Financial Development, Shocks, and Growth Volatility

Mallick, Debdulal

Deakin University

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Debdulal Mallick*

School of Accounting, Economics and Finance
Deakin University
Burwood, VIC 3125
Australia
Phone: (61 3) 92517808
Fax: (61 3) 92446283
Email: dmallic@deakin.edu.au

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Abstract

This paper argues that studying the effect of financial development and shocks on aggregate growth volatility will not be informative because they affect growth volatility through its different components. Volatility declines either a consequence of a change in the nature of shocks or a change in how the economy reacts to shocks. If two economies differ only in terms of volatility of shocks experienced, the GDP growth spectrum of one economy will lie proportionately below that of another at all frequency ranges so that both business cycle and long-run variances will be lower. Conversely, if change in volatility is due to propagation mechanism such as financial development, a country having developed financial markets will have disproportionately lower variance at the business cycle than at other frequencies relative to that of a country having less developed financial markets. Therefore, the variance at only the business cycle frequency range will be influenced by financial development. The novelty of this paper is that different components of growth volatility are extracted using spectral method.

Empirical evidence provides qualified support for both hypotheses. Higher private credit, which is used as proxy of financial development, dampens business cycle volatility but not the long-run volatility. Shocks, as measured by changes in the terms of trade, affect both business cycle and long-run volatility negatively. These results are robust to alternative market-based measure of financial development, and corrections for reverse causality. These results have important implications for growth theory as they shed lights on the factors causing permanent and transitory deviations from the steady state.

JEL Classification codes: C21, C22, E32, E44, O16, O50

Keywords: Financial development, growth volatility, business cycle, spectral analysis

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I. Introduction

Growth models focus on the trend growth and a large body of literature has studied the role of the financial development in economic growth.[1] Business cycle volatility is related to financial development through several channels including the flow of information and the enforcement of contracts. Shocks, on the other hand, generate and magnify the business cycle volatility and also affect the long-run trend growth that depends on the shock persistence. There are several models that try to bridge growth and business cycle models and explain the role of financial development and shocks in growth volatility (Aghion et al., 2007, and papers cited therein). There is also a nascent literature that empirically investigates the role of financial development in growth volatility but without making any distinction between its long-run and business cycle components. These studies use the standard deviation of the growth rate of per capita real GDP as the measure of volatility.

In this paper we argue and show that financial development and shocks affect total volatility through its different components. Specifically, we show that financial development impacts only on the business cycle component of volatility while shocks impact on both the long-run and business cycle components, and therefore on total volatility. In other words, volatility caused by shocks is more persistent than that caused by financial underdevelopment.[2] This paper can be considered as an attempt to investigate the bridge between the two approaches mentioned above. The novelty of this paper is that it employs spectral method to extract business cycle and long-run components of the variance of the growth rate of real GDP per capita. This investigation has also important implications for growth theory. Previous studies do not distinguish the factors that cause permanent and transitory deviations from the steady state growth rate.

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[1] Levine (1997) provides an excellent discussion.

[2] Long-run volatility can be a consequence when serial correlation of output growth rate is very large or an economy does not revert to the original steady state after deviation or exhibits limit cycles. In the latter two cases growth rate is nonstationary. Long-run volatility estimated in the paper is more consistent with the first case. We use long-run volatility and persistent volatility interchangeably.

This paper sheds some lights on this issue by investigating two important factors—financial development and shocks.

Assuming that the output growth series is covariance stationary, its variance can be expressed as the integral of the spectrum of the series across all frequencies, $-\pi \leq \omega \leq \pi$. Therefore, a country with lower growth variance would have a spectrum lying below the one for the country with higher growth variance. It does not necessarily mean that the spectrum will lay below at all frequency ranges; the area under the spectrum will be smaller. Distribution of the two spectra across different frequency ranges is very informative in explaining the relative volatility at different frequency ranges (Ahmed et al., 2004, p. 825).

Any stochastic model of the economy can be thought of a combination of some shocks and a propagation mechanism. Output growth volatility declines either as a consequence of a change in the nature of shocks or as a change in the propagation mechanism, i.e., a change in how the economy reacts to shocks, or a combination of both. If two economies differ only in terms of volatility of shocks experienced, the GDP growth spectrum of one economy will lie proportionately below that of another at all frequency ranges. The reason is that a covariance-stationary series, such as output growth, can be expressed as an infinite moving-average (MA) process whose spectrum is proportional to the innovation variance. Therefore, the lower volatility of shocks can be interpreted as a lower innovation variance with the same MA coefficients for two economies. Given that a particular component of the variance is the integral of the spectrum over the respective frequency ranges, both the long-run and business cycle components of the variance will be lower for the country experiencing lower volatility of shocks.

Conversely, if change in volatility is solely due to change in propagation mechanism, such as financial development, this would be manifested in the contour of the spectrum (Ahmed, et al., 2004, p. 824). One would expect that, *ceteris paribus*, the country having developed financial markets will have disproportionately lower variance at the business cycle than at other frequencies relative to that of a country having less developed financial markets. Therefore, the variance at the business cycle frequency range will be influenced by financial development. If better business practices such as better inventory management that smooth output in the short-run is mainly responsible for lower volatility, variance will be lower primarily at relatively high frequencies. Measurement errors would also be reflected in the high frequency range. Finally, if a lower volatility is due to a combination of changes in both shocks and propagation mechanism, one spectrum will lie below another disproportionately at some frequency range depending on the relative importance of the factors.

The above econometric argument can also be supplemented by predictions of growth models. The main argument is that shocks generate long-run volatility but financial development does not. The real business cycle (RBC) models cannot explain persistence volatility unless shocks are very volatile and persistent. In endogenous growth models, shocks generate persistent volatility. For example, in Fatás (2002), expected profitability of innovation depends on aggregate demand, and negative shocks to aggregate demand reduce the incentive to innovate. When the economy gets out of recession, innovation is permanently lower and therefore, output remains at a permanently low level. Economic downturns also impact negatively on the amount of learning by doing that permanently lowers the steady state growth rate (Stadler, 1986; 1990).

There are several models that explain the role of financial development in business cycle volatility but long-run volatility does not occur in standard situations. The best example can be Aghion and Banerjee (2005) where long-run volatility is a remote possibility for intermediate level of financial development. They show that financial underdevelopment interacts with interest rate (or real exchange rate in open economy) to generate volatility but volatility can be persistent (in the sense that an economy exhibits limit cycles) only in the countries at the medium level of financial development. Investments and borrowing are higher in a boom that leads to higher interest rate. But higher interest rate also creates a pecuniary externality as it increases the debt burden of all entrepreneurs, which slows down growth of entrepreneur's wealth and investment capacity. At some point, investment capacity falls below total savings, the economy enters recession and interest rate will eventually fall. The process will then revert to a boom. But only countries at intermediate level of financial development may experience limit cycles. In a highly financially underdeveloped country entrepreneurs rely entirely on their retained earnings for investment. On the other hand, financially developed countries will not also experience long-run volatility because firms can invest up to the expected net present value of their project since they face no credit constraints.

Based on the above discussions, this paper aims to test two hypotheses. First, a country with developed financial markets will experience lower business cycle component of growth volatility but the long-run component will not be affected by such development. The effect on total volatility will, therefore, depend on the share of the business cycle component in total volatility. Second, a country experiencing lower shocks will have both lower business cycle and long-run components of volatility and, therefore, lower total volatility. Our measure of financial development is the private sector credit by bank and other financial institutions as a percentage of GDP. We also check the robustness using an alternative measure—value of total stock market capitalization as a percentage of GDP. Both measures are standard in the literature. We use changes in the terms of trade (TOT) defined as the ratio of export prices to import prices as a proxy measure of shocks, which is considered as exogenous to a country.

Empirical evidence provides qualified support for our hypotheses. After controlling for country specific fixed factors and the effects of possible outliers, we find, in a sample of 79 countries for the period 1980-2004, that higher private credit dampens the business cycle component of volatility but not the long-run component, while a TOT deterioration (improvement) magnifies (dampens) both business cycle and long-run components of volatility. The role of higher private credit in reducing volatility is not found to be important for the high income countries when examined at different stages of economic development. However, when we construct a two-period panel only for selected OECD countries for which longer period of data are available, we find that higher private credit reduces business cycle volatility for these countries as well. When private credit is replaced by value of stock market capitalization, we find a robust negative effect only for the low-income countries. All results are robust to corrections for reverse causality.

The rest of the paper is organized as follows. Section II briefly discusses different channels through which financial development dampens growth volatility, reviews empirical works and explains the motivation for investigating different volatility components. We discuss estimation of different components of volatility in the frequency domain, data and summary statistics at the cross-country level in section III. In section IV, we present our findings. Finally, section V concludes.

II. Related literature and motivation

The existing literature describes several routes through which financial development and shocks might impact on volatility.

Developed financial markets and institutions lessen separation between savers and investors and facilitate diversification which has implications for growth volatility. In Aghion et al. (1999) savings exceed investment during periods of slow growth resulting in low demand for savings and therefore low equilibrium interest rates, which in turn implies that investors can retain large portion of their profits and expand investment. This process continues until investment increases sufficiently to put upward pressure on interest rates. Then the process is reversed taking the economy back to a period of slower growth. The higher the degree of separation between savers and investors, the larger is the growth volatility. Acemoglu and Zilibotti (1997) argue that in the early stages of development indivisibility of investment limits the degree of diversification of idiosyncratic risk that discourages investment in risky projects which are more productive. This slows down capital accumulation and introduces large growth volatility. However, Koren and Tenreyro (2007) did not find support that low income countries invest in safe projects; rather, these countries' investment is concentrated in more volatile sectors.

Financial development also reduces volatility by reducing cost of acquiring information and improving risk management. Underdeveloped financial markets are characterized by imperfect information and costly enforcement of contracts that interfere with smooth functioning of the financial market. Bernanke and Gertler (1995) and Bernanke et al. (1998) argue the balanced sheet (or net worth) channel of the firm in mitigating business cycle volatility as imperfect information and costly enforcement of contracts create "external finance premium" that is a wedge between the cost of external funds and the opportunity cost of internal funds. Tighter monetary policy exacerbates the borrower balance sheet problem thus amplifying and propagating the business cycle. This problem will be more pronounced in the financially underdeveloped countries where "external finance premium" is greater. Greenwald and Stiglitz (1993) also develop models in which developed financial markets dampen volatility by reducing information. In Aizenman and Powell (2003) a weak legal system interacts with high costs for information verification leading to a first-order effect of volatility on production, employment and welfare. Their calibration illustrates that a 1% increase in the coefficient of variation of productivity shocks would reduce welfare by more than 1%. However, these are not models of persistent business cycle.

Aghion et al. (2007) try to bridge the apparent disjoint between long-run growth and business cycles models. In their model the share of long-term investment is countercyclical when the capital market is perfect but becomes procyclical with an imperfect capital market. Since long-term investment enhances productivity more than short-term investment, this implies that the cyclical behavior of the composition of investment mitigates fluctuations when financial markets are perfect, but amplifies them when credit constraints are sufficiently tight.

There are several studies that empirically investigate the role of financial development and shocks in growth volatility with mixed support. Easterly et al. (2002) find that financial development (as measured by private credit to GDP) lowers growth volatility but in a nonlinear fashion. Financial development reduces volatility up to a point, but too much private credit can increase volatility. Kunieda (2008) also finds a nonlinear relationship in that financial development has a hump-shaped effect on growth volatility. In early stages of financial development, growth rates are less volatile. As the financial sector develops, an economy becomes highly volatile but becomes less volatile once again as financial sector matures. Lopez and Spiegel (2002), Denizer et al. (2002), Silva (2002), and Tharavanij (2007) also confirm a negative relationship between financial development and growth volatility.

Raddatz (2006) examines US industry level data and finds that financial development leads to a comparatively larger reduction in the volatility of output in sectors with high liquidity needs. Phumiwasana (2003) finds evidence that bank-based financial system increases the volatility among developed countries, while decreases volatility among developing countries. However, Silva (2002) finds that bank-based or market-based financial structure is unimportant in explaining growth volatility.

On the other hand, Tiryaki (2003) and Beck et al. (2006) do not a find relationship between financial development and growth volatility. Acemoglu et al. (2003) suggest that distortionary macroeconomic policies are symptoms of underlying institutional problems rather than main causes of economic volatility. They find that financial aspects become insignificant for explaining volatility once the effect of institutions are controlled. These results contrast the mechanisms behind the difference in cross-country growth volatility explained above.

Beck et al. (2006) investigate the channels through which financial development potentially affects growth volatility. They find inflation volatility magnifies growth volatility in countries with low level of financial development but no effect in the countries with better financial system. They also find weak evidence for a dampening effect of financial intermediary development on the impact of TOT volatility. Aghion et al. (2007) use a panel data of 21 OECD countries over the 1960-2000 period and find that the impact of commodity price shocks on the long-run investment (share of structural investment is their proxy) is more negative in countries with lower private credit. In contrast, they find no such effect in the case of overall investment rate.

The literature discussed above invariably uses the standard deviation of the per capita GDP growth as the measure of volatility[3] without making any distinction between its different components. In the following, we argue that this aggregate measure of volatility is not informative because financial development and shocks impact on total volatility through its different components.

Assuming that the output growth series is covariance stationary, its variance can be expressed as the integral of the spectrum of the series, $g(\omega)$, across all frequencies $-\pi \le \omega \le \pi$. A country with lower growth variance would have a spectrum lying below the one for the country with higher growth variance. It does not necessarily mean that the spectrum will lay below at all frequency ranges; the area under the spectrum will be smaller. Distribution of the two spectra across different frequency ranges provides useful

[3] Silva (2002) and Tharavanij (2007) are exceptions who use band-pass filtered series. None of the papers decomposes volatility into different components.

information about the relative volatility at different frequency ranges. Ahmed et al. (2004, p. 825) exploits this information to explain the reduction in different components of volatility of US GDP growth and inflation for two distinct periods, and the relative importance of improved monetary policy, exogenous shocks and improved inventory practices in explaining the reduced volatility. This argument can be extended to explain varying degree of growth volatility at the cross-country level.[4]

To understand this, suppose that two countries experience different magnitude of the volatility of shocks; otherwise, they are similar in terms of their structural features. Then the spectra of the output growth for the two countries will be of similar shape but the spectrum of the country experiencing lower volatility of shocks will lay proportionately below the other at all frequency ranges. This can be explained by Wold's theorem, which suggests that output growth, assuming it as covariance-stationary, can be expressed as an infinite moving-average (MA) process. Since the spectrum of any MA series is proportional to its innovation variance, the country experiencing lower volatility of shocks will have lower innovation variance than the other but the MA coefficients will be the same. Given that a particular component of the variance is the integral of the spectrum over the respective frequency ranges, all components of the variance will be lower for the country experiencing lower volatility of shocks. This hypothesis can be analyzed more precisely using the concept of the normalized spectrum, $h(\omega) = g(\omega)/\sigma^2$, that indicates the fraction of the total variance, σ^2, occurring at each frequency. The normalized spectrum is invariant to the magnitude of the innovation variance because both $g(\omega)$ and σ^2 are proportional to the innovation variance. Therefore, the two normalized spectra will be the same.

The argument that shocks generate long-run volatility can also be explained by endogenous growth theory. For example, in Fatás (2002) optimal research depends on the expected profitability of innovation (or imitation) which is a function of aggregate demand. Negative shocks to aggregate demand reduce the incentive to innovate and as a result when the economy recovers from recession output does not revert to the trend rather remains at a permanent low level. In Stadler (1986, 1990) economic downturns

[4] The following discussion is drawn on Ahmed et al. (2004).

impact negatively on the amount of learning by doing that also generate persistence fluctuations. In Kiyotaki and Moore (1997), a negative shock to profit decreases investment which in turn reduces the price of collateral. This increases borrowing constraints on investors thus deteriorating investment capacity which amplifies the negative shock on profit. A negative serial correlation in aggregate output is thus generated.

In contrast, if the structures of the two economies differ, the spectrum of the low-volatility country will lie below disproportionately at the business cycle and higher frequencies. For example, if the lower variance is due mainly to better business practices such as better inventory management that smooth output on a quarter-by-quarter basis, variance will be lower primarily at relatively high frequencies. Measurement errors would also be reflected in these frequencies. If financial development dampens business cycle fluctuations, as we have discussed above, one would expect that a country having developed financial markets will have its spectrum disproportionately lower at the business cycle than at other frequencies relative to that of a country having less developed financial markets. Therefore, a country with developed financial markets will have lower business cycle component of the variance than another.

Financial development impacts on long-run growth by reducing information and transaction costs, which in turn influences saving and investment decisions and technological innovation (Levine, 1997, p. 689) but its effect on long-run volatility is not clear. Aghion and Banerjee (2005) develop a model that is capable of generating endogenous volatility in an economy with credit constraints but long-run volatility can be a possibility only for countries at the intermediate level of financial development. The basic mechanism in their model is the interaction of credit constraints and endogenous changes in the interest rate. Investments and borrowing are higher in a boom that leads to higher interest rate. But higher interest rate also creates a pecuniary externality as it increases the debt burden of all entrepreneurs, which slows down growth of entrepreneur's wealth and investment capacity. At some point, investment capacity falls below total savings and the economy enters recession and interest rate will decrease. The process will then revert to a boom. However, in a highly underdeveloped country entrepreneurs rely entirely on their retained earnings for investment. Conversely, in financially developed countries firms face no credit constraints and thus can invest up to the expected net present value of their project. Therefore, financially developed or underdeveloped countries will not experience long-run volatility leaving vulnerable the countries at the intermediate level of financial development. This result also holds in the context of open economy where the relevant price is the real exchange.

Finally, if a lower volatility is due to a combination of changes in both shocks and propagation mechanism, one spectrum will lie below another disproportionately at some frequency range depending on the relative importance of these two.

The above motivation allows us to test the following two hypotheses:

1. Financial development affects only the business cycle component of volatility and therefore, the effect on total volatility depends on the relative magnitude of its business cycle component, and
2. Shocks affect both the long-run and business cycle components of volatility and therefore, total volatility.

III. Volatility at the cross-country level

In this section, we briefly explain the spectral method that is employed to extract variance at different frequency range. We then present the summary statistics of different variance components.

III.A Estimation in the frequency domain

The variance of output growth can be expressed as the integral of the spectrum of this series, $g(\omega)$, across all frequencies $-\pi \leq \omega \leq \pi$. The spectrum is symmetric around zero so that only the frequency range $0 \leq \omega \leq \pi$ becomes relevant. The novelty of spectral method is that it provides a simple yet elegant way to decompose the total variance into different components. For example, the long-run component of the variance will be the integral of the spectrum over the long-run frequency range.[5] The business

[5] The long-run component of the variance is equivalent to passing the GDP growth series through a low-pass filter, and then estimating the variance of the resulting series (Levy and Dezhbakhsh, 2003, p. 1502). It is also a measure of persistence of volatility. Another way to estimate the persistence is Cochrane's (1988) variance ratio statistic. Similarly, business cycle (short-run) component of the variance is equivalent to passing the GDP growth series through a band-pass (high-pass) filter, and then estimating the variance of the resulting series.

cycle and short-run components can also be extracted in a similar way by integrating the spectrum over the relevant frequency ranges. The sum of the three variance components—long-run, business cycle, and short-run—add to the total variance of the series. It is important to note that any variance component is orthogonal to other components because the covariance between spectral estimates at different frequencies is zero.

Suppose, x_t is a covariance-stationary series. The periodogram, which is the sample analog of the spectrum, is given by:

$\hat{g}(\omega) = \frac{1}{2\pi} \sum_{j=-(T-1)}^{T-1} \hat{\gamma}^j e^{-i\omega j} = \frac{1}{2\pi}\left[\hat{\gamma}^0 + 2\sum_{j=1}^{T-1}\hat{\gamma}^j \cos(\omega j)\right]$, where $\hat{\gamma}^j$ is the *j*-th order sample autocovariance given by $\hat{\gamma}^j = \frac{1}{T}\sum_{t=j+1}^{T}(x_t - \bar{x})(x_{t-j} - \bar{x})$,[6] for *j* = 0, 1,2, -------, (*T*-1). Here, $\bar{x}$ is the sample mean given by $\bar{x} = \frac{1}{T}\sum_{t=1}^{T} x_t$. By symmetry, $\hat{\gamma}^j = \hat{\gamma}^{-j}$. The integrated periodogram for the frequency range (ω_1, ω_2) is given by:

$\hat{G}(\omega_1,\omega_2) = 2\int_{\omega_1}^{\omega_2} \hat{g}(\omega)d\omega = \frac{\omega_2 - \omega_1}{\pi}\hat{\gamma}^0 + \frac{2}{\pi}\sum_{j=1}^{T-1}\hat{\gamma}^j \frac{\sin(\omega_2 j) - \sin(\omega_1 j)}{j}$, and represents the variance of the series x_t attributed to the frequency range $\omega_1 \le |\omega| \le \omega_2$. The frequency, ω, is inversely related to periodicity or cycle length according to $p = 2\pi/\omega$. The frequency ranges of the long-run, business cycle and short-run are given respectively, by $0 \le \omega \le \omega_1$, $\omega_1 \le \omega \le \omega_2$, and $\omega_2 \le \omega \le \pi$, where values of ω_1 and ω_2 for annual series are chosen to be 0.786 and 2.09, respectively. These cut-off frequencies are chosen following modern business cycle literature in that the long-run corresponds to cycles of 8 years or longer, and the business cycle corresponds to cycles of 3 to 8 years (Baxter and King, 1999). Therefore, low frequency is related to long-run[7] and high frequency is related to short-run.

[6] Variance of x_t is given by $\frac{1}{T-1}\sum_{t=1}^{T}(x_t - \bar{x})^2$, which slightly differs from $\hat{\gamma}^0$ because of different denominators in the two formulas.

[7] Ahmed et al. (2004) argue that periodogram at low frequencies is subject to greater sampling variation.

The periodogram is an asymptotically unbiased estimate of the spectrum (Priestley, 1981; p.693). But this is inconsistent because the variance of $\hat{g}(\omega)$ does not tend to zero as *T* tends to infinity (Priestley, 1981, p. 432). The reason is that although $\hat{g}(\omega)$ involves *T* sample autocovariances and the variance of each is of order (1/*T*), the combined effect of the *T* terms produces a variance of order 1. One way to reduce the variance is to specify a "spectral window", i.e. truncating the periodogram at some point $M < (T-1)$. We use Bartlett's window that assigns linearly decreasing weights to the autocovariances in the neighborhood of frequency considered and zero thereafter. The number of ordinates, M, is set using the rule $M = 2\sqrt{T}$ (Levy and Dezhbakhsh, 2003, p. 1527).[8]

III.B <u>Data and Descriptive statistics</u>

Growth rate is calculated by taking the first-difference of the log of real per capita GDP.[9] Calculation of the growth variance requires collapsing several years of GDP growth data. Data on private credit are not available for many countries for a long period. Given that data come from different sources, we choose the time period 1980-2004 for the analysis so that GDP and private credit data are available for relatively longer period for a good number of countries. There are 116 such countries among which, according to the World Bank classification, there are 39, 50 and 27 low income, middle income and high income countries respectively. However, data for the control variables used in the regressions are not available for many countries for that period especially for many developing countries; therefore, the sample size reduces to 79 countries for which data for all variables are available (29, 32 and 18 low, middle and high income countries respectively). Appendix A.1 provides description of all variables, their sources, and time periods. For several OECD countries, all data are available for a longer period of time.

[8] However, Engle (1974, p.3) and Priestly (1981, p. 471) argued that the integrated periodogram is consistent, not because it approaches its spectral value at each frequency, but because the sum (integral) of the periodogram over all frequencies approaches the sum (integral) of the spectral values, which is the variance attributed to frequency ranges. Priestly (1981, p. 483) mentions that both approaches—with and without spectral window—are equivalent as far as their asymptotic sampling properties are concerned.

[9] For an interesting debate on the measurement of the average growth rate, see Chatterjee and Shukayev (2005) and Ramey and Ramey (2006).

We split the sample period into two intervals—1960-1979 and 1980-2004—to construct a two period panel for this set of countries.[10]

Insert Table 1 here

Table 1 reports descriptive statistics of different components of the variance of GDP growth and their relative shares for 116 countries (variances for all sample countries are listed in Appendices A.2-A.4). Mean total variance is decreasing with income level. It is 32.9, 26.7 and 9.6 for the low, middle and high income countries, respectively. The mean value of business cycle component of the variance follows a similar pattern (13.5, 11.1 and 3.7, respectively). The mean value of long-run component is the same in the low and middle income countries at 8.3, while it is almost half in the high income countries. Note that the long-run component of the variance is one way of representing the degree of shock persistence (Levy and Dezhbakhsh, 2003, p. 1500-01). This then implies no difference in shock persistence between the low and middle income countries but the high income countries are about half shock persistent than other countries. The high income countries include both OECD and non-OECD countries. For the 20 OECD countries (column 6), the mean value of the variance at each frequency range is lower than that for all high income countries implying higher variance for the non-OECD high income countries.

However, another pattern emerges if we examine the share of different variance components. For example, the mean share of the long-run component is increasing while the mean share of the short-run component is decreasing with income level. The mean share of the business cycle component is almost the same for low and middle income countries (0.42 vs. 0.41) and is slightly lower for the high income countries (0.39). This finding contrasts Levy and Dezhbakhsh (2003), who find a statistically significant positive relationship between income level and the share of the business cycle component of the variance (their Table 6 in p. 1519). Their sample period (1950-1994) and set of

[10] Choice of this break point is based on convenience rather than statistical test as it divides the sample period in almost two equal halves. Cecchetti et al. (2005, Table 1 in p. 118) found structural break in growth volatility in only 16 of 25 developed countries and for most countries break took place at around 1981-85.

countries are different from ours. To compare their results with ours, we compute the shares for the same set of countries as Levy and Dezhbakhsh for the period 1960-2004 and report the results in Table 2.

Insert Table 2 here

We find that mean share of the business cycle component is marginally increasing with income level. However, for this set of countries, total variance and also its long-run and business cycle components are larger for the middle income than low income countries. This implies that results may be driven by the choice of sample countries and time period because Levy and Dezhbakhsh sample period excludes more recent crises including the East Asian one. We therefore also report the statistics of the 79 countries included in the regressions (Table 3). Results follow similar patterns in our two samples (116 countries vs. 79 countries) with the only exception that mean shock persistence (long-run component of the variance) is now slightly lower in the middle income than low income countries. It is also evident that in both samples the business cycle component of the variance dominates in the cases of low and middle income countries, while it is the long-run component that dominates in the case of high income countries. On the other hand, in Levy and Dezhbakhsh (2003) sample, the business cycle component dominates in the case of all income categories.

Insert Table 3 here

There is also a difference in the mean private credit to GDP ratio (which is the time series average for each country for the 1980-2004 period) in the two samples. In the sample of 116 countries, the mean is the lowest for the middle income countries (0.38), while in the reduced sample of 79 countries it is clearly increasing with the income level. In the latter sample the mean values are 0.38, 0.40 and 0.45 for the low, middle and high income countries, respectively. The same applies to the initial mean value of private credit to GDP ratio in 1980. It is also evident that the low and middle income countries on average experience negative TOT shocks, while the high income countries experienced positive TOT shocks.

IV. Empirical analysis

IV.A Estimation method

We follow a simple estimation method in line with other kindred studies in which we regress long-run and business cycle components of the volatility of the growth rate of per capita real GDP on financial development, shocks and other variables related to the growth variances. The equations we estimate are as follows:

$$GrVol\_bc_i = const + \alpha \cdot fin\_dev_i + \beta \cdot shock_i + \boldsymbol{\gamma} X_i + \varepsilon_i \qquad \text{--- (1)}$$

$$GrVol\_lr_i = const + \alpha \cdot fin\_dev_i + \beta \cdot shock_i + \boldsymbol{\gamma} X_i + \varepsilon_i \qquad \text{--- (2)}$$

$$GrVol\_total_i = const + \alpha \cdot fin\_dev_i + \beta \cdot shock_i + \boldsymbol{\gamma} X_i + \varepsilon_i \qquad \text{--- (3)}$$

Here, $GrVol\_bc_i$, $GrVol\_lr_i$, and $GrVol\_total_i$ are the business cycle, long-run, and the total volatility of the growth rate of real per capita GDP in country *i*, respectively. We first calculate variance (and its components) using spectral method, and then take the square root to calculate volatility. This has been done because in the literature the standard deviation is used as the measure of volatility. As a measure of financial development (fin_dev_i), we use (log) the value of credit disbursed to the private sector by banks and other financial institutions relative to GDP. It is preferred to other measures of financial development because it excludes credit extended to the public sector and funds provided from central or development banks (Aghion, 2007, p. 17). As a part of robustness checks, we also use an alternative market-based measure—the value of stock market capitalization relative to GDP. Our proxy for the shock variable is the change in the terms of trade (TOT) defined as the ratio of export prices to import prices.
The TOT is exogenous to a country and, therefore, a change in TOT can be considered as an exogenous shock. This proxy is also standard in the literature.

Other controls (X_i) include (log) the initial level of per capital real GDP, the initial high school enrolment rate that is intended to account for human capital, black market premium on foreign exchange that accounts for the market distortions, openness measured as the sum of exports and imports as a percentage GDP, and "polity score", which is used as a proxy for institutions. All the variables in X_i (excluding the initial values) are averaged over the period 1980-2004. The institution variable is intended to isolate the effect of financial development from other institutional characteristics (Aghion et. al., 2007, p. 19). Acemoglu et al. (2003) suggest that distortionary macroeconomic policies are symptoms of underlying institutional problems rather than main causes of economic volatility. They find that financial aspects become insignificant for explaining volatility once the effect of institutions are controlled. Mobarak (2005) also finds that higher levels of democracy and diversification lower volatility. The "polity score" is an index taken from Polity-IV dataset that captures the regime authority spectrum on a 21-point scale ranging from -10 (hereditary monarchy) to +10 (consolidated democracy). It examines concomitant qualities of democratic and autocratic authority in governing institutions, rather than discreet and mutually exclusive forms of governance.

We also include country characteristics such as latitude, dummies for tropical and landlocked countries and legal origins. Some regions, such as East Asia and Latin America, have experienced severe economic crises than others and crises in some regions are also more frequent. In order to control for the effect of the outliers, we also include regional dummies.

IV.B Benchmark Results

Although the dependent variables are "generated", measurement errors are unlikely to influence our results for two reasons. First, the effect of measurement errors in the dependent variable is not statistically serious in the classical sense as these are absorbed into the residual term. Second, measurement errors corrupt estimates at the high frequency range. We focus on the long-run and business cycle components of the variance that exclude high frequency components. However, total variance, as in other studies, consists of all three components, and may be subject to measurement errors.

Insert Table 4 here

Table 4 reports the results for equation (1) where business cycle volatility is the dependent variable and credit to the private sector relative to GDP is the measure of financial development. Columns 2-6 report results for various combinations of the explanatory variables. In all regressions, the coefficient of private credit is negative and statistically significant at least at 10% level. The significance level increases to 5% when country specific fixed factors and regional dummies are controlled for. The magnitude of the coefficient is -0.38 when all controls are included. This implies that increasing the (log) private credit from the 25th (-1.772) to the 75th (-0.528) percentile results in 0.48 percentage point decrease in business cycle volatility. However, private credit alone can explain only 2% of the variation in business cycle volatility.

The coefficient of TOT change enters negatively and significantly at least at 5% level in all regressions. Therefore, the results support our argument that both financial development and TOT change reduce business cycle volatility. The coefficient of TOT change when all controls are included is -19.036 implying that if TOT improves from the 25th (-0.020) to the 75th (0.003) percentile, business cycle volatility reduces by 0.44 percentage point.

In columns 7-11, we replicate the results in column 2-6 by disaggregating financial development into three stages of economic development—low, middle and high income. Equation (1) is rewritten as:

$$GrVol\_bc_i = const + \sum_j \alpha_j \cdot fin\_dev_{ij} + \beta \cdot shock_i + \boldsymbol{\gamma} X_i + \varepsilon_i \qquad \text{--- (1a)}$$

where *j* represents low, middle and high income countries. This is equivalent to multiplying financial development by dummies for low, middle and high income countries. We find a negative and significant coefficient of financial development for the low income countries in all regressions. For the middle income countries, statistical significance is not robust. The coefficient is significant only if all controls are excluded or all of them but regional dummies are included. The coefficient of the high income countries is significant but positive only in the simple regression of no control. Change in TOT enters negatively and significantly again in all regressions.

Insert Table 5 here

Table 5 reports results of equation (2) with the long-run component of growth volatility as the dependent variable. We also estimate kindred equation disaggregating financial development.

$$GrVol\_lr_i = const + \sum_j \alpha_j \cdot fin\_dev_{ij} + \beta \cdot shock_i + \boldsymbol{\gamma} X_i + \varepsilon_i \qquad \text{--- (2a)}$$

Neither the coefficient of private credit nor that for different stages of economic development is significant. However, the coefficient of TOT change is negative and significant at least at 5% level in all regressions. This supports our argument that shocks affect both long-run and business cycle volatility while financial development affects only business cycle volatility. With all controls, the coefficient of TOT change is -18.653 implying that if TOT improves from the 25th (-0.020) to the 75th (0.003) percentile long-run volatility reduces by 0.43 percentage point, which is almost the same as the magnitude of decrease in business cycle volatility.

Insert Table 6 here

We now estimate equation (3) in which total volatility is the dependent variable, and the kindred equation disaggregating financial development.

$$GrVol\_total_i = const + \sum_j \alpha_j \cdot fin\_dev_{ij} + \beta \cdot shock_i + \boldsymbol{\gamma} X_i + \varepsilon_i \qquad \text{--- (3a)}$$

Results, reported in Table 6, show that the significance of financial development is fragile in different combinations of the control variables. This is because total volatility consists of all components and, as we have shown, financial development has no explanatory power in explaining the long-run component. The robustness of TOT change is again confirmed.

Insert Table 7 here

IV.C Correction for reverse causality

Using both growth volatility and average financial development over the same period does not account for their potential endogenous determination. To take this into account, the initial value of the financial development is now used. Results are reported in Tables 7 for business cycle volatility (equations (1) and (1a)). The coefficient of initial financial development is always negative; although it is not significant in all combinations of the explanatory variables, it is significant with all controls and after accounting for country specific fixed factors and possibility of outliers (captured by regional dummy), as shown in columns 5-6. When initial financial development at different development stages are used as regressors (columns 7-11), results differ from those in columns 7-11 of Table 4. Financial development mitigates business cycle volatility in middle income countries with weak robustness, while the result is not robust for low income countries. The coefficient of TOT change is negative and highly significant in all specifications. Tables 8 reports results for the long-run volatility as the dependent variable (equations (2) and (2a)). Results follow those in Table 5 with no significant effect of the initial financial development, and continued and robust significance of the TOT change. Finally, when total variance is used as the dependent variable, results are more or less the same as those without correcting reverse causality (Table 9).

Insert Tables 8 and 9 here

We also find in these regressions that market distortions measured by black market premium on foreign exchange increases the long-run volatility and openness increases the business cycle volatility but the latter significance is not robust.

IV.D Sensitivity analysis

To check the robustness of the previous results, we use the value of the stock market capitalization relative to GDP as an alternative measure of financial development. As before, our dependent variables are business cycle, long-run and total volatility. We first estimate a simple model using the time average of the stock market capitalization.

We also estimate the model using the initial value of stock market capitalization to account for reverse causality.

Insert Table 10 here

Table 10 reports results for the business cycle volatility as the dependent variable (equations (1) and (1a)). The coefficient of financial development is negative but not significant in columns 2-6 (equations (1)). However, when we estimate equation (1a), we find that financial development reduces business cycle volatility in the low income countries (columns 7-11). This result is robust in all regressions. No such effect is found for the middle or high income countries. Change in TOT is also negative and significant in all regressions. Results for the long-run volatility are presented in Table 11. The coefficient of financial development at both aggregate or disaggregate level is insignificant, but the coefficient of TOT change appears negatively significant and weakly robust. Results for total variance presented in Table 12 mimic that for long-run variance.

Insert Tables 11 and 12 here

These models are also estimated accounting for reverse causality where the relevant variable is the initial value of stock market capitalization. Results for the business cycle volatility as the dependent variable are reported in Table 13. Results do not qualitatively change from those without such correction. The coefficient of initial value of stock market capitalization for the low income countries is negative and robustly significant although the magnitude of the coefficient is now smaller. When the long-run volatility is used as the dependent variable, the coefficient is significantly negative for the low income countries in some specifications but its robustness does not survive when the effects of country specific factors and outliers are controlled for (Table 14). Much similar results are obtained in the case of total variance (Table 15). Note that stock market capitalization data for the period considered are available for smaller number of countries so that sample size reduces to 51 when all controls are included.

Insert Tables13-15 here

Although we find support for the mitigating effect on business cycle volatility of private credit and stock market capitalization both relative to GDP, there is a difference in the pattern. Stock market capitalization explains business cycle volatility better when disaggregated at different stages of economic development, while private credit explains better without such disaggregation. It is important to note that the former represents market-based and the latter represents bank-based financial development. Stock markets provide a different bundle of financial services from those provided by banks and other financial intermediaries. For example, stock markets mainly diversify risk and boost liquidity. Banks, on the other hand, reduce the cost of information acquisition and enhance corporate governance. But there are also important overlaps between the services provided by these two types of financial systems (Levine, 1997, p. 719). We do not explore the reason for such difference in the results; our objective is not to compare the performance of these two types of financial development.

As another robustness check, we estimate a panel for only 20 OECD countries for which data for longer period are available. The two sample intervals are 1960-79 and 1980-2004.

Insert Table 16 here

In the panel estimation, we exclude regional dummies because most developed countries are from Europe and North America. Initial private credit is the explanatory variable so the model is corrected for reverse causality. In columns 2-4 of Table 16, we report results for business cycle volatility as the dependent variable (equation (1). Hausman test suggests fixed-effect estimation in all specifications. We find that financial development reduces business cycle volatility and this result is robust. However, we do not find any significant effect of TOT change in reducing business cycle volatility. This result may occur because there is little variation in the TOT change for the developed countries in the sample. With long-run volatility as the dependent variable, Hausman test suggests fixed effect estimation (column 5) when only financial development is included but random effect estimation if other controls are included (columns 6a-7a). In all estimations, the coefficient of financial development is insignificant. Change in TOT is negative but its significance is not robust.

We do not find any evidence that financial development dampens the effects of shocks on (any component of) volatility (results not reported). When we add an interaction term of TOT change and financial development the coefficient of the interaction term is not significant and its sign alters in different specifications. However, the inclusion of the interaction term does not change the results reported in the paper.

V. Concluding remarks

In this paper, we argue that the study of the effect of financial development and shocks on aggregate growth volatility will not be informative because they affect growth volatility through its different components. Specifically, we argue that financial development affects only the business cycle volatility and therefore, the effect on total volatility is dependent on its share in total volatility. On the contrary, shocks affect total volatility through both its long-run and business cycle components.

Assuming that GDP growth is covariance-stationary, we decompose its variance into business cycle and long-run components using spectral method. Unlike other studies that use the total variance of GDP growth as the measure of volatility and regress it on financial development and shocks, we estimate the effect on different components of volatility separately. After controlling for, among others, country characteristics and possible outliers, results suggest that higher private credit, which is used as proxy for financial development, dampens the business cycle volatility but not the long-run volatility. Shocks, as measured by changes in TOT, affect both business cycle and long-run volatility. Improvement (deterioration) in TOT mitigates (magnifies) both volatility components. These results are robust to alternative market-based measure of financial development, and corrections for reverse causality.

These results have important implications for growth theory. It is imperative to distinguish the factors that cause permanent and transitory deviations from the steady state growth rate. Previous studies fail to address this issue. Our findings shed some lights on this by investigating two important factors—financial development and shocks.

Spectral analysis has also been found to be useful in separating different volatility components and can be used in other areas that are concerned with the importance of different cycle lengths.

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Tables

Table 1: Summary Statistics (for the period 1980-2004)

	(2)	(3)	(4)	(5)	(6)
	Low income	Middle income	High income	All	OECD
Total variance	32.90 (24.13)	26.65 (19.62)	9.57 (11.80)	24.77 (21.59)	5.86 (5.65)
LR variance	8.37 (7.13)	8.33 (7.88)	4.10 (5.81)	7.36 (7.36)	2.57 (2.68)
BC variance	13.50 (10.36)	11.09 (8.54)	3.65 (4.25)	10.17 (9.20)	2.40 (2.43)
SR variance	11.03 (10.04)	7.22 (5.84)	1.81 (2.23)	7.24 (7.79)	0.90 (1.13)
LR variance share	0.26 (0.12)	0.32 (0.15)	0.43 (0.12)	0.32 (0.15)	0.45 (0.12)
BC variance share	0.42 (0.11)	0.41 (0.10)	0.39 (0.07)	0.41 (0.09)	0.40 (0.06)
SR variance share	0.33 (0.12)	0.27 (0.14)	0.18 (0.09)	0.27 (0.13)	0.15 (0.08)
Private credit/GDP	0.42 (0.35)	0.38 (0.34)	0.47 (0.43)	0.41 (0.36)	0.46 (0.38)
Private credit/GDP (initial)	0.32 (0.28)	0.29 (0.24)	0.39 (0.37)	0.33 (0.29)	0.38 (0.28)
N	39	50	27	116	20
(X + M)/GDP	58.44 (26.87) N = 37	86.98 (39.29) N = 50	92.75 (86.25) N = 24	78.71 (51.88) N = 111	57.76 (21.23) N = 20
Black market Premium	178.36 (656.78) N = 38	57.42 (156.89) N = 47	1.30 (2.39) N = 27	84.93 (398.74) N = 112	17.76 (72.92) N = 20
TOT change	-0.01 (0.02) N = 33	-0.01 (0.01) N = 40	0.003 (0.005) N = 21	-0.008 (0.02) N = 94	0.01 (0.007) 0.02 N = 20

Figures in the parentheses are standard deviations.

Table 2: Variance of different frequency range for Levy-Dezhbakhsh (2003) sample for the period 1960-2004 (the same income group classification as Levy-Dezhbakhsh.

	(2)	(3)	(4)	(5)
	Low income*	Middle income	High income	All
Total variance	19.94 (10.50)	21.36 (13.52)	7.84 (4.43)	15.32 (11.49)
LR variance	5.95 (3.95)	6.65 (4.25)	3.00 (2.10)	4.93 (3.74)
BC variance	8.27 (5.29)	9.06 (6.64)	3.30 (2.07)	6.44 (5.42)
SR variance	5.72 (2.89)	5.65 (4.69)	1.53 (1.01)	3.95 (3.66)
LR variance share	0.30 (0.13)	0.35 (0.12)	0.38 (0.12)	0.35 (0.12)
BC variance share	0.40 (0.09)	0.41 (0.11)	0.43 (0.09)	0.42 (0.10)
SR variance share	0.29 (0.09)	0.24 (0.09)	0.19 (0.061)	0.24 (0.09)
N	15	17	23	55

Figures in the parentheses are standard deviations.
* In the original Levy-Dezhbakhsh sample, there are 18 low income countries—data for the period considered are not available for 3 countries (Guyana, Myanmar, and Zaire).

Table 3: Summary Statistics (for the period 1980-2004) for 79 countries

	(2)	(3)	(4)	(5)
	Low income	Middle income	High income	All
Total variance	29.53 (23.00)	21.44 (17.50)	5.08 (4.68)	20.68 (20.46)
LR variance	7.13 (6.28)	6.63 (6.35)	2.05 (1.51)	5.77 (5.91)
BC variance	11.74 (9.09)	9.43 (8.18)	2.11 (2.19)	8.61 (8.43)
SR variance	10.66 (11.21)	5.38 (5.35)	0.92 (1.36)	6.30 (8.43)
LR variance share	0.25 (0.10)	0.32 (0.16)	0.44 (0.12)	0.32 (0.15)
BC variance share	0.41 (0.10)	0.42 (0.10)	0.40 (0.07)	0.41 (0.09)
SR variance share	0.34 (0.13)	0.25 (0.15)	0.16 (0.08)	0.26 (0.15)
Private credit/GDP	0.38 (0.30)	0.40 (0.36)	0.45 (0.36)	0.41 (0.34)
Private credit/GDP (initial)	0.31 (0.26)	0.33 (0.26)	0.38 (0.25)	0.33 (0.25)
(X + M)/GDP	57.61 (26.97)	75.10 (37.09)	79.19 (86.79)	69.61 (50.36)
Black market Premium	222.95 (748.86)	81.44 (186.05)	1.26 (2.31)	115.12 (472.07)
TOT change	-0.01 (0.02)	-0.01 (0.01)	0.002 (0.006)	-0.010 (0.02)
N	29	32	18	79

Figures in the parentheses are standard deviations.

Table 4: Dependent variable: Business cycle variance for the period 1980-2004

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Private credit	-0.218* (-1.80)	-0.291* (-1.83)	-0.312* (-1.90)	-0.336** (-2.17)	-0.384** (-2.44)					
Private credit (low income)						-0.446** (-2.63)	-0.446* (-1.90)	-0.454* (-1.83)	-0.386* (-1.87)	-0.500** (-2.06)
Private credit (middle income)						-0.224* (-1.72)	-0.296 (-1.50)	-0.320 (-1.60)	-0.349* (-1.77)	-0.329 (-1.57)
Private credit (high income)						0.533** (2.36)	0.156 (0.68)	0.121 (0.52)	-0.141 (-0.53)	-0.223 (-0.74)
TOT change (shock)		-24.747*** (-3.24)	-25.352*** (-3.31)	-20.083*** (-2.68)	-19.036** (-2.33)		-25.234*** (-3.00)	-25.709*** (-3.05)	-20.252** (-2.44)	-20.772** (-2.28)
Black market premium			0.0002 (1.23)	0.0003 (0.91)	0.0002 (0.83)			0.0002 (1.04)	0.0002 (0.87)	0.0002 (0.73)
Openness			0.004** (2.12)	0.001 (0.43)	0.003 (0.92)			0.004** (1.99)	0.001 (0.48)	0.002 (0.85)
R-square	0.023	0.353	0.374	0.487	0.563	0.161	0.375	0.395	0.491	0.567
N	116	80	80	79	79	116	80	80	79	79

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Private credit = Ratio of private credit by deposit banks and other financial institutions to GDP

Table 5: Dependent variable: Long-run variance for the period 1980-2004

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Private credit	-0.088 (-0.77)	-0.144 (-1.03)	-0.173 (-1.23)	-0.159 (-1.20)	-0.193 (-1.52)					
Private credit (low income)						-0.146 (-0.86)	-0.278 (-1.37)	-0.282 (-1.37)	-0.174 (-0.97)	-0.226 (-1.00)
Private credit (middle income)						-0.124 (-0.98)	-0.127 (-0.72)	-0.162 (-0.92)	-0.139 (-0.81)	-0.145 (-0.90)
Private credit (high income)						0.316 (1.72)	0.161 (0.71)	0.095 (0.43)	-0.190 (-0.86)	-0.317 (-1.25)
TOT change (shock)		-21.113*** (-2.95)	-21.304*** (-3.04)	-17.326** (-2.62)	-18.653** (-2.52)		-21.979*** (-3.03)	-21.922*** (-3.11)	-17.798*** (-2.71)	-20.121** (-2.63)
Black market premium			0.001** (2.59)	0.0005** (2.00)	0.0005* (1.94)			0.001** (2.44)	0.0005* (1.95)	0.0005* (1.79)
Openness			0.001 (1.04)	-0.001 (-0.48)	-0.000 (-0.01)			0.001 (0.98)	-0.001 (-0.50)	-.0000 (-0.01)
R-square	0.005	0.220	0.271	0.396	0.508	0.051	0.238	0.284	0.397	0.512
N	116	80	80	79	79	116	80	80	79	79

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Private credit = Ratio of private credit by deposit banks and other financial institutions to GDP

Table 6: Dependent variable: Total variance for the period 1980-2004

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Private credit	-0.319* (-1.69)	-0.363 (-1.46)	-0.403 (-1.58)	-0.400 (-1.59)	-0.452* (-1.81)					
Private credit (low income)						-0.655** (-2.26)	-0.603 (-1.58)	-0.614 (-1.55)	-0.464 (-1.30)	-0.582 (-1.39)
Private credit (middle income)						-0.336* (-1.74)	-0.336 (-1.11)	-0.382 (-1.25)	-0.379 (-1.24)	-0.367 (-1.21)
Private credit (high income)						0.827** (2.55)	0.195 (0.60)	0.116 (0.35)	-0.297 (-0.83)	-0.396 (-0.96)
TOT change (shock)		-31.604** (-2.63)	-32.250*** (-2.70)	-23.981* (-1.95)	-21.196 (-1.47)		-33.088** (-2.63)	-33.440*** (-2.68)	-24.860* (-1.95)	-23.847 (-1.58)
Black market premium			0.001** (2.43)	0.001 (1.63)	0.001 (1.62)			0.001 (2.20)	0.001 (1.57)	0.001 (1.46)
Openness			0.004 (1.62)	-0.001 (-0.16)	0.001 (0.32)			0.004 (1.53)	-0.001 (-0.14)	0.001 (0.30)
R-square	0.022	0.361	0.386	0.480	0.560	0.162	0.377	0.399	0.480	0.562
N	116	80	80	79	79	116	80	80	79	79

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Private credit = Ratio of private credit by deposit banks and other financial institutions to GDP

Table 7: Dependent variable: Business cycle variance for the period 1980-2004 (Initial value of Private credit is the explanatory variable)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Initial private credit	-0.301** (-2.35)	-0.269 (-1.56)	-0.295 (-1.63)	-0.328* (-1.87)	-0.357** (-2.05)					
Initial private credit (low income)						-0.462*** (-2.80)	-0.382 (-1.48)	-0.399 (-1.43)	-0.334 (-1.31)	-0.473 (-1.58)
Initial private credit (middle income)						-0.300** (-2.04)	-0.261 (-1.34)	-0.292 (-1.45)	-0.343* (-1.68)	-0.292 (-1.50)
Initial private credit (high income)						0.413 (1.57)	0.257 (0.84)	0.224 (0.72)	-0.140 (-0.34)	-0.290 (-0.67)
TOT change (shock)		-25.393*** (-3.26)	-26.008*** (-3.33)	-20.954*** (-2.78)	-20.113** (-2.45)		-25.835*** (-3.02)	-26.327*** (-3.06)	-20.652** (-2.47)	-22.620** (-2.52)
Black market premium			0.0002 (1.16)	0.0002 (0.86)	0.0002 (0.75)			0.0002 (0.85)	0.0002 (0.82)	0.0002 (0.60)
Openness			0.004** (2.12)	0.001 (0.57)	0.003 (1.01)			0.004** (2.12)	0.001 (0.61)	0.003 (0.98)
R-square	0.036	0.342	0.364	0.474	0.549	0.166	0.362	0.383	0.477	0.553
N	114	79	79	78	78	114	79	79	78	78

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Private credit = Ratio of private credit by deposit banks and other financial institutions to GDP

Table 8: Dependent variable: Long-run variance for the period 1980-2004 (Initial value of Private credit is the explanatory variable)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Initial private credit	-0.221 (-1.62)	-0.190 (-1.20)	-0.216 (-1.36)	-0.194 (-1.22)	-0.196 (-1.29)					
Initial private credit (low income)						-0.243 (-1.42)	-0.338 (-1.57)	-0.324 (-1.45)	-0.219 (-0.99)	-0.260 (-0.94)
Initial private credit (middle income)						-0.254* (-1.70)	-0.159 (-0.87)	-0.200 (-1.10)	-0.182 (-0.99)	-0.152 (-0.91)
Initial private credit (high income)						0.108 (0.35)	0.341 (1.10)	0.239 (0.78)	-0.121 (-0.33)	-0.320 (-0.87)
TOT change (shock)		-21.561*** (-2.99)	-21.800*** (-3.08)	-18.006*** (-2.71)	-19.315** (-2.54)		-22.661*** (-3.07)	-22.424*** (-3.11)	-18.396*** (-2.76)	-21.159** (-2.65)
Black market premium			0.0005** (2.62)	0.0005** (2.03)	0.0005* (1.90)			0.0005** (2.31)	0.0005* (1.94)	0.0004* (1.70)
Openness			0.002 (1.12)	-0.001 (-0.37)	0.000 (0.03)			0.002 (1.17)	-0.001 (-0.35)	0.000 (0.01)
R-square	0.025	0.225	0.276	0.398	0.506	0.058	0.257	0.298	0.398	0.509
N	114	79	79	78	78	114	79	79	78	78

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Private credit = Ratio of private credit by deposit banks and other financial institutions to GDP

Table 9: Dependent variable: Total variance for the period 1980-2004 (Initial value of Private credit is the explanatory variable)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Initial private credit	-0.503** (-2.32)	-0.409 (-1.40)	-0.451 (-1.50)	-0.457 (-1.42)	-0.471 (-1.50)					
Initial private credit (low income)						-0.772*** (-2.68)	-0.684 (-1.52)	-0.689 (-1.45)	-0.559 (-1.15)	-0.716 (-1.25)
Initial private credit (middle income)						-0.479** (-2.16)	-0.330 (-1.10)	-0.386 (-1.26)	-0.407 (-1.26)	-0.329 (-1.13)
Initial private credit (high income)						0.547 (1.19)	0.418 (0.93)	0.317 (0.70)	-0.207 (-0.35)	-0.412 (-0.67)
TOT change (shock)		-32.476*** (-2.70)	-33.177*** (-2.78)	-25.210** (-2.07)	-22.592 (-1.59)		-35.048*** (-2.78)	-35.299*** (-2.81)	-26.857** (-2.11)	-28.117* (-1.88)
Black market premium			0.001** (2.43)	0.001 (1.63)	0.001 (1.57)			0.0005* (1.92)	0.0005 (1.50)	0.0005 (1.26)
Openness			0.004 (1.66)	-0.0000 (-0.01)	0.002 (0.40)			0.005 (1.67)	0.000 (0.01)	0.002 (0.37)
R-square	0.044	0.360	0.385	0.477	0.555	0.171	0.382	0.403	0.479	0.562
N	114	79	79	78	78	114	79	79	78	78

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Private credit = Ratio of private credit by deposit banks and other financial institutions to GDP

Table 10: Dependent variable: Business cycle variance for the period 1980-2004

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Stock market cap	-0.099 (-0.82)	-0.179 (-1.34)	-0.191 (-1.37)	-0.136 (-0.87)	-0.133 (-0.73)					
Stock market cap (low income)						-0.558*** (-2.73)	-0.634** (-2.37)	-0.654** (-2.30)	-0.413* (-1.94)	-0.425** (-2.13)
Stock market cap (middle income)						-0.069 (-0.52)	-0.086 (-0.64)	-0.090 (-0.65)	-0.045 (-0.27)	0.015 (0.07)
Stock market cap (high income)						0.209 (0.89)	0.136 (0.52)	0.104 (0.37)	-0.175 (-0.78)	-0.354 (-1.15)
TOT change (shock)		-20.072** (-2.19)	-20.891** (-2.25)	-11.145 (-1.07)	-9.241 (-0.75)		-29.484*** (-3.24)	-30.518*** (-3.27)	-19.784* (-1.88)	-19.489* (-1.76)
Black market premium			0.0001 (0.86)	0.0001 (0.43)	0.0001 (0.49)			0.000 (0.22)	7.51e-06 (0.05)	-0.000 (-0.16)
Openness			0.004* (1.85)	0.002 (0.69)	0.004 (1.02)			0.004** (2.06)	0.003 (1.09)	0.005 (1.45)
R-square	0.007	0.334	0.355	0.478	0.562	0.151	0.410	0.433	0.513	0.608
N	82	58	58	57	57	82	58	58	57	57

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Stock market cap = Ratio of stock market capitalization to GDP

Table 11: Dependent variable: Long-run variance for the period 1980-2004

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Stock market cap	-0.057 (-0.52)	-0.069 (-0.70)	-0.087 (-0.85)	-0.015 (-0.14)	-0.045 (-0.38)					
Stock market cap (low income)						-0.198 (-1.04)	-0.334 (-1.22)	-0.327 (-1.20)	-0.097 (-0.46)	-0.129 (-0.56)
Stock market cap (middle income)						-0.056 (-0.44)	-0.010 (-0.10)	-0.029 (-0.29)	0.033 (0.28)	0.018 (0.13)
Stock market cap (high income)						0.059 (0.29)	0.069 (0.28)	0.016 (0.06)	-0.300* (-1.78)	-0.536* (-1.94)
TOT change (shock)		-14.720* (-1.79)	-15.563** (-1.98)	-7.604 (-0.89)	-11.101 (-1.06)		-20.351** (-2.32)	-20.733** (-2.47)	-11.230 (-1.28)	-15.657 (-1.68)
Black market premium			0.0004*** (2.82)	0.0003** (2.41)	0.0004** (2.25)			0.0004** (2.64)	0.0003** (2.50)	0.0003** (2.04)
Openness			0.001 (0.69)	-4.12e-06 (-0.00)	0.001 (0.34)			0.001 (0.84)	0.0004 (0.19)	0.002 (0.58)
R-square	0.003	0.202	0.249	0.489	0.567	0.023	0.248	0.287	0.518	0.614
N	82	58	58	57	57	82	58	58	57	57

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Stock market cap = Ratio of stock market capitalization to GDP

Table 12: Dependent variable: Total variance for the period 1980-2004

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Stock market cap	-0.136 (-0.76)	-0.240 (-1.33)	-0.262 (-1.39)	-0.168 (-0.78)	-0.118 (-0.51)					
Stock market cap (low income)						-0.442 (-1.48)	-0.448 (-1.25)	-0.465 (-1.25)	-0.267 (-0.79)	-0.158 (-0.49)
Stock market cap (middle income)						-0.060 (-0.28)	-0.115 (-0.52)	-0.138 (-0.65)	-0.099 (-0.40)	-0.002 (-0.01)
Stock market cap (high income)						0.326 (0.83)	0.063 (0.20)	-0.023 (-0.07)	-0.613** (-2.40)	-0.469 (-0.97)
TOT change (shock)		-19.798 (-1.41)	-21.017 (-1.48)	-7.851 (-0.47)	-1.706 (-0.08)		-44.679 (-2.79)	-46.266*** (-2.79)	-41.294* (-1.86)	-29.537 (-1.44)
Black market premium			0.0004** (2.39)	0.0003 (1.52)	0.0004 (1.52)			0.0004** (2.34)	0.0004** (2.06)	0.0004* (1.77)
Openness			0.003 (1.10)	0.001 (0.17)	0.003 (0.51)			0.006* (1.68)	0.007 (1.26)	0.008 (1.22)
R-square	0.006	0.381	0.398	0.502	0.589	0.063	0.434	0.471	0.543	0.637
N	82	58	58	57	57	82	58	58	57	57

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Stock market cap = Ratio of stock market capitalization to GDP

Table 13: Dependent variable: Business cycle variance for the period 1980-2004 (Initial stock market capitalization is the explanatory variable)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Init Stock market cap	-0.045 (-0.40)	-0.152 (-1.14)	-0.170 (-1.20)	-0.101 (-0.68)	-0.144 (-0.86)					
Init Stock market cap (low income)						-0.339*** (-2.84)	-0.445*** (-3.26)	-0.519*** (-3.42)	-0.323** (-2.12)	-0.358** (-2.29)
Init Stock market cap (middle income)						-0.004 (-0.03)	-0.061 (-0.44)	-0.063 (-0.44)	0.026 (0.17)	0.043 (0.22)
Init Stock market cap (high income)						0.348** (2.00)	0.113 (0.45)	0.124 (0.45)	-0.167 (-0.79)	-0.217 (-0.86)
TOT change (shock)		-18.934* (-1.87)	-19.628* (-1.91)	-6.277 (-0.56)	-8.738 (-0.67)		-26.141*** (-2.76)	-27.936*** (-2.93)	-14.037 (-1.49)	-16.279 (-1.60)
Black market premium			0.0001 (0.61)	0.0001 (0.30)	0.0001 (0.47)			-0.0001 (-1.06)	-0.0001 (-0.77)	-0.0001 (-0.80)
Openness			0.004** (2.24)	0.002 (0.87)	0.005 (1.31)			0.006*** (2.90)	0.004 (1.50)	0.006** (1.98)
R-square	0.002	0.345	0.376	0.512	0.607	0.216	0.408	0.455	0.575	0.667
N	75	52	52	51	51	75	52	52	51	51

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Stock market cap = Ratio of stock market capitalization to GDP

Table 14: Dependent variable: Long-run variance for the period 1980-2004 (Initial stock market capitalization is the explanatory variable)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Init Stock market cap	-0.025 (-0.23)	-0.107 (-0.88)	-0.115 (-0.93)	0.005 (0.04)	-0.026 (-0.21)					
Init Stock market cap (low income)						-0.131 (-0.84)	-0.393*** (-2.74)	-0.387** (-2.49)	-0.180 (-1.25)	-0.214 (-1.29)
Init Stock market cap (middle income)						-0.021 (-0.18)	-0.016 (-0.12)	-0.029 (-0.22)	0.129 (1.32)	0.159 (1.37)
Init Stock market cap (high income)						0.133 (0.54)	0.137 (0.61)	0.093 (0.39)	-0.203 (-1.22)	-0.258 (-1.25)
TOT change (shock)		-13.849 (-1.42)	-14.848 (-1.59)	-2.294 (-0.23)	-6.025 (-0.55)		-20.927** (-2.51)	-21.386** (-2.61)	-8.925 (-1.35)	-13.231* (-1.74)
Black market premium			.0004*** (2.95)	0.0003** (2.26)	0.0004** (2.34)			0.0003** (2.03)	0.0002** (1.97)	0.0001 (1.07)
Openness			0.001 (0.82)	0.0002 (0.07)	0.002 (0.57)			0.002 (1.40)	0.001 (0.55)	0.003 (1.19)
R-square	0.001	0.213	0.263	0.535	0.600	0.068	0.320	0.350	0.656	0.722
N	75	52	52	51	51	75	52	52	51	51

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Stock market cap = Ratio of stock market capitalization to GDP

Table 15: Dependent variable: Total variance for the period 1980-2004 (Initial stock market capitalization is the explanatory variable)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Init Stock market cap	-0.116 (-0.63)	-0.298 (-1.49)	-0.317 (-1.52)	-0.189 (-0.87)	-0.235 (-0.93)					
Init Stock market cap (low income)						-0.262 (-1.38)	-0.372 (-1.57)	-0.435* (-1.69)	-0.186 (-0.70)	-0.199 (-0.70)
Init Stock market cap (middle income)						0.086 (0.48)	0.016 (0.08)	0.0002 (0.00)	0.192 (0.99)	0.299 (1.41)
Init Stock market cap (high income)						0.592* (1.89)	0.228 (0.81)	0.192 (0.61)	-0.327 (-1.12)	-0.070 (-0.17)
TOT change (shock)		-20.269 (-1.34)	-21.559 (-1.43)	-2.229 (-0.13)	-3.583 (-0.18)		-39.769** (-2.37)	-41.966** (-2.42)	-28.490 (-1.48)	-22.324 (-1.04)
Black market premium			0.0004** (2.55)	0.0003 (1.50)	0.0004 (1.68)			0.0002 (0.91)	0.0001 (0.63)	0.0001 (0.43)
Openness			0.004 (1.46)	0.001 (0.28)	0.005 (0.79)			0.008** (2.04)	0.007 (1.10)	0.009 (1.41)
R-square	0.006	0.407	0.427	0.537	0.621	0.152	0.444	0.490	0.637	0.712
N	75	52	52	51	51	75	52	52	51	51

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (8) and (9) control for log of income in 1980, high school enrolment in 1980, and polity2.
Columns (5) and (10) control for log of income in 1980, high school enrolment in 1980, polity2, and fixed factors (landlocked, tropical and legal origin dummies, and latitude).
Columns (6) and (11) control for log of income in 1980, high school enrolment in 1980, polity2, fixed factors (landlocked, tropical and legal origin dummies, and latitude), and regional dummies.

Stock market cap = Ratio of stock market capitalization to GDP

Table 16: Panel estimation for the OECD countries for the period 1960-2004

	Dependent variable: Business cycle variance			Dependent variable: Long-run variance		
	(2)	(3)	(4)	(5)	(6)	(7)
	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Random Effect	Random Effect
Initial private credit	-0.266** (-2.54)	-0.207** (-2.06)	-0.207* (-1.94)	-0.0493 (-0.44)	-0.050 (-0.39)	-0.098 (-0.70)
TOT change (shock)		0.833 (0.08)	0.513 (0.05)		-22.265* (-1.95)	-17.993 (-1.63)
Black market premium			0.0002 (0.22)			0.032** (2.36)
Openness			0.002 (0.40)			0.023 (1.59)
Hausman test (Prob of Chi-square)	0.296	0.643	0.677	0.998	0.084	0.061
R-square	0.132	0.492	0.495	0.005	0.057	0.3432
N	40	36	36	40	36	36

All regressions include a constant. Figures in the parentheses are White (1980) heteroskedasticity corrected t-values. ***, ** and * are 1%, 5% and 10% significance level respectively.

Columns (3), (4), (6) and (7) control for log of initial income (1960 and 1980), initial high school enrolment (1960 and 1980), and polity2

Private credit = Ratio of private credit by deposit banks and other financial institutions to GDP

Appendix

A.1 Description of data

Variable name	Source	Period
Real per capita GDP (RGDPL)	Penn World Table 6.2	1960-2004
Private credit by deposit banks and other financial institutions / GDP	Thorsten Beck, Asli Demirgüç-Kunt and Ross Levine, 2000 (updated Nov. 2008)	1960-2004 (Initial period varies by country)
Value of stock market capitalization / GDP	Thorsten Beck, Asli Demirgüç-Kunt and Ross Levine, 2000 (updated Nov. 2008)	1960-2004 (Initial period varies by country)
Openness (X + M as % of GDP)	World Development Indicators, World Bank	1960-2004
High school enrolment	World Development Indicators, World Bank	1960-2004
Terms of trade	Global Development Network	1960-1999
Black market premium	Global Development Network	1960-1999
Institution (revised polity-2)	Polity IV Project: Political Regime Characteristics and Transitions, 1800-2007	1960-2004
Legal origin, landlocked, latitude, income group (low, middle and high)	Global Development Network, and World Development Indicators, World Bank	

A.2: Variance of different frequency range (Low income countries: World Bank classification) for 1980-2004

Country Name	Total variance	Lon run variance	Business cycle variance	Lon run variance share	Business cycle variance share
Bangladesh	5.47	1.47	2.66	0.27	0.49
Benin	10.96	1.50	3.42	0.14	0.31
Bhutan	34.08	5.39	16.00	0.16	0.47
Burkina Faso	14.82	3.68	7.17	0.25	0.48
Burundi	50.50	10.99	23.59	0.22	0.47
Central African Republic	37.54	10.93	15.72	0.29	0.42
Chad	60.12	10.14	33.22	0.17	0.55
China	7.99	1.86	3.05	0.23	0.38
Comoros	11.31	4.60	3.76	0.41	0.33
Dem. Rep. Congo	94.17	26.32	45.82	0.28	0.49
Ethiopia	91.09	14.19	23.23	0.16	0.25
Gambia	18.39	5.73	8.18	0.31	0.44
Guinea	12.64	5.37	4.30	0.42	0.34
Haiti	34.66	5.10	9.72	0.15	0.28
Honduras	9.14	0.78	5.57	0.09	0.61
India	3.80	1.26	1.76	0.33	0.46
Indonesia	16.18	5.41	7.62	0.33	0.47
Korea (North)	28.81	19.68	4.25	0.68	0.15
Laos PDR	33.22	5.06	16.77	0.15	0.50
Lesotho	33.57	7.66	14.50	0.23	0.43
Madagascar	15.00	1.80	5.90	0.12	0.39
Malawi	35.56	7.42	21.41	0.21	0.60
Mali	34.30	3.52	13.40	0.10	0.39
Mauritania	20.62	5.08	4.27	0.25	0.21
Mozambique	62.28	21.81	29.67	0.35	0.48
Nepal	10.94	1.02	5.24	0.09	0.48
Nicaragua	21.62	8.71	4.64	0.40	0.21
Nigeria	27.11	5.04	11.76	0.19	0.43
Pakistan	3.24	1.56	1.24	0.48	0.38
Sao Tome and Principe	45.10	16.21	15.02	0.36	0.33
Senegal	24.16	2.66	12.87	0.11	0.53
Solomon Islands	50.45	22.28	16.01	0.44	0.32
Somalia	46.71	8.17	21.80	0.17	0.47
Sudan	19.17	4.71	11.14	0.25	0.58
Tanzania	88.43	25.57	36.15	0.29	0.41
Togo	32.02	7.50	14.40	0.23	0.45
Uganda	27.80	7.90	13.26	0.28	0.48
Zambia	32.03	8.74	12.26	0.27	0.38
Zimbabwe	78.05	19.65	25.75	0.25	0.33

Countries in bold are included in the regressions with all controls

A.3: Variance of different frequency range (Middle income countries: World Bank classification) for 1980-2004

Country Name	Total variance	Lon run variance	Business cycle variance	Lon run variance share	Business cycle variance share
Algeria	8.97	2.01	4.78	0.22	0.53
Barbados	8.99	3.90	3.17	0.43	0.35
Belize	46.48	14.61	16.98	0.31	0.37
Botswana	33.77	5.57	15.68	0.16	0.46
Brazil	12.56	3.15	4.76	0.25	0.38
Cape Verde	19.93	5.08	4.66	0.25	0.23
Chile	23.58	10.26	9.16	0.44	0.39
Colombia	1.91	1.04	0.63	0.54	0.33
Costa Rica	11.86	4.62	6.12	0.39	0.52
Cuba	69.55	31.88	23.86	0.46	0.34
Dominica	40.00	6.90	17.04	0.17	0.43
Dominican Republic	13.30	5.20	5.81	0.39	0.44
Egypt	5.33	0.52	2.25	0.10	0.42
El Salvador	7.79	5.08	2.00	0.65	0.26
Fiji	41.95	5.81	23.35	0.14	0.56
Guatemala	3.64	1.88	1.18	0.52	0.32
Iran	50.08	18.30	22.76	0.37	0.45
Jamaica	12.05	3.32	5.23	0.28	0.43
Jordan	37.60	22.32	10.62	0.59	0.28
Korea (South)	18.55	5.08	8.48	0.27	0.46
Malaysia	7.17	2.84	3.31	0.40	0.46
Maldives	31.17	5.15	16.85	0.17	0.54
Mauritius	10.75	2.90	4.77	0.27	0.44
Mexico	12.23	3.06	6.55	0.25	0.54
Micronesia	28.05	6.53	11.06	0.23	0.39
Morocco	23.40	0.98	4.02	0.04	0.17
Namibia	25.84	2.33	14.68	0.09	0.57
Oman	17.33	4.05	7.83	0.23	0.45
Panama	20.56	5.18	10.42	0.25	0.51
Papua New Guinea	42.85	8.34	19.18	0.19	0.45
Peru	40.81	13.73	21.96	0.34	0.54
Poland	21.13	12.08	7.77	0.57	0.37
Puerto Rico	9.70	3.50	3.36	0.36	0.35
Romania	30.33	18.49	9.26	0.61	0.31
Samoa	31.87	10.08	9.21	0.32	0.29
Saudi Arabia	50.38	23.08	19.37	0.46	0.38
South Africa	4.07	1.90	1.58	0.47	0.39
Sri Lanka	8.59	0.99	4.84	0.11	0.56
St. Kitts and Nevis	27.27	4.59	11.18	0.17	0.41
St. Lucia	22.21	9.99	6.97	0.45	0.31
St. Vincent and the Grenadines	31.54	5.06	12.23	0.16	0.39
Swaziland	10.96	4.28	4.03	0.39	0.37
Syrian Arab Republic	35.66	10.38	13.99	0.29	0.39
Thailand	15.91	9.04	4.74	0.57	0.30

Tonga	80.24	30.58	31.13	0.38	0.39
Trinidad and Tobago	81.26	28.30	32.63	0.35	0.40
Tunisia	4.55	0.42	1.44	0.09	0.32
Uruguay	41.81	14.13	21.73	0.34	0.52
Vanuatu	68.09	14.79	32.62	0.22	0.48
Venezuela	28.71	3.23	17.47	0.11	0.61

Countries in bold are included in the regressions with all controls

A.4: Variance of different frequency range (High income countries: World Bank classification) for 1980-2004

Country Name	**Total variance**	**Lon run variance**	**Business cycle variance**	**Lon run variance share**	**Business cycle variance share**
Australia	2.36	0.63	1.02	0.27	0.43
Austria	1.36	0.57	0.57	0.42	0.42
Bermuda	9.73	2.22	3.89	0.23	0.40
Brunei	34.65	12.49	16.30	0.36	0.47
Canada	5.29	1.99	2.39	0.38	0.45
Cyprus	6.92	2.06	2.53	0.30	0.37
Denmark	3.09	1.13	1.15	0.37	0.37
Finland	12.19	6.18	4.69	0.51	0.38
Germany	2.05	0.84	0.94	0.41	0.46
Greece	5.24	2.83	1.74	0.54	0.33
Hong Kong	15.24	5.56	7.00	0.36	0.46
Israel	7.27	1.56	4.08	0.21	0.56
Italy	1.50	0.62	0.66	0.41	0.44
Japan	3.49	2.02	1.25	0.58	0.36
Macao, China	28.52	14.23	9.31	0.50	0.33
Netherlands	2.80	1.50	1.14	0.54	0.41
Netherlands Antilles	11.58	5.30	3.79	0.46	0.33
New Zealand	3.47	1.48	1.08	0.43	0.31
Norway	2.86	1.27	1.33	0.44	0.46
Portugal	6.21	3.67	1.98	0.59	0.32
Qatar	51.87	27.94	15.07	0.54	0.29
Singapore	20.86	5.04	9.71	0.24	0.47
Spain	2.60	1.71	0.71	0.66	0.27
Sweden	4.05	1.93	1.53	0.48	0.38
Taiwan, China	6.36	3.09	1.85	0.49	0.29
United Kingdom	3.06	1.55	1.29	0.51	0.42
United States	3.69	1.19	1.65	0.32	0.45

Countries in bold are included in the regressions with all controls