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Impact of Financial Integration on Production Volatility in Developing Countries

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Abstract
The purpose of this paper is to study the interaction between financial integration and ICT developments, and how thishas an effect onproduction volatility. It usespanel data on ten developing countries taken from 1987 to 2010. We use the PVAR approach, the response impulsionfunctionand the variance decomposition. Our results on countries that are exceptionally financially integrated and/or possess a high level of ICT indicate that theyexperience strong fluctuations of production in cases of monetarypolicyshocks, and small fluctuations of production in cases of budgetary policy shock.
Keywords: financial integration, production volatility, ICTs, panel VAR.

1. Introduction

Due to capital flows, financial markets in developing countries are experiencing faster integration. Several economic policies adopted by developing countries, including liberalization of capital flows, the opening of capital markets, and development of ICT, have contributed to the financial integration of these countries on a world level. This is mainly due to a reduction of transaction costs between countries.

Theoretically, one of the main objectives of financial integration is to reduce macroeconomic volatility. However, contrary to expectations, macroeconomic volatility has increased as a result of account capital convertibility; this led to crises in several countries at the end of the1990s. This has generated a wide debate on the disadvantages and advantages of capital account convertibility. It is therefore important to know how financial integration and ICT developments influence macroeconomic fluctuations.

There are few empirical studies that are focused on the relationship between financial integration and macroeconomic volatility. The studies that do exist have not found the same results. Indeed, some work has found a non-significant link between financial integration and macroeconomic volatility (Razin and Rose, 1994;Buchet al., 2005). Other works have tested the effects of interactions between world financial integration and financial development on national macroeconomic volatility; they have found mixed results.Most of the empirical works are based on cross-sectional analysis. These empirical works point towards two results:

-The absence,in general, of any significant relationship between financial openness and macroeconomic volatility.

- A positive and significant relationship between macroeconomicvolatility and financial integration in low or medium income countries.

Razin and Rose (1994) have studied the effects of trade and financial openness on production, consumption and investment through using panel data on 138 countries over a period from 1950 to 1988. They find financial openness had no significant effect on all theexplanatory variables.

Easterly et al. (2004) examined sources of production volatility for a large sample of countries over two periods: 1960-1978 and 1979-97. They find that trade generatesgreater production volatility, but the level and the volatility of private capital flows have no significant effects on production volatility growth. By contrast, the financial development level has a significant smoothing effect on production growth, but this impact is non-linear.

Kari (2004) studied the effects of financial integration on macroeconomic volatility using annual data on the UMCO regionfrom1986 to 2003. He tested a fixed-effects model by the least squares generalized method and by using cross-sectional weights. He found no stable relationship between financial integration and production volatility in the UMCO region. However, he found that a low level of financial integration reduces the volatility of consumption and increases investment.

Buch and al. (2005) studied the effects of financial opening on production volatility usingannual data on a sample of OECD countries from 1960 to 2000. Their analysis is based onthe Sutherland (1996) model that assumes financial opening should depreciate monetary shocks and amortizebudget shocks. Results of this study prove the absence of a significant link between financial openness and productionvolatility. They support predictions according to which financial integration amplifies monetary shocks and absorbs tax shocks.

Kose and al. (2003) studied the volatility of production and consumption for 76 countries using data from 1960 to 1999. They used two indicators of financial opening:a dummy variable for the restrictions of capital account, and private capital flow. Their results confirm the smoothing effect of financial development and the positive effect of trade integration on volatility. The financial opening has a positive but not significant effect on the volatility of production and that of consumption; but this effect is highly significant and non-linear on the volatility of relative consumption (share of consumption in production). These results suggest that an increase in financial integration can bring benefits in terms of smoothing consumption, only after a threshold level of financial opening is reached (for flows of private capital this threshold is estimated to be 49% of GDP). Belowthe threshold, consumptionvolatility increases to thedegree of financial integration.

Simon (2005) empirically studied the effect of world financial integration on macroeconomic volatility in eight developing MENA countriesover a period from 1980 to 2002. Simon showsthat financial opening, measured by restrictions of the capital account and the current account, and by gross flows to GDP, has increased the volatility of production and that of consumption. This illustrates that these countries have not benefited from financial integration in terms of smoothing the consumption. However, in economies that are less financially integrated; only restrictions of the current account are associated with a decline in the volatility of the production and that of consumption.

Kose and al. (2006) used panel data for 85 countries to study the effect of trade and financial integration on the relationship between growth and volatility. They found that trade and financial integration weakens negative relationship between growth and volatility. This means that, in countries most open to trade and to capital flows,volatility implies a smaller negative effect on economic growth. Kose and al. have also found that the relationship between growth and volatility is positive in most financially integrated countries,and negative in the least financially integrated ones.

Chen and Wang (2009) empirically studied the effect of financial openness on macroeconomic volatility in 35 countries over a period from 1970 to 2003. They found that the outflows of capital significantly reduce the volatility of production and that of consumption, but the entries of capital increase fluctuations of consumption and production growth. Comparisons between developed and developing countries show that financial openings reduce volatility, but only in developed countries. Chen and Wang do not consider the net effect of capital flows, but they have studied separately the effect of outflows of capital andthe entries of capital,and have measured volatility by conditional variance. This could explain the differences between their results and those obtained by other empirical studies, in which financial integration is measured by gross capital flows and volatility is measured by standard deviation.

Previous empirical studies have examined the influence of financial conditions on volatility taking into account internal and external finance. Other works have explicitly studied the effects of interaction between world financial integration and local financial development on national macroeconomic volatility.

Aghion et al. (1999)found that countries with low level of financial domestic developmenthave more volatilegrowth rates. However, Beck et al. (2006) show that this is not necessarily the case and the effect of financial development on volatility depends on the existence of real or monetaryshocks. Using panel data on 63 countries over a period from 1960 to 1997, the authors do not find any strong relationship between financial development and productionvolatilitygrowth.

Eozenou (2008) has used the Panel GMM method to studythe effectoffinancial domestic conditions on the relationship between financial integration and macroeconomic volatility in a sample of 90 countries over a period from 1960 to 2000. He has found that financial integration has no effect on production volatility, but its effect on consumption volatility depends on the level of financial development. In effect, financial integration increases consumption volatility in countries with low levels of financial development, and reduces this volatility in those with high levels of financial development.

This empirical literature reviewshows that empirical studies relevant to the relationship between financial integration and macroeconomic volatility are few. They also demonstrate different results. The purpose of this paper is to study the relationship between financial integration (combined with ICT development) and production volatility. It will use panel data on ten developing countries over a period from 1987 to 2010.

Following Buch et al. (2005), we will also analyzethe effects of policy shocks on the volatility of macroeconomic aggregates. Technically, we use the panel vector autoregressive (PVAR) approach, response of pulse analysis and variance decomposition.Our purpose in this work is to test the following two assumptions:

- That financial integration increases or decreases production volatility in the presence of a monetary or budgetary policy shock.
- That ICT increases capital flows because these technologies reduce the costs of transactions.

Our study is concerned, therefore, with the shockeffects of monetary and budgetary policieson productionfluctuations. It also considers the role of financial integration and ICT development on this relationship.

The next section is devoted to our empirical analysis. Weuse a panel VAR approach, response of pulse analysis and variance decomposition analysis.

2. Econometric analysis

To study empirically the relationship between financial integration and macroeconomic volatility we use the autoregressive vector model.

2.1 The autoregressive vector model

We have used the following VAR structural model:

$$POL_{j,t} = k_1 - a_{12}FI_t - a_{13}Y_t + b_{11}POL_{j,t-1} + b_{12}FI_{t-1} + b_{13}Y_{t-1} + \varepsilon_t^{pol}$$
$$FI_t = k_2 - a_{21}\, POL_{j,t} - a_{23}Y_t + b_{21}POL_{j,t-1} + b_{12}FI_{t-1} + b_{23}Y_{t-1} + \varepsilon_t^{FI}, \qquad (1)$$
$$Y_t = k_3 - a_{31}\, POL_{j,t} - a_{32}FI_t + b_{31}POL_{j,t-1} + b_{32}FI_t - b_{33}Y_{t-1} + \varepsilon_t^{y}, \quad j = 1, 2$$

Where:

FI_t is the capital flows, Y_t is the aggregate production, $POL_{t,1}$ and POLt,2 are respectively the monetary policy and budgetary policy .ε_t^{pol}, ε_t^{FI} and ε_t^{y} are three structural shocks. This is white noise of normal distribution with anaverageequal to zero and a constant variance.

System (1) canbewrittenunder compact form as:

$$AZ_t = K + B_1 Z_{t-1} + \varepsilon_t (2)$$

Where:

$$A = \begin{bmatrix} 1 & a_{12} & a_{13} \\ a_{21} & 1 & a_{23} \\ a_{31} & a_{32} & 1 \end{bmatrix}, \quad Z_t = \begin{bmatrix} POL_{j,t} \\ FI_t \\ Y_t \end{bmatrix}, K = \begin{bmatrix} k_1 \\ k_2 \\ k_3 \end{bmatrix},$$

$$B_1 = \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix}, \text{ and } \varepsilon_t = \begin{bmatrix} \varepsilon_t^{pol} \\ \varepsilon_t^{FI} \\ \varepsilon_t^{y} \end{bmatrix}$$

Relations of system (2) give structural representation of this VAR. This representationis not usable in itself. For this reason, we use the reduced form of the VAR (representation (3))whichisobtained by multiplyingeachtermof the representation(2) by the inverse of the matrix A, notesA^{-1}. The model (2) isthen:

$$Z_t = \Gamma_0 + \Gamma_1 Z_{t-1} + e_t \qquad (3)$$

Where: $\Gamma_0 = A^{-1}K$, $\Gamma_1 = A^{-1}B_1$, and$e_t = A^{-1}\varepsilon_t$

Given that explanatory variables are correlated with the error term in each equation of the Structural VAR (1), they cannot be estimated using ordinary least squares. Similar problems do not exist for estimation of the reduced form of VAR (3). However, VAR (3)may not provide estimations of 18 parameters, while the structural VAR model (1) contains 21 parameters, so it is impossible to recover the totality of information of system (1) from system (3). In other words, the reduced form of VAR (3) is under identified. To overcome this identificationproblem, restrictions are imposed on the structural VAR (1) so that matrix A is a lower triangular with $a_{12} = a_{13} = a_{23} = 0$

By adding the individual effects (f_i) to take account of differences between countries, the VAR model (3) becomes:

$$Z_{i,t} = \Gamma_0 + \Gamma_1 Z_{i,t-1} + f_i + e_t, \quad i = 1, \dots, 10 \qquad (4)$$

Where i, refers to the country i.

By following Love and Zicchino (2006), we use the GMM estimator of Arellano and Bover (1995).Arellano and Bover (1995) have proposed a solution to eliminate the individual effects. They propose orthogonal deviations consisting of applying the Helmert transformation of Love and Zicchino (2006) program to the variables of the model. This transformation allowsthe expressing variables to act as deviations from the future medium. We substitute (T -1) first observations by their differences to the average of the (t-t+1) following observations. By this transformation, the orthogonality between the transformed variables and the explanatory variables delayed is retained, therefore, we can use explanatory variables delayed as instruments and estimate the coefficients by the GMM. The transformed model is:

$$\tilde{Z}_{i,t} = \Gamma_1 \tilde{Z}_{i,t-1} + \tilde{e}_t (5)$$

Theimpulse responsefunctions for system (3) are:

$$X_t = \mu + \sum_{i=0}^{\infty} \Phi_i \varepsilon_{t-i} (6)$$

Where $\Phi_s = \Gamma_1^i A^{-1}$is the impulse response ofthe column j to a shock of a unit of ε_{t-i}. Therefore, the impact of a shock of a givenpolicy (for example,ε_t^{pol}) canbestudied by takinginto account other shocks (ε_t^{FI} andε_t^{y}).

It shouldbenotedthatthe results of the impulsion responsefunctiondepend on the variables order.Residues$e_t$are expressed as follows:

$$\begin{bmatrix} e_t^{pol} \\ e_t^{FI} \\ e_t^{y} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ a_{21} & 1 & 0 \\ a_{31} & a_{32} & 1 \end{bmatrix}^{-1} \begin{bmatrix} \varepsilon_t^{pol} \\ \varepsilon_t^{FI} \\ \varepsilon_t^{y} \end{bmatrix} \qquad (7)$$

The orderindicated in system (7) impliesthat a change in policyshock ε_t^{pol} directly affects ε_t^{FI} and ε_t^{y}, which, in turn, affects the FI_t and Y_t paths. So, the policyshockisexogenousbecause the FI shockε_t^{FI}, or the production shockε_t^{y}, have no effect on the policy. It is therefore justified for thisshock to come first in the equations system.

2.1.1 Sample and variables

We use a sample of ten developing countries over a period from 1987 to 2010. To compare the production volatility between countries with high and low financial integration level, this sample is divided into two sub-groups. Table 1 represents the evolution of the overall average value of production volatility, measured by the standard deviation of GDP.

Table 1. Evolution of the production volatility (in %)

country	**1987-1992**	**1993-1998**	**1999-2004**	**2005-2010**
Argentina	5.6	3.8	4.95	2.43
Malaysia	1.37	3.97	1.73	2
Turkey	2.27	3.55	2.7	3.77
Mexico	1.05	3.06	1.66	2.55
Brazil	2.46	1.04	1.06	1.62
Morocco	2.77	4.15	1.24	0.94
China	3.24	0.44	0.3	1.14
Tunisia	2	1.12	0.99	0.9
India	1.8	1.03	1.51	1.53
Egypt	1.15	0.39	0.99	1.33
Overall Average	2.371	2.209	1.713	1.822

Note: The production volatility is equal to standard deviation of the filter band-pass of natural logarithm of real GDP in each period.
Source: Author's calculations

Table 1 shows that the average value of overall productionvolatility is almost the same during the two periods1987-1992 and 1993-1998 (2.371% compared to 2.209%).These high values are due to several global phenomena. Indeed, the 1987-1992 period was marked by the emergence of neo-liberal policies in several countries. These policies werefavorable to the development of the financial markets. Similarly, the 1993-1997 period was marked by the Mexican crisis in 1994 and the Asian crisis in 1997. In the period, from 1999 to 2004, production volatility declined. It then increased slightly from 1.713% to 1.822% during the 2005 to 2010period,notable for the sub-prime crisis in 2007.

To estimate model (1), variables of monetarypolicy and budgetary policy (($POL_{i,t}$)) are measured respectively by the loan rate and public expenditure. Total production (Y_t) is approximated by real GDP (US dollars).

Financial liberalization and the development of ICT play an important role in the increase of capital flows. To approximate financial integration ($FI_{i,t}$) we use the measure of Lane and Milesi-Ferretti (2007). It is an annual measure equal to assets, commitments of direct investment and portfolio (as a percentage of GDP). The authors divided the data of assets and commitments into four categories: portfolio investment,FDI, foreign exchange reserves and debts (debt as portfolios, loans, deposits and commercial credits). Lane and Milesi-Ferretti (2007) built a set of data comprising of estimates of external assets and liabilities looking at more than 140 countries during the period 1970 to 2004. This variable is expressed as follows:

FI = (national assetsheld by foreigners +foreignassetsheld by national)/GDP

The ICT index contains three variables that are:

- The investment expenditure on telecommunications per capita. This variable reflects the quality of telecommunications infrastructure.

- Trade on communication equipment per capita given by the sum of exports and imports of communications equipment. This variable reflects the strengthof national communications infrastructure development.

- The sum of the users of fixed and mobile phones per 1000 people. This variable measures the extent of the use of communications equipment.

The composite indicator of ICTdevelopment is based on principal components analysis. The mean values of three components of the index from 1987 to 2010 are used for each country. Then, these variables are rescaled to the standard units(with unit variances and averages equal to zero), so that they can be combined into one single index. The main components are extracted from the correlation matrix of this normalized data. The first component, representing 90% of the variance of three variables, is retained to calculate the scores for each country.

To compare data across countries, the score of each country is converted on a scale from 1 to 5 using a linear transformation. The formula used to determine the score of gross index is the following:

$$ICT = 4 \times \left[\frac{(\text{value of the country} - \text{minvalue of sample})}{\text{max value of sample} - \text{minvalue of sample}}\right] + 1 \quad (8)$$

From equation 8 we determine the global ICT index from 1987 to 2010. This study includes analysis of the main components mentioned above to construct the ICT index of each sub-period, during all 6 years. Table 2 shows the global ICT index, the indices of each sub-periods and the rank of each country.

Table 2. ICTs Index

country	global index	Rank of the country	1987-1992	1993-1998	1999-2004	2005-2010
Argentina	2.9967	1	2.1604	2.9509	2.7222	3.0888
Malaysia	2,6296	2	2.6363	3.2021	2.9507	2.7874
Turkey	2,6090	3	2.8664	2.6789	2.6984	2.5495
Mexico	2,4963	4	2.3571	2.5744	3.3462	3.4932
Brazil	2.4912	5	2.7333	2.5227	2.9411	2.9976
Morocco	2,4597	6	2.4285	2.7733	3.0830	2.8085
China	2,2287	7	2.7773	2.6266	2.8938	2.9931
Tunisia	2,0620	8	2.500	2.6844	2.7391	2.6734
India	1,8500	9	2.5466	4.3332	2.3333	2.9976
Egypt	1,7918	10	2.7947	2.6528	2.9745	3.2444

Source: Authors 'calculations

2.1.2 Panel VARModel

In our estimations of the Panel VAR model, with the exception of variables representing the loan,all other variables are expressed in logarithms.The selection of the correct length of delay is essential for the panel VAR;in effect, delays too short fail to capture the dynamics of the system and led to a bias of omitted variable, and long delays create a loss in degrees of freedom. A length of common delay is imposed on two groups to facilitate comparison between their results. To estimate the correct number of delays, we use the criteria of conventional Information AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion), with:

$$AIC = Log\left[\det(\widehat{\Sigma}_{\varepsilon})\right] + \frac{2N^2p}{T} \quad (9)$$

$$BIC = Log\left[\det(\widehat{\Sigma}_{\varepsilon})\right] + N^2p\frac{\log T}{T} \quad (10)$$

Where:

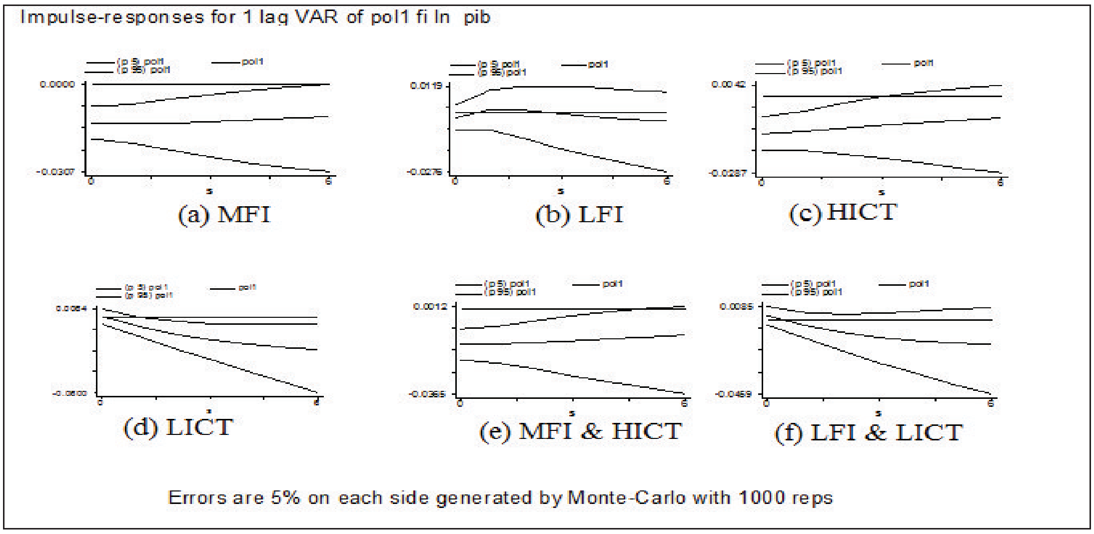
- T is the number of observations, N the number of variables, $\widehat{\Sigma}_{\varepsilon}$ the variance-covariancematrix of estimated residuals of the VAR.

We have chosen the order $p \in \{1,\ldots, p_{max}\}$which minimizes the information criterion. The number of delays chosen is based on the lowest values of AIC or BIC. AIC indicates that four delays are appropriate for most of the country,while BIC mainly proposes a single delay or four delays. Four delays are not accepted for assessingimpulsion response functions because the determinant matrix is almost singular. For this reason, a single delay is chosen.

2.1.3 Effects of monetary policy shock on production.

To study the shock effects of monetary and budgetary policies, we divided our sample into several categories of countries. In the first case, the sample is divided into two groups of countries according to their degrees of financial integration. To do this, we used the median of the variable measuring financial integration (FI). In effect, the first five countries which have the highest median are considered more integrated (MFI) and those with a lesser median are considered less integrated (LFI).

Chart 1 shows the responses of GDP (Y_t) and capital flows (FI) to the shock of a restrictive monetary policy; it is a standard deviation in a loan rate shock in the initial period**.** In the panels (a) and (b), which respectively represent the shocks in MFI countries and in LFI ones, one finds that such a shock causes a decrease in production which implies that a high loan rate (a restrictive monetary policy) reduces production, while a low loan rate (an expansionary monetary policy) increases it.



Source: Author's calculations

Chart 1.Effects of monetary policy shock on production (POL1)

In the second case, we have classified our sample into two groups according to the global ICT index. The first five countries constitute the group with a high level of ICT development (HICT). The other five countries constitute the group with a low level of ICT development (LICT).

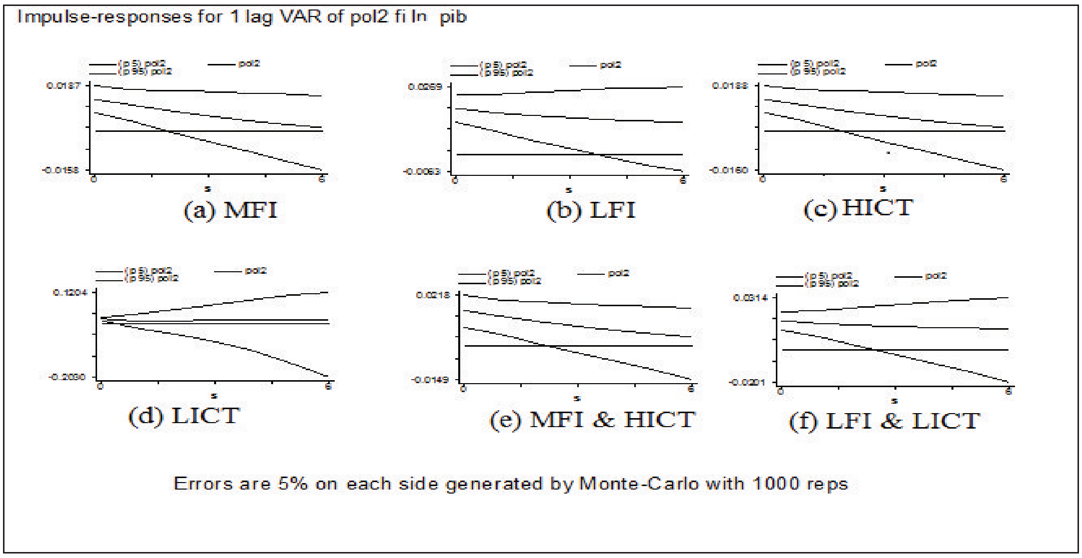
A high development level of ICT creates strong financial integration. The panels (c) and (d) in Chart 1 represent, respectively, the shock of monetary policy in HICT and LICT groups. We find that the effects on production are negative and production fluctuations are important in countries with a high level of ICT development. In countries with low-level ICT development, production fluctuations are also low.

In the third case, we divided our sample into two groups: the first contains most financially integrated countries and those having a high ICT development level (MFI and HICT).The second group contains the least financially integrated countries and those with a low ICT development level (LFI and LICT). Panels (e) and (f) of Chart 1 show the effects of monetary policy shock on the first and second group, respectively, of this third case. Results show negative effects on production. In addition, during the initial period (t = 0), the production response in the first group is slightly smaller than that in the second one but the production results in the second group become higher in subsequent periods.

2.1.4 Effects of budgetary policy shock on production

The budgetary shock is expressed by a standard deviation in public expenditure. In all cases, results show positive effects of budgetary shocks on production. These results imply that a shock involving expansionist (restrictive) budgetary policy produces a positive (negative) effect on production. In the first case (panel a, Chart 2), the MFI group proves the significant effects of the budgetary shock on production during the initial period. For the LFI group (panel (b) results show more important effects on production but in subsequent periods.

Panels (c), (d), (e) and (f) of Chart 2 show the effects on production in the second and third case groups. In the first group (HICT or MFI and HICT), the effects of budgetary shock on production are higher than those in the second group (LICT or LFI and LICT). Our results confirm the predictions of Sutherland (1996) and Ghazouani et al. (2016), according to which, the production volatility of most financially integrated countries is less than that in the least financially integrated ones.



Source: Author's calculations
Chart 2. Effects of budgetary policy shock on production (POL2)

In addition, our results confirm the assumptions that in most financially integrated countries; the production volatility is low in the case of a monetary shock and strong in the case of a budgetary chock.

2.2 Decomposition of the variance

By using response impulse function, we can determine the relative importance of different structural shocks in endogenous variables by measuring the contributions of shocks to changes in the variance of these variables.Decomposition of variance gives the proportion of dependent variables variations (GDP in our case), generated by their own shocks, in relation to shocks of different policies (POL1 and POL2) and those of financial integration (FI). Table 3 shows the decomposition of variance of production from an orthogonal matrix of response impulse coefficients after a monetary shock.

Table 3. Impact of monetary chock and decomposition of variance of production (Ln GDP)

Part 1 **MFI, HICT, MFI and HICT**					**Part 2** **LFI, LICT, MFI and HICT**			
	s	Ln_GDP	FI	POL1		Ln_GDP	FI	POL1
MFI group					**LFI group**			
Ln_GDP	10	0.9737	0.0205	0.0056		0.6939	0.2983	0.0076
FI	10	0.1293	0.8683	0.0022		0.0735	0.8222	0.0642
POL1	10	0.0989	0.0710	0.8300		0.0105	0.0046	0.9847
Ln_GDP	20	0.9707	0.0204	0.0087		0.6383	0.3478	0.0138
FI	20	0.1302	0.8674	0.0022		0.0808	0.8147	0.0643
POL1	20	0.1013	0.0724	0.8262		0.0115	0.0058	0.9826
HICT group					**LICT group**			
Ln_GDP	10	0.9749	0.0245	0.0004		0.4849	0.1726	0.3424
FI	10	0.1471	0.8525	0.0003		0.0631	0.8990	0.0177
POL1	10	0.0865	0.0778	0.8355		0.0003	0.0157	0.9838
Ln_GDP	20	0.9710	0.0281	0.0007		0.3409	0.1475	0.5114
FI	20	0.1486	0.8509	0.0003		0.0548	0.8686	0.0464
POL1	20	0.0884	0.0790	0.8325		0.0006	0.0174	0.9818
MFI and HICT group					**LFI and LICT group**			
Ln_GDP	10	0.9851	0.0130	0.0018		0.5244	0.3669	0.1085
FI	10	0.1577	0.8400	0.0022		0.0601	0.8793	0.0205
POL1	10	0.0966	0.0830	0.8202		0.0051	0.1346	0.8601
Ln_GDP	20	0.9838	0.0133	0.0027		0.4299	0.4339	0.0277
FI	20	0.1580	0.8396	0.0023		0.0622	0.8700	0.0277
POL1	20	0.0996	0.0850	0.8153		0.0069	0.1503	0.8427

Source: Author's calculations

The first column of this table shows that the effect of monetary shock on production increases over time, in particular in MFI and HICT countries. Indeed, in MFI countries, fluctuations of GDP, explained by the monetary shock, account for a 9.89 per cent variation in the first ten years to a 10.13 per cent variation in the 20th year. For MFI and HICT groups (Part 1 of Table 3), results also show that the impact of monetary policy accounts for a higher fraction of production variation in the first and second groups.

In relation to the effects of budgetary policy shock, the results of decomposition of variance in production are given in Table 4. Regardless of the degree of financial integration, this shock carries an important weight in the production fluctuation. In the MFI and LFI groups, the variance of production explained by the budgetary policy shock is almost 25 per cent and 30 per cent, respectively, in the first ten years.

Table 4. Impact of budgetary policy shock and decomposition of variance of production (Ln GDP)

Part 1 **MFI, HICT, MFI and HICT**					**Part 2** **LFI, LICT, LFI and LICT**			
	s	Ln_GDP	FI	POL2		Ln_ GDP	FI	POL2
MFI group					**LFI group**			
Ln_GDP	10	0.9209	0.0285	0.0504		0.6857	0.3122	0.0020
FI	10	0.1988	0.7140	0.0870		0.0565	0.9094	0.0340
POL2	10	0.2510	0.1757	0.6388		0.3085	0.3507	0.3406
Ln_GDP	20	0.8458	0.1101	0.1034		0.6128	0.3770	0.0101
FI	20	0.2054	0.6842	0.1103		0.0571	0.8995	0.0433
POL2	20	0.3636	0.0943	0.5420		0.2955	0.4135	0.62909
HICT group					**LICT group**			
Ln_GDP	10	0.9528	0.0256	0.0215		0.5999	0.2799	0.1200
FI	10	02430	0.6514	0.1055		0.0216	0.7348	0.2435
POL2	10	0.9049	0.0687	0.6896		0.4894	0.1668	0.3437
Ln_GDP	20	0.2571	0.0402	0.0548		0.5793	0.2759	0.1446
FI	20	0.3124	0.6032	0.1396		0.0237	0.7327	0.2435
POL2	20	0.3124	0.0619	0.6256		0.4876	0.1806	0.3316
MFI and HICT group					**LFI and LICT group**			
Ln_GDP	10	0.9419	0.0186	0.0393		0.6637	0.3341	0.0021
FI	10	0.2433	0.6477	0.1089		0.0484	0.9178	0.0336
POL2	10	0.2109	0.1399	0.6490		0.3488	0.3581	0.2930
Ln_GDP	20	0.8742	0.0384	0.0873		0.5895	0.4055	0.0048
FI	20	0.2517	0.6074	0.1407		0.0494	0.9102	0.0402
POL2	20	0.3017	0.1256	0.5725		0.3362	0.4270	0.2367

Source: Author's calculations

In the case of monetary and budgetary policy, results show that financial integration shock (capital flows) plays a low role in explaining the production variation in LFI and LICT countries. In the first column (part 2 of Table 3 and Table 4), we see that LFI and LICT countries are less affected by the shocks of capital flows which represent approximately 6 per cent of the production fluctuations.

2.3 Regressions with panel data

In this section, we use a specification and an additional methodology to check the robustness of *p-VAR* results. Fixed effects regression, random effects regression and OLS regression are used to estimate the following model:
Volatility of ln (real GDP)$_{i,t}$ = $a_1$volatility of ln(loan rate)$_{i,t}$ + a_2 volatility of (ln (consumption of real government consumption))$_{i,t}$ + $a_3$ln (FI)$_{i,t}$ + a_4 (ICT index of sub-period)$_{i,t}$ + a_5 (interaction term) + γ_i + $\varepsilon_{i,t}$
Where ln is the natural logarithm, i and t refer, respectively, to the country and the period, $\varepsilon_{i,t}$ is the error term, and γ_i are the fixed effects of country i.We specify the model as follows:

$$\sigma_{PIB_{i,t}} = a_1\sigma_{I_{i,t}} + a_2\sigma_{G_{i,t}} + a_3 FI_{i,t} + a_4 ICT_{i,t} + a_5 INT_{i/t} + \gamma_i \varepsilon_{i,t} \qquad (11)$$

The period of our study is 24 years, which allows us to choose four sub-periods of 6 years. It is a justified choice because, according to Stock and Watson (1999), economic cycles generally have frequencies ranging from 6 to 32 years. Our sub-periods are the following: 1987–1992, 1993–1998, 1999–2004 and 2005–2010.
Dependent variable: is the production volatility measured by the volatility of the ln_GDP which is equal to the standard deviation of the band-pass filter of the natural logarithm of real GDP in each period.
Independent variables:

- The shock of monetary policy measured by the volatility of the ln_loan rate.
- The shock of budgetary policy measured by the volatility of the ln_real public expenditure which is equal to the standard deviation of the band-pass filter of the natural logarithm of real public expenditure in each period.

- The financial integration (FI) measured by the volatility of (ln_Fi) which is equal to the volatility of [Ln (national assets held by foreigners + foreign assets held by the nationals)/GDP]
- The development of ICT measured by the ICT index in each period.
- The interaction terms are:

(ICT index of sub-period)$_{i,t}$ × (ln_FI)$_{i,t}$; volatility of (ln_loan rate)$_{i,t}$ × (ln_FI)$_{i,t}$; volatility of (ln real public spending)$_{i,t}$ × (ln_FI)$_{i,t}$; (ICT index of sub-period)$_{i,t}$ × volatility of (ln_loan rate)$_{i,t}$; (ICT index of sub-period)$_{i,t}$ × volatility of (ln real public spending)$_{i,t}$,

Analysis of the panel data allows the control of observations' heterogeneity in their individual dimensions by taking into account a fixed effect or a random effect. Estimations with fixed effect eliminate the persistent differences between countries, favor the variability within countries and allow the identifying and measuring effects that are not directly observable in cross section or in time series. In our case, the fixed effect model allows γ_i to be correlated with the error term, $\varepsilon_{i,t}$. The random effects model assumes the independence of the term of errors which takes into account the specific effect and the explanatory variables. It allows γ_i to be independent of the error, $\varepsilon_{i,t}$.

Table 5.Random effect model

	I	II	III	IV	V	VI
Dependent variable : σ_{GDP}						
σ_G	0.184* (0.136)	0.176* (0.137)	0.165* (0.204)	-1.443* (1.391)	0.161* (0.142)	0.163* (0.136)
σ_I	0.008** (0.068)	0.015** (0.068)	0.009** (0.069)	0.010** (0.067)	-0.024** (0.090)	-0.693** (0.472)
FI	-0.044 (0.102)	-0.549 (0.895)	-0.61** (0.145)	-0.44 (0.101)	-0.172 (0.242)	-0.050 (0.101)
ICT	-0.354 (0.611)	-0.639 (0.805)	-0.35** (0.960)	-1.22** (-1.28)	-0.309 (0.619)	-2.175* (1.358)
$FI \times ICT$		0.169** (0.301)				
$FI \times \sigma_G$			-0.009 (0.074)			
$ICT \times \sigma_G$				0.58 (0.493)		
$FI \times \sigma_I$					0.015* (0.027)	
$ICT \times \sigma_I$						0.252* (0.169)
Husman test *Prob>χ^2* Test LM *Prob> χ^2* N	*χ^2 = 0.90* *0.9245* *χ^2 = 8.88* *0.0014* 40	*χ^2 = 0.75* *0.979* *χ^2 = 8.98* *0.0014* *40*	*χ^2 = 0.66* *0.9852* *χ^2 = 8.62* *0.0017* *40*	*χ^2 = 0.50* 0.9922 *χ^2 = 8.95* *0.0014* 40	*χ^2 = 1.34* 0.9307 *χ^2 = 8.68* *0.0016* 40	*χ^2 = 0.86* 0.9733 *χ^2 = 10.36* *0.006* 40

*Note: (.) are standard deviations, * and ** means significant respectively at 1% and 5%*
Source: Author's calculations

We used the Hausman test to choose between the fixed effect model and the random effect model and this test allows us to use the random effect model. To choose between the OLS model and the random effect model, we used the Lagrange multiplier test of Breusch-Pagan (1980) to test the presence of random effects. The results of this test (LM) (Table 5) accept the assumption of the presence of random effect at a 1 per cent level.

The coefficients of variable$FI \times \sigma_G$ (column III), estimated by the fixed effect model and by the OLS model, show results with different signs and no significance[1]. This confirms our prediction that the difference in budgetary shock effects between the most financially integrated countries and the least financially integrated ones is not very significant

Results (Table 5) show that the coefficient of financial integration is negative (-0.044) and non-significant. This result differs from those of Kose et al. (2003) and Buch and al. (2005) who found a positive relationship (but not significant) between financial integration and economic cycle volatility. The coefficient of the interaction variable between financial integration and ICT development (FI *ICTS) is positive (0.3) and indicates that if capital flows are accompanied by ICT development, they exercise an important positive effect on

[1] Appendix (Tables 6 and 7)

economic cycle volatility.

The coefficients of interaction variables between budgetary shock and financial integration on the one hand and between budgetary shock and ICT development level, on the other hand, are not significant. This result implies that the effects of budgetary shock in MFI countries are not very different from those in LFI countries.

In columns V and VI of Table 5, the coefficients of interaction variables, between monetary shock and financial integration, on the one hand, and between monetary shock and ICT development level, on the other hand, are positive and significant at the level of 1 per cent. This result shows that the effects of monetary shock are more important in MFI countries then in LFI countries.

Finally, the results of columns III, IV, V and VI confirm the estimations of the Panel VAR model.

3. Conclusion

Although conventional wisdom suggests that an increase in financial integration willinfluence fluctuations of macroeconomic variables, the economic literature has not yet, to our knowledge, empirically verified this link. The structural differences between countries introduced in the studies with panel data (Mendoza, 1994), and the inability to distinguish between idiosyncratic shocks and global shocks (Razin and Rose, 1994) have been proposed as explanations.

The empirical objective of this paper is to study the effects of financial integration on production volatility; to do this it used the theoretical lessons of Sutherland's (1996) general equilibrium model. According to this, the financial integration effects on production volatility depend on the shock of economic policy being used.

Our results confirm these predictions and show that more financially integrated and/or advanced ICT countries have high fluctuations of production, in the case of monetary policy shock, and small fluctuations of production, in the case of budgetary policy shock.

The introduction of the ICT index in regressions shows that the interaction between the monetary policy shock and the ICT index has a significant effect on macroeconomic volatility, whereas the interaction between budgetary policy shocks and the ICT index has no significant effect. This supports the results of simulations that indicate a slight difference in production volatility between MFI and LFI groups in the presence of budgetary policy shocks.

All these evidences confirm the results of Buch and al. (2005), according to which the effects of financial integration on macroeconomic volatility depend on the shock of used economic policy. The results of this study show that, in countries that actively adjust their monetary policy, production volatility, in the short run, depends on financial integration.

The results also show that in most financially integrated countries, and in those that have a high level of ICT development, control of capital is less efficient.

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Appendix
Table 6. Fixed effect model

	I	II	III	IV	V	VI
dependent variable : σ_{GDP}						
σ_G	0.187 (1.28)	0.172 (1.15)	0.183 (0.83)	-1.275 (-0.85)	0.140 (0.89)	0.146 (1.02)
σ_I	0.032 (0.43)	0.041 (0.53)	0.032 (0.42)	0.029 (0.39)	-0.017 (-0.18)	-0.804 (-1.67)
FI	-0.082 (-0.71)	-0.736 (-0.76)	-0.085 (-0.53)	-0.074 (-0.64)	-0.305 (-1.09)	-0.116 (-1.02)
ICT	-0.277 (-0.43)	-0.657 (-0.76)	-0.278 (-0.42)	-1.074 (-1.03)	-0.185 (-0.28)	-2.426 (-1.77)
$FI \times ICT$		0.219 (0.68)				
$FI \times \sigma_G$			-0.019 (-0.02)			
$ICT \times \sigma_G$				0.52 (0.98)		
$FI \times \sigma_I$					0.026 (0.88)	
$ICT \times \sigma_I$						0.306 (1.76)

Source: Author's calculations

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Table 7. OLS model

	I	II	III	IV	V	VI
Dependent variable : σ_{GDP}						
σ_G	0.128 (0.79)	0.127 (0.77)	0.054 (0.21)	-1.980 (-1.12)	0.132 (0.79)	0.133 (0.82)
σ_I	-0.044 (-0.58)	-0.044 (-0.57)	-0.048 (-0.62)	0.040 (-0.53)	-0.031 (-0.26)	-0.497 (-0.81)
FI	0.027 (0.26)	-0.096 (-0.08)	-0.023 (-0.14)	0.010 (0.10)	0.061 (0.23)	0.033 0.31)
ICT	-0.504 (-0.66)	-0.577 (-0.56)	-0.527 (-0.68)	-1.65 (-1.35)	-0.509 (-0.65)	-1.707 (-0.95)
$FI \times ICT$		0.042 (0.11)				
$FI \times \sigma_G$			-0.033 (-0.38)			
$ICT \times \sigma_G$				0.748 (1.20)		
$FI \times \sigma_I$					-0.004 (-0.14)	
$ICT \times \sigma_I$						**0.161** **(0.74)**

Source: Author's calculations