**Introduction and Background**

In the early days of the Internet, it was conjectured that the technology would lead to an increase in political freedom by facilitating more unfettered access to information and ideology, and by enabling interpersonal communication that was less amenable to centralized control. However, an interesting pattern has emerged over the last decade. While digital access has grown substantially across the globe, it appears that this growth has accompanied a steady decline in some measures of global democracy. In fact, the most recent survey released by FreedomHouse.org in January this year noted that 2009 was the “fourth consecutive year in which global freedom suffered a decline—the longest consecutive period of setbacks for freedom in the nearly 40-year history of the report.” Previous research into the spread of democracy across political borders noted the importance of communication technologies in the diffusion process.

“Approached as a diffusion process, democratic change can be viewed in terms of two important elements: namely, the transfer of information and its reception. The quality and cost of particular communication channels... affect the extent to which political information is shared and ultimately influence whether democracy is implemented.”

The level to which information communicated via Internet – be it email, IM, Twitter posts or user-generated blog content – can be centrally controlled and moderated by a government is becoming clearer with each passing year of Internet usage; the recent disagreement between Google and the Chinese government is merely one visible example of a seemingly open network potentially facilitating control. The role of digital access in promoting or suppressing freedom may therefore warrant closer investigation.

While it may seem that the connection between digital access and freedom is somewhat far removed from the economics of IT, we believe that investigating this relationship is foundational to the study of IT and economic progress. As the adoption of information technologies spreads from the developed world to emerging markets and the less wealthy nations, the facets of these latter countries that are impacted by these technologies is likely to be different. Civil rights, political liberties and economic institutions are fundamental to economic development and progress. While our study is only a small first step in understanding how IT may be transformative on this front, it may represent the beginning of an important new sphere of inquiry for scholars interested in the broader economic impact of technologies like IT.

In our study, we analyze the relationship between networks that may naturally form the basis for the diffusion of ‘democracy’, the extent of internet access at different nodes (typically countries, measured by their Internet access per 100 population) in these networks and two measures of freedom.

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democracy – the level of political rights and the level of civil liberties granted to a country’s citizens.

We have initiated our study using two political networks – the network of trade flows between countries, and the network implied by shared political borders. Our basis for this choice is that each of these networks is well documented and is likely to be related to the natural ‘channels’ through which ideas and influence relating to democracy might flow.

Digital access alters how local (social and cultural) networks form and sustain political beliefs, the diversity of opinions an individual is exposed to and the level of technology-mediated interpersonal communication. However, we also conjecture that the role of political networks is altered when there is widespread digital access across borders, since it is possible that the flow of influence and ideas becomes less dependent on existing networks. Put another way, access to information technology-based networks and capabilities alter the connectedness and network structure of the global graph of countries by superimposing a technological network on the political network and each country’s local social networks. This (differently connected) technological network can form an alternate channel over which ideas and influence might flow, and it may thus alter the diffusion of democracy in political networks.

**Preliminary Empirical Analysis**

This abstract reports on our data and preliminary empirical analysis. The networks are constructed with annual trade and economic data during 2000 – 2008 from the Comtrade and World Development Indicators database. The digital access and democracy measures are gathered from the World Telecommunication/ICT Indicators Database and the Freedom in World report, respectively, during the same time frame. Our preliminary results found both that countries display assortative mixing in their levels of freedoms in both the trade and the geographic network and that a positive correlation exists between the level of digital access and freedom. These two preliminary correlations suggest that there is an empirical basis to our theory and motivate our next three more involved estimations: fixed effects estimation, ordered logit regression, and longitudinal estimation.

**Figure 1**

Identifying the assortative mixing among countries based on their freedom status

Blue nodes = Free countries
Green nodes = Partially-free countries
Red nodes = Not-free countries
Fixed Effects Estimation

The underlying model for the fixed effects estimation is given by:

\[ CL_{it} = \alpha_i + \delta_t + \beta_{it}X_{it} + \gamma_{it}N_{it} + \varepsilon_{it} \]

where \( CL_{it} \) is the country civil liberties measure for country \( i \) in year \( t \), \( \alpha_i \) are the country-specific effects, \( \delta_t \) are the yearly effects, \( X_{it} \) are the country-specific characteristics, and \( N_{it} \) are the network neighbor covariates. The country covariates contain measures for political rights, civil liberties, Gross Domestic Product (GDP), internet access per 100 people, broadband access per 100 population. The network covariates consist of the mean value of the neighboring countries on the country-specific attributes.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Geographic Network</th>
<th>Trade Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Political Rights</td>
<td>0.256</td>
<td>0.0182 ***</td>
</tr>
<tr>
<td>Digital Access</td>
<td>-0.00123</td>
<td>0.00171</td>
</tr>
<tr>
<td>Network neighbors’ average digital access</td>
<td>-0.0106</td>
<td>0.00278 ***</td>
</tr>
</tbody>
</table>

**Figure 2**

The results of the fixed effects regression of civil liberties and digital access

Our analysis supports the hypothesis that countries’ civil rights are influenced by their neighbors. The analysis with the geographic network shows a positive correlation between a country’s civil liberties and the digital access for their geographic neighbors’ population. This correlation exists only for civil liberties and digital access; there was no significant relationship between political rights and digital access. The trade network analysis shows a significant positive correlation between a country’s civil liberties and their digital access. Civil liberties are not significantly correlated with their top-five trade neighbors’ digital access, suggesting that digital access may not correlate with political empowerment or economic ties. The different results with the trade and the geographic network highlight the nuances in the relationship between digital technologies, democratic ideals, and links in country-country networks.

Ordinal Logistic Regression

The ordinal logistic regression constructs an estimate of the correlation between political freedoms and digital access with the dependent variable civil liberties measured as an ordinal variable. The underlying model is:

\[ \log\left( \frac{\Sigma CL_{it}}{1 - \Sigma CL_{it}} \right) = \alpha_i + \beta_{it}X_{it} + \gamma_{it}N_{it} + \varepsilon_{it} \]

where, as above, \( CL_{it} \) is the civil liberties measure for country \( i \) in year \( t \), \( \alpha_i \) are the country-specific indicators, \( X_{it} \) are the country-specific characteristics, and \( N_{it} \) are the network neighbor covariates. The same set of country and neighbor-specific attributes were employed for the
The results of the ordinal logistic regression of civil liberties and digital access

<table>
<thead>
<tr>
<th>Variable</th>
<th>Geographic Network</th>
<th>Trade Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Std Error</td>
</tr>
<tr>
<td>Political Rights</td>
<td>2.215</td>
<td>0.2123</td>
</tr>
<tr>
<td>Digital Access</td>
<td>-0.0145</td>
<td>0.0221</td>
</tr>
<tr>
<td>Log(GDP)</td>
<td>-1.68</td>
<td>0.5405</td>
</tr>
<tr>
<td>Network neighbor’s average civil liberties</td>
<td>1.763</td>
<td>0.4518</td>
</tr>
<tr>
<td>Network neighbors’ average digital access</td>
<td>-0.087</td>
<td>0.0358</td>
</tr>
</tbody>
</table>

The ordinal regression and the fixed effects estimation, and the analysis modeled the neighbors in both the geographic and trade networks.

These findings mirror those of the fixed-effects estimation. The ordinal analysis with the geographic network confirms a correlation between a country’s civil liberties and the average neighboring digital access. The assortative mixing is evidenced by the positive correlation in both networks between the civil liberties of neighboring countries.

**Longitudinal Analysis (in progress)**

Our longitudinal network analysis extends these baseline findings towards gaining a deeper understanding of the evolution of this three-way relationship by analyzing the 2000, 2004, and 2008 trade networks. Our analysis is based on a model that considers the co-evolution of the underlying networks between the countries as well as the characteristics (both the measures of freedom as well as the controls). Put simply, it is possible that the networks influence these characteristics, that the characteristics in turn alter the networks, and so on. For example, the level of civil liberties in a country affects their trade connections with other countries; these trading flows in turn can alter the civil liberties in each of the partner countries over time via the exposure of the population in each to the others’ way of life. As a consequence, it seems useful to base analysis on a model that considers the dynamics of co-evolution of the networks and the “behaviors”. We adapt models developed by Snijders and others and base this longitudinal analysis on the SIENA software package (Snijders, Steglich and van de Bunt 2010). Our first analysis included the homophily, alter, and ego effects for the democratic and digital access measures. Our preliminary evidence implies that neighboring countries in the trade network have a propensity to form ties with other countries having similar digital access and similar civil liberties. This preliminary analysis has also identified another expected relationship, that there is a high likelihood of reciprocal trade partners. We are working actively on this longitudinal analysis and on adapting the underlying Markovian models to fit our problem’s context more effectively, and hope to report further on this analysis at WISE 2010.
Concluding Remarks

Our preliminary findings support the importance of networks in the diffusion of democracy through the consistent positive correlation between civil liberties, digital access, and neighboring countries digital access. There are a number of interesting opportunities for future research. First, the link formation in the trade network may be driven by mutual economic benefit and not reflect channels of information and communication. Future research may investigate similar questions using a different network as the proxy for idea flows among countries. Second, the relationship between political rights and digital access suggest that communication technologies may not lead to civilian political empowerment. Instead, the correlation between digital access and civil liberties may reflect a government’s attitude towards their citizens, and the significance of a neighboring country’s digital access on a particular country’s civil liberties could indicate the influence of a neighboring government’s attitude towards civilian freedoms. One opportunity for future research is to include additional data about governmental censorship practices, particularly related to the Internet. Another opportunity is to add data on cultural norms, which is potentially an important factor in how technology mediates the spread of democratic ideals.

As information technologies continue to be more widely adopted across a greater number of countries and people in less developed regions receive their first ever digital access, we believe that the economic impacts will initially be more foundational and fundamental, affecting underlying institutions, social structures and the flow of ideas well before they alter industrial production, the primary focus of IT economics in the 1990’s. Our study represents a first step towards defining research that links IT and digital access to these more basic measures of progress. While there is some reason to support the optimism of earlier Internet researchers that digital access will promote civil liberties, our evidence thus far suggests a far more nuanced relationship between freedoms, access to technology and government control than one might have originally envisaged. An opportunity to share our findings at WISE 2010 will not just inform researchers who might be interested in how IT changes political rights and civil liberties, but might serve to broaden the field’s focus on traditional economic measures and towards inquiry that sheds light on the impact of IT on more fundamental underlying institutions and systems that lead to more traditionally measurable economic progress in the future.