Putting Together the FDI Puzzle: An Endogenous Model of Foreign Direct Investment, Democracy, Economic Development, and Human Capital

Mark David Nieman*

University of Iowa

Abstract

I draw on endogenous growth theory to develop a dynamic formal model that treats foreign direct investment (FDI), economic growth, democracy, and human capital as endogenous and mutually dependent. Economic growth and democracy are thought to encourage FDI. But the amount of FDI a country can receive is limited by the availability of human capital. This ceiling acts as a carrying capacity, as FDI utilizes existing human capital, eventually exhausting its supply. Yet, FDI is sought, in part, because it increases the level of human capital via direct knowledge transfers and by stimulating the economy, thus creating more resources to be dedicated towards human capital. As such, the carrying capacity—the idea that 'another mouth to feed is also another pair of hands to work'—is an important variable in the model—a variable that is rarely accounted for. Once included in the model, carrying capacity leads to previously untested predictions that posit non-linear relationships among variables. I

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test the model's predictions using a system of simultaneous equations and find support for the hypotheses. I conclude that foreign investment and human capital growth lead to greater per capita economic growth in developed than in developing countries.

Introduction

The causes and consequences of foreign direct investment (FDI) continue to be in the spotlight of attention within the international political economy literature, in part due to the high degree of endogeneity between FDI and factors associated with economic growth.[1] FDI is theorized to encourage human capital transfers and economic growth. Economic growth is thought to lead to democratization. At the same time, some argue that democracy attracts FDI. Similarly, human capital is theorized to be both the cause and result of economic development and FDI. How do all of these puzzle pieces fall into place? This paper develops a unified theoretical and empirical model that links a number of disparate theories and findings from the literatures on economic growth, FDI, democratization, and human development.

Despite dramatic increases in the volume of FDI and the assumption among policymakers that it drives economic development, little political science research has been devoted towards uncovering the endogenous processes associated with FDI and its long term effects.[2] Within political science, most scholarly attention has focused on whether democracies attract FDI (Busse 2004; Busse and Hefeker 2007; Choi and Samy 2008; Jakobsen and de Soysa 2006; Jensen 2003; Li 2009*b*; Li and Resnick 2003; Oneal 1994). However, the relationship between democracy and FDI may not be so straightforward, as there are several feedback mechanisms at play.

Economists have devoted considerable attention to these questions. Many theoretical models expect FDI to have a positive effect on economic growth (Markusen and Vernables 1999; Rodríguez-Clare 1996) and human capital (Baldwin, Braconier and Forslid 2005; Find-

[1]FDI is defined as "investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor" (World Bank 2011). Notably, FDI refers to more than portfolio diversification; it is private capital flows that have a lasting management interest in the company that is acquired or created.

[2]Notable exceptions include Pinto and Zhu (2008) and Malesky (2008).

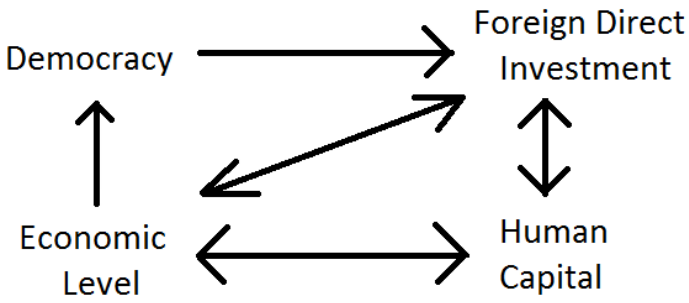
lay 1978; Glass and Saggi 1998). Yet, empirical results for each of these expectations are mixed. Borensztein, Gregorio and Lee (1998) finds a positive relationship between FDI inflows and economic growth while Herzer, Klasen and Nowak-Lehmann (2008) and Zhu and Jeon (2007) find little to no relationship. Xu (2000) finds that FDI only increases productivity in developed, but not in developing countries. Moreover, some studies find that FDI inflows have a positive impact on human capital (Baldwin, Braconier and Forslid 2005; Hejazi and Safarian 1999; Xu 2000) while others find no such effect (van Pottelsberghe de la Potterie and Lichtenberg 2001). Resolving debates surrounding FDI requires treating key variables in a more holistic manner, which constitutes this paper's main contribution.

A possible cause of these mixed results is the role of human capital as a time-varying carrying capacity for investment. Firms must consider how much investment a market can withstand, as there is a limit to available human capital, particularly at lower economic development levels. This ceiling operates as a carrying capacity. The relationship between FDI and human capital resembles a function of the form $y = x^3$, as the human capital utilized by early FDI eventually exhausts the supply and investment slows down. Yet, FDI is sought precisely because it increases the level of economic development. As such, the carrying capacity operates as a variable.[3] FDI uses available human capital while at the same time creating more human capital. Yet this important variable is rarely included in existing theoretical and empirical models. This paper corrects for this common oversight by explicitly modeling carrying capacities, and as a result, develops non-linear predictions regarding the causes and effects of FDI, economic growth, democracy, and human capital.

As Figure 1 illustrates, the processes linking FDI with the other key variables noted—democracy, economic level, human capital—are complex. Due to numerous feedback mechanisms, it is difficult to disentangle between the explanatory and the outcome variables. Developing a simple dynamic formal model allows us to examine the nature of these relationships more closely (Thompson 1983). The dynamic aspect of the model captures the

[3]A useful way to think about a carry capacity is in terms of 'another mouth to feed is also another pair of hands to work' espoused by some concerning the Earth's carrying capacity of the human population (Cohen 1995).

Figure 1: Dynamic Links between Democracy, Economic Level, FDI, and Human Capital.



interdependent nature of the key variables and their change over time. Moreover, such a model is easily translated into a system of cross-sectional time-series equations to account for endogeneity and serial correlation with only slight modifications (Hsiao 2003, 85-90, 113-126).

I use interaction variables to explore the non-linear effects predicted by the formal model. The results demonstrate that FDI encourages economic growth, which in turn promotes human capital formation. Moreover, economic growth attracts FDI, but this is conditioned by the available pool of human capital. Interestingly, democracy has only an indirect effect on economic development—through FDI—and this effect is negative. This finding questions the positive relationship between political institutions and economic development, which is sometimes posited in the literature. Lastly, past growth appears to be a positive predictor of future economic growth, democracy, and human capital formation, but not FDI.

Previous Literature and Dynamic Model

This section provides an overview of the complex relationships between FDI and democracy, economic level and human capital, and lays out the main pieces of the formal model. Currently, each of the model's pieces has been explored either independently or in groups.[4]

[4]The endogenous growth literature in economics has been at the forefront of accounting for feedback mechanisms in theories of economic growth or human capital development (Grossman and Helpman 1991; Howitt 2000; Lucas 1988; Romer 1990). Some studies, for example, include only one or two of the economic factors, but exclude the political factors. While there are potential justifications for downplaying the direct

Somewhat surprisingly, however, the four pieces have not been combined into an encompassing system of equations. In this paper, I take this next natural step.

An endogenous model of FDI, economic growth, democracy, and human capital provides several important contributions. First, it allows for exploring whether the existing predictions obtained from individual models hold when accounting for the system in its entirety. Second, it unifies several disparate theoretical and empirical predictions within a unified framework (Morton 1999). Third, the model allows for exploring the effect of system's carrying capacities—a rarely explored yet important constraint on the four moving pieces of the model. Many theories, for example, assume that FDI promotes knowledge transfers and stimulates human capital growth (Findlay 1978; Glass and Saggi 1998, 1999; Jensen 2004). This process, however, may is gradual rather than instantaneous. Moreover, the rate of human capital growth is non-constant over time: firms entering foreign markets are restricted by local human capital reserves as they cannot bring in an infinite number of high-skilled labor. In other words, FDI is limited by local levels of human capital (Borensztein, Gregorio and Lee 1998). This limitation operates as the carrying capacity on FDI that the state can absorb—just as geographical regions contain biological carrying capacities on the amount of life they can support (Edwards and Penney 1985: 74-76; Erye 1978). Over time, however, this capacity can increase as the knowledge transfers take hold and the economy expands in response to FDI stimulus, which triggers greater education spending. This means that human capital capacity is a time-varying parameter (Cohen 1995). By accounting for the endogenous role of carrying capacities, the model is able to capture non-linear and conditional effects effects of this nature, which would be missed with a less sophisticated modeling approach.

The first equation that I develop captures the determinants of economic growth over time, denoted as $\frac{\partial E(t)}{\partial t}$. Economic growth, $\frac{\partial E(t)}{\partial t}$, is a function of FDI, F, the change in the human capital, H', and the business cycle, modeled as $cos\,[t]$. The amount of change

role of political factors (e.g., Burkhart and Lewis-Beck 1994; Doucouliagos and Ulubaşoğlu 2008; Gartzke 2007; though see Bueno de Mesquita et al 2003), modeling all four pieces simultaneously might uncover some new insights.

in human capital, H', is, however, limited by the economy's ability to support education spending and the existing knowledge base (i.e., those teaching must possess the skills they are teaching) (Borensztein, Gregorio and Lee 1998)—or *the economic carrying capacity*, captured by $\left(1 - \frac{E}{H}\right)$ (Cohen 1995, 343-344).

FDI, F, promotes economic growth, $\frac{\partial E(t)}{\partial t}$, by creating jobs and infusing the local economy with outside funds (Dunning 1981, 1993, 2002; Freeman 1978; Oneal 1994), or more formally:

$$\frac{\partial E(t)}{\partial t} = f(F).$$

Markusen and Vernables (1999) and Rodríguez-Clare (1996) derive formal models that support this argument. Yet, the empirical record behind this relationship is mixed. Herzer, Klasen and Nowak-Lehmann (2008) and Zhu and Jeon (2007), for example, find little evidence of a positive relationship between FDI and economic growth. Xu (2000) finds that FDI does promote growth, but that this relationship only holds in developed countries. I argue that this disconnect between theory and the existing empirical record is due to the endogenous relationship between FDI and human capital. I will elaborate on this in describing the FDI equation below.

Economic growth, $\frac{\partial E(t)}{\partial t}$, also depends on changes in the level of human capital, H':

$$\frac{\partial E(t)}{\partial t} = f(F, H').$$

Lucas (1988) and Romer (1986, 1990) developed models that show human capital producing increasing rates of return. Human capital development spurs technological innovation which, in turn, encourages economic growth (Schumpeter 1942; Wolf 2005). While this assumption is somewhat crude—simply because a population has high levels of human capital does not automatically mean that it will have a penchant to be innovative or entrepreneurial—there is a strong relationship between the two (Salmi 2001, 2009; World Bank 1999). The inclusion of human capital as a determinant of economic growth simply acknowledges that innovation is not random, but is related to research and development, and education levels of the

population. This, the rate of return is non-constant, due to the varying levels of human capital (Grossman and Helpman 1991; Howitt 2000).

Moreover, the economics of education literature suggests that this influence is contingent upon the current economic level—the amount of money available for education—while the current level of human capital acts as an existing carrying capacity, $\left(1 - \frac{E}{H}\right)$ (Bloom, Canning and Chan 2005; Hanushek and Wößmann 2007; Linden, Arnhold and Vasiliev 2008; Salmi 2001). Thus, increases in human capital produce constant growth rates, which do not return to a steady state, contrary to neoclassical theories of growth. This again suggests that human capital exerts a non-linear effect on economic growth.

Finally, I use the cosine function of time, $cos\,[t]$ to represent the business cycle.[5] More formally, the determinants of economic growth are expressed as:

$$\frac{\partial E(t)}{\partial t} = \alpha F + \beta H' \left(1 - \frac{E}{\delta H}\right) - cos\,[t]\,, \tag{1}$$

where α, β, and δ are constant parameters.

The second equation models the change in the level of FDI with respect to time, $\frac{\partial F(t)}{\partial t}$. Among the variety of political factors, D, affecting the level of FDI are regime type (Busse 2004; Busse and Hefeker 2007; Choi and Samy 2008; Jakobsen and de Soysa 2006; Jensen 2003) as well as particular government policies and protections (Ahlquist 2006; Li 2009*a*,*b*; Li and Resnick 2003; Oneal 1994). This research identifies the rule of law, usually associated with democratic regimes, as one of FDI's main determinants (Choi 2009; Jensen 2003; Li and Resnick 2003). The argument is that rule of law attracts investors by lowering the risk associated with conducting business in a given country (Jensen 2008; Li 2009*a*). As the level of available FDI has increased over time, states characterized by strong rule of law and democratic institutions demonstrate a greater rate of change in FDI inflows, $\frac{\partial F(t)}{\partial t}$ (Li and

[5]Economic models frequently paint the world as overly rosy and ignore potential slowdowns or outright contraction. As Gilpin (2001, 264) notes, "some economists have even argued that economic and institutional changes have made serious financial crises impossible, and that if crises were to occur, they could be caused by unique historical circumstances and would certainly not be caused by the inherent workings of the capitalist system." For exceptions to this, see Minsky (1982), Conybeare (1987, 45-46), Shiller (2005), and Akerlof and Shiller (2009). It is important to note that none of these exceptions in the literature account for economic crises within a formal model.

Resnick 2003; Nieman and Thies 2012; World Bank 2011). More formally:

$$\frac{\partial F(t)}{\partial t} = f(D).$$

Foreign firms that directly invest are restricted in how many high-skilled labors they can import from their host countries. The local labor force's human capital reserves must be able to employ and utilize the knowledge transfers that provide investment returns (Jeon, Tang and Zhu 2005; Reuveny and Thompson 2008; Salmi 2001). Thus, FDI, $\frac{\partial F(t)}{\partial t}$, increases with levels of human capital, H:

$$\frac{\partial F(t)}{\partial t} = f(D, H).$$

However, it is the level of human capital development—or, more precisely, its technological sophistication—that determines the saturation point for country's FDI growth (Borensztein, Gregorio and Lee 1998; Findlay 1978; Gartzke 2007). As the level of FDI inflows reaches this point of saturation—the point at which additional inflows are no longer absorbed by the human capital and hence lead to no return—its growth naturally slows down. To account for this relationship, I include another carrying capacity term—*human capital carrying capacity*, $\left(1 - \frac{F}{H}\right)$. In addition, the degree of economic change is constrained by the current economic level and the expected rate of return associated with it, or the economic carrying capacity, $\left(1 - \frac{E}{H}\right)$ (Smith 1776; Ricardo 1817).

Based on this, FDI growth equation can be written out as:

$$\frac{\partial F(t)}{\partial t} = \epsilon D + \phi H \left(1 - \frac{F}{\gamma H}\right) + \eta E' \left(1 - \frac{E}{\kappa H}\right), \tag{2}$$

where ϵ, ϕ, γ, η and κ are constant parameters.

The third equation models the determinants of democratization D'. The level of democracy is theorized to increase with economic growth, E' (Acemoglu and Robinson 2006; Boix 2003; Burkhart and Lewis-Beck 1994; though see Przeworski and Limongi 1997):

$$\frac{\partial D(t)}{\partial t} = f(E').$$

Economic development encourages democratization by decreasing the marginal returns of authoritarianism to the losing side of an election (Benhabib and Przeworski 2006; Lipset 1960; Przeworski 2005). Democracy is also argued to be path dependent:

$$\frac{\partial D(t)}{\partial t} = f(E', D).$$

Przeworski and Limongi (1997) propose a two-stage democratization process, arguing that democratization may occur following an autocratic regime's failure induced by an event such as economic crises or war. However, the event that triggered the regime's failure may not be the same as the event leading to a democratic consolidation. They find that consolidation is more likely given previous experience with democracy. Consistent with this, Elklit (1999) argues that experiencing a credible, transparent election increases the probability of democratic consolidation (see also Przeworski 1991). Pevehouse (2002) and Goldstein (1996) propose an alternative mechanism for prior democracy to induce further democratization. They suggest that many international organizations have minimum standards regarding the level of democracy of member states. In addition, they also argue that many international organizations induce "hand-tying" mechanisms that restrict domestic governing activities to prevent democratic backsliding.[6]

Finally, a functioning democracy requires a (somewhat) educated populace H (Putnam 1993; Verba, Scholozman and Brady 1995):

$$\frac{\partial D(t)}{\partial t} = f(E', D, H).$$

Educated populations make up the social capital that encourages critical evaluations of government effectiveness. Both economic growth E' and previous experience with democracy D are constrained by the current level of human capital. As previously argued, human capital development and growth is limited by their existing levels. This means that the level of democracy that a state can achieve is in some way constrained by how educated the

[6]For a more in-depth examination of how international organizations influence democratization, see Chyzh (2011).

populace is. This indicates non-linearities of the effect of both previous levels of democracy and economic growth based on the underlying carrying capacity of human capital, $\left(1 - \frac{F}{H}\right)$. That is,

$$\frac{\partial D(t)}{\partial t} = \lambda D\left(1 - \frac{D}{\mu H}\right) + \nu E'\left(1 - \frac{D}{\pi H}\right), \tag{3}$$

where λ, μ, ν, and π are constant parameters.

Lastly, the fourth equation models the determinants of human capital growth $\frac{\partial H(t)}{\partial t}$. Human capital is an important piece of the model, because it encourages sustainable development at all levels of development (World Bank 2002) and drives innovation that benefits the private sector (Cookman 2007). Human capital growth, $\frac{\partial H(t)}{\partial t}$, is in part dependent upon the existing pool of human capital, because only those with the requisite skill sets are able to train others barring exogenous factors and the amount of available resources (Salmi 2001, 2009):

$$\frac{\partial H(t)}{\partial t} = f(H).$$

Several formal theories posit that FDI encourages human capital and technology transfers (Findlay 1978; Glass and Saggi 1998, 1999; Markusen 1995):

$$\frac{\partial H(t)}{\partial t} = f(H, F).$$

However, as was the case between FDI and economic growth, the empirical literature is mixed. Several articles find support for this expectation (Baldwin, Braconier and Forslid 2005; Hejazi and Safarian 1999; Xu 2000; Zhu and Jeon 2007, e.g.,) while others find no effect (van Pottelsberghe de la Potterie and Lichtenberg 2001; Xu and Wang 2000). The human capital equation can then be written out in the following form:

$$\frac{\partial H(t)}{\partial t} = \sigma H + \tau E + \omega F' \tag{4}$$

where σ, τ, and ω are constant parameters.

Notably, each one of these equations is related in some way to all others. The four outcome variables are interrelated and contingent upon one another, either directly or indirectly through feedback mechanisms. The formal dynamic model developed here allows us to account for these mutually-dependent and time sensitive relationships. Equations [1], [2], [3], and [4] constitute a system. In the next section, I describe and discuss the predictions of the model, reserving the technical solutions to the appendix.

Empirical Predictions

The model leads to three types of predictions: (1) those consistent with the existing knowledge; (2) novel predictions that advance the endogenous growth theory, and (3) counter-intuitive predictions resulting from accounting for the endogeneity among the four outcome variables. In what follows, I lay out and and describe the three types of predictions in this order. Despite being consistent with the existing literature, the first type of predictions are important. A theoretical model provides an advance over the existing explanations, when in addition to generating novel empirical predictions, it is first able to explain known empirical patterns (Lakatos 1970). By re-affirming the existing knowledge, such predictions ground the model within the exiting literature and provide it with face validity. Such credibility, in turn, paves the way for more surprising findings of the model. With this in mind, consistent with the literature, the models predicts that FDI encourages economic and human capital growth and that economic growth increases the levels of human capital.

H_1: FDI increases the rate of economic growth.

H_2: FDI increases the rate of human capital growth.

H_3: Economic growth increases the rate of human capital growth.

Next, the model leads to several predictions that are consistent with the endogenous growth literature, but in contrast to the traditional neoclassical models. First, the model predicts that past economic and democratic growth will lead to continued growth. The

intuition behind this is rather straightforward: economic growth attracts FDI and generates human capital, which in turn promotes continued economic growth. Democracy, on the other hand, increases at a near constant rate, appearing to be almost entirely path dependent and only minimally impacted by changes in other variables. Prior FDI and human capital growth, however, do not appear to exert a major impact on future FDI or human capital growth. Such patterns in economic and democracy growth, as well as the lack of similar effects in the FDI and human capital growth outcomes result from the complex model specifications, that include multiple constraining effect of the carrying capacity terms and feedback loops. Dynamic modeling provides a tool to separate these relationships and make sense of otherwise intractable inter-dependencies.

H_{4a}: Past economic growth increases the rate of future economic growth.

H_{4b}: Past democratization increases the rate of future democratization.

H_{4c}: Past FDI does not increase the rate of future FDI.

H_{4d}: Past human capital does not increase the rate of future human capital.

Next, and closely connected to the previous set of predictions, the model expects that states with advantageous initial positions will continue to maintain and even enhance such positions. That is, barring an exogenous shock, all outcome variables are mutually reinforcing and generate virtuous cycles (Chang 2003*a*; Fujita, Krugman and Venables 1999; Krugman 1986, 1995). Rather than a return to a steady state, the model shows that initial disparities in the starting values lead to increases in such differences. If we think of states with lower (less advantageous) starting values as developing or underdeveloped, and the ones with higher (more advantageous) starting values as developed, this prediction implies a growing disparities between developed and developing countries. Although in contradiction with the traditional neoclassical model, this prediction is rather consistent with some of the newer literature on endogenous growth (e.g., Chang 2003*b*; Reuveny and Thompson 2008). While there are a handful of states that have developed quickly, most notably the "Asian tigers" and

Ireland, the economies of these states have experienced considerable volatility and stagnation following recent financial crises (particularly the 1999 crises for the case of the former and the 2008 crisis for the latter). Empirical support for this prediction is also provided by Chang (2003*a*, 2), who finds that per capita income in the developing world has grown less quickly than that in the developed world during the period from 1980-2000. He argues that per capita income in Latin American experienced no growth during this period, while in Sub-Saharan Africa it actually shrunk. Moreover, much the the empirical support for increased economic growth among developing as opposed to developed countries is accounted for by the case of China (Choi 2009; Harvey 2005; Jakobsen and de Soysa 2006). Finally, a lot of support for the neoclassical theories tends to erode in the view of more accurate measures of economic growth (e.g., studies that measure economic growth based on simply GDP rather than GDP per capita may accidentally mistake economic growth for mere faster population growth in the developing world).

> H_5*: Economic, FDI, democracy, and human capital grow more quickly in developed than in developing countries.*

Finally, the model produces two counter-intuitive predictions. First, economic growth does *not* affect democratization. This holds despite equation [3] being constructed to favor economic growth as a direct determinant of democratization (for possible explanations, see Przeworski and Limongi 1997). Second, the model produces the novel prediction that economic carrying capacity reduces FDI growth. Economic carrying capacity itself varies and increases as a result of economic growth, but in the short term reduces the rate of FDI, inducing a non-linear effect on the part of economic growth.

> H_6*: Economic growth does not promote democratization.*

> H_7*: Economic carrying capacity reduces the rate of FDI growth.*

Research Design

I test the empirical predictions of the theoretical model by estimating a system simultaneous equations—a statistical test that provides for the closest match between the theoretical and empirical models (Achen 2005; Morton 1999). The level of analysis is the country-year. The empirical analysis includes 140 countries from 1970-2010. The economic data are obtained from the World Development Indicators (World Bank 2011). Due to missing data and countries gaining independence at different times, the final analysis includes 2322 observations. The key variables are logged, first differenced, and included in a generalized three stage least squared estimator with lagged outcome variables to account for the endogeneity within the system of equations, stationarity, and serial correlation within the country panels (Hsiao 2003, 113-126).

The four key variables are *GDP*, *FDI*, *democracy*, and *human capital*. Each of these four variables operates as both an outcome variable in one equation and as an explanatory variable in at least one other equation. Logging and first differencing these variables allows them to meet the model assumptions and converts them into growth rates, as suggested by the theoretical model. A practical advantage of using logged first differences is that such a transformation precludes error correlation between the outcome variable and the lagged term (Hsiao 2003, 85-90). Including the lagged terms also helps with model identification. Finally, lagged dependent variables can also be used to evaluate whether growth has decreasing marginal returns, as would be expected by the neoclassical theories.

GDP is measured on a per capita basis to account for the size of a country. *FDI* is measured as net inflows as a percent of GDP.[7] *Human capital* is operationalized as the percentage of gross tertiary enrollment. I use the tertiary education measure because research has shown that primary and secondary education have little direct impact on economic

[7]Pinto and Pinto (2008) and Blanton and Blanton (2009) demonstrate the utility of disaggregating FDI by sector. While this paper's argument applies most directly to FDI in high value-added products, its application is not exclusive to any specific sectors, such as technology. Value-added production can occur across sectors. In addition, sectoral FDI data inflows data are largely limited to OECD countries, restricting the analysis to developed countries and eliminating tests of whether the wealthy states grow faster than the developing states, as a result of the feedback mechanisms—an important deduction of the model.

development (World Bank 2002; Yusef and Nabeshima 2007). *Democracy* is measured on a 21 point scale where 1 represents a fully autocratic regime and 21 a fully democratic regime (Marshall and Jaggers 2008*b*).[8]

I use a series of interaction variables to represent the carrying capacities described in the formal model. In all cases, human capital serves as a constitutive term over which the marginal effect of another explanatory variable varies. *Skill carrying capacity* is the interaction of the *human capital growth rate* and the existing *human capital*. *Economic carrying capacity* is the product of the *economic growth rate* and *human capital*. Lastly, *democratic carrying capacity* is the interaction of the existing level of *democracy* and *human capital*.

I adhere to the advice of Achen (2005) and Ray (2003, 2005) and only include variables that are theoretically justified by the model.[9] However, a few other variables identified as theoretically relevant are included in the model. Trade has long been expected to increase economic output (Dollar 1992, Frankel and Romer 1999, Ricardo 1817; though see Rodriguez and Rodrik 2001). In addition, a rich literature has found that trade promotes human capital (Coe and Helpman 1995; Xu and Wang 2000; Zhu and Jeon 2007). *Trade* is measured as the total amount of trade (imports plus exports) as a percent of GDP. *Democracy Squared* represents the square of the previously noted *democracy* variable to account for the existence of an upper limit in the democracy scale. *Life expectancy* measures the average lifespan at birth in years and serves as a surrogate measure for the quality of health care. This is

[8]While rule of law is conceptually distinct from democracy, debate exists regarding whether frequently used operationalizations adequately capture this difference or differ in operational terms from measures of democracy. In fact, the most commonly used measure of democracy, the polity index, explicitly acknowledges rule of law in its user's manual and accounts for it in one of components that is used to create the index (Marshall and Jaggers 2008*a*, 14, 24, 49, 66, 68-70). Moreover, rule of law measures suffer their own problems. The International Country Risk Guide's (ICRG) index and the Henisz measure of judicial independence found in Gibler and Randzaao (2011) (itself a combination of the ICRG and polity measures), differ in both conceptual and operational terms from the level of contract intensive money. A recent study on civil conflict compares these rule of law measures, finding that different operationalizations of rule of law can change the sign on coefficients, leading to substantively different interpretations of results (Gleason 2011).

[9]Studies in international relations, and political science more generally, suffer from overspecification of variables in empirical models that do not correspond to the theoretical model on which they are based (Kadera and Mitchell 2005; Ray 2003). The inclusion of unnecessary control variables can mask the relationship of theoretically relevant variables and the dependent variable(Achen 2005; Greene 2000, 337-338; Ray 2005).

expected to help cause human capital growth. Finally, regression results are displayed in both a table and graphically to ease interpretation (Gelman, Pasarica and Dodhia 2002; Kastellec and Leoni 2007).

Empirical Analysis

The results of the simultaneous estimation are displayed in Table 1 and Figure 2. Looking at the Economy equation in Table 1, it is apparent that all variables are statistically significant. *Lagged GDP growth*, *FDI*, and *Trade* have a positive effect on economic growth. The findings for *lagged GDP growth* and *FDI* provide support for H_1 and H_{4a}, that FDI promotes economic growth and that prior growth encourages future growth, respectively. The latter also provides some support for H_5, that the growth of developed countries out-paces that of developing countries. The *change in human capital* variable is negative, as is the overall level of *human capital*. However, these variables are interacted and their relationship with economic growth changes depending on the existing level of *human capital*. Because of this, their effect is difficult to interpret by simply looking at Table 1 and Figure 2. These interaction terms and their constitutive terms are displayed in Figure 3 and interpreted below.

All variables are statistically significant in the FDI equation as well. *Lagged FDI growth rate* has a negative sign, suggesting that previous growth serves to constrain and reduce the rate at which FDI is attracted. That is, it regresses to the mean, consistent with H_{4c}. *Democracy* also has a negative coefficient, indicating that democracy has a negative impact on FDI growth. On the other hand, the coefficients for *human capital* and its squared term are both positive, suggesting an increasingly positive effect, though it is important to consider that *human capital* is a constituent term in an interaction. *GDP growth* has a positive coefficient. This result suggests that FDI is increasingly attracted to growing economies, which was previously found to lead to economic growth. This provides support for H_5 as the two variables create a virtuous, reinforcing cycle. As was the case with the economic growth equation, an interaction is included in the equation and interpreted below.

The Democracy equation reveals that only two of the explanatory variables are statis-

Table 1: Economic, FDI, Democratic, and Human Capital Growth Rates.

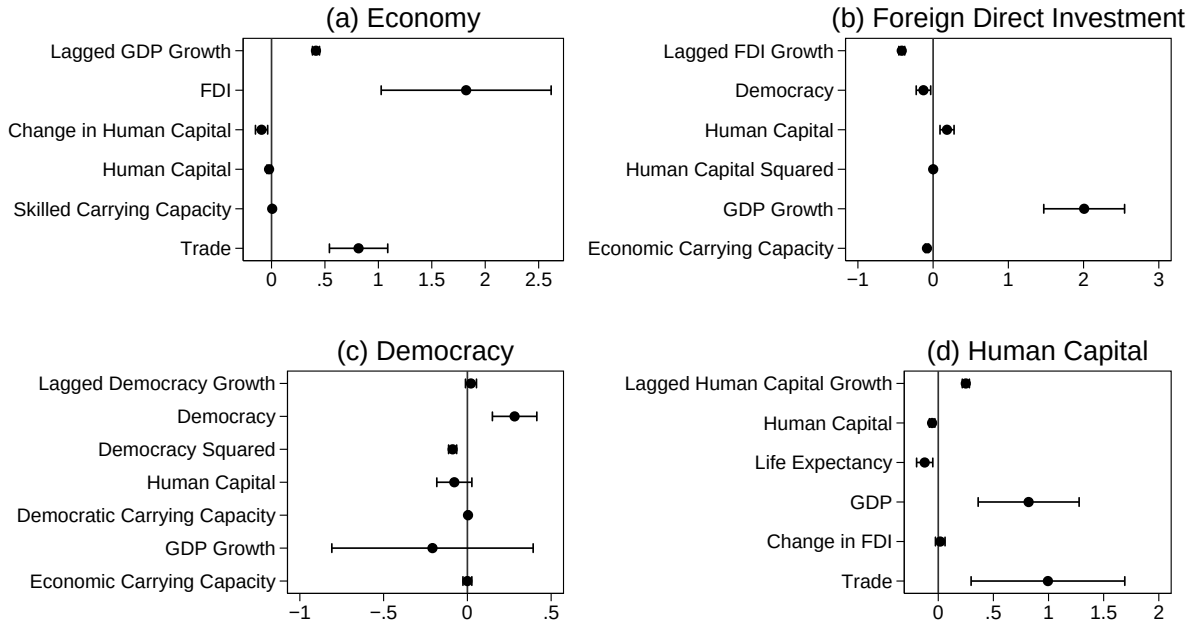
Economy Equation		FDI Equation	
Lagged GDP Growth	0.4160***	Lagged FDI Growth	-0.4167***
	(0.0201)		(0.0238)
FDI	1.8217***	Democracy	-0.1284**
	(0.4834)		(0.0585)
Change in Human Capital	-0.0930***	Human Capital	0.1849***
	(0.0347)		(0.0568)
Human Capital	-0.0225*	Human Capital Squared	0.0013**
	(0.0124)		(0.0007)
Skill Carrying Capacity	0.0065**	GDP Growth	2.0081***
	(0.0027)		(0.3265)
Trade	0.8149**	Economic Carrying Capacity	-0.0813***
	(0.1659)		(0.0139)
Constant	-46.2707***	Constant	-3.4938***
	(11.8195)		(0.8323)
Democracy Equation		**Human Capital Equation**	
Lagged Democracy Growth	0.0215	Lagged Human Capital Growth	0.2501***
	(0.0200)		(0.0195)
Democracy	0.2819***	Human Capital	-0.0554***
	(0.0806)		(0.0151)
Democracy Squared	-0.0881***	Life Expectancy	-0.1229***
	(0.0146)		(0.0446)
Human Capital	-0.0778	GDP	0.8197***
	(0.0636)		(0.2781)
Democratic Carrying Capacity	0.0039	Change in FDI	0.0182
	(0.0037)		(0.0265)
GDP Growth	-0.2082	Trade	0.9947**
	(0.3653)		(0.4236)
Economic Carrying Capacity	0.0000	Constant	3.2634
	(0.0161)		(2.3207)
Constant	8.2628***		
	(1.1284)		
		Observations	2322
		Log Likelihood	-35160.96

*p <0.1, **p <0.05, ***p <0.01. Coefficients are listed above standard errors. Simultaneous equation model using three stage least squared regression (Hsiao 2003). Dependent variable is the growth rate associated with each model.

tically significant. *Democracy* is positive while the *democracy squared* has a negative sign. This shows that more democratic states encourage further democratization, but this effect is limited, as the variable has an upper limit. That is, democracy begets more democracy, which supports H_{4c}, but there is a limit to how democratic a state can become. Two interaction terms are also included and are discussed and interpreted below.

In the Human Capital equation, Human capital growth appears to be encouraged by previous increases in human capital and GDP size, as evident by the positive coefficient on *GDP* and *lagged human capital*. These findings support H_3, that economic growth promotes

Figure 2: Economic, FDI, Democratic, and Human Capital Growth Rates.

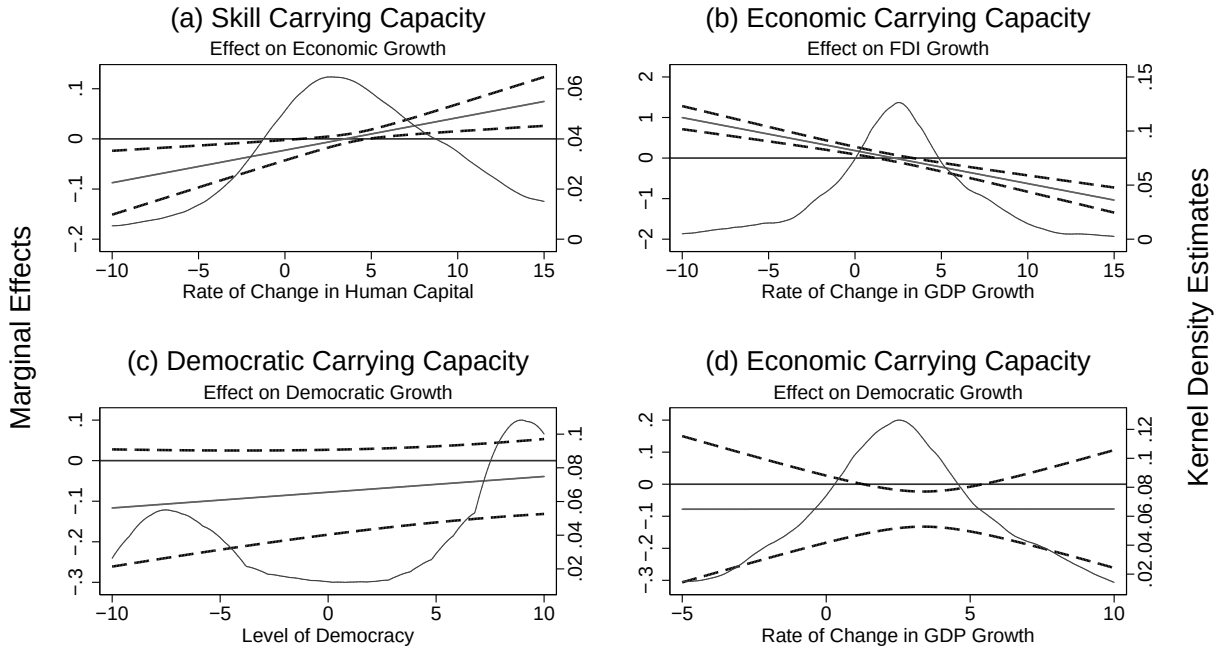


Note: Simultaneous equation model using three stage least squared regression. Dependent variable is the growth rate associated with each figure. Bands represent 90% confidence intervals.

increases in human capital, but runs in contrast to H_{4d}, which expected that past human capital had little to no direct influence on future growth. The coefficient for *human capital* is negative, suggesting that human capital growth rates decline as the existing level of human capital increases. In conjunction with the *lagged human capital*, which is the rate of previous human capital growth, the marginal effect of human capital growth declines at higher levels of human capital stock. This suggests that there exists an upper limit as to how much human capital a country can generate. It is also important to note that *change in FDI* is statistically insignificant. This means that there is little support for the notion that changes in the amount of attracted FDI has a direct impact on the increasing the rate of human capital growth, as suggested by H_2.

Because several of the models include interaction terms, intended to capture carrying capacities, it is important not to simply look at the results and interpret them as those in additive regression models. Interactive terms are multiplicative and non-linear in nature,

Figure 3: Marginal Effects of Human Capital.



Note: Thick dashed lines give 90% confidence interval. Thin gray line is a kernel density estimation.

and as a result, neither the interactive nor the constitutive terms have an inherent meaning on their own (Kam and Franzese 2007; Braumoeller 2004). Instead, these terms are best interpreted by constructing graphs of marginal effects (Brambor, Clark and Golder 2006). These results are shown in Figure 3.

Figure 3(a) shows that the effect of *human capital carrying capacity* is statistically different from zero for much of the data, as evident from the kernel density estimate. However, the effect changes depending on the rate of change in human capital. Decreases in *human capital* have an increasingly negative impact on economic growth, as evident by the statistically negative marginal effect at values below 0. This negative marginal effect stops once the *rate of change in human capital* becomes a positive value. At this point, it is indistinguishable from zero until it reaches about 5 percentage points, when it starts to exert a positive effect.

In contrast, the marginal effect of *human capital* on FDI growth in the economic growth equation is negative and statistically significant for *GDP growth rates* above 3 (see Figure

3(b)). This effect is positive as *GDP growth* shrinks. These results support H_7, which posits that *economic growth* is constrained by the existing level of *human capital*.

Figure 3(c) displays the marginal effect of *human capital* on democratic growth as the level of *democracy* varies. The marginal effect is statistically insignificant, indicating that *democratic carrying capacity* has no effect on democratic growth.

Figure 3(d) shows that the marginal effect of *human capital* on democratic growth as the *change in economic growth* increases is largely statistically insignificant. However, this effect is statistically significant between the range of 1 and 5 percentage points change in economic growth rates, where the marginal effect is negative, but increasing. This is important, because the kernel density estimates demonstrate that this data range includes a large number of observations. The results provide support for H_6, which expected that democratic growth will not be not positively affected by economic growth.

Discussion

The evidence presented here provides a great deal of support for empirical hypotheses. FDI encourages economic growth, which in turn promotes human capital formation. Economic growth makes a market more attractive for FDI, but this is conditioned by the available pool of human capital. Lastly, the lagged dependent variables for each equation, with the exception of FDI, are positive. This means that except in the case of FDI, past growth predicts future performance.

The paper suggests several interesting implications. First, both the theoretical and the empirical models allow to capture complex inter-dependence and endogeneity among the four variables of interest, which also modeling the constraining effects of carrying capacities. Disentangling such complicated relationships, further exacerbated by the presence of multiple feedback loops is made possible by constructing a dynamic theoretical model.

Second, the theoretical model has a high degree of credibility, as it generates a number of empirical predictions consistent with the existing literature. Such predictions enhance the credibility of the additional predictions of the model, some of which challenge the neoclas-

sical economic theories that expect an over-time convergence in economic growth between the developed and developing countries (Ricardo 1817; Smith 1776). In contrast to this, but consistent with the newer predictions of the endogenous growth theory (Howitt 2000; Krugman 1986; Romer 1990), the model presented here suggests a growing divergence between the states with low and high initial values on the economic indicators explored here. In other words, if the situation of state j resembles that of a developed state within the international system and state k that of a developing country, the model suggests that the economies of state j and state k will fail to converge without an exogenous shock. In fact, state j will find itself in a stronger relative position to that of state k, with the gap between them increasing with time. Moreover, assuming scarce rather than infinite level of FDI is likely to further increase this divergence, as state j will always be better equipped to attract FDI than state k.

Lastly, democracy does not appear to exert much impact, either directly on FDI or indirectly on economic growth through FDI. This result supports the findings of Sattler, Freeman and Brandt (2008) that government has little direct impact on macroeconomic outcomes. This also supports the findings of Jensen (2008) and Li (2006, 2009*a*) that the impact of regime type on investment is accounted for in the form of credibility and reflected indirectly via insurance premiums rather than directly by attracting investment. Meanwhile, economic growth has little impact on democracy. In fact, democratic growth appears to be a largely self-driven process, where previous democratization makes future democratization more likely.

Conclusion

This paper makes a contribution to the rapidly expanding FDI literature by formalizing the process of attracting FDI and its subsequent direct and indirect effects. The paper unites several existing theoretical models and empirically tests the hypotheses using a system of simultaneous equations that accounts for the inherent endogeneity and serial correlation (Hsiao 2003, 85-90, 113-126). I use a number of interaction variables to account for the

non-linear effects associated with the constraining effects of carrying capacities on economic growth, FDI, democracy, and human capital. The results demonstrate that FDI encourages economic growth, which in turn promotes human capital formation. Economic growth attracts FDI, but this is conditioned by the available pool of human capital. Interestingly, democracy has only an indirect effect on economic development—through FDI—and this effect is negative. This suggests that the literature might have over-estimated the effect of political institutions on economic development. Lastly, past growth appears to be a positive predictor of future economic growth, democracy, and human capital formation, but not FDI.

These results have important policy implications, particularly for developmental programs, as policy changes in any one area feed back through the system through direct and indirect pathways. An important implication for the FDI incentives literature is that past FDI does not directly encourage future investment. Instead, FDI is attracted towards growing economies that have a sufficient supply of readily available human capital. Consistent with Chang (2003*a*) and Lipsey (2002), the results suggest that incentive programs should focus on long-term educational programs that encourage human capital development rather than redirect resources towards short-term policies in the hope of immediate returns.

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Appendix

In order to analyze the model, we must identify the system's equilibria. Numerical solutions for each of the variables in the system of equations are obtained by setting equations [1], [2], [3], and [4] to zero. The system has two equilibria, which are displayed in Table 2.

Before proceeding, it is worth noting that though the term 'equalibria' is common to both dynamic and game theoretic formal models, they are not viewed in the same way. In game theoretic models, equilibria are generally sought by the modeler as the outcome of strategic behavior of n actors. That is, an equilibrium represents a steady state (Osborne 2004, 22). Equilibria in the case of dynamic models are also thought of as steady states. However, in dynamic models we care about the trajectories of the equations around the equilibria. This is because the dynamic nature of the phenomena being studied suggests that feedback mechanisms are present (illustrated in equations [1], [2], [3], and [4]). A steady state would mean that no change (i.e. growth or decline) would occur in any of the variables. Since this state of affairs is unlikely to occur naturally, we want to know what the behavior is *near* equilibria so that we can deduce each variables trajectories (Boyce and DiPrima 1986: chapter 9; Brown 2007:75-91; Mester-Gibbons 1989: chapter 2). This allows us to see, for

example, if the theorized relationships cause economic growth rates between developed and developing countries to converge or diverge from one another.

The eigenvalues for equilibrium [1] contain all real numbers with both positive and negative values, indicating that the equilibrium is unstable and placed at a saddlepoint. Eigenvalues for equilibrium [2] include positive and negative real numbers, and imaginary numbers. Because the equalibrium includes both imaginary and negative real numbers, equilibrium [2] has unstable spirals. In substantive terms, the results indicate that each of the equilibria is unstable and projecting away (Boyce and DiPrima 1986, 474-476; Brown 2007, 85-92).

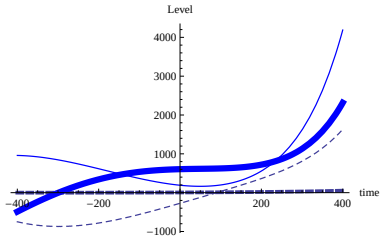
In order to generate predictions, simulations are conducted by generating initial values near the equilibria. Figure 4 provides a substantive illustration of these results. This graph provides a visual display of two different types of countries in order to trace their pathways if their initial conditions are set near equilibria [1].[10] Figure 4(a) displays a time series plot tracing the four key variables for a developing country while Figure 4(b) does the same for a developed country. The values of the initial conditions are somewhat arbitrary. In Figure 4, the variables for developing country case was given initial conditions of 5 while developed country case was given 15. Other initial values were also used, all conditioned that that initial conditions for developed country was greater than that of the developing country. However, changing the initial conditions only alters where the variables' initial position on the x-axis at time = 0; the substantively important pattern of the trajectories from those initial values do not change.

Several important features about the relationships of the FDI, Economic Level, Democracy, and Human Capital emerge after inspection of the graphs. First, FDI (the thick, solid line) increases very slowly until Human Capital (thin, solid line) begins to increase. Shortly after Human Capital begins to increase, the increase in FDI accelerates as well. Furthermore, while Economic Level (thin, dashed line) increases in a near linear manner, as one expands further in time, it begins to increase exponentially. In fact, each of the variables, save Democracy (thick, dashed line), increases exponentially at the last point of time = 400.

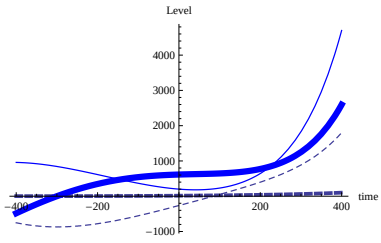
[10]Only the results of initial conditions set near the first equilibrium are presented. Since equilibrium [2] is also unstable, the same general trend of outwards projection holds for each equilibria.

Figure 4: Time Series Plots from near Equilibria for Countries with Different Levels of Development.

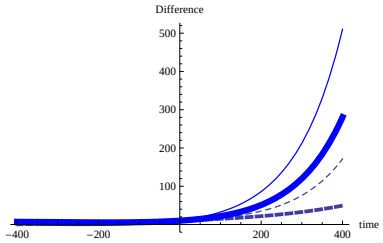
(a) Low Level



(b) High Level



(c) Δ High and Low



Note: Economy is denoted by the thin dashed line, Democracy by the thick dashed line, Human Capital by the thin solid line, and FDI by the thick solid line.

If the graphs are extended beyond time = 400, it would be evident that this exponential growth continues. On the other hand, democracy starts just above zero and, while it too increases quickly and eventually exponentially, it is not able to match the rate of growth of the other variables at any congruent point in time.

An interesting feature of Figure 4(a) and Figure 4(b) is the sameness in their structure. However, this initial sameness is deceiving upon closer inspection. The growth rates of each of the variables for the developed country out pace those of the developing country case. Figure 4(c) presents the difference between the developed and developing cases at each value of time to make these differences more evident. The developed country, given its higher initial conditions, not only outperforms the developing country at each time period but does so at a continuously increasing rate.

Table 2: System Equilibria and Properties

Equilibria (F^*, E^*, D^*, H^*)	Eigenvalues	Type and Local Stability
1. $\left(\frac{cos(t)}{\phi}, -\frac{cos(t)\omega}{\phi\nu\gamma}, 0, \frac{cos(t)}{\phi\gamma}\right)$	$\left(0, 0, -\sqrt{\phi}\sqrt{\omega}\sqrt{\gamma}, \sqrt{\phi}\sqrt{\omega}\sqrt{\gamma}\right)$	saddlepoint, unstable
2. $\left(\frac{cos(t)}{\phi}, \frac{cos(t)\kappa\omega}{\pi\nu\gamma(\kappa+\pi\sigma)}, \frac{cos(t)\kappa\sigma}{\pi\gamma(\kappa+\pi\sigma)}, \frac{cos(t)\kappa}{\pi\gamma(\kappa+\pi\sigma)}\right)$	Imaginary and real numbers with both positive and negative*	saddlepoint, unstable
Eigenvalues about 2 pages to print		