



The impact of financial development on energy consumption in emerging economies

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ABSTRACT

Financial development is often cited as a very important driver of economic growth in emerging economies and it is thus likely that financial development affects energy demand. This study uses generalized method of moments estimation techniques to examine the impact of financial development on energy consumption in a sample of emerging countries. Several different measures of financial development are examined. Using a panel data set on 22 emerging countries covering the period 1990–2006, the empirical results show a positive and statistically significant relationship between financial development and energy consumption when financial development is measured using stock market variables like stock market capitalization to GDP, stock market value traded to GDP, and stock market turnover. The implications of these results for energy policy are discussed.

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1. Introduction

Understanding the determinants of energy consumption in emerging economies is an important research topic for several reasons. First, energy is used in the production of almost all goods and services and it is thus crucial to have a good understanding of the determinants of energy demand. Many emerging economies are growing very rapidly and as economic growth increases so too does the demand for energy. According to the International Energy Agency (IEA) (2007, p. 73), between 2005 and 2030 world primary energy demand is expected to grow at an average annual growth rate of 1.8%. Developing economies will contribute to 74% of the increase in global energy demand. Moreover, just two countries, China and India will together account for 45% of the increase in global energy demand. Over the period 2005–2030, primary energy demand in China and India is expected to grow at average annual growth rates of 3.2% and 3.6%, respectively (IEA, 2007, p. 73). Understanding the determinants of energy demand is essential to gaining a better understanding how the demand for energy in emerging countries is going to change in the future. Energy demand modeling is also crucial to gaining a better understanding of how to manage global emissions of greenhouse gases (GHGs) because energy-related GHG emissions make up the bulk of GHG emissions. According to the World Resources Institute, 61.4% of global GHG emissions come from the energy sector.¹ While most of the world's GHG emissions have

historically come from the developed countries, this is set to change as developing countries are expected to release more GHG emissions as their economies continue to grow.

To date, there has been a large body of published research investigating the demand for energy in emerging economies but most of this research has focused on the relationship between energy consumption and income (see for example, the multi-country studies by, Akinlo, 2008; Al-Iriani, 2006; Apergis and Payne, 2009a, 2009b; Chontanawat et al., 2008; Lee, 2005; Lee and Chang, 2008; Mahadevan and Asafu-Adjaye, 2007; Sadorsky, 2009; Sari and Soytas, 2007; Wolde-Rufael, 2009). Despite the enormous volume of work that has been done investigating the relationship between energy demand and income, there appears to be no strong consensus as to which way the relationship goes. This point was recently made by Karanfil (2009). Moreover, Karanfil (2009) also suggests that there are other potentially interesting variables, like financial variables, that could impact the demand for energy. To date, however, very little is known about the relationship between financial development and energy demand. This study uses recently developed generalized method of moments estimation techniques that explicitly deal with endogeneity issues in dynamic models to examine the impact of financial development on energy consumption in a sample of emerging countries. In doing so, this paper takes an important step towards more fully understanding the relationship between financial development and energy demand.

Financial development, which refers to a country's decision to allow and promote activities like increased foreign direct investment (FDI), increases in banking activity, and increases in stock market activity, presents one possible avenue for which economic growth can be increased and this will affect the demand

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¹ <http://cait.wri.org/figures.php?page=World-FlowChart&view=100>.

for energy. Financial development is important because it can increase the economic efficiency of a country's financial system. Financial development encourages a number of changes within a country including for example, a reduction in financial risk and borrowing costs, greater transparency between lenders and borrowers, access to greater financial capital and investment flows between borders and access to the latest energy efficient products and cutting edge technology all of which can affect the demand for energy by increasing consumption and business fixed investment. Financial development can affect the demand for energy in several ways. One of the most direct ways that financial development can affect the demand for energy is by making it easier for consumers to borrow money to buy big ticket items like automobiles, houses, refrigerators, air conditioners, and washing machines. In other words, financial development makes it easier for consumers to satisfy their wants and needs. These big ticket consumer items typically consume a lot of energy which can affect a country's overall demand for energy. Businesses also benefit from improved financial development because it makes it easier and less costly to gain access to financial capital which can be used to expand existing businesses (by buying or building more plants, hiring more workers, and buying more machinery and equipment) or create new ones. Stock market development is particularly attractive to businesses because it allows them access to an additional source of funding, equity financing, that can be used to grow their business in addition to debt financing. Increased stock market activity can increase risk diversification for both consumers and businesses alike which is an important component to generating wealth in an economy. Increased stock market activity also creates a wealth effect that in turn affects consumer and business confidence (Mankiw and Scarth, 2008). The stock market is often viewed as a leading economic indicator and increased stock market activity may be viewed as a sign of economic growth and prosperity which in turn bolsters consumer and business confidence. Increased economic confidence increases the demand for energy intensive goods.

The impact that financial development has on the demand for energy is a topic that has received very little attention. Mielnik and Goldemberg (2002) find a relationship between foreign direct investment and energy intensity while Tamazian et al. (2009) find that financial development lessens CO₂ emissions. Outside of these papers, however, there appears to be little research on the link between financial development and energy. The purpose of this paper is to investigate the impact of financial development on energy demand for a panel of 22 emerging economies. Empirical models are estimated using panel generalized method of moments (GMM) regression techniques. The following sections of the paper set out the theoretical background material, empirical model, data, empirical results and discussion, policy analysis and conclusions.

2. Economic growth, financial development and energy demand

There is an extensive literature looking into the relationship between financial development (especially FDI) and economic growth (Levine, 1997). One view is that financial development leads to greater economic growth (Schumpeter, 1911; Goldsmith, 1969; McKinnon, 1973; Shaw, 1973). From a theoretical perspective, differences between the quantity and quality of financial institutions are an important determining factor for economic growth. More specifically, there are two different channels through which financial development can lead to economic growth (Fung, 2009). Factor productivity is one channel through which financial development may lead to economic growth.

In this channel, financial innovations and technologies lessen informational asymmetries and this leads to better monitoring and selection of investment projects (Townsend, 1979; King and Levine, 1993b; Baier et al., 2004). Financial liberalization improves risk sharing which should lower the cost of equity and increase investment, ultimately resulting in increased economic growth (Bekaert and Harvey, 2000; Bekaert et al., 2001, 2002, 2005). The second channel, factor accumulation, emphasizes the spread of organized financial systems over self-finance. Organized financial systems increase efficiency as previously unproductive resources are put to better uses (Gurley and Shaw, 1955; Bencivenga and Smith, 1991; Xu, 2000; Bell and Rousseau, 2001). Consistent with this view that financial development leads to greater economic growth is the likelihood that energy demand should be positively impacted by increases in financial development. Increased financial development makes it easier for consumers and business to save, invest and borrow money. As development occurs within an emerging economy's financial services sector consumers find it easier and cheaper to borrow money and buy goods and services. Consumer purchases of some big ticket items, like automobiles or houses, directly increases the demand for energy since automobiles are powered by petroleum products and houses are heated with or cooled by energy products. Financial development allows businesses cheaper and/or easier access to financial capital, either through lower borrowing costs or through new sources of financing like equity financing as a country's stock market develops, which can be used to expand existing operations or construct new plants and factories, all of which increase the demand for energy (both in the construction of new infrastructure and in the operation of new infrastructure).

Another view is that economic growth leads to financial development (Robinson, 1952; Lucas, 1988; Stern, 1989). Financial development increases as the demand for financial services grows and the demand for financial services is directly tied to economic growth. In this view financial development follows economic growth. Consistent with this view is the likelihood that energy demand should be relatively non-responsive to financial development.

Based on these two views, there is an ambiguity as to what effect, if any financial development has on the demand for energy. This ambiguity can only be resolved through empirical analysis.

3. Empirical model

The empirical model is specified as a reduced form dynamic panel model of energy demand. Energy demand (e) depends upon income (y), price (p), and a measure of financial development (d)

$$e_{it} = \alpha_1 e_{it-1} + \beta_{11} y_{it} + \beta_{12} p_{it} + \beta_{13} d_{it} + v_i + \psi_t + \varepsilon_{it} \quad (1)$$

where i denotes the country ($i=1, \dots, 22$) and t denotes the time period ($t=1990, \dots, 2006$). Eq. (1) is a fairly general specification which allows for dynamic energy demand effects, individual fixed country effects (v), fixed time effects (ψ), and a stochastic error term (ε).

Eq. (1) is an example of a linear dynamic panel model (Arellano and Bond, 1991). This model contains unobserved panel-level effects which may be either fixed or random. By construction, the unobserved panel-level effects are correlated with the lag(s) of the dependent variable and this makes most standard estimation approaches inconsistent (Arellano and Bond, 1991). Arellano and Bond (1991) develop a generalized method of moments (GMM) estimator which yields consistent parameter estimates for models of this type. In their approach the unobserved firm-specific heterogeneity is eliminated by using a

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