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NIPE WP 19/ 2009

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Fundamentals, Financial Factors and The Dynamics of Investment in Emerging Markets*

Tuomas A. Peltonen† Ricardo M. Sousa‡ Isabel S. Vansteenkiste§

Abstract

The paper uses a Panel Vector Auto-Regression (PVAR) approach to analyze the short-run adjustment of private investment to shocks to fundamental and financial factors in emerging market economies.

By relying on a panel of 31 emerging economies and quarterly frequency data for the period 1990:1-2008:3, we show that: (*i*) investment sluggishly adjusts to its own shocks; (*ii*) GDP and equity price shocks have a positive and sizeable impact on investment; (*iii*) unexpected variation in the cost of capital and the lending rate has a negative (although economically small) effect on investment; and (*iv*) the response of investment to credit market developments seems to be driven by the demand side.

In addition, the empirical evidence suggests that the effects of equity price shocks are similar for emerging Asia and Latin America, but credit shocks are more important in Latin America. Moreover, shocks to the lending rate have a very pronounced and negative impact in emerging European markets.

Finally, we show that the stock market bubbles may have encouraged real investment during the nineties.

Keywords: *fundamentals, financial factors, investment, emerging markets, panel VAR.*

JEL Classification: *E22, E44, D24.*

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1 Introduction

Private investment is a critical determinant of long-run economic performance, being pivotal to a country's economic growth and employment situation. For emerging market economies, private investment is particularly relevant as it contributes to their catching-up process with advanced countries. In fact, despite the wide differences across countries,[1] private investment represented, on average, 20-25% of GDP in emerging countries over the period 1990-2007.

While the role of private investment is unquestionable, there is surprisingly little research on its determinants in emerging market economies, a fact that can not be detached from the scarcity of data.

Moreover, the distinction between the "fundamental" and the "financial" determinants of investment remains important. In fact, despite the popularity of the neoclassical model, there is a growing literature that emphasizes the role played by financial constraints - namely, via interest rates and credit - on investment in emerging markets (McKinnon, 1973; Shaw, 1974; Fry, 1980; Sundararajan and Thakur, 1980; Tun Wai and Wong, 1982; Tybout, 1983; Blejer and Khan, 1984; O'Brien and Browne, 1992; Serven and Solimano, 1992; Whited, 1992; Harris et al., 1994; Jaramillo et al., 1996; Demirguc-Kunt and Maksimovic, 1998; Rajan and Zingales, 1998; Wurgler, 2000).

More recently, Peltonen et al. (2009) provide an attempt to uncover the long-run determinants of private investment growth in emerging markets. The authors show that: (*i*) the GDP and the cost of capital are among the "fundamental" determinants of investment; (*ii*) the equity price impacts positively and significantly on investment; (*iii*) "financial" factors (such as, credit and lending rate) play an important role on the dynamics of investment, in particular, for emerging Asia and Latin America; (*iv*) investment growth exhibits substantial persistence; and (*v*) crises episodes magnify the negative response of investment.

The current financial turmoil and the extreme volatility of private investment have, however, brought to the first stage other similarly important policy questions: What explains the short-run dynamics of private investment in emerging markets? What are the likely effects of unexpected variation in "fundamental" and "financial" determinants? How large are their impact and for how long do they persistent?

These are important issues, particularly, if one takes into account that part of the solution to the exit of the current crisis lies on the economic performance of emerging market economies given its increasing role in the world economy. Moreover, they lack a clear answer which we try to tackle with the current work.

In this paper, we use a Panel Vector Autoregression (PVAR) approach aimed at analyzing the short-run adjustment of investment to shocks to "fundamental" and "financial" factors in emerging market economies. We build a panel of 31 emerging economies using quarterly frequency data for the period 1990:1-2008:3, and show that: (*i*) investment shocks are, in general, persistent; (*ii*) GDP shocks have a positive and sizeable effect on investment, reflecting the strong co-movement between the two macroeconomic aggregates; (*iii*) similarly, shocks to the equity price impact positively on investment, supporting the Tobin's Q approach; (*iv*) in contrast, the cost of capital affects negatively investment, although the magnitude of the effect is small; and (*v*) the response of investment to a shock in credit is, in general, negative, suggesting that credit demand shocks (as opposed to credit supply shocks) play the dominant

[1] A few countries, in particular the large emerging Asian markets, exhibit very high rates of private investment, exceeding 30%. At the other extreme, Brazil and the Philippines experience much lower rates of private investment, falling below 20% of GDP.

role.

Our findings are robust to the exclusion of the equity price index, to the replacement of credit by a monetary aggregate, and are not biased due to the occurrence of crises episodes.

In addition, the empirical findings suggest that the effects of equity price shocks (on investment) are of similar magnitude in emerging Asia and Latin America, but credit shocks are more important in Latin America. Moreover, shocks to the lending rate have a very pronounced and negative impact in emerging European markets, reflecting the fact that these economies tend to be bank-based.

Finally, we show that the impact of the equity price on investment was stronger in the first half of the sample, that is, 1990:1-1999:4, a period characterized by a strong boom of stock markets. While this suggests that access to equity markets may actually amplify investment growth, it also poses important challenges to emerging markets, in particular, in the outcome of a downturn of financial markets.

The rest of the paper is organized as follows. Section 2 reviews the existing literature on the fundamental and financial factors determining private investment. Section 3 presents the estimation methodology and Section 4 describes the data. Section 5 discusses the empirical results and Section 6 provides the sensitivity analysis. Finally, Section 7 concludes with the main findings and policy implications.

2 A Brief Review of the Literature

Two models describing the "fundamental" determinants of private investment often compete in the literature: (*i*) the traditional neoclassical model, i.e., the Jorgenson (1963) approach; and (*ii*) the alternative Q approach by Tobin (1969).

According to the Jorgenson approach investment can be modelled as the joint process of investment, output and the cost of capital. While the Jorgenson approach is still widely used by those who forecast investment using models of systems of equations, it has been rejected by most theorists (Lucas, 1976).

In the Q approach, investment is seen as the joint process with the Tobin's Q ratio, that is, the ratio of the market valuation of a firm's securities to the replacement cost of the physical assets they represent (Brainard and Tobin, 1968). This ratio is an indicator of future profitability that combines asset prices in a sufficient statistic: stock prices, bond prices, and the replacement cost of the capital stock (Fischer and Merton, 1984).

There are a number of reasons to believe that stock prices may influence investment: (*i*) when the market value of an additional unit of capital exceeds its replacement cost, a firm can raise its profit by investing (Tobin, 1969; Von Furstenberg, 1977; Doan et al., 1984; Barro, 1990; Galeotti and Schiantarelli, 1994); (*ii*) a rise in stock prices improves the balance sheet position of the firm (Bernanke and Gertler, 1989; Tease, 1993), which reduces the cost of capital (Fischer and Merton, 1984) and/or increases the availability of external funding (Bernanke and Gertler, 1989); and (*iii*) if the role of management is to maximize the wealth of existing shareholders, then investment should respond to stock prices even when they deviates from the true value of the firm.

In contrast, another strand of the literature rejects the Q approach (Barro, 1990; Sensenbrenner, 1991) and considers that there is a minor role for stock prices beyond their ability to predict fundamental determinants of investment (Morck et al., 1990; Blanchard et al., 1993; Andersen and Subbaraman, 1996; Chirinko and Schaller, 1996). This is explained by: (*i*)

the argument that the stock market is a passive predictor of future activity and the firm's management is only concerned about its long-run market value (Bosworth, 1975); and (*ii*) the fact that it may be optimal for the firm to respond to fluctuations in stock prices by simply restructuring its financing patterns without altering investment (Blanchard et al., 1993).

In the case of emerging market economies, the neoclassical flexible-accelerator model has been the most popular in use, although it has generally been hard to test because key assumptions (such as perfect capital markets and little government investment) are inapplicable, and data for certain variables (capital stock, real wages, and real financing rates for debt and equity) are normally either unavailable or inadequate.

Accordingly, research has proceeded in several directions. While these efforts have not yet produced a full-fledged model of investment behavior in emerging market economies, they identified a number of "financial" variables that may affect private investment in these economies.[2]

One of such variables is the interest rate. The notion that business spending on fixed capital falls when interest rates rise is a theoretically unambiguous relationship that lies at the heart of the monetary transmission mechanism. Sundararajan and Thakur (1980), Tun Wai and Wong (1982) and Blejer and Khan (1984) suggest that private investment should be negatively related to the real interest rate as a measure of the user cost of capital.[3] Nevertheless, the presence of a robust negative relationship between investment expenditures and real interest rates has been difficult to document (Abel and Blanchard, 1986; Schaller, 2006).

Another financial determinant of investment refers to credit and there is a growing literature on its effect on investment (Stiglitz and Weiss, 1981; Fazzari et al., 1988; Calomiris and Hubbard, 1989; MacKie-Mason 1989; Mayer, 1988; Hubbard, 1990; Whited, 1991). Indeed, the quantity of credit is likely to be important in a credit market where interest rates are controlled at below market clearing levels and/or directed credit programmes exist for selected industrial sectors. Further, banks specialise in acquiring information on default risk. This information is highly specific to each client. Hence, the market for bank loans is a customer market, in which borrowers and lenders are very imperfect substitutes. A credit squeeze rations out some bank borrowers who may be unable to find loans elsewhere and so be unable to finance their investment projects (Blinder and Stiglitz, 1983). Also, asymmetric information will lead to credit rationing even in perfectly competitive markets (see Stiglitz and Weiss, 1981). For these reasons, we could expect investment to be influenced by domestic bank credit.

[2] Apart from the "fundamental" and "financial" factors, other studies have identified several additional explanatory variables playing a role in private investment, namely: (*i*) public investment (Blejer and Khan, 1984; Aschauer, 1989); (*ii*) the domestic inflation rate (Dornbusch and Reynoso, 1989); (*iii*) large external debt burdens (Mirakhor and Montiel, 1987; Borensztein, 1990; Froot et al., 1991); (*iv*) income per capita; (*v*) exchange rate volatility (Serven, 2003); (*vi*) investor's confidence; (*vii*) measures of natural resource endowments (Papyrakis and Gerlagh, 2004; Gylfason and Zoega, 2006); (*viii*) political stability; (*ix*) the quality of political institutions (Bond and Malik, 2007); (*x*) aspects of governance such as bureaucratic quality, corruption and law (Poirson, 1998; Brunetti and Weder, 1998); (*xi*) indicators of political checks and balances (Henisz, 2000; Beck et al., 2001; Stasavage, 2002); and (*xii*) corporate tax policy (Auerbach, 1983; Chirinko, 1993; Cummins et al., 1994; Devereux et al., 1994; Chirinko et al., 1999, 2004; Hassett and Hubbard, 1997; House and Shapiro, 2006; Schaller, 2006; Gilchrist and Zakrajsek, 2007). Not surprisingly, some of these variables are hard to quantify and are unlikely to capture the rich diversity in institutional arrangements that exists, particularly, in developing countries. Moreover, they are also quite time invariant.

[3] The real interest rate is closer to the spirit of the neoclassical model than are measures of the availability of financing, which some studies have been using in the absence of interest rate data

The importance of "financial" factors is also confirmed for developing market economies both at the micro and macro levels (McKinnon, 1973; Shaw, 1974; Fry, 1980; Tybout, 1983; Whited, 1992; Harris et al, 1994; Jaramillo et al., 1996; Peltonen et al., 2009). These constraints have also been considered as one of the reasons behind the poor investment performance of many developing countries in the 1980s and 1990s (Serven and Solimano, 1992). Additionally, developed financial intermediaries are often seen as driving force of economic growth (Demirguc-Kunt and Maksimovic, 1998; Rajan and Zingales, 1998; Wurgler, 2000).

While the dichotomy between "fundamental" and "financial" factors seems unavoidable, little is known about the reaction of investment to shocks to those variables, in particular, for emerging market economies. What are the effects of unexpected variation in "fundamental" determinants? How does investment respond to shocks in "financial" factors? What is the magnitude and the persistence of the effects on investment?

The panel-data VAR approach is, particularly, well suited to answer these questions.[4] For instance, Gilchrist and Himmelberg (1995, 1998) look at the relationship between investment, future capital productivity and firms' cash flow using US firm level data. Gallegati and Stanca (1999) also investigate the relationship between firms' balance sheets and investment for a panel of UK firms. Love and Zicchino (2006) build a panel of 36 countries and find evidence of financing constraints in investment at the firm's level, after controlling for marginal profitability.

3 Empirical Methodology

We use a panel-data vector autoregression (PVAR) methodology. It combines the traditional vector autoregression (VAR) approach, which treats all the variables in the system as endogenous, with the panel-data approach, which allows for unobserved individual heterogeneity. We specify a first-order VAR model as follows:

$$Y_{i,t} = \Gamma_0 + \Gamma(L)Y_{i,t} + \nu_i + d_{c,t} + \varepsilon_{i,t} \qquad i = 1, ..., N \qquad t = 1, ..., T_i \tag{1}$$

where $Y_{i,t}$ is a vector of endogenous variables, Γ_0 is a vector of constants, $\Gamma(L)$ is a matrix polynomial in the lag operator, ν_i is a matrix of country-specific fixed effects, $d_{c,t}$ and $\varepsilon_{i,t}$ is a vector of error terms.[5] The vector of endogenous variables comprises the investment (I_{it}), the cost of capital ($CAPCOST_{it}$), the GDP (GDP_{it}), the lending rate ($LENDRATE_{i,t}$), the credit aggregate ($CREDIT_{i,t}$), and the equity price index ($EQ_{i,t}$), which are all measured in log differences of real terms. In practice, the vector of endogenous variables can be expressed as $Y_{i,t} = [GDP_{i,t}, CAPCOST_{i,t}, I_{i,t}, LENDRATE_{i,t}, CREDIT_{i,t}, EQ_{i,t}]'$. Our model also allows for country-specific time dummies, $d_{c,t}$, which are added to model (1) to capture aggregate, country-specific macro shocks. We eliminate these dummies by subtracting the means of each variable calculated for each country-year.[6]

[4] The PVAR framework has also been used in different contexts. See, for instance: Beetsma (2006, 2008), in analyzing the effects of fiscal policy on trade balances; Assenmacher-Wesche and Gerlach (2008a, 2008b), in studying the response of property and equity prices to monetary policy shocks; and Goodhart and Hofmann (2008) in assessing the links between money, credit, housing prices, and economic activity.

[5] The disturbances, $\varepsilon_{i,t}$, have zero mean and a country-specific variance, σ_i.

[6] We neglect the international linkages between the countries, i.e. we restrict the coefficients on the foreign variables in Y_{it} to zero. In fact, our aim is not to investigate the international transmission of the different shocks to the system. Some approaches to deal with this issue include: (*i*) the Global Vector Autoregression (GVAR) methodology by Pesaran et al. (2004) and Dees et al. (2006); and (*ii*) a reparameterization of the

The main advantage of using a PVAR approach is that it increases the efficiency of the statistical inference, which would otherwise be suffering from a small number of degrees of freedom when the VAR is estimated at the country level. While this comes at the cost of disregarding cross-country differences by imposing the same underlying structure for each cross-section unit, Gavin and Theodorou (2005) emphasize that the panel approach allows one to uncover common dynamic relationships.

Moreover, by introducing fixed effects, ν_i, one can allow for "individual heterogeneity" and overcome that problem. However, the correlation between the fixed effects and the regressors due to the lags of the dependent variables implies that the commonly used mean-differencing procedure creates biased coefficients (Holtz-Eakin et al., 1988), being particularly severe if the time dimension is small (Nickell, 1981; Pesaran and Smith, 1995).

This drawback of the fixed effects OLS panel estimator can be avoided by a two-stage procedure. First, one uses the 'Helmert procedure', that is, a forward mean-differencing approach that removes only the mean of all future observations available for each country-year (Arellano and Bover, 1995). Second, one can estimate the system by GMM and use the lags of the regressors as instruments, as the transformation keeps the orthogonality between lagged regressors and transformed variables unchanged (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). In our model, the number of regressors is equal to the number of instruments. Consequently, the model is "just identified" and the system GMM is equivalent to estimating each equation by two-stage least squares.

Another issue that deserves attention refers to the impulse-response functions. Given that the variance-covariance matrix of the error terms may not be diagonal, one needs to decompose the residuals so that they become orthogonal.[7] We follow the usual Choleski decomposition of variance-covariance matrix of residuals, in that after adopting the abovementioned ordering, any potential correlation between the residuals of two elements is allocated to the variable that comes first. By transforming the system in a "recursive" VAR (Hamilton, 1994) and imposing a triangular identification structure, we, therefore, assume that the investment adjusts simultaneously to shocks to GDP and the cost of capital. Moreover, shocks to the lending rate, the credit aggregate and the equity price affect investment only with a lag. The ordering of the first four variables in the system is common in the literature on monetary policy (Christiano et al., 1999; Christiano et al., 2005). In what concerns the credit aggregate and the equity price, the equity price was ordered last as it refers to assets that are traded in markets where auctions take place instantaneously. Nevertheless, changing the ordering of the variables does not have a significant impact on the results.

4 Data

We use an unbalanced panel of 31 emerging economies, 10 from emerging Asia (China, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand), 6

panel VAR (Canova and Ciccarelli, 2006).

[7] One should, however, note that the orthogonalised shocks can be interpreted as reduced form but not as structural shocks. This could be achived by imposing some sort of sign restrictions (Mountford and Uhlig, 2008; Canova and Pappa, 2007), long-run restrictions (Blanchard and Quah, 1989; Beaudry and Portier, 2006) or short-run restrictions (Leeper and Zha, 2003; Sims and Zha, 2006a, 2006b) and estimate the VAR at the country level. Unfortunately, the sample size is relatively short by country which would not allow one to be confident on the statistical inference based on the use of these approaches. In this context, the PVAR approach appears to be the most appropriate framework.

from Latin America (Argentina, Brazil, Chile, Colombia, Mexico, and Peru), 12 from emerging Europe (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Slovenia) and 3 other countries (Israel, South Africa, and Turkey).

The sample covers the period 1990:1-2008:3 for which data is available at quarterly frequency and the main sources of the data are as follows:

- Investment:

Investment (I_{it}). Proxied by gross fixed capital formation and provided by Haver Analytics.

- "Fundamental" factors:

GDP (GDP_{it}). Used as a proxy for economic activity and business cycle and provided by Haver Analytics.

Cost of Capital ($CAPCOST_{it}$). Proxied by the ratio of investment deflator to GDP deflator and provided by Haver Analytics.

- Tobin's Q:

Stock Price Index (EQ_{it}). Used to assess the role of Tobin's Q *versus* the relevance of the direct financing hypothesis in explaining private investment and obtained from Haver Analytics and Global Financial Database (Argentina, Chile, Colombia, Croatia, Czech Republic, Hong Kong, Israel, Korea, Peru, Philippines, Russia, Singapore, and South Africa).

- "Financial" factors:

Interest rate ($LENDRATE_{it}$). Proxied by the lending rate available to firms or the interbank rate (Romania, and Turkey) and provided by the International Financial Statistics (IFS) of the International Monetary Fund (IMF).

Credit ($CREDIT_{i,t}$). Consists of claims on private sector and is provided by the IFS of IMF.

Data are also transformed in several ways for the econometric analysis. First, all variables are deflated using the GDP deflator, with the exception of Singapore, where the CPI index (all items) is used. Second, data on real GDP, real investment and the corresponding deflators for China are annual, and, therefore, interpolated to quarterly frequency using a cubic conversion method. In addition, some missing data points are linearly interpolated, namely: credit (Hong Kong 1990-1993, South Africa 1991:3-1991:4) and lending rate (Argentina 2002:2). Third, the following variables are seasonally adjusted using the X11 ARIMA procedure:[8] gross fixed capital formation at constant prices (India, Korea, Mexico, and Romania), gross fixed capital formation at current prices (India and Korea), GDP at constant prices (Korea and Romania), GDP at nominal prices (Korea), and claims on private sector (all countries).

Table A.1 in the Appendix provides a detailed description of the variables and data sources used in the analysis, while Tables A.2 to A.5 also present a range of descriptive statistics. Table A.6 summarizes the panel unit root tests of Levin et al. (2002), and Im et al. (2003) and shows that the log differences (year-on-year) of all key variables are stationary. Data on private investment rates over the period 1990-2007 are displayed in Table A.7.

[8] The other series are seasonally adjusted either by the national source or by Haver Analytics.

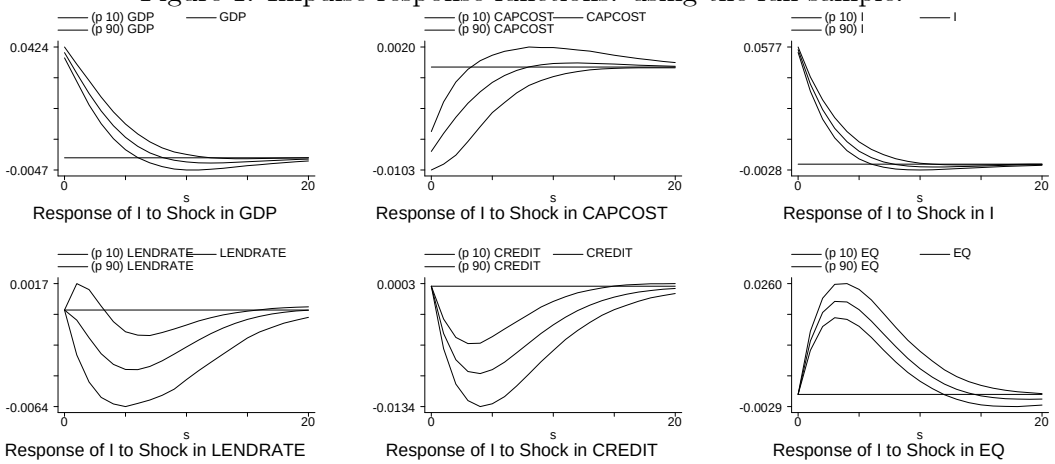
5 Empirical Results

We estimate the coefficients of the system given in equation (1) after the fixed effects and the country-time dummy variables have been removed. We also compute the standard errors of the impulse-response functions and generate confidence intervals by using 1000 Monte Carlo simulations. In practice, we randomly draw from the estimated coefficients and their variance-covariance matrix, and use this procedure to generate the 10th and 90th percentiles of the distribution.

Figure 1 plots the impulse-response functions and the 10% error bands generated by Monte Carlo simulation, where we consider the full sample. The panels represent the response of investment to a one standard deviation shock in the other variables of the VAR. The impact on investment of a shock to GDP is positive, reflecting the co-movement that one typically finds in real business cycles. Also, as predicted by the neoclassical model of investment, a shock in the cost of capital has a negative effect on investment (of almost -1%) that lasts for 5 quarters. The investment shocks tend to persist for about 10 quarters, and reveal the strong persistence of investment growth. In what concerns the financial variables, the response of investment to a shock in the lending rate suggests that investment gradually falls after the shock and the trough of around -0.4% is reached after 5 quarters. In line with the Tobin's Q approach, it can also be seen that a shock to the equity price has a positive and sizeable impact on investment (around 2% increase) which peaks after 3 quarters and lasts for about 12 quarters. As a result, the empirical findings seem to support the idea that capital markets play a role that is more influential than monetary policy itself.

Summing up, the results are in accordance with Peltonen et al. (2009), as they highlight a strong role for "fundamental" factors, but also provide evidence of an important linkage to "financial factors" and to the capital markets.

Figure 1: Impulse-response functions: using the full sample.



The response of investment to a shock in credit is interesting: investment starts falling after the shock, the trough of about -1% is reached after 5 quarters, and then starts recovering. This result may be related with the fact that our approach does not allow us to disentangle between credit supply and credit demand shocks. As Bernanke and Blinder (1988) show, a positive credit demand shock is contractionary for GDP, lowers the money supply but also raises credit. As a result, a monetarist central bank would turn expansionary and would cut

the interest rates, therefore, boosting investment. A positive credit supply shock has, however, an expansionary effect on GDP, and increases both credit and money supply. Consequently, the central bank would try to stabilize the economy by increasing the interest rates, which would have a negative effect on investment.

The pattern of the response of investment to a shock in credit seems, therefore, to suggest that our approach is capturing the effects of a credit demand shock, which would push up the interest rates and, consequently, have a negative impact on investment. In contrast, if the developments in credit markets were driven by the supply side, one should observe a fall in the interest rates following the shock to credit.

Figure 2 shows the response of lending rate to the shock to credit and confirms our hypothesis: the lending rate increases after the shock, reaches a peak of about 60 basis points after 3 quarters and, then, starts gradually falling.

Figure 2: The response of lending rate to a shock to credit.

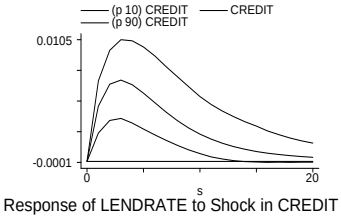


Table 1 presents the variance decompositions for our PVAR model, where we use the full sample. We look at the percent of variation in the row variable (20 quarters ahead) explained by column variable, accumulated over time. The results show that the GDP (a fundamental factor) and the equity price (which proxies the Tobin's Q) explain a very important fraction of the investment variation 20 quarters ahead (respectively, 28.9% and 19.8%). In contrast, the cost of capital (another fundamental determinant of investment in the neoclassical model) and the financial factors (credit and the lending rate) play a secondary role, as they represent a small share of the variation of investment (respectively, 1.2%, 4.6% and 0.8%).

Table 1: Variance decompositions.

	GDP	CAPCOST	I	LENDRATE	CREDIT	EQ
GDP	0.6867	0.0012	0.0041	0.0097	0.0308	0.2675
CAPCOST	0.0065	0.9857	0.0000	0.0059	0.0001	0.0018
I	0.2889	0.0123	0.4475	0.0079	0.0456	0.1978
LENDRATE	0.0239	0.0067	0.0135	0.9253	0.0160	0.0146
CREDIT	0.0920	0.0042	0.0215	0.0112	0.6199	0.2513
EQ	0.0133	0.0054	0.0103	0.0254	0.0044	0.9413

Note: Percent of variation in the row variable (20 quarters ahead) explained by column variable.

We now look at the response of investment to shocks to the different variables of the system by geographical area. Figure 3 plots the impulse-response functions and the 10% error bands generated by Monte Carlo simulation for emerging Asia. Figure 4 summarizes the information for Latin American markets. Figure 5 displays the results for emerging European economies.

The results are overall consistent with the findings for the full sample. However, one can still emphasize that: (*i*) investment in all geographical regions exhibit a strong co-movement with GDP; (*ii*) the cost of capital has a temporary and negative impact on investment, especially, in Latin America and emerging Europe; (*iii*) the negative effect of lending rate on investment is more pronounced and significant for emerging European markets, reflecting the fact that these economies tend to be bank-based;[9] (*iv*) credit shocks have a negative and significant effect in Latin America; and (*v*) equity price shocks have a positive impact of similar magnitude for Asia and Latin America, but the effects tend to be smaller for emerging Europe.

[9]Edison and Slok (2003) also show that wealth effects on consumption are typically larger in countries that are market-based (i.e., where the role of the financial market is prominent) than in countries that are bank-based (i.e., where the financial system is based on bank loans). Two explanations are offered: (*i*) the share of financial assets in total wealth is larger for households and firms in the market-based group; and (*ii*) households and firms can borrow more easily against their assets in market-based economies due to deeper financial deregulation and wider financial instruments.

Figure 3: Impulse-response functions: sample of emerging Asian markets.

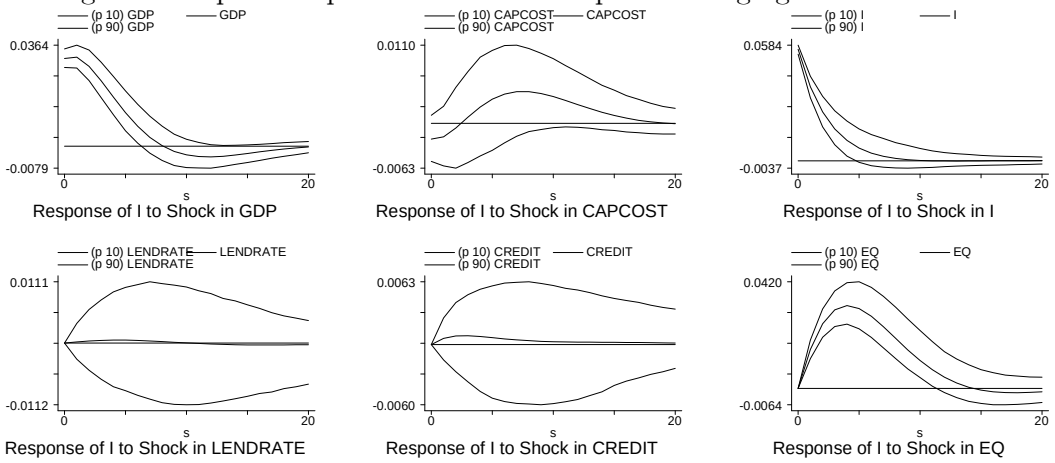


Figure 4: Impulse-response functions: sample of Latin America markets.

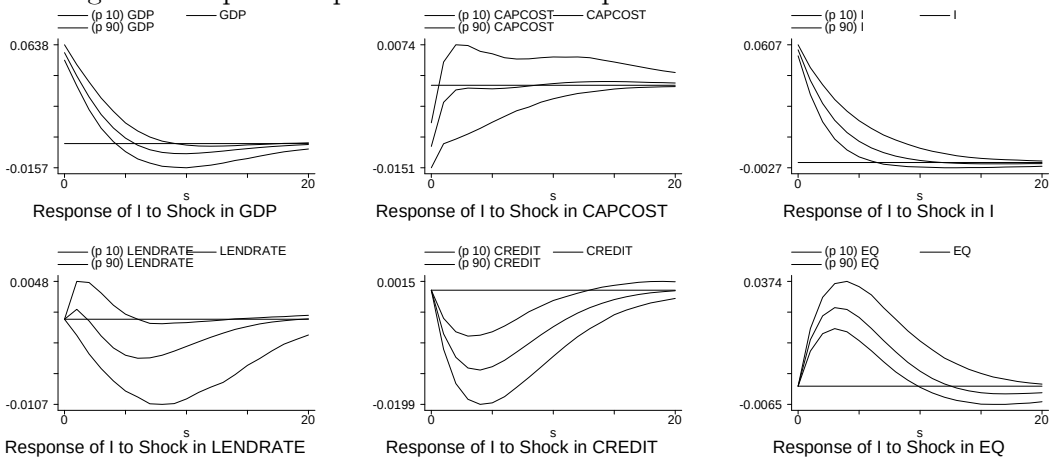
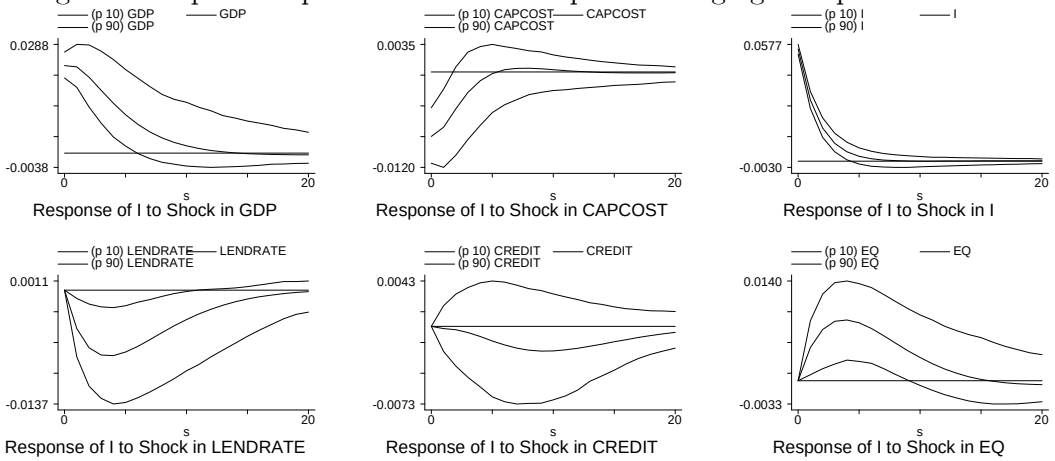


Figure 5: Impulse-response functions: sample of emerging European markets.



6 Sensitivity analysis

We start by looking at the impulse-response functions for different sub-samples. We consider two periods: 1990:1-1999:4 (Figure 6) and 2000:1-2008:3 (Figure 7). The major difference between the two sub-samples lie on the response of investment to a shock to the equity price. In fact, the results suggest that the effects are stronger in the period 1990:1-1999:4 (a peak of about 3% reached after 3 to 5 quarters which compares with roughly 1% in the period 2000:1-2008:3), reflecting the boom of stock markets in that period, which may have, therefore, contributed to amplify investment growth. While this may be supporting the Tobin's Q approach, it is also in accordance with the findings of Caballero and Hammour (2002) who suggest that stock market bubbles may encourage real investment and with the work of Edison and Slok (2003) who argue that firms have exploited part of the increase in stock market valuations in the nineties to rise their investment.

In addition, the results also show that: (i) the sensitivity of investment with respect to shocks to GDP was larger in the first sub-sample, probably, reflecting a stronger co-movement between the two macroeconomic aggregates and the instability associated to episodes of crises; (ii) investment has become less responsive to shocks in the cost of capital (iii) the negative response of investment to shocks in the lending rate is smaller in magnitude and shorter in duration in the period 2000:1-2008:3; and (iv) while a positive credit shock impacts negatively on investment in the first sub-sample, it seems to produce a positive (although) lagged response of investment in the second sub-sample. This piece of evidence is consistent with the idea that constraints in the access to credit were more important during the nineties, when, not surprisingly, credit demand shocks played an important role. In contrast, the period of 2000:1-2008:3 was characterized by an easier access to international capital markets, stronger financial linkages, deeper global imbalances and, in general, expansionary monetary policy. As a result, credit supply shocks seem to be more prominent in this period, thereby generating a positive effect on investment.

Figure 6: Impulse-response functions: sub-sample period 1990:1-1999:4.

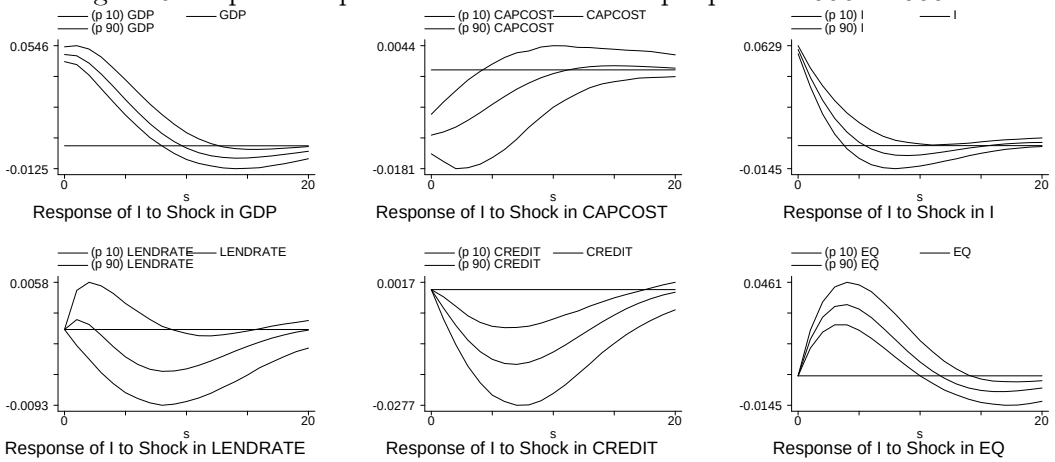
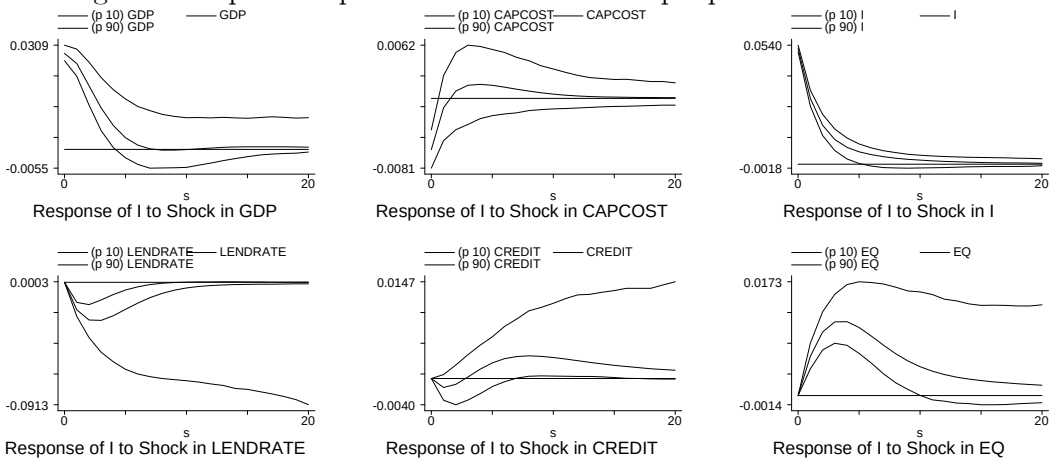


Figure 7: Impulse-response functions: sub-sample period 2000:1-2008:3.



We now drive the attention to the framework that focuses on the fundamental (or neo-classical) and the financial determinants of investment. In practice, we drop the equity price, EQ, from the set of variables of the PVAR model. This empirical exercise aims at analyzing whether the previous results are somewhat biased by the presence of a variable that is related with markets where trade takes place instantaneously. Moreover, it assesses whether the equity price is just capturing useful leading information about investment opportunities, in particular, and the economy, in general.

The results can be found in Figure 8 and clearly show that the previous conclusions do not change: (i) a shock to GDP has a positive impact on investment, reflecting the co-movement between the two macroeconomic aggregates; (ii) the cost of capital has a negative (although temporary) effect on investment; and (iv) shocks to investment tend to be persistent; and (iv) a shock to credit has a negative effect on investment that gradually dissipates as the shock erodes. Nevertheless, the response of investment to a shock in the lending rate becomes insignificant.

Figure 8: Impulse-response functions: without EQ.

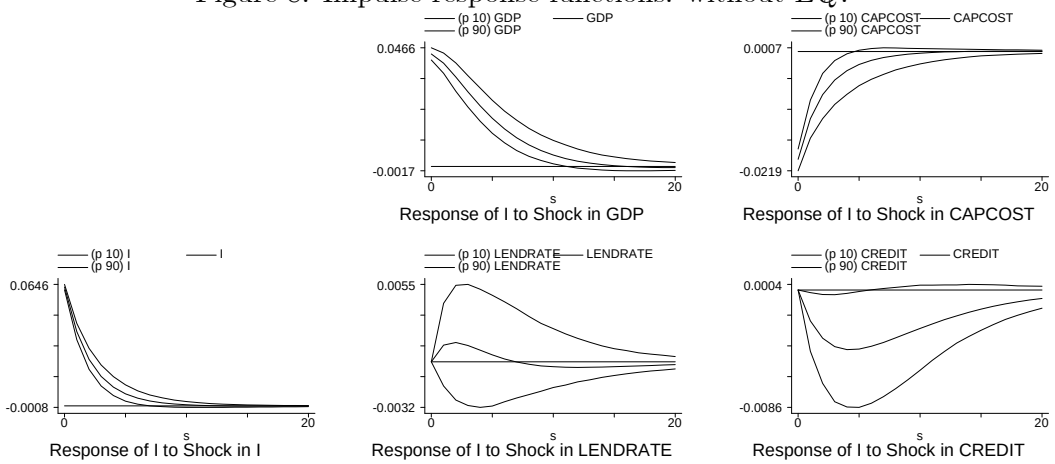
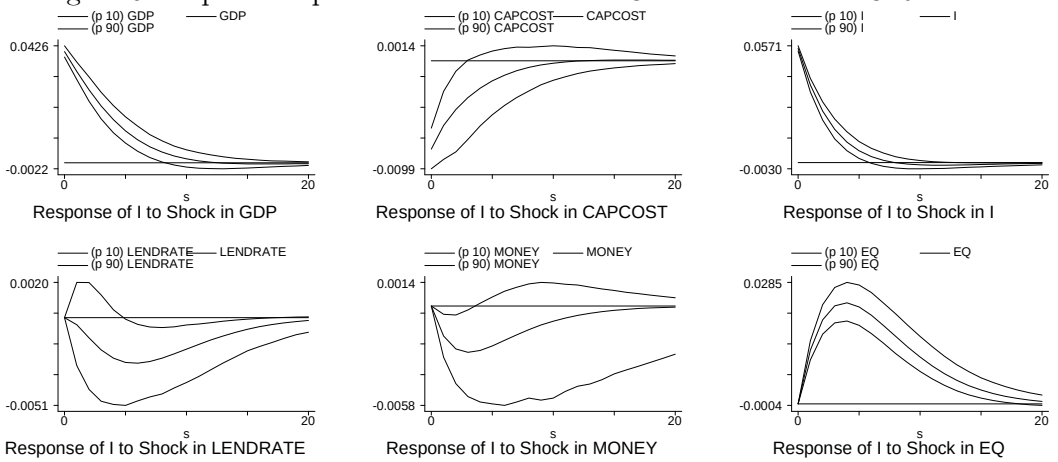


Figure 9 displays the impulse-response functions of the model where we replace $CREDIT$ by $MONEY$. Bernanke and Blinder (1988) show that a creditist central bank reacts differently to observable variables (for instance, income, money and credit) than a monetarist central bank. We, therefore, use $MONEY$ (instead of $CREDIT$) in our PVAR model. The results remain robust relative to the previous findings. Noticeably, the negative response of investment (that one observed for the credit shock) *de facto* disappears, as it becomes statistically not significant after a few quarters in the case of the monetary aggregate. As a result, a shock to $MONEY$ can be associated with an improvement of the liquidity conditions: by increasing the level of liquidity in the economy and reducing the number of liquidity-constrained companies, a shock to the monetary aggregate may actually induce an increase of private investment.

Figure 9: Impulse-response functions: with $MONEY$ instead of $CREDIT$.



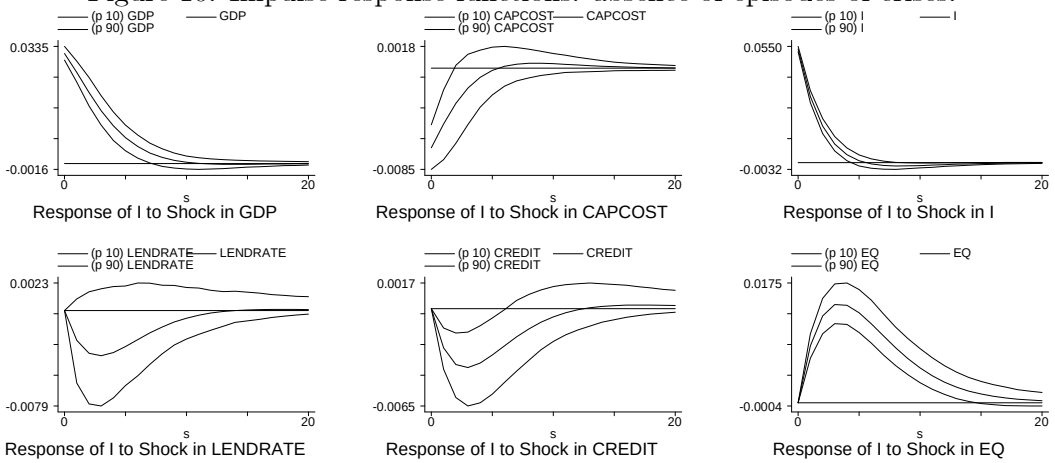
Finally, given that emerging markets have frequently been the stage for episodes of economic, financial and/or currency crises, we create two dummy variables, $D_{i,t}^{CRISIS}$ and $D_{i,t}^{NO\ CRISIS}$, aimed at identifying them. We define the dummy variable $D_{i,t}^{CRISIS}$ as follows: it takes the value of 1 if either the change (year-on-year) of real GDP or real equity price index is more than two times the country-specific standard deviation of the variable; and 0, otherwise. In addition, the quarters before and after the peak of crisis are also marked with 1, and all other periods (normal periods) are marked with 0. By its turn, the dummy variable $D_{i,t}^{NO\ CRISIS}$ takes the value of 1 in case of absence of episodes of crises and 0 otherwise. Then, we estimate a dummy variable augmented PVAR model of the form:

$$Y_{i,t} = \Gamma_0 + \Gamma_{CRISIS}(L)Y_{i,t} \cdot D_{i,t}^{CRISIS} + \Gamma_{NO\ CRISIS}(L)Y_{i,t} \cdot D_{i,t}^{NO\ CRISIS} + \\ + \nu_i + d_{c,t} + \varepsilon_{i,t} \qquad \text{with} \qquad i = 1, ..., N \qquad t = 1, ..., T_i. \tag{2}$$

This robustness test checks whether the previous findings were biased because the episodes of crises were not appropriately controlled for. Figure 10 displays the impulse-response functions in the case of $NO\ CRISIS$ scenario. The results support the robustness of the previous

findings and show that, in the absence of periods of extreme instability (that is, in "normal" periods), investment still responds in the same manner to shocks in the different variables of the system.

Figure 10: Impulse-response functions: absence of episodes of crises.



7 Conclusion

This paper uses a Panel Vector Auto-Regressive (PVAR) approach to analyze the short-run dynamics of private investment to shocks to fundamental and financial factors in emerging market economies.

By relying on a panel of 31 emerging economies and quarterly frequency data for the period 1990:1-2008:3, we show that: (*i*) the persistence of investment shocks is large; (*ii*) there is a strong co-movement between investment and GDP; (*iii*) shocks to the equity price have a positive and sizeable impact on investment; (*iv*) unexpected variation in the cost of capital has a negative (although temporary) effect on investment; (*v*) credit demand shocks seem to be particularly important. The robustness of these findings is also assessed against the exclusion of the equity price index and the presence of crises episodes.

The negative response of investment to the credit shock *de facto* disappears and becomes not statistically significant after a few quarters when the measure of credit is replaced by a monetary aggregate. Therefore, by increasing the level of liquidity in the economy, a shock to the monetary aggregate may actually induce an increase of private investment.

In addition, we show that the effects of equity price shocks are of similar magnitude in emerging Asia and Latin America, but unexpected variation in credit conditions has more pronounced effects in Latin America. Moreover, shocks to the lending rate have a negative effect in emerging European markets, a fact that can be explained by the higher reliance of the financial system on bank loans.

Finally, we show that the impact of the equity price on investment was stronger in the first half of the sample, that is, 1990:1-1999:4. It, therefore, suggests that the boom of stock markets may have amplified investment growth in emerging markets and that stock market bubbles may have, indeed, encouraged real investment. This piece of evidence should be

carefully addressed as it poses important challenges to emerging markets, in particular, in the case of a downturn of financial markets.

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8 Appendix

A Data and Summary Statistics

Table A.1: Data sources.

Variable	Source	Definition	Remark
Investment	HA	Gross Fixed Capital Formation	CP, SA
GDP	HA	Gross Domestic Product	CP, SA
Cost of capital	HA	Ratio investment / GDP deflator	CP, SA
Equity	HA / GFD*	Composite Index	Deflated
Credit	IMF code SAP	Claims on Private Sector	Deflated
Lending rate	IMF code IP**	Lending rate	Deflated

Notes: * for Argentina, Chile, Colombia, Croatia, Czech Republic, Hong Kong, Israel, Korea, Peru, Philippines, Russia, Singapore, South Africa; ** interbank rate for Romania and Turkey.
In the source section, HA stands for Haver Analytics, GFD for Global Financial Database, IMF for International Monetary Fund IFS statistics, CP means constant price, SA means seasonally adjusted, and Deflated means deflated using the GDP deflator.

Table A.2: Annual average change in log series.

Variable	Obs	Mean	Std. Dev.	Min	Max
Investment	1469	0.0552	0.1268	-0.8383	0.4051
GDP	1469	0.0450	0.0374	-0.1652	0.1594
Cost of capital	1469	-0.0081	0.0418	-0.2123	0.2377
Equity	1469	0.0714	0.3411	-2.5877	1.4276
Credit	1469	0.0922	0.1355	-0.4754	0.6037
Lending rate	1469	-0.1284	2.9841	-101.8218	1.6363

Table A.3: Sample period and number of observations per country.

Country	Obs	Sample period
Argentina	55	1995:1-2008:3
Brazil	43	1998:1-2008:3
Bulgaria	28	2001:4-2008:3
Chile	67	1992:1-2008:3
China	43	1997:2-2007:4
Colombia	51	1996:1-2008:3
Croatia	27	2002:1-2008:3
Czech Republic	43	1998:1-2008:2
Estonia	44	1997:2-2008:1
Hong Kong	68	1991:4-2008:3
Hungary	47	1997:1-2008:3
India	42	1998:2-2008:3
Indonesia	30	2001:2-2008:3
Israel	47	1997:1-2008:3
Korea	74	1990:2-2008:3
Latvia	31	2001:1-2008:3
Lithuania	31	2001:1-2008:3
Malaysia	46	1997:2-2008:3
Mexico	57	1994:3-2008:3
Peru	71	1991:1-2008:3
Philippines	71	1990:2-2007:4
Poland	36	1998:1-2006:4
Romania	27	2002:1-2008:3
Russia	47	1997:1-2008:3
Singapore	71	1990:2-2007:4
Slovakia	42	1998:2-2008:3
Slovenia	36	1998:1-2006:4
South Africa	74	1990:2-2008:3
Taiwan	27	2002:1-2008:3
Thailand	55	1995:1-2008:3
Turkey	38	1999:1-2008:3

Table A.4: Annual average change in log series.

	Investment	GDP	Cost of capital	Equity	Credit	Lending rate
All	0.0552	0.0450	-0.0081	0.0714	0.0922	-0.1284
Asia	0.0383	0.0466	-0.0011	0.0254	0.0615	-0.0027
Latin America	0.0547	0.0384	-0.0077	0.1039	0.0598	-0.5192
Emerging Europe	0.0817	0.0524	-0.0161	0.1039	0.1620	-0.0173
Other	0.0390	0.0337	-0.0098	0.0643	0.0712	-0.0059
Argentina	0.0404	0.0303	0.0028	0.0643	0.0001	-0.0068
Brazil	0.0302	0.0300	0.0068	0.0940	0.0382	-0.0285
Bulgaria	0.1573	0.0586	-0.0097	0.3059	0.2963	-0.0068
Chile	0.0866	0.0546	-0.0265	0.0777	0.0956	0.0005
China	0.0387	0.0188	0.0000	0.0235	0.0420	-0.0033
Colombia	0.0326	0.0319	-0.0145	0.0923	0.0477	-0.0116
Croatia	0.1013	0.0446	-0.0062	0.1627	0.1308	-0.0035
Czech Republic	0.0316	0.0352	-0.0167	0.0678	0.0032	-0.0010
Estonia	0.1126	0.0695	-0.0288	0.1006	0.2127	0.0038
Hong Kong	0.0347	0.0403	-0.0092	0.0932	0.0405	0.0005
Hungary	0.0510	0.0384	-0.0173	0.0843	0.1381	-0.0048
India	0.1044	0.0689	0.0036	0.0865	0.1363	-0.0002
Indonesia	0.0690	0.0509	0.0184	0.1170	0.0862	-0.0132
Israel	0.0129	0.0372	0.0033	0.1113	0.0688	-0.0043
Korea	0.0456	0.0547	0.0019	-0.0069	0.0992	0.0000
Latvia	0.1156	0.0753	-0.0082	0.0823	0.2845	-0.0154
Lithuania	0.1234	0.0738	-0.0072	0.1538	0.2660	-0.0178
Malaysia	-0.0016	0.0447	-0.0173	-0.0393	0.0158	-0.0111
Mexico	0.0434	0.0288	-0.0057	0.0592	-0.0058	-0.0062
Peru	0.0753	0.0470	-0.0038	0.2094	0.1468	-2.4804
Philippines	0.0256	0.0371	-0.0106	-0.0057	0.0547	-0.0024
Poland	0.0374	0.0385	-0.0417	0.0701	0.0912	-0.0090
Romania	0.1454	0.0621	-0.0105	0.1910	0.3046	-0.0194
Russia	0.0816	0.0535	-0.0204	0.0137	0.1849	-0.0985
Singapore	0.0616	0.0652	-0.0140	0.0478	0.0718	-0.0012
Slovakia	0.0323	0.0499	-0.0084	0.0498	0.0231	-0.0095
Slovenia	0.0591	0.0410	-0.0077	0.1002	0.1409	-0.0077
South Africa	0.0463	0.0268	-0.0138	0.0384	0.0502	0.0003
Taiwan	0.0291	0.0450	0.0284	0.0828	0.0558	-0.0007
Thailand	-0.0099	0.0361	0.0174	-0.0727	0.0177	-0.0026
Turkey	0.0572	0.0429	-0.0183	0.0563	0.1153	-0.0197

Table A.5: Correlation coefficients.

	Investment	GDP	Cost of capital	Equity	Credit	Lending rate
Investment	1.0000					
GDP	0.7597	1.0000				
Cost of capital	-0.2825	-0.2287	1.0000			
Equity	0.2587	0.2624	-0.0075	1.0000		
Credit	0.4359	0.4424	-0.1815	0.0892	1.0000	
Lending rate	-0.2429	-0.2174	0.0752	0.0410	0.1772	1.0000

Note: All series are in log differences.

Table A.6: Panel Unit Root Test Results.

	Investment	GDP	Cost of capital	Equity	Credit	Lending rate
Levin, Lin Chu t-stat	-4.9499	-4.9035	-6.8433	-4.9035	-2.4534	-114.736
p-value	0.0000	0.0000	0.0000	0.0000	0.0071	0.0000
Im, Pesaran and Shin W-stat	-8.1168	-8.512	-11.8380	-8.5123	-6.2376	-43.6758
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: All series are in log differences.

Table A.7: Ratio of investment to GDP.

Date	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Argentina				19.0	19.9	17.9	18.1	19.4	19.9	18.0	16.2	14.1	11.9	15.1	19.2	21.4	23.3	24.2
Brazil					20.9	18.4	16.9	17.4	17.0	15.7	16.8	17.0	16.4	15.3	16.1	15.9	16.7	17.8
Bulgaria					14.3	15.3	13.0	11.3	13.0	15.0	15.7	18.2	18.2	19.3	20.5	24.1	25.9	29.8
Chile	23.8	20.7	23.2	25.9	24.4	25.2	26.4	26.9	25.8	20.5	20.2	21.1	20.5	20.2	19.3	21.2	19.5	20.6
China	21.4	23.0	26.4	30.9	29.6	28.3	27.8	27.3	28.3	28.7	29.4	29.7	31.1	33.6	34.8	35.1	34.9	34.3
Colombia					27.8	28.3	24.4	22.8	21.6	14.1	15.7	16.7	17.1	18.9	20.0	21.6	24.3	24.9
Croatia								24.2	23.3	23.3	21.8	22.3	24.3	28.5	28.2	28.1	29.8	30.0
Czech Republic						31.5	32.1	30.0	28.2	27.0	28.0	28.0	27.5	26.7	25.8	24.9	24.6	24.1
Estonia						27.0	26.5	28.2	30.5	24.7	26.0	26.6	29.7	31.7	31.0	30.7	33.8	32.5
Hong Kong	26.1	26.2	27.0	26.9	29.2	30.0	30.8	33.1	30.0	25.7	26.4	25.6	22.4	21.2	21.3	20.9	21.8	20.3
Hungary						20.0	21.4	22.4	23.8	24.4	23.8	23.6	23.3	22.2	22.5	22.9	21.2	21.1
India								25.4	24.6	25.4	25.1	25.3	25.8	26.4	30.0	33.1	35.0	37.1
Indonesia											19.8	19.7	19.4	19.5	22.4	23.6	24.1	24.8
Israel						23.7	23.7	22.6	20.6	20.2	18.7	17.8	17.3	16.6	16.5	16.4	17.1	18.7
Korea	37.0	38.9	36.9	36.3	36.4	37.3	37.5	35.6	30.3	29.7	31.1	29.5	29.1	29.9	29.5	29.3	29.0	28.8
Latvia			11.9	13.6	14.7	13.5	16.4	16.9	24.7	23.0	24.2	24.8	23.8	24.4	27.5	30.6	32.6	32.3
Lithuania				24.6	20.6	21.0	21.1	22.6	24.0	22.0	18.8	20.2	20.3	21.1	22.3	22.7	25.2	28.0
Malaysia							42.5	43.2	26.8	21.9	25.3	25.1	23.5	22.4	21.0	20.5	20.8	21.7
Mexico				18.6	19.3	16.2	17.8	19.4	20.9	21.2	21.4	20.0	19.3	18.9	19.6	19.3	20.4	20.8
Peru	19.9	17.1	17.3	19.4	22.2	24.8	22.8	24.1	23.6	21.1	20.1	18.8	18.4	18.4	18.1	17.8	20.0	22.9
Philippines	23.1	20.1	20.9	23.7	23.6	22.2	23.4	24.4	21.2	19.1	21.2	17.9	17.6	16.8	16.1	14.4	14.0	14.8
Poland							29.1	28.7	28.0	26.8	24.9	20.6	18.4	18.2	19.1	18.2	19.5	22.0
Romania								21.0	18.3	18.1	18.9	20.7	21.3	21.4	21.9	23.0	25.6	30.4
Russia				21.7	22.2	20.8	20.0	18.3	16.3	14.4	16.8	18.9	17.9	18.4	18.4	17.7	18.4	21.0
Slovakia				29.9	26.6	26.0	32.6	34.9	36.3	30.0	25.7	28.5	27.3	24.8	23.9	26.5	26.4	26.1
Slovenia						20.9	21.8	23.1	24.2	26.5	26.5	25.0	23.4	24.4	25.5	25.7	26.7	28.1
South Africa	19.2	17.2	15.7	14.7	15.1	15.9	16.3	16.5	17.1	15.5	15.1	15.1	15.0	15.9	16.2	17.1	18.9	21.1
Taiwan	22.3	22.1	23.9	25.0	24.4	24.8	22.4	22.7	23.7	23.1	23.9	19.4	18.6	18.6	21.9	21.3	21.3	21.2
Thailand				39.5	39.7	41.0	41.1	33.9	22.4	20.9	22.0	23.0	22.9	24.1	26.0	29.0	28.2	26.4
Turkey									23.0	19.0	20.4	16.1	16.7	17.0	20.3	21.0	22.3	21.6

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