Developing Country: Democracy vs. Dictatorship", *Review of Economics and Statistics* 84 (3), pp. 497-508.

OECD (2009), "Testing the Services Trade Restrictiveness Index: Gravity Regressions and Trade Costs Analysis", paper presented at the OECD Experts Meeting on the Services Trade Restrictiveness Index (STRI), 2-3 July 2009, Paris.

Portugal-Perez, Alberto and John S. Wilson (2008), "Trade Costs in Africa: Barriers and Opportunities for Reform", World Bank Policy Research Working Paper # 4619.

Raballand, Gaël, Charles Kunaka and Bo Giersing (2008), "The Impact of Regional Liberalization and Harmonization in Road Transport Services: A Focus on Zambia and Lessons for Landlocked Countries", World Bank Policy Research Working Paper No. 4482.

Raballand, Gaël and Patricia Macchi (2009), "Transport Prices and Costs: The Need to Revisit Donors' Policies in Transport in Africa", BREAD Working Paper No. 190, Bureau for Research and Economic Analysis of Development.

Robert, Maryse and Sherry Stephenson (2008), "Opening services markets at the regional level under the CAFTA-DR: the cases of Costa Rica and the Dominican Republic," Chapter 15 in: Juan A. Marchetti and Martin Roy (eds.), "Opening markets for trade in services : countries and sectors in bilateral and WTO negotiations," Cambridge University Press, pp. 537-572.

Ros, Agustin J. (1999), "Does Ownership or Competition Matter? The Effects of Telecommunications Reform on Network Expansion and Efficiency", *Journal of Regulatory Economics* 15, pp. 65–92.

Schlumberger, Charles E. (2007), "Air Transport: Revitalizing Yamoussoukro", chapter 5 in: Aaditya Mattoo and Lucy Payton (ed), "Services Trade and Development: The experience of Zambia", co-publication of Palgrave Macmillan and the World Bank, pp. 191-211.

Shapiro, Carl (1989), "Theories of Oligopoly Behavior", in: Richard Schmalensee and Robert D. Willig (eds), Handbook of Industrial Organization, Chapter 6, Amsterdam: Elsevier Science Publishers B.V., pp. 329-414.

Suzumura, Kotaro and Kazuharu Kiyono (1987), "Entry Barriers and Economic Welfare", *Review of Economic Studies* 54, pp. 157-167.

World Bank (2009), "Air Freight: A Market Study with Implications for Landlocked Countries", Transport Papers No. TP-26, Washington D.C.: The World Bank Group.

Zhao, Jingang (2009), "Necessary and sufficient conditions for the optimal number of firms", *Journal of Economics* 98(3), pp. 235-246.

**Annex 1: Intermediate steps in oligopoly model**

*A.1 Derivation of the first-order condition*

Let us first derive how optimal firm output, q*(n), responds to changes in n which active providers take as fixed. Based on a provider's first-order condition (see Assumption A4), we may assert

$$q^*(n)' = -\frac{(P'(Q) + qP''(Q))\mathrm{q}}{\mathrm{n}(P'(Q) + qP''(Q)) + \mathrm{P}'(\mathrm{Q}) - \mathrm{C}''(\mathrm{q})}$$

$$\mathrm{Q}^*(n)' = -\frac{(\mathrm{P}'(\mathrm{Q}) - \mathrm{C}''(\mathrm{q}))\mathrm{q}}{\mathrm{n}(P'(Q) + qP''(Q)) + \mathrm{P}'(\mathrm{Q}) - \mathrm{C}''(\mathrm{q})}$$

As in Zhao (2009), in order to simplify notation it will be convenient to define

$$\alpha \equiv P'(Q) + qP''(Q) < 0$$

$$\beta \equiv \mathrm{P}'(\mathrm{Q}) - \mathrm{C}''(\mathrm{q}) < 0$$

where both inequalities follow from Assumptions (A2) and (A3), respectively. Substituting back we see that in the decentralized equilibrium firm output falls when more providers are allowed to enter the market, whereas aggregate output increases with n.

$$q^*(n)' = -\frac{\alpha\mathrm{q}}{(\mathrm{n}\alpha + \beta)} \;\; ; \;\; \mathrm{Q}^*(n)' = \frac{\beta\mathrm{q}}{(\mathrm{n}\alpha + \beta)}$$

Now rearranging the first-order condition

$$\gamma P\{q + nq'(n)\} + (\gamma - 1)P'(Q)\{q + nq'(n)\}nq(n) - \gamma C(q) - \gamma nC'(q)q'(n) = 0$$

and making use of the of the terms introduced above to eliminate $q^*(n)'$ yields the optimality condition for the number of firms

$$P(n^*q^*(n^*)) = \frac{\gamma\varepsilon}{\gamma(\varepsilon + 1) - 1} \cdot \left[\frac{C(q^*)}{q^*} - \frac{n^*\alpha}{\beta}\{AC'(q^*)q^*\}\right]$$

*A.1 Properties of the factor $\kappa(\gamma, \varepsilon)$*

Differentiating the factor $\kappa(\gamma, \varepsilon)$, which inflates the wedge between price and average cost, with respect to the demand elasticity yields

$$\kappa'(\varepsilon) = \frac{\gamma(\gamma - 1)}{[\gamma(\varepsilon + 1) - 1]^2} > 0$$

Since $\varepsilon$ is negative (subject to Assumption A5(ii)), this expression shows that, holding governments welfare mindedness fixed, the factor $\kappa(\gamma, \varepsilon)$ will be higher in countries in which the demand for the service under consideration is less elastic. In turn, the larger the wedge between price and the bracketed function involving average cost, the smaller the optimal number of providers as implicitly defined by the optimality above.

Again, in the special case of equal weights given to consumer surplus and profits, the effect exerted by the demand elasticity vanishes (and $\kappa$ certainly does not vary with ε). Since there is no particular reason to believe that this case accurately represents reality, the generalization proposed here may be useful for empirical work.

Differentiating $\kappa(\gamma, \varepsilon)$ with respect to the government's welfare mindedness yields

$$\kappa'(\gamma) = \frac{-\varepsilon}{[\gamma(\varepsilon + 1) - 1]^2} > 0$$

The second expression illustrates that, for any given demand elasticity, governments oriented more towards public welfare, i.e. those that do not place as high a relative weight on profits, will see the factor $\kappa(\gamma, \varepsilon)$ shrink towards unity and thus admit a higher number of providers.

## Annex 2: Additional estimation results

### *A.2.1 Instrumental variables estimation first-stage results*

| | (1) STRI Fixed Line | (2) STRI Fixed Line | (3) STRI Mobile | (4) STRI Mobile |
|---|---|---|---|---|
| Log GDP (2007) | 0.0068 | 0.0021 | 0.0040 | 0.0008 |
| | (0.0191) | (0.0193) | (0.0173) | (0.0174) |
| Log GDP p.c. (2007) | -0.0311 | -0.0663 | -0.0183 | -0.0405 |
| | (0.0363) | (0.0463) | (0.0363) | (0.0427) |
| Urban population (% of total) | 0.0019 | 0.0024 | 0.0002 | 0.0006 |
| | (0.0016) | (0.0017) | (0.0014) | (0.0014) |
| Population Density (people/sqkm) | 0.0001 | 0.0001 | 0.0000 | -0.0000 |
| | (0.0002) | (0.0001) | (0.0001) | (0.0001) |
| LLC Dummy | 0.1027 | 0.0976 | 0.0405 | 0.0305 |
| | (0.0780) | (0.0822) | (0.0617) | (0.0640) |
| Africa Dummy | 0.1358 | 0.1165 | 0.1659** | 0.1629* |
| | (0.0923) | (0.0948) | (0.0803) | (0.0833) |
| Polity IV Index | -0.0240*** | -0.0365*** | -0.0152*** | -0.0222*** |
| | (0.0057) | (0.0100) | (0.0047) | (0.0079) |
| EIU Demo Score | | 0.0490 | | 0.0298 |
| | | (0.0323) | | (0.0256) |
| Constant | 0.4742* | 0.5577* | 0.4121 | 0.4596* |
| | (0.2721) | (0.2940) | (0.2498) | (0.2636) |
| Obs | 103.0000 | 99.0000 | 103.0000 | 100.0000 |
| Log L | -4.4725 | -4.8630 | 19.4451 | 18.4263 |
| R-sq | 0.3223 | 0.3328 | 0.3031 | 0.3031 |

First-stage results (dependent variable: HHI)

| | STRI AirPass M0 |
|---|---|
| Log GDP (2007) | 0.0165 |
| | (0.0153) |
| Log GDP p.c. (2007) | -0.0105 |
| | (0.0262) |
| Urban population (% of total) | -0.0012 |
| | (0.0011) |
| Population Density (people/sqkm) | 0.0000 |
| | (0.0001) |
| Percent Tourists/Population | -0.0076 |
| | (0.0205) |
| LLC Dummy | 0.0625 |
| | (0.0490) |
| Africa Dummy | 0.0721 |
| | (0.0595) |
| airports paved runways | -0.0000 |
| | (0.0000) |
| Polity IV Index | -0.0113*** |
| | (0.0033) |
| Constant | 0.4787** |
| | (0.1979) |
| Obs | 100.0000 |
| Log L | 34.1924 |
| R-sq | 0.2489 |

First-stage results (dep var: total number of flights)

*A.2.2 Telecom Market Structure – Number of Operators*

As an alternative measure of market structure, we also study the cross-country distribution of the number of telecom operators. Since the number of operators is a strictly positive count variable (with most of its mass at values of 1 to 3 and a maximum at 10), it is not well represented by a linear framework. Thus we model it as a Poisson process and use a zero-truncated Poisson estimator for the specification treating the STRI variable as exogenous (columns 1-2), and then instrument for the STRI with the Polity IV variable using an IV Poisson estimator (column 3). The main finding, discussed in section 4.1, of higher restrictiveness being associated with a less competitive market structure is robust to using the number of operators as dependent variable in both telecom markets.

Table A.1: Telecommunications market structure: number of operators, fixed line market

| | (1) | (2) | (3) |
|---|---|---|---|
| | F-ZTP | F-ZTP | F-PIV |
| Number fixed operators | | | |
| Log GDP (2007) | 0.3743*** | 0.3634*** | 0.3210*** |
| | (0.0600) | (0.0522) | (0.0467) |
| Log GDP p.c. (2007) | -0.2758** | -0.2326** | -0.2119*** |
| | (0.1214) | (0.1131) | (0.0677) |
| Urban population (% of total) | 0.0041 | 0.0045 | 0.0029 |
| | (0.0047) | (0.0050) | (0.0038) |
| Population Density (people/sqkm) | 0.0009* | 0.0006 | 0.0007* |
| | (0.0005) | (0.0005) | (0.0004) |
| LLC Dummy | 0.3134 | 0.1715 | 0.2943** |
| | (0.2042) | (0.2193) | (0.1223) |
| Africa Dummy | -1.0241*** | -1.0058** | -0.2512 |
| | (0.3762) | (0.4068) | (0.1627) |
| License Limit | -0.8177** | | |
| | (0.3914) | | |
| Public Licensing Criteria | 0.6561 | | |
| | (0.4128) | | |
| Foreign Ownership Limit | 0.0047 | | |
| | (0.0054) | | |
| Independent Regulator | 0.0253 | | |
| | (0.2081) | | |
| STRI Fixed Line | | -0.5764 | -1.2620*** |
| | | (0.3955) | (0.3468) |
| Constant | 0.0409 | 0.8759 | 1.3323** |
| | (0.8060) | (0.8209) | (0.5225) |
| Obs | 101.0000 | 103.0000 | 103.0000 |
| Log L | -140.1808 | -147.4328 | |
| Pseudo R-sq | 0.2905 | 0.2634 | |

Dependent variable: number of telecom operators
Excluded instruments: p4_polity2

Table A.2: Telecommunications market structure: number of operators, mobile market

| | (1) M-ZTP | (2) M-ZTP | (3) M-PIV |
|---|---|---|---|
| Number mobile operators | | | |
| Log GDP (2007) | 0.2369*** | 0.2355*** | 0.2035*** |
| | (0.0345) | (0.0384) | (0.0284) |
| Log GDP p.c. (2007) | -0.2029*** | -0.2292*** | -0.1941*** |
| | (0.0514) | (0.0534) | (0.0387) |
| Urban population (% of total) | 0.0011 | 0.0018 | 0.0011 |
| | (0.0027) | (0.0026) | (0.0021) |
| Population Density (people/sqkm) | 0.0000 | 0.0000 | 0.0001 |
| | (0.0001) | (0.0001) | (0.0001) |
| LLC Dummy | -0.0485 | 0.0164 | 0.0234 |
| | (0.0952) | (0.0908) | (0.0831) |
| Africa Dummy | -0.1836 | -0.2072 | -0.1290 |
| | (0.1228) | (0.1298) | (0.1035) |
| License Limit | -0.0077 | | |
| | (0.1251) | | |
| Public Licensing Criteria | 0.4195 | | |
| | (0.2756) | | |
| Foreign Ownership Limit | 0.0045* | | |
| | (0.0028) | | |
| Independent Regulator | 0.0729 | | |
| | (0.0903) | | |
| STRI Mobile | | -0.5690** | -0.7526* |
| | | (0.2261) | (0.3908) |
| Constant | 1.0012** | 2.1844*** | 2.1565*** |
| | (0.4978) | (0.4062) | (0.3460) |
| Obs | 100.0000 | 103.0000 | 103.0000 |
| Log L | -168.7668 | -175.0526 | |
| Pseudo R-sq | 0.1391 | 0.1280 | |

Dependent variable: number of telecom operators
Excluded instruments: p4_polity2

Table A.3: Telecommunications teledensity

| | (1) F-OLS | (2) F-OLS | (3) F-OLS | (4) F-OLS | (5) F-OLS |
|---|---|---|---|---|---|
| Log GDP (2007) | 2.0357*** | 2.3389*** | 2.3435*** | 2.2461*** | 2.1543*** |
| | (0.6580) | (0.6841) | (0.7112) | (0.6813) | (0.6710) |
| Log GDP p.c. (2007) | 10.4809*** | 10.1666*** | 10.3549*** | 10.2758*** | 9.9810*** |
| | (1.6516) | (1.7899) | (1.7671) | (1.7730) | (1.6394) |
| Urban population (% of total) | 0.0214 | -0.0063 | -0.0146 | -0.0111 | 0.0360 |
| | (0.0672) | (0.0711) | (0.0696) | (0.0709) | (0.0679) |
| Population Density (people/sqkm) | 0.0049 | 0.0046 | 0.0041 | 0.0046 | 0.0055 |
| | (0.0039) | (0.0038) | (0.0038) | (0.0038) | (0.0035) |
| Africa Dummy | 3.2275 | 2.1954 | 2.1372 | 2.2543 | 3.2486 |
| | (2.9383) | (2.8856) | (3.0004) | (3.0790) | (3.1012) |
| LLC Dummy | 5.2806** | 4.0740* | 3.8753 | 4.3053* | 5.1857* |
| | (2.3718) | (2.2487) | (2.3840) | (2.4200) | (2.8143) |
| Log HHI residual | 0.0001 | 0.0001 | 0.0001 | 0.0001 | -0.0000 |
| | (0.0004) | (0.0004) | (0.0005) | (0.0005) | (0.0005) |
| VoIP/IG not allowed | -5.8151* | | | | -6.1347* |
| | (3.1381) | | | | (3.6374) |
| Minority stake publ | | -1.2816 | | | -0.9387 |
| | | (2.1592) | | | (2.1883) |
| License Limit | | | 1.0414 | | 0.8410 |
| | | | (3.8328) | | (3.3491) |
| Public Licensing Criteria | | | | 2.6978 | -3.2170 |
| | | | | (3.2487) | (4.2084) |
| Independent Regulator | | | | | 2.9457 |
| | | | | | (1.9913) |
| Constant | -85.5945*** | -82.2732*** | -83.9176*** | -85.3157*** | -81.6715*** |
| | (12.3430) | (12.9483) | (12.8869) | (12.7560) | (13.1324) |
| Obs | 98.0000 | 102.0000 | 101.0000 | 100.0000 | 97.0000 |
| Log L | -355.0599 | -373.1268 | -370.0877 | -366.5046 | -350.9366 |
| R-sq | 0.7249 | 0.7037 | 0.6997 | 0.7005 | 0.7288 |

Dependent variable: Number of mainlines/cellular subscriptions per 100 people

Table A.4: Telecommunications cellular subscriptions per hundred people

| | (1) M-OLS | (2) M-OLS | (3) M-OLS | (4) M-OLS | (5) M-OLS |
|---|---|---|---|---|---|
| Log GDP (2007) | -2.5614* | -2.5522* | -2.6259* | -2.6756* | -2.8138* |
| | (1.4972) | (1.4072) | (1.5230) | (1.5144) | (1.5597) |
| Log GDP p.c. (2007) | 25.4453*** | 24.5318*** | 25.5349*** | 25.4823*** | 24.4109*** |
| | (2.6757) | (2.7566) | (2.9678) | (2.7830) | (2.6785) |
| Urban population (% of total) | 0.1297 | 0.1959 | 0.1283 | 0.1171 | 0.1722 |
| | (0.1426) | (0.1407) | (0.1501) | (0.1420) | (0.1451) |
| Population Density (people/sqkm) | 0.0062 | 0.0063 | 0.0035 | 0.0031 | 0.0062 |
| | (0.0105) | (0.0116) | (0.0105) | (0.0109) | (0.0119) |
| Africa Dummy | -4.7465 | -4.6610 | -3.7420 | -4.5563 | -5.8182 |
| | (4.8912) | (4.5889) | (4.7865) | (5.2421) | (4.9394) |
| LLC Dummy | -0.1133 | -2.7555 | -1.0930 | -1.3938 | -0.3004 |
| | (4.5384) | (4.3037) | (4.5809) | (4.8433) | (4.6098) |
| Log HHI residual | -0.0027 | -0.0028** | -0.0028* | -0.0017 | -0.0027* |
| | (0.0017) | (0.0014) | (0.0017) | (0.0016) | (0.0015) |
| VoIP/IG not allowed | -11.5082** | | | | -6.2002 |
| | (4.7472) | | | | (4.9653) |
| Minority stake publ | | -12.9983*** | | | -11.2175** |
| | | (4.2341) | | | (4.9144) |
| License Limit | | | -4.8368 | | -0.0339 |
| | | | (4.6228) | | (4.1854) |
| Public Licensing Criteria | | | | 14.4144** | 4.4386 |
| | | | | (6.8861) | (7.4526) |
| Independent Regulator | | | | | 1.8224 |
| | | | | | (4.6506) |
| Constant | -149.0247*** | -142.0864*** | -149.8065*** | -162.1428*** | -143.3345*** |
| | (19.5466) | (20.1769) | (21.3301) | (21.3525) | (21.3576) |
| Obs | 99.0000 | 102.0000 | 101.0000 | 99.0000 | 97.0000 |
| Log L | -429.3130 | -438.3440 | -439.0172 | -429.7485 | -417.0405 |
| R-sq | 0.7692 | 0.7878 | 0.7650 | 0.7665 | 0.7844 |

Dependent variable: Number of mainlines/cellular subscriptions per 100 people

**Annex 3: Data Sources and Description**

The following data series are obtained from the World Development Indicators (WDI) 2010 database of the World Bank: GDP, GDP per capita, percentage of urban population, total population, land area, the number of airports with a paved runway, and number of international tourist arrivals. GDP is measured in US dollars at constant prices in billions for the year 2007, GDP per capita is measured in thousands of constant 2005 international dollars adjusted for purchasing power parity. Population density is obtained by dividing the population by land area; it is measured in millions of people per square kilometer. The relative measure of tourist attractiveness is calculated as international tourist arrivals as a percentage of domestic population.

Data for telecom market structure are based on the number of active operators and their market shares in the fixed line and mobile segment, respectively, as reported in TeleGeography's GlobalComms database. Telecom performance indicators – fixed line per 100 inhabitants, mobile subscription per 100 inhabitants are taken from the ITU (2009), which reports information for 2007.

The number of airlines providing international flights (both inbound and outbound), the total number of flights, total seat capacity and available seat kilometers are obtained from Air Transport Intelligence's (ATI) Flightglobal database.