

# Creating an Innovation Ecosystem: Governance and the Growth of Knowledge Economies

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Muhammad H. Zaman

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The Frederick S. Pardee Center  
for the Study of the Longer-Range Future

A PARDEE CENTER RESEARCH REPORT

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## The Frederick S. Pardee Center for the Study of the Longer-Range Future

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## Acronyms

GI 1:	Governance Indicator 1, Voice and Accountability
BERD:	Business Expenditures in Research and Development
GERD:	Government Expenditures in Research and Development
GDP:	Gross Domestic Product
STEM:	Science Technology Engineering and Mathematics
UNESCO:	United Nations Educational, Scientific and Cultural Organization
WB:	World Bank
WIPO:	World Intellectual Property Organization

## Section 1: Introduction

The role of innovation in economic growth of countries across the globe has been an important part of the conversation in many academic and policy circles (Julien 2007). Silicon Valley in California, Korea's Digital Media City, Japan's Kansai Science City, the Oti-gba Computer Village Cluster in Nigeria, India's IT hub of Bangalore, and Nairobi's Silicon Savannah all serve as models of economic development founded on innovation.<sup>1</sup> In recent years, many regions have shifted their economies to more knowledge-based wealth creation as their more traditional means of livelihood have become unsustainable (Volinets 2006). Such regions include the Catalanian region of Spain, where a biotech hub has emerged in the last 20 years while its tourism industry has been overshadowed by newer members of the European Union such as Croatia (Mas 2009). Several emerging economies have also invested large amounts of government resources on the development of a knowledge economy, including Chile, whose investment in public education is a model in Latin America (Perez-Aleman 2005), and Ethiopia, where in order to meet the medical needs of its population the government is building generic drug fabrication facilities and plans to turn this production facility into a driver of economic growth by eventually being a producer of generic drugs for the rest of sub-Saharan Africa (Sbhatu 2010).

*"... how is good government connected to the growth of knowledge economies?"*

The examples above demonstrate a trend that has inspired many questions about the growth of knowledge economies, including how much governments can influence their growth. What does it take to create a successful knowledge economy? What can national

governments and international organizations do to ensure success of this mission that has clearly taken on global importance? And in the long run, how is good government connected to the growth of knowledge economies? How are knowledge economies better for a nation than an economy based on tourism or raw material resources such as oil? In *Development as Freedom*, Amartya Sen argues that economic development is more than an increase in GDP per capita, and that the wealth of a nation is not measured by the contents of its coffers, but by the freedom of its citizens. It is our hypothesis that this freedom, measured by the "Voice and Accountability indicators" as established by the World Bank, forms an integral part of both the growth of knowledge economies and the strength of a free society.

To test this hypothesis, we have examined the correlation between the growth of knowledge economies and improvements in governance. Knowledge economies are defined generally as an economy whose development relies on the ability to create and use knowledge. This definition was first employed by Virginier (2002) in his work on the evolution of a knowledge economy in France, wherein the term knowledge economy was crystallized. We further narrow this definition to a state where scientific research and development provide jobs and create wealth for a nation. In particular we examine the factors that can be controlled by government policies, which include but are not limited to political freedom, government spending on research and development (R&D), and government spending on tertiary education. We examine the bi-directional interaction between these factors and their effect on knowledge economies.

<sup>1</sup> Sources for these examples include MIT Center for Real Estate Studies; Zhihua Zeng 2008; Dahlman and Utz 2005; and *The Economist* 2012.

## Section 2: Methodology

In this analysis, we test the hypothesis that the growth of knowledge economies is affected by governance; that is, knowledge economies are a function of good governance, where governance is the input variable that can result in the growth of knowledge economies as the output variable. We acknowledge there are other factors that can also be deemed independent variables in the growth of knowledge economies. If these variables, when increased, result in an increase of knowledge economy indicators, they may serve as counter-hypotheses to our original claim. The two other variables examined in this paper are government expenditure on R&D and tertiary education expenditures. These two indicators are the more generally accepted methods of measuring a government’s investment in its knowledge economy.

To track governance over time, we used the Governance Indicator for Voice and Accountability established by the World Bank. According to the World Bank, “Voice and Accountability” captures perceptions of the extent to which a country’s citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. This indicator is determined for each country annually by aggregating a large set of data collected by outside parties. These organizations include: other governments; non-governmental organizations (NGOs) such as Freedom House and Reporters without Borders; academic research institutions such as Vanderbilt University; international organizations such as the World Bank, the European Bank for Reconstruction and Development, and African Development Bank; and a variety of others. For more information about how this indicator is measured, please see the report by Kaufman et al (2010) cited in the References section.

Table 1 shows the indicators for government input used in this analysis.

**Table 1: Input Variables for Government Influence on Growth of Knowledge Economies**

Government Input indicator	Value and Scale	Data Source
Governance Indicator: Voice and Accountability	-2.5 to 2.5	World Bank
Tertiary Education Expenditures	% GDP	UNESCO
Government Investment in R&D (GERD)	% GDP	World Bank

Our goal was to determine whether the variables outlined above correlate to changes in established indicators for knowledge economies. The primary indicator for knowledge economy growth was business expenditure in R&D. If we define a national economy by the strength of non-government (i.e. private sector) institutions’ involvement in wealth creation, business investment in R&D (BERD) is a useful form of knowledge economies; that is, the creation of wealth through knowledge. However, BERD data is limited primarily to Organization for Economic Cooperation and Development (OECD) member states. In addition to BERD, we examine the level of patent filings as a potential indicator of growth in knowledge economies. This demonstrates the level of innovation occurring in a nation’s economy. It also indicates a protection of intellectual property for potential commercial gain,



which in turn points to the belief by a population that there will be possible wealth creation through knowledge. While ideally this indicator would be examined only for patent filings by the private sector, in most cases data availability required us to examine all patent filings from each examined state. Another indicator for knowledge economies is the translation of R&D efforts through high tech product manufacturing and export. This indicates more than hope for potential commercial gain, in comparison to patent filings; rather, it demonstrates existent success in the global market through the accumulation of wealth by knowledge creation and translation. It is important to note that BERD is also a variable in the growth or decline of the other two variables we have indicated above, patent filings and high-tech exports. We explore this relationship in our analysis as well.

The indicators used for measurement of knowledge economies are shown in Table 2. In addition to the Organization for Economic Cooperation and Development (OECD) and the World Bank (WB), data sources include the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Intellectual Property Organization (WIPO). Data for most developing countries came from UNESCO’s Institute for Statistics.

**Table 2: Measures of Knowledge Economy Growth**

Knowledge Economy Indicator	Value and Scale	Data Source
Business Enterprise Investment in R&D (BERD)	% GDP	OECD/UNESCO
Patent Filings	Number of annual filings	UNESCO/WB/ WIPO
High Tech Exports	As percentage of overall manufactured exports	World Bank

Having established the two sets of input and output variables we examine, we then track the growth of knowledge economies from 1996 to 2010 and their correlation to the input variables we have outlined above: governance, government expenditure on R&D and tertiary education expenditures. Our time range is limited by data availability, but we anticipate that prior data will not significantly change our findings.

## 2.1 SAMPLE SELECTION

To test our hypothesis, we examined emerging economies and emerging democracies. Countries that have an established knowledge economy such as Singapore and Israel (Cook and Loet 2006) served as a positive control for factors such as high GERD and resultant high levels of high tech exports and patent filings. In the category of emerging economies, we examined Russia and India as our sample cases. Lower income countries with targeted economic growth in the last 10 years were

*“The cross section of emerging economies with emerging democracies is precisely the grouping within which emerging knowledge economies can be found.”*

also included in the study, subject to data availability. We also examined emerging democracies. By this we mean states that have transitioned from dictatorships to democracies in the last 20 to 30 years. The most obvious group of nations that fall under this category are the post-Soviet states as well as other countries behind the Iron Curtain during the cold war such as Estonia, Slovakia, Romania and Poland. In addition, several sub-Saharan states fall under this

category, namely Ethiopia, Uganda and South Africa. The cross section of emerging economies with emerging democracies is precisely the grouping within which emerging knowledge economies can be found.

Our choice of states to test this hypothesis was greatly influenced by data availability. For this reason, OECD states are a large majority of the nations examined.

## Section 3: Results

The data demonstrates that our hypothesis is not relevant to established democracies. This is to be expected. The rise of knowledge economies is in line with a trend driven not by governments but by crowd-sourcing and popular movements. In a state that is transitioning from a state-controlled to a free market economy, many people yearn to act on the inspiration of the world's examples of success purely from intellectual endeavors. This predilection towards technology entrepreneurship has risen to the forefront only in the last 20 years. The effect of being allowed to pursue one's passions can only truly be measured in countries where that right is newly established. In states where a free-market economy has been the norm, the growth of any particular sector is unlikely to be affected.

### 3.1 IMPROVING INNOVATION THROUGH R&D EXPENDITURES

Our data shows across the board that patent filings increased with increased government spending in R&D (GERD). In the cases where governance decreases but government spending increases, the patent filings are unaffected.

However, when a government spends less on R&D, but BERD increases, the patent filings still increase. We examine how the government creates an environment conducive to private sector support of R&D by testing our hypothesis of the role good governance can play in enhancing BERD.

Later in this report, we demonstrate that patent filings may increase without increased government or business expenditures in R&D, as is apparent from the data for Slovakia in Table 1. This exception supports our hypothesis that governance can play as important a role as spending on R&D in the creation of knowledge economies.

**Table 3: Role of Government and Business Expenditures on Patent Filings as Measure of Innovation by State**

Country	GERD	BERD	Patent Filings
Estonia	↑	↑	↑
France	↓	↑	↑
Israel	↑	↑	↑
Mexico	↑	↑	↑
Poland	↑	↓	↑
Romania	↓	↓	↓
Russian	↑	↓	↑
Singapore	↑	↓	↑
Slovakia	↓	↓	↑
South Africa	↑	N/A	↑

### 3.2 INVESTING IN HUMAN CAPITAL THROUGH EDUCATION

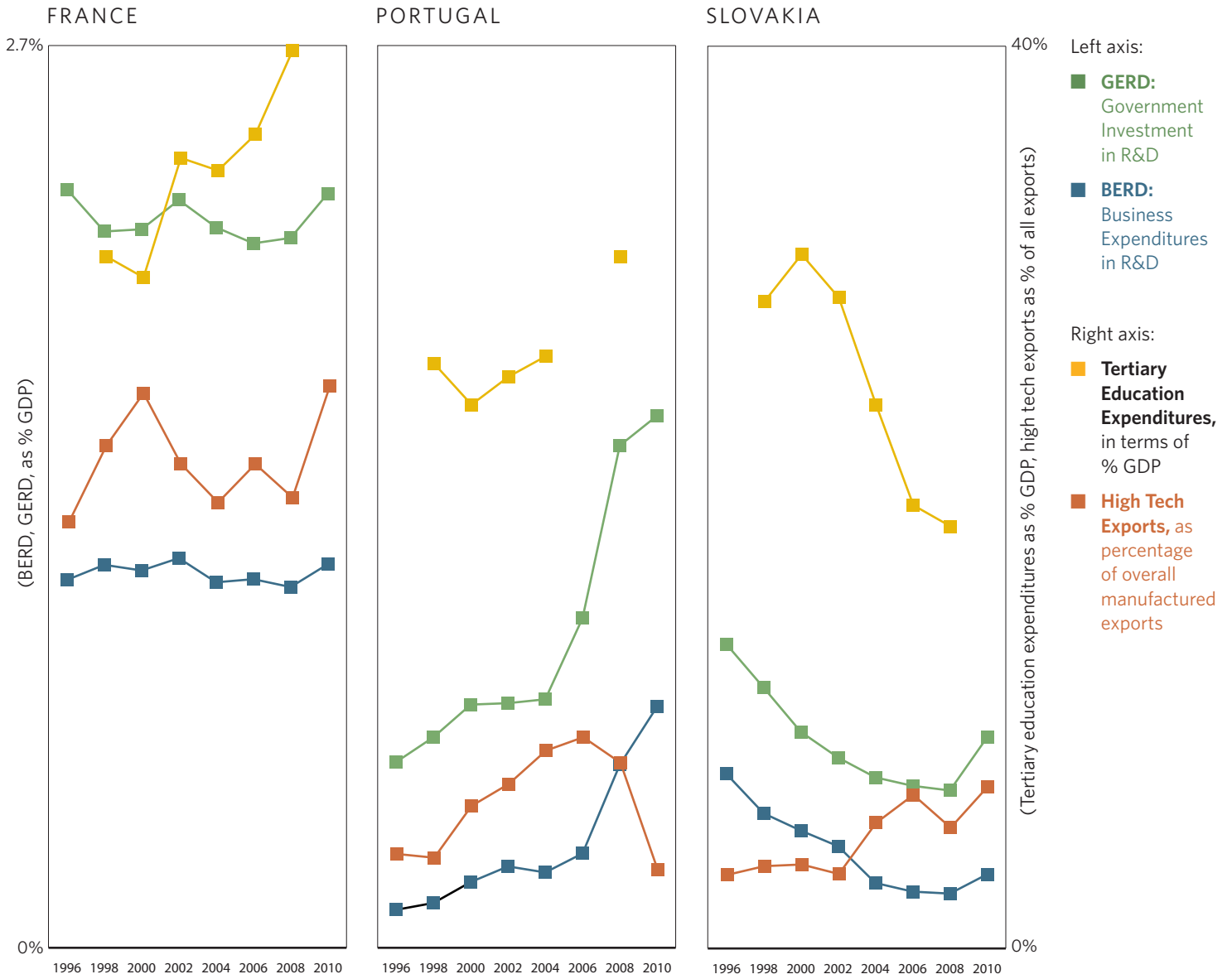
We can isolate the cases in which knowledge economies have certainly grown by examining solely those states in which all three indicators, (patent filings, BERD, and high tech exports) have risen from 1996 to 2010. In those cases, we observe that there has always been an increase in governance. This increase in governance indicators is always accompanied by either an increase in GERD or an increase in tertiary education expenditures.

**Table 4: Government Spending and Growth of Knowledge Economies**

Country	GERD	Tertiary Education Expenditures	Governance	High Tech Exports	Patent Filings	BERD
Estonia	+	-	+	+	+	+
France	-	+	+	+	+	+
Greece	-	+	+	+	+	+
India	+	-	+	+	+	+
Portugal	+	+	+	+	+	+

It appears that government spending on education, when coupled with either increased government expenditures on R&D or increased Business expenditures in R&D, results in increased high tech exports. The investment in human capital through spending on tertiary education, combined with either private or public sector investment in R&D capacity, clearly has an effect on the improvement of knowledge economy indicators such as high tech exports. This occurred in France, and in Portugal until 2008, where we see a drop in high tech exports in that year. This drop may be attributed to the global financial crisis that began in 2008, which hit certain members of the European Union with less established high tech industries such as Portugal and Spain.

**Figure 1: Education Expenditures and the Growth of Knowledge Economies**

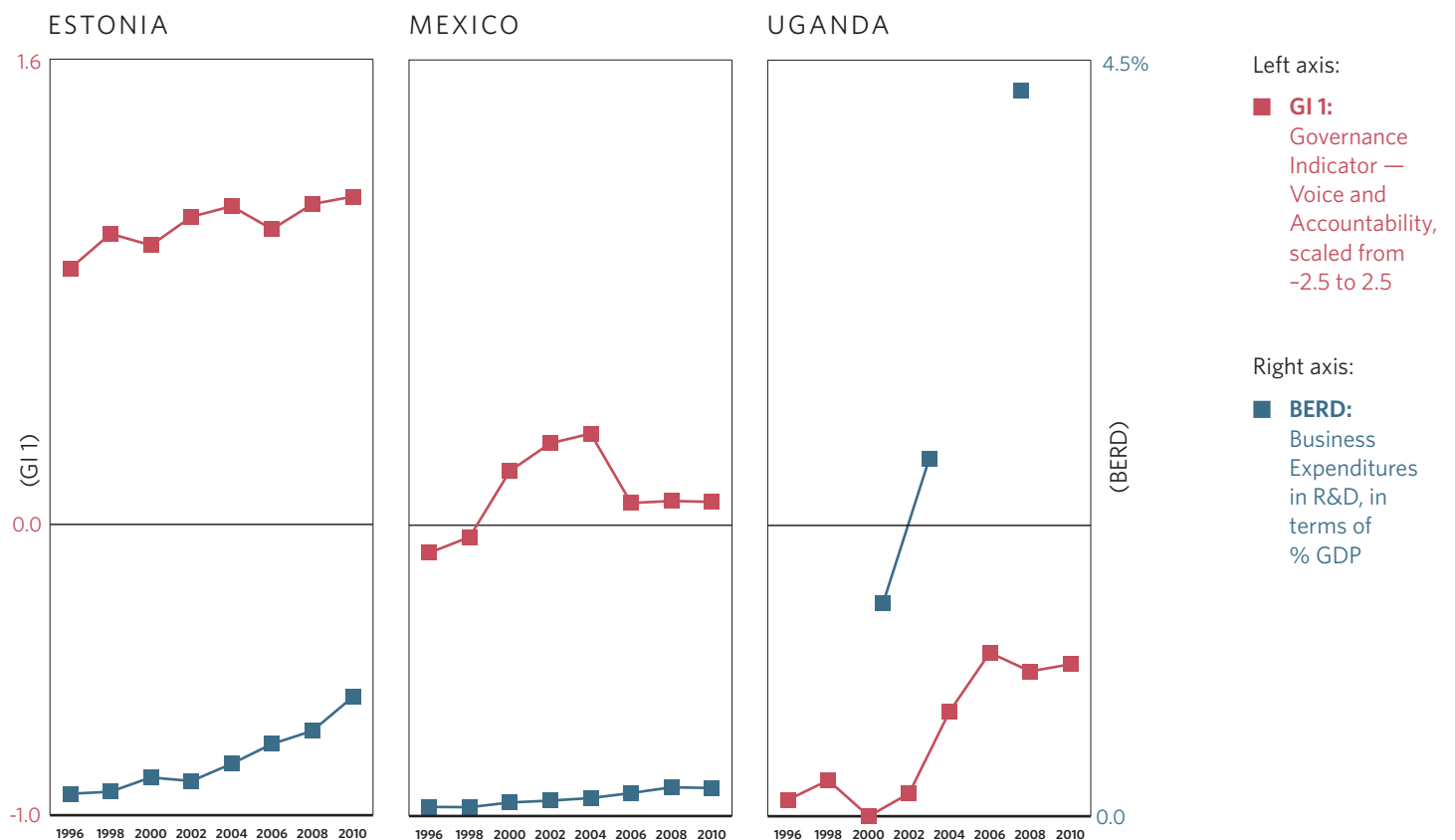


When tertiary education expenditures were reduced along with government expenditures in R&D, we observe a decrease in BERD. This occurred in Slovakia.

### 3.3 ENCOURAGING BUSINESS EXPENDITURES IN R&D THROUGH GOOD GOVERNANCE

We observe that improved governance and higher BERD from 1996 to 2006 occurs in Estonia, Uganda and Mexico. This correlation occurring in three different continents with countries having no connection each other gives strong support to our hypothesis that governance can improve knowledge economies. Estonia has recently emerged from the Soviet rule, attaining its independence in 1991. Mexico was under single party rule from 1929 to 1988. President Vicente Fox was the first elected President not to come from the institutional Revolutionary party since 1929. Uganda was under dictatorship of Idi Amin until 1979, followed by single party rule until 2005. Although its President, Yoweri Museveni, has been in power since 1986, improvements in Uganda's electoral policies have resulted in higher evaluation of its voice and accountability in recent years. The only commonality among these three states is their emergent democracies.

**Figure 2: Positive Influence of Governance on BERD**



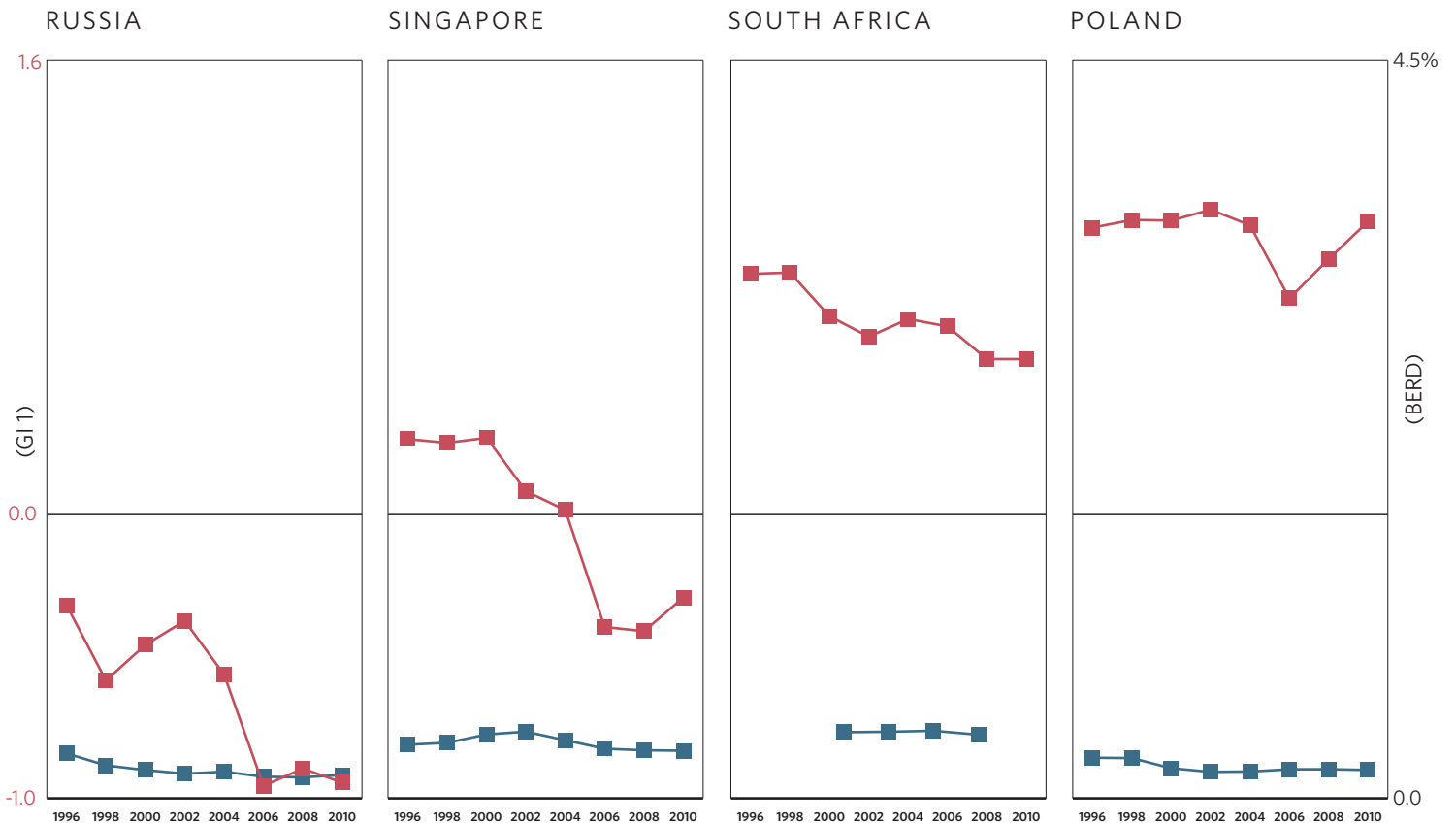
We observe a reduction in governance indicators and a reduction in BERD from 1996 to 2006 in the following states: Russia, Singapore, South Africa, Poland (until 2003).

The same correlation discussed above occurred with the reduction of governance resulting in reduced BERD in three different continents. The commonality among these states can also be found in their recent transitions from authoritarian rule to electoral democracies. However, the commonality also extends to the fact that in all of these states, this transition has been marred by reductions in political

and civil liberties. Russia seceded from the Soviet Union in 1992, but over the years has seen curtailing of the democratic reforms first introduced by Boris Yeltsin. Similarly, recent laws in Singapore have further reduced the freedom of assembly through the Public Order Act of 2009 (Human Rights Watch, 2010). Censorship of media outlets is also widespread in Singapore (Lee and Willnat, 2006). Although South Africa doesn't have the same history of political repression in the last 20 years, its large income disparities are often attributed to an absence of economic freedom and possibilities of upward mobility. The number of people living in extreme poverty has risen 20.2 million in 1995 to 21.9 million in 2002. South Africa also has one of the most unequal distribution of incomes in the world: 60 percent of the population earns less than R42,000 per annum (about US\$7,000), whereas 2.2 percent of the population earn more than R360,000 per annum (about US\$50,000) (Leibbrandt 2010). Despite widespread calls to nationalize the natural resources of South Africa, the vast majority of resources in the state are held by the private sector and the wealth generated thereof does not provide significant benefits to most South Africans. (Motsoeneng, Lakmidas 2012). Poland was a nascent democracy, having held its first democratic elections in 1990. Its democratically-elected government was marred by accusations of corruption throughout the 1990s (Wolszczak 2010).

This implies that if a government does not have the financial resources to invest directly in an innovation ecosystem, it can still create an environment conducive to private sector investment in R&D.

**Figure 3: Negative Influence of Governance on BERD**

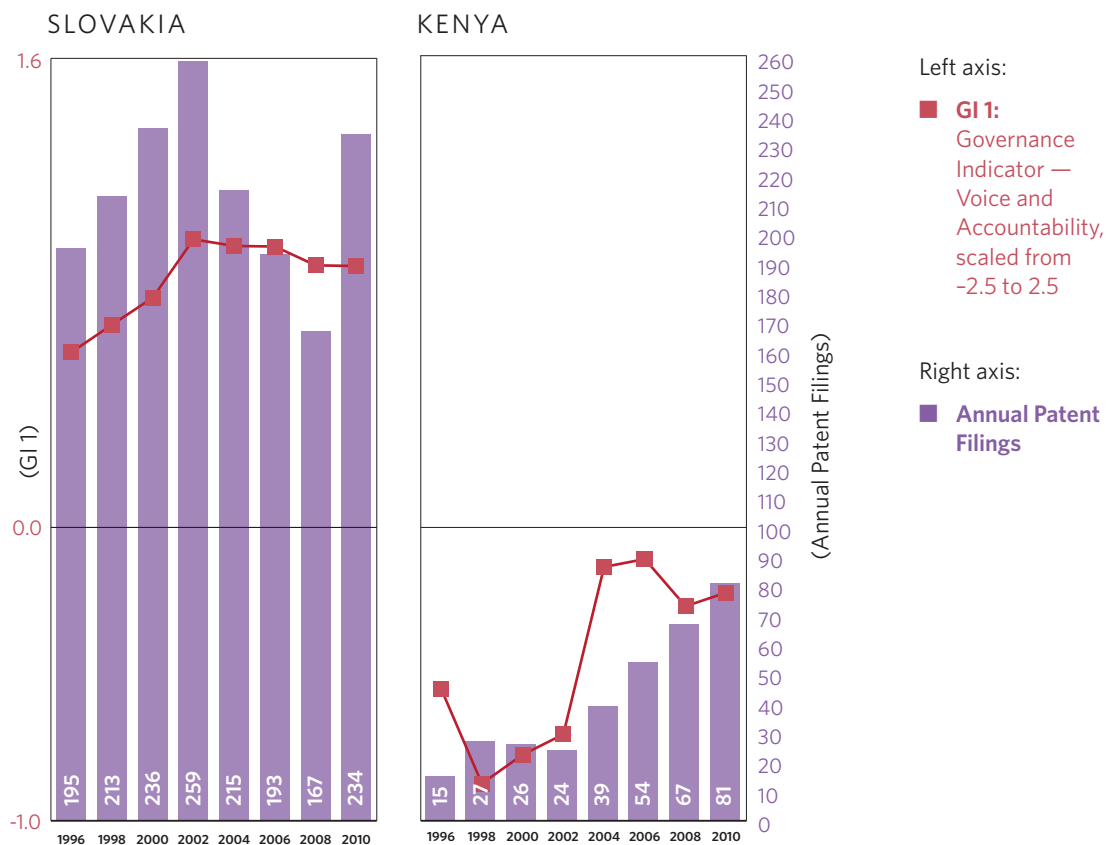


Left axis: ■ GI1: Governance Indicator — Voice and Accountability, scaled from -2.5 to 2.5  
 Right axis: ■ BERD: Business Expenditures in R&D, in terms of % GDP

### 3.4 ENCOURAGING INNOVATION THROUGH GOOD GOVERNANCE

We also observe that there are some cases where patent filings rise despite reductions in GERD and BERD. This phenomenon was observed in Slovakia before 2003. Patent filings rise with the rise in good governance. This may be due to an enhanced trust in the government and its legal institutions, thereby encouraging inventors to file patents with their national patent office rather than seeking intellectual property (IP) protection elsewhere through filings in regional IP organizations or directly to World Intellectual Property Organization (WIPO) through the Patent Cooperation Treaty (PCT). Mistrust of government institutions may lead inventors to not file patents at all and instead protect intellectual property through secrecy. We observe a similar phenomenon in Kenya, where despite an absence of data on GERD and BERD, we can see an increase in patent filings along with an increase in governance indicators. The sharpest increase in governance indicators in Kenya occurred between 2002 and 2004, when the National Rainbow Coalition came to power in the 2002 elections. In June of 2003, the newly-elected government put in place an Economic Recovery Strategy whose mission was to be achieved through sound governance structures that addresses the country’s vulnerabilities (African Development Bank/OECD 2004).

**Figure 4: Positive Influence of Governance on Patent Filings**

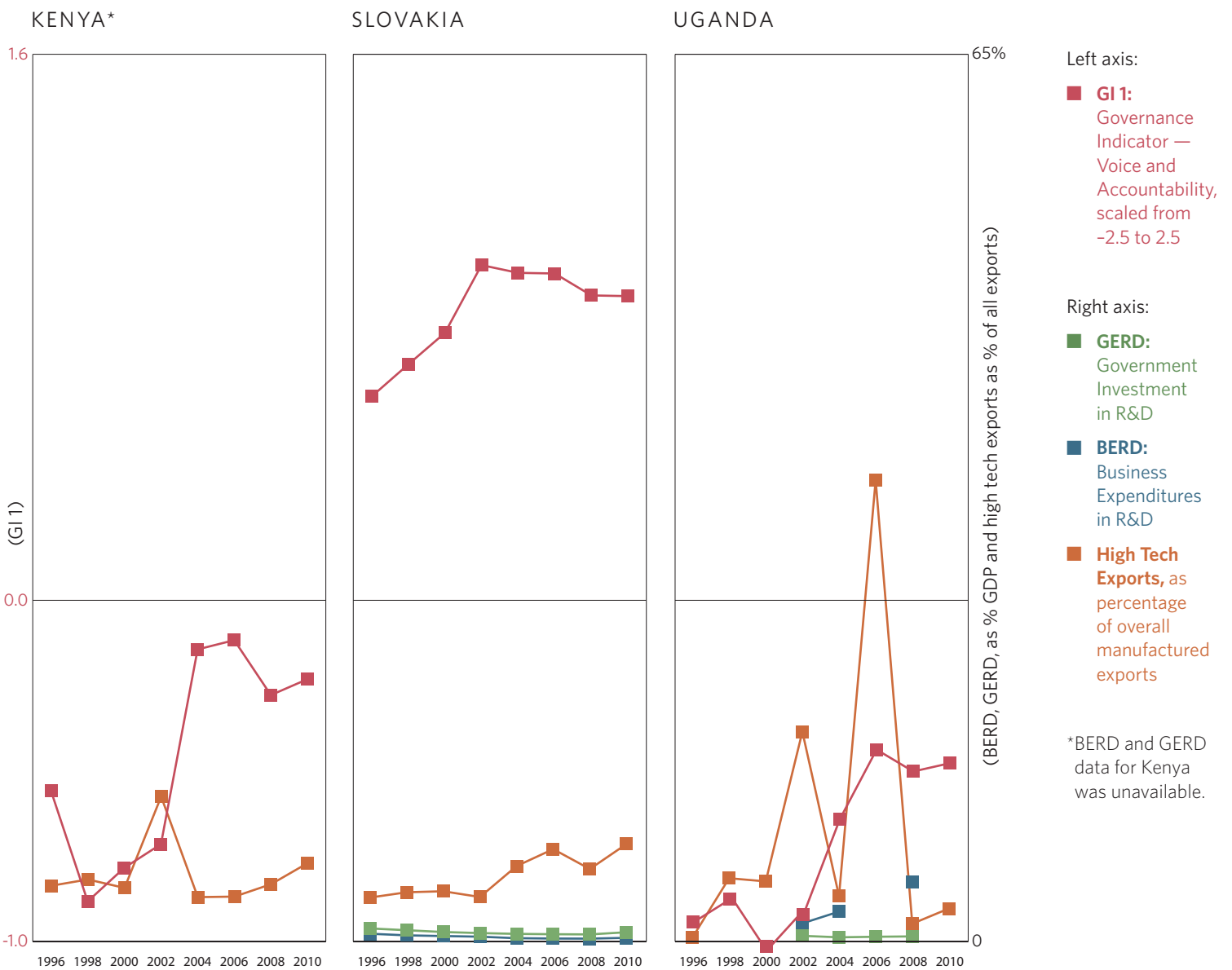




### 3.5 ENHANCING EXPORT OF HIGH TECH PRODUCTS THROUGH GOOD GOVERNANCE

We observe in several states a relationship between the rise in governance indicators and the rise in percentage of exports being based on high tech manufacturing. Although a drop in governance generally doesn't result in a drop in these exports, the initial increase is almost always correlated to an increase in governance indicators. We indicated earlier in this paper that high tech exports are an excellent indicator of the development of knowledge economies because they provide data on actual commercialization and profits generated by the "ability to create and use knowledge", whereas patents simply indicate potential commercial opportunities through the demarcation of knowledge that may be an asset.

**Figure 5: Positive Influence of Governance on High Tech Exports**



Our analysis has shown that a rise in governance frequently occurs just before a sharp peak in the percentage of exported high tech goods. This is particularly true in emerging markets as indicated by two examples, namely Slovakia and Uganda. Slovakia's increase in governance indicators were in part due to the improvement of democratic institutions following the fall of the Iron Curtain. The fall in its governance indicators from 2004 on may be in part due to reduced freedom of the press since the elections in 2006, which were followed by government policies that reduced freedom of the press and minority rights (Kneuer et al 2011).

In Uganda we observe a dramatic increase in the value of governance indicators from 2002 to 2006. Immediately at the end of this period of improvement in governance, we observe a peak in high tech exports. In the period of 2002 to 2006, Uganda's government put tremendous efforts into peace building and constitutional reform. From 2001 to 2005, the Ugandan government implemented a Constitutional Review Process, which was concluded with the Constitutional Amendment Act of 2005. This Act enabled increased political participation by the opposition parties, limited terms of office for most executive positions in government. The Political Parties and Organizations Act of 2005 further reformed democratic institutions and enabled improvements in political expression and government accountability to citizens (Republic of Uganda Ministry of Finance, 2010). We also observe a sharp increase in high tech exports from 2004 to 2006. This observed growth is due to the increase in exports of electronic goods from Uganda starting in 2006. The overlap in the period of democratic reform and growth of a knowledge economy in Uganda serves as an excellent case in point to corroborate our central hypothesis on the correlation between governance and economies based on technological innovation.

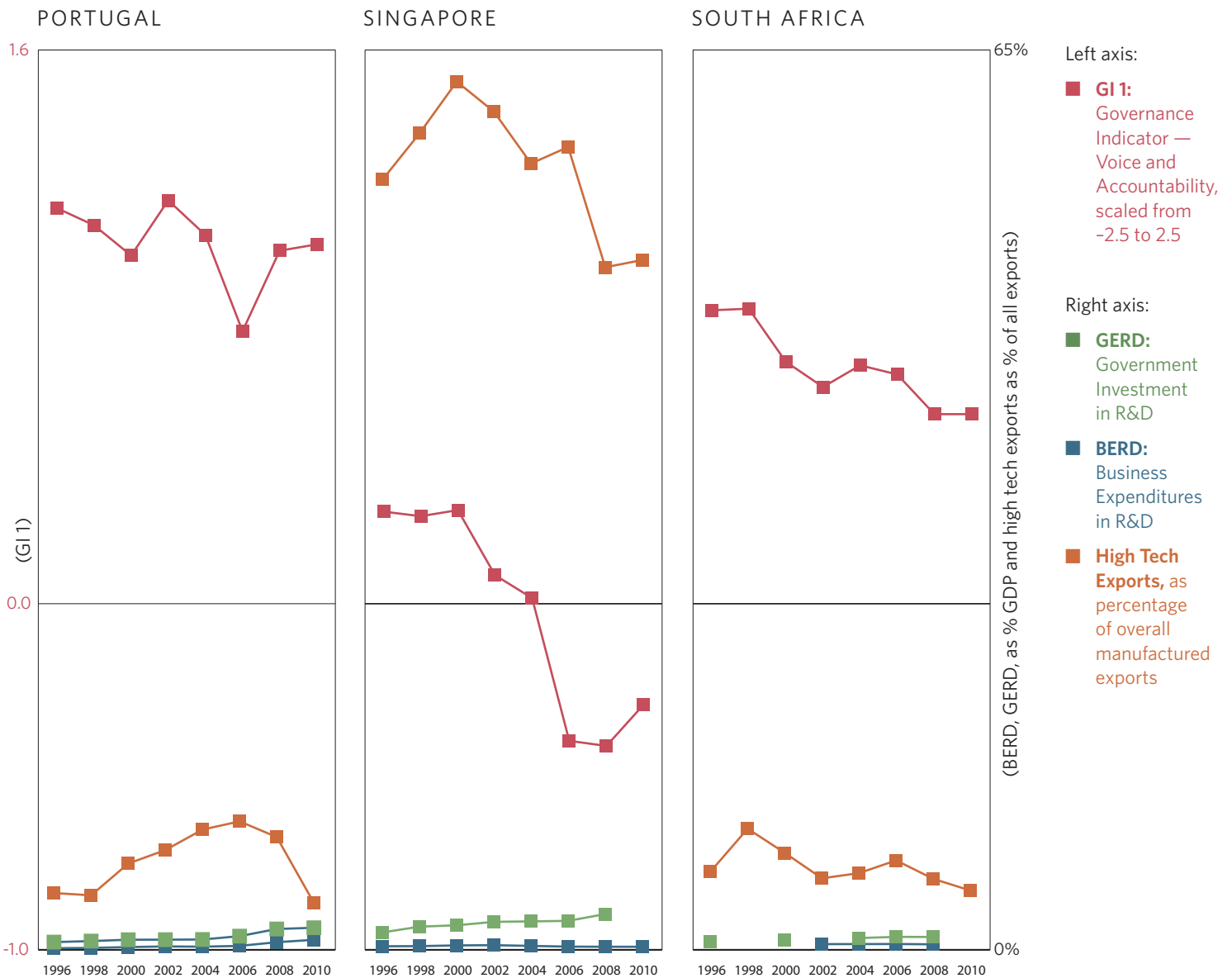
On the other hand, a reduction in the accountability of the government to its citizens appears to correlate with a drop in high tech exports. We also note that a drop in high tech exports is simultaneous with a drop in governance, despite BERD and GERD increasing during that period. This is the case in Portugal, Singapore and South Africa.

In Portugal, we observe a decline of high tech exports from 4.3 percent to nearly 3 percent after a growth of almost 9 percent over the time period of 1996 to 2010. This rise and then dramatic fall is paralleled by the changes in governance indicators over the same period; during that time, the Portuguese government heavily invested in R&D, as is clear by its GERD data, and its private sector also focused most of its investments in R&D. Despite these efforts, the high tech exports rate fell dramatically.

In Singapore, we observe a drop in high tech exports from 55 percent in 1996 to a drop to 49 percent in 2010, (which included a rise up to 62 percent in 1998 in the intervening time frame) that is simultaneous with a drop both in BERD (from .33 to .29 percent GDP) and in governance indicators ( from .266 to -.299). This is despite a rise in GERD (from 1.33 percent GDP to 2.66 percent GDP and a dramatic rise in patent filings (from 224 patents to 895 patents) over the period from 1996 to 2010. This implies that both BERD and high tech exports were affected by the drop in governance.

In South Africa, we note a sharp drop in high tech exports from 1998 (8.75 percent) to 2002 (5.16 percent). This is despite an overall increase in GERD from .49 percent to .73 percent and an increase in patent filings. BERD data for this period is not available. During that period, the governance dropped more than .2 points, from .84 to .62.

**Figure 6: Negative Influence of Governance on High Tech Exports**



## Section 4: Consideration of Confounding Variables

For emerging democracies in Eastern Europe seeking to join the European Union, we have excluded the data after their EU accession referendum was passed. The incentive for improved governance (EU membership) was removed and creates a discontinuity in tracking good governance. It also removes the direct relationship between national governments and the strength of their knowledge economies due to a more open relationship with established democracies. Specifically, we applied this rule to Estonia, Slovakia, Poland and Romania.

## Section 5: Conclusions

Our primary aim in this work was to determine the ways in which governments can encourage the growth of knowledge economies. We have successfully shown that even without increasing government spending on R&D, the rate of innovation in a country can grow when the political freedoms associated with voice and accountability are improved. We have shown this in a quantitative manner, using indicators established and measured by leaders in economic development such as the World Bank and the Organization for Economic Cooperation and Development. The results of our analysis show the role that good governance (in the form of political liberties) plays in determining the outcome of investments in a knowledge economy. The results also show the means to boost the growth of a knowledge economy even for those states with limited capacity for government investment in R&D.

*“... government’s investment in its intellectual capital is paramount to the growth of knowledge economies.”*

This conclusion opens the door to a deeper exploration of other ways good governance and investment in civil society and social welfare can impact the growth of knowledge economies.

The investment a government makes in its national infrastructure, for example, can have dramatic effects on capacity building. Telecommunications, clean water, transportation and resource extraction are all

infrastructures that play a significant role in the capacity of a country to develop a knowledge economy. The cases of both the Indian and Kenyan government investing in its telecommunications infrastructure and the resultant boom of the IT sector is an excellent case in point (Dahlman and Utz 2005; *The Economist* 2012). A further case in point is the Danish government’s investment in resource extraction for the acquisition of oil, which it transformed into a domestic industry of polymer fabrication (Danish Research Agency 2002). These examples demonstrate the merit of a detailed investigation of the correlation between investments in infrastructure and the growth of knowledge economies. The health care needs of a country can also influence the development of industry around high tech products. The dramatic rise in Ethiopia’s high tech manufacturing in 2004 (World Bank b) came from the government’s role in increasing production as well as demand for generic drugs to treat the AIDS pandemic (Tadesse 2004).

The government also plays a significant role in encouraging knowledge economies by having a legal system that enables and encourages technology entrepreneurship. These incentive structures can include tax cuts for technology startups, patent laws that reduce barriers to individual patent filers both domestically and in foreign patent filings, and the facilitation of high tech exports through trade agreements that support domestic industry. A more rigorous examination of these measures would also shed further light on how governments can encourage the growth of knowledge economies with little fiscal expenditure.

Perhaps most significantly, the government's investment in its intellectual capital is paramount to the growth of knowledge economies. In addition to tertiary education expenditures, which have been examined in this report, funding for training of researchers beyond college as well as facilitation of international collaborations and knowledge transfer may serve as factors to the growth of knowledge economies.

*“A nation with freedom of expression and assembly, where the government is accountable to its citizens, fosters an environment in which innovation can occur.”*

The ability of a country's brilliant minds to exercise and implement their ideas in a way that enhances its national wealth and welfare is based on the quality of governance under which those brilliant minds can operate. A nation with freedom of expression and assembly, where the government is accountable to its citizens, fosters an environment in which innovation can occur. It also creates an environment where entrepreneurship and innovation meet to create knowledge economies. The direct correlation between increases in BERD and governance can be further investigated by qualitative assessments and interviews of business leaders and technology entrepreneurs in states

in democratic transitions. We are cognizant that many of these stakeholders will argue that the increased trust in the government enables them to invest in long term projects such as STEM-based research and development, as well as trust in the institutions meant to support technology entrepreneurship, such as intellectual property protection and support of domestic industries in foreign markets through trade agreements that enable exports of high tech goods. A government that is accountable to its people can dynamically respond to the needs of technology entrepreneurs in a way that totalitarian regimes cannot. Our results support this conclusion, and our hope is that those nations striving to rise with the tide of economic growth based on knowledge will incorporate better governance into their policies. ■

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