What does it take to grow out of recession? A comparative approach towards long-run growth determinants of European and transition countries

by

Olivier Damette[a], Mathilde Maurel[b] , Michael A. Stemmer[c]

December, 2015

- Preliminary draft, please do not cite -

Abstract

Consequences from the subsiding 2008 financial crisis on long-run economic growth are widely debated. Existing literature on previous recessions, such as Cerra and Saxena (2008), emphasizes the long-term loss inflicted on per capita GDP levels. This paper concentrates on typical business cycles in European and transition countries and assumes that lower than normal growth during recessions is followed by a recovery period with above normal growth until the economy reaches its pre-crisis level. The objective is to assess what conditions affect the speed of convergence towards a normal growth path.
Through exploiting the cointegration relationships among variables in long-run growth regressions and by employing linear error-correction models, results show a different linear speed in the convergence processes towards normal growth with the transition economies outpacing western European countries. Our analysis is further extended into a Panel Smooth Transition Error-Correction Model (PSTR-ECM) to account for different regimes in convergence patterns according to a selection of transition variables. Whereas the velocity of convergence for European core countries exhibits a nonlinear pattern and differs with respect to price flexibility, transition countries remain linear in their return to the growth trend. Finally, our results suggest that internal adjustments may remain the key factor for both European and transition countries to recover from negative economic growth shocks.

Keywords: Economic growth, business cycles, transition economies, error-correction models, smooth-transition models
JEL Classification Codes: C23, C50, E32, F43, O40

We thank Michael Funke, Valerio Scalone and our discussant Michael Graff at the Makroökonomik und Konjunktur Workshop at the ifo Dresden for their helpful comments. Comments from participants in seminars at the Paris School of Economics, the Université de Lorraine, the Conference on the Imperative of Economic Growth in the Eurozone in Brno and at the Annual DIW Macroeconometric Workshop have been highly appreciated. All remaining errors remain our own.

[a]Université de Lorraine, 34 cours Léopold CS 25233, 54052 Nancy Cedex, BETA-CNRS and LEF INRA Agroparitech, and IXXI – "Complex Systems Institute" – ENS Lyon, email: olivier.damette@univ-lorraine.fr;
[b]Corresponding author: Director of Research, CES, Université Paris 1 Panthéon-Sorbonne, 106-112 Boulevard de l'Hôpital, 75647 Paris cedex13 and Fondation pour les Études et Recherches sur le Développement International (FERDI), 63 Bd François Mitterand, Clermont-Ferrand, France, email: maurelm@univ-paris1.fr;
[c]CES, Université Paris 1 Panthéon-Sorbonne, 106-112 Boulevard de l'Hôpital, 75647 Paris cedex13, email: michael.stemmer@univ-paris1.fr

Introduction

The consequences of the subsiding 2008-09 financial crisis on long-run economic growth and the policy implications that can be drawn from it have become widely debated. For many, the recovery in both the United States and Europe has been unusually sluggish and has been characterized by persistently high unemployment rates. (Bordo and Haubrich, 2012; Beyer and Stemmer, 2015). The 2012 conference of the Federal Reserve Bank of Boston on “Long-Term Effects of the Great Recession” was, for instance, exclusively devoted to this topic. In the accompanying conference issue, Papell and Prodan (2012) find evidence of a full recovery in the US not until late 2016 but no lasting effect on long-term potential GDP.

Yet, this has not always been the case. Covering crises earlier and elsewhere, Cerra and Saxena (2005), for instance, provide evidence that the banking crisis in Sweden in the early nineties explains why the country has incurred a permanent loss in its long term GDP per capita level. Coricelli and Maurel (2011), by focusing on transition countries which have switched from planned to market economies and experienced severe transitional recessions, argue that the capacity to rebound, proxied by the depth and length of the crisis, depend foremost on the quality of the financial institutions and trade liberalization.

However, studies on financial crises cover in many respects only the extreme versions of cyclical downturns. In this work we move beyond the mere focus on economic crises and concentrate instead on typical business cycle swings, which may have a permanent effect on long-term average growth. We assume that lower than normal growth during a recession is followed by a recovery period with above normal growth rates. Once the economy reaches its potential output (and full employment), growth continues to follow its normal trend. Our objective is to assess whether different factors affect the speed of convergence towards this normal growth path. We find that according to the degree of price flexibility, countries converge at different speed. Typically, the more flexible a country is, the faster the catching-up process it will experience. Moreover, not flexible enough countries may fail to converge to their long run average growth.

In the subsequent analysis we focus on European core countries and the Eastern European transition economies. Initially, we estimate long-term growth models to check for growth determinants of our country sample. We further employ linear error-correction models to assess potential differences in adjustment velocity towards the long-run growth trend among the countries. Indeed, we do find different speeds, with the transition countries outpacing the advanced EU economies.

In order to account for non-linearity and different regimes in growth developments, we estimate nonlinear Panel Smooth Threshold Regression-Error Correction Models (PSTR-ECM), which allow for a determination of different regimes according to a selection of transition variables. Results show that the error-correction terms from the linear models, that is the speed of convergence towards the normal growth, is different according to the degree of price flexibility.

The rest of the paper is structured as follows: Section 2 presents previous literature on the topic and sets the theoretical underpinning for the analysis thereafter. Subsequently, the used dataset is briefly explained. Section 4 focuses on the technical specificities of the estimation design where part one covers the dynamic long-term growth models including tests for unit roots and co-integration in the variables as well as a linear error-correction model. Part 2 focuses on non-linearity by describing in detail estimations with the Panel Smooth Threshold Regression-Error Correction Model and sets out the various specification tests. Section 5 presents the results and Section 6 concludes.

Related Literature and Theoretical Underpinning

From 2008 to 2012 the European debt crisis revealed the different adjustment strategies to a crisis. EMU membership prohibited depreciation as a quick remedy for the adjustment of unit labour costs to regain international competitiveness. The loss of independent monetary policy made price and wage adjustments necessary, which magnified the recession and provoked different policy responses. Whereas Ireland (like the Baltic countries and Bulgaria) embarked on drastic reforms in the private and public sector, in Greece political resistance delayed reforms and paved the way to the recent political crisis.
This situation is reminiscent of a discussion during the world economic crisis in the 1930s. Whereas Keynes (1936) called for a depreciation to provide a short-term growth impulse, Hayek (1937) stressed the need of price and wage adjustment. While the former emphasised the need for a timely anti-cyclical macroeconomic impulse, the latter believed in the self-stabilizing forces of the market. In the same vein, Mundell (1961) assumes that countries need to preserve the exchange rate as an adjustment mechanism, even more if prices and wages are not flexible, while Hayek (1937) and Schumpeter (1911) insist on declining prices and wages as the prerequisites for a robust recovery after a crisis. According to them, whatever the policy needed, there is no need to make a strong distinction between the long run and the short run growth.

In contrast to those historical insights, the most recent literature on growth dynamics after a negative economic shock focuses on the detection of depth and length of a crisis as well as its associated capacity to rebound.[1] Cerra and Saxena (2008) examined a variety of country groups and found varying degrees of persistence of output loss following different financial and socioeconomic crises. The argue that most of the time, crisis are not neutral on long run average growth, and the return to the latter depends upon a range of institutional features. Papell and Prodan (2012) reach a different conclusion. They analyse the length and structure of slumps, defined as a contraction and part of an expansion until the economy reaches its long-run growth rate, across a cross-section of several countries. They find that most recessions associated with financial crises in advanced countries do not cause permanent

[1] The separate emphasis on crisis on the one hand and long run growth on the other reflects a strong tradition among macroeconomists, which consists in studying business cycles and long-term growth as two separate phenomena. For business cycle theorists, long-term growth is a fundamentally exogenous trend, while for growth theorists, short-term shocks are neutral on the long-run growth rate of the economy.

reductions in potential GDP. The situation is different for emerging countries where potential GDP is only restored in two out of six cases analysed. Beyond the divide developed versus emerging countries, Coricelli and Maurel (2011) demonstrate that more flexible financial institutions diminish the length and depth of crisis. They highlight the importance of reform complementarity, particularly in financial sector reform.

Another complementary strand of research focuses on explicit policy measures and country characteristics that exert influence on a recovery and its persistence. Bicaba et al. (2014), for example, focus on policy measures that influence stability periods between financial crises. Cerra et al. (2013) investigate macroeconomic policies that can influence the speed of recovery and mitigate the persistence of such shocks for different groups of industrialized and developing countries. Monetary expansion is thus a powerful tool in industrialized countries, yet only to rebound from recession and not during regular expansion years. Expansionary fiscal policy is found to have a positive impact for recovery in both industrialized and non-Sub-Saharan countries. Floating exchange rate regimes perform best in facilitating a growth rebound from recession and are also the preferred regime for industrialized countries to support recoveries. The opposite holds for developing countries, where a fixed regime is associated with highest rates of growth over an entire expansion. During recovery years, real appreciation deteriorates growth perspectives, impacting in particular developing countries.

A clear distinction between the short and the long run was formalised in the nineties, where endogenous growth theorists show (both at the theoretical and empirical level) that there is a relation between short-term economic instability and long-run growth. According to Aghion and Saint-Paul (1993), this relation can be positive or negative, depending on whether the activity that generates growth in productivity is a complement or a substitute to production. For Aghion and Saint Paul (1991), they are substitutes, which implies that a larger amplitude of business cycle fluctuations has a positive effect on long-run. For Stadler (1990) and Martin and Rogers (2000), they are complementary: if growth is generated via learning by doing, a negative correlation between short and long run growth will hold, particularly in developing and emerging countries. In a similar vein, Comin and Gertler (2006) examine medium-term business cycles in the US post-war period, which are found to be more variable and persistent than conventional cycles. They find that fluctuations feature significant procyclical movements in technological change with productivity swings as a central element to the persistence of cycle fluctuations. Bianchi and Kung (2014) approach the link between business cycle shocks and long-run growth through a medium-sized DSGE framework. Apart from knowledge accumulation which links business cycle shocks and long-run growth, shocks to the marginal efficiency of investment help to explain a large share in overall macroeconomic volatility. This debate finds an echo in Fatas and Mihov (2006), who argue in a slightly different policy setting that there are two forces at work: fiscal discretion, which should reduce volatility, and responsiveness of fiscal policy, which might amplify the business cycle. At the empirical level and for the sample of 48 American states, they show that a more restrictive fiscal policy leads to less volatility in output.[2]

The recent work by Kocenda et al. (2013) is one of the most recent empirical papers belonging to this tradition, by disentangling long-term and short-term effects of exchange rate flexibility on growth and arguing that short run growth can be painful in the long run. On a panel of 60 emerging and developing countries the authors find that exchange rate adjustments stimulate growth in the short-term, but hamper it on the long run. Confirming the results of Maurel and Schnabl (2012), long-term growth should therefore be achieved via price and wage flexibility and stable exchange rates. Moreover, monetary expansion and depreciation as a recovery strategy from a crisis may bring short-term relief, but long-term pain.

This paper aims to contribute to this debate by initially analysing convergence speeds towards the long-run growth trend via long-run growth regressions and error-correction models. It thus adds some empirical evidence to the recent attempts of Bianchi and Kung (2014) of studying economic growth and business cycles in a more unified setting within a European context. By further assessing the non-linearity of factors that drive economic growth along business cycles and demonstrating that price flexibility affects the speed of growth convergence processes, it also blends well with the recent discussion initiated by Olivier Blanchard (2014), who emphasizes the importance of accounting for nonlinearities in the growth process, particularly in light of the recent crisis period[3]. To our knowledge of the existing literature, we are the first to analyse the non-linearity in the present context.

Data

We use an original dataset of quarterly frequency that is partly borrowed from Kocenda et al. (2013) and has been extended to include the recent crisis. For most of the series, it covers a period from 1995Q1 to 2010Q4, thus the panel is unbalanced across countries. As this paper wants to single out different long-term drivers for economic growth out of recessions of western European and transition countries, the original dataset includes 15 European core countries and 15 eastern European transition countries plus Turkey[4]. For some countries certain series were not available on a quarterly frequency and have therefore been linearly interpolated from annual data[5].

[2] If we consider fiscal policy as a driver of the business cycle, this result can be interpreted as evidence that fiscal policy is a substitute to production in the long run.

[3] We thank Michael Funke for pointing at this link.

[4] Euro-Area countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

Transition countries: Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Slovak Republic, Slovenia, Serbia, Turkey

[5] Data on real GDP and government consumption for Albania and Bosnia-Herzegovina have been linearly interpolated from annual WDI data.

The data comes from the IMF's International Financial Statistics. Missing or inconsistent data are completed and cross-checked with national statistics, mainly at national central banks. Series used in estimations come in quarterly frequencies and, where necessary, were seasonally adjusted[6]. Quarterly real GDP growth rates and inflation rates are calculated as year-over-year quarterly growth rates to filter out seasonal patterns and lower the erratic volatility of the series ($x_{it} = ln(X_{i,t}) - ln(X_{i,t-4})$). Quarterly *de facto* exchange rate flexibility is measured by the standard deviation of quarterly percent exchange rate changes of the respective quarter (σ) and the quarterly arithmetic average of monthly percent exchange rate changes (μ). Both measures can be summarized by the z-score $z = \sqrt{\sigma^2 + \mu^2}$, as in Schnabl (2009) and Maurel and Schnabl (2012). All three variables are calculated against the euro (the Deutsch mark before 1999) or the dollar, depending on the respective anchor currency. Once a country has entered the EMU the proxy for exchange rate flexibility is set to zero. We further employ a variable for price flexibility, whose proxies in terms of changes of the producer price index (PPI) for the respective year are calculated analogue to the exchange rate flexibility measures.

The sample period starts in 1995Q1 because we want to exclude the beginning of the 1990s. For most of the Central, Eastern and Southeastern European countries the early nineties implied a transition pattern different from the business cycles framework in normal market economies, which is used in this paper.

Estimation Design

Panel Cointegration Framework

In the first step, we estimate endogenous long-term growth models in order to single out drivers of economic output in the long run. We estimate both subsamples separately to account for a different economic structure and economic development in both country blocks.

In this paper, we set the following growth model:

$$y_{i,t} = \alpha_i + \beta_1 T_t + \beta_2 X'_{i,t} + Z\epsilon_{i,t}, \qquad (1)$$

where T_t is a time trend, $X'_{i,t}$ is the vector of all endogenous (supposedly cointegrated) variables, and the vector Z comprises all exogenous variables that are not cointegrated.
The selection of growth determinants is based on the theory and empirical results laid out in the relevant growth literature. Even though Durlauf et al. (2005) have identified 140 growth regressors, the number of growth determinants in our equations, however, has been kept rather limited due to several reasons. A more parsimonious approach is also advocated by Ciccone

[6] For seasonal adjustment the X12-ARIMA package provided by the US Census Bureau was used.

and Jarocinski (2010) and Moral-Benito (2012)[7]. They find that the fewer variables are included in the regressions, the less sensitive are results. Another reason is a limitation in data availability for the Eastern European transition countries. Moreover, Durlauf et al. (2008) find consistent significance for canonical neoclassical growth variables independent of the underlying growth theory followed.

We include the investment to output ratio, which is a typical Solow-type determinant and has been found to have a positive effect on economic growth (see e.g. DeLong and Summers, 1991; Sala-i-Martin, 1997). It represents the increasing relationship between capital accumulation, i.e. investment, and economic growth. We further employ the size of the labor force, defined here as the amount of people in employment compared to overall population (see e.g. Aghion and Howitt, 1992). In their endogenous theory growth benefits from a larger scale in the population for inventing new products and production techniques. Trade integration in terms of exports and imports as a share of GDP contributes to economic growth through increased opportunities for profitable investments (Levine and Renelt, 1992). Government consumption as a ratio to GDP represents distortional effects through taxation or government expenditure and has thus a negative impact on growth (Barro, 1997; Sachs and Warner, 1995). Average inflation, constructed as the average quarterly year-on-year changes of the consumer price index, controls for (detrimental) growth effects originating in macroeconomic instability (Bruno and Easterly, 1998). We also tried other usually employed variables such as the domestic credit to GDP ratio as a measure of financial development, which, however, does not turn out to be significant.

Before estimating the long-run relationships, we test for stationarity of the included variables via several unit-root tests and need to confirm whether our variables are indeed cointegrated.

Panel Unit-Root and Cointegration Tests

In order to avoid spurious regressions and to provide a robust analysis, we employ a battery of panel unit-root tests (PURT) for each variable, using the Levin, Lin, and Chu (2002) test, the Im, Pesaran, and Shin (2003) test, and the Fisher-type ADF test (Maddala and Wu, 1999). The literature has shown that Maddala and Wu (1999) exhibit the best properties.

Table 1: Panel Unit Root Tests (EU-Core Countries)

PURT	**Production**	**Labor Force**	**Investment**	**Trade**	**Government**
Levin Lin Chu	0.341 (0.633)	-0.967 (0.167)	-1.361 (0.087)	-0.907 (0.182)	1.055 (0.854)
Im Pesaran Shin	0.882 (0.811)	1.016 (0.845)	-6.453 (0.000)	0.016 (0.507)	-0.038 (0.485)
Maddala-Wu (ADF)	30.575 (0.437)	31.614 (0.386)	125.495 (0.000)	26.366 (0.656)	33.980 (0.282)

[7] The authors use Bayesian averaging techniques to address both model uncertainty and endogeneity issues when testing their growth equations.

Specification	Constant and Trend	Constant	Constant	Constant	Constant
CIPS (Second generation) 1 to 4 lags included	0.062 (0.525) 0.757 (0.775) 2.340 (0.990) 1.837 (0.967)	-1.278 (0.101) 0.268 (0.606) 0.476 (0.683) 1.661 (0.048)	-2.141 (0.016) 0.086 (0.534) 0.294 (0.616) 1.131 (0.871)	0.514 (0.696) 1.069 (0.857) 2.267 (0.988) 1.124 (0.870)	0.497 (0.690) 1.164 (0.878) 2.267 (0.988) 2.645 (0.996)
Carrion-i-Silvestre (Third generation)	-	-	6.138 (0.000) 5.845 (0.000)	-	-

Remarks: AIC selection is used to perform first panel generation tests. Carrion-i-Silvestre's test assumes as the null hypothesis stationarity; it is performed considering a maximum of two structural breaks.

Table 2: Cross-section Dependence Tests (EU-Core and Transition Countries)

Variable	**CD test**	**p-Value**	**Correlation**	**Absolute Correlation**
Production	33.98	0.00	0.487	0.553
Investment	32.47	0.00	0.470	0.474
Gov Consumption	42.74	0.00	0.617	0.626
Trade	39.60	0.00	0.566	0.591
Labor	59.15	0.00	0.843	0.843

Variable	**CD test**	**p-Value**	**Correlation**	**Absolute Correlation**
Production	26.94	0.00	0.815	0.815
Investment	17.04	0.00	0.532	0.556
Gov Consumption	9.58	0.00	0.302	0.330
Trade	7.21	0.00	0.232	0.367
Labor	11.21	0.00	0.352	0.510

Concerning the EU-core countries (Table 1) and the first generation tests, we do find an integration of order 1 for labor force, trade openness, government consumption, and by construction, the trend. The inflation rate is stationary and will thus be added to the set of exogeneous explanatory variables that are outside the cointegration vector. However, the case of investment leads to mixed results since only the LLC test shows no rejection of the null hypothesis of no unit root.

For the transition countries, the results of the first-generation PURT are in favor of the presence of a unit root in the dynamics of the series except again for investment as well as for the government expenditure variable.

Since we expect some contagion and common factor effects between the countries of each sub-sample, we perform absolute values of the pairwise correlations and also the Pesaran

(2004)[8] cross-section dependence test (CD test). As shown in Table 2, we find evidence of significant cross-section dependence between our series. We thus reinvestigate the previous unit root testing and take into account common factors by using so-called second generation PURT from Pesaran (2007) named CIPS.

Finally, considering that investment series may contain structural breaks that might lead to biased unit root tests results, we also perform the panel unit root test from Carrion-i-Silvestre et al. (2005) that extends a panel KPSS (or Hadri) specification introducing potential structural breaks.

Results from these tests (see the two last lines in Table 1) suggest that investment may be also considered as a nonstationary variable in core countries. The test from Carrion-i-Silvestre et al. (2005) clearly reject the null of stationarity and all the CIPS results (except with a one-lag specification) are in favor of the unit root hypothesis. However, results are not that clear-cut in the transition country case and the presence of a cointegration relationship needs to be cautiously concluded.

Table 3: Panel Unit Root Tests (Transition Countries)

PURT	**Production**	**Labor Force**	**Investment**	**Trade**	**Government**
Levin Lin Chu	-2.056 (0.019)	-0.999 (0.159)	-1.298 (0.097)	-1.129 (0.129)	-3.744 (0.000)
Im Pesaran Shin	0.503 (0.692)	-0.897 (0.185)	-2.943 (0.002)	-1.030 (0.151)	-6.768 (0.000)
Maddala-Wu (ADF)	20.865 (0.831)	37.958 (0.151)	43.865 (0.008)	38.401 (0.056)	117.533 (0.000)
Specification	Constant	Constant	Constant	Constant	Constant
CIPS (Second generation) 1 to 4 lags included	na	-1.141 (0.127) 1.677 (0.953) 2.655 (0.996) 3.950 (1.000)	-1.867 (0.031) -1.426 (0.077) -1.917 (0.028) -0.959 (0.169)	-2.608 (0.005) -0.411 (0.341) na na	-1.823 (0.034) -1.461 (0.072) -1.774 (0.038) -0.225 (0.411)
Carrion-i-Silvestre (Third generation)	-	-	-	-	-

Remarks: na refers to not available statistics due to the lack of observations.

Regarding previous PURT tests, it should be reasonable to assume that all the variables exhibit I(1) or near I(1) properties, at least in the case of core countries. We thus assess in the next step the null hypothesis of a non-cointegrating relationship against the alternative of cointegration among these variables by relying on Pedroni's (1999, 2004) as well as Westerlund's (2007) panel cointegration techniques. The Pedroni first generation cointegration tests are residual tests extending the Engle and Granger methodology in a panel context. Pedroni introduced some heterogeneity in terms of cointegration vectors and developed some pooled (or panel) tests and also some group-mean (or heterogeneous) tests. The results in

[8] Moscone and Tosetti (2009) evaluate other tests to assess cross-sectional dependence but none perform better than the Pesaran (2004) one.

Table 4 show that four test statistics out of seven lead to reject the null of no cointegration regarding the core countries but only three in the case of transition countries[9].

Considering potential cross-section dependence in the production dynamics, we also perform the Westerlund (2007) test based on an ECM approach and on bootstrap critical values robust to the presence of cross-section dependence. Results from the Westerlund test are clearly not in favor of cointegration. As the correlation is weak in the case of core countries concerning the dependent variable (production) since the correlation value is inferior to 0.6 (see Hlouskova and Wagner (2006) and the Table 2), the cross-section dependence issue is not very important and we can thus follow the conclusions from Pedroni and argue in favor of a cointegration relationship in both sub-samples.
Note that there were no indications of major breaks in the production dynamics over the period 1995-2010, therefore there was no need to apply cointegration tests that account for structural breaks.

Table 4: Cointegration Tests

	EU-Core Countries		**Transition Countries**	
Dimension	**Statistic**	**Standardized values (p-value)**	**Statistic**	**Standardized values (p-value)**
Panel (Pooled)	$Z_{vN,T}$	-0.2807 (0.6105)	$Z_{vN,T}$	-0.4804 (0.6845)
	$Z_{\rho N,T^{-1}}$	-2.5776 (0.0050)	$Z_{\rho N,T^{-1}}$	-0.5704 (0.2842)
	$Z_{tN,T}$	-3.809 (0.0000)	$Z_{tN,T}$	-2.0309 (0.0211)
	$Z^{*}_{tN,T}$	1.4145 (0.9214)	$Z^{*}_{tN,T}$	-1.9783 (0.0239)
Group (Heterogeneous)	$\tilde{Z}_{\rho N,T^{-1}}$	-2.3062 (0.0106)	$\tilde{Z}_{\rho N,T^{-1}}$	0.8409 (0.7998)
	$\tilde{Z}_{tN,T}$	-3.9000 (0.0000)	$\tilde{Z}_{tN,T}$	-1.9512 (0.0255)
	$\tilde{Z}^{*}_{tN,T}$	1.6485 (0.9504)	$\tilde{Z}^{*}_{tN,T}$	-1.0817 (0.3107)
Westerlund ECM test	1.204	0.51	0.785	0.52
	2.128	0.56	2.408	0.84
	1.990	0 .77	0.536	0.51
	2.024	0.82	1.002	0.63

Remarks: The seven statistics follow a N(0,1) under the null of no cointegration of the Pedroni test. Specification with only a constant but no trend. Z-values and robust p-values with one lag are presented concerning the Westerlund test. Results with zero or two lags are similar in a qualitative manner.

[9] Using a simulation study with T=200 and N superior to 5, Orsal (2009) find that the panel-t test has the best size and size adjusted power properties. On the contrary, the group-p, panel-p and group-t tests have poor size-adjusted powers. Other studies show that Pedroni's parametric tests perform best in terms of power.

The cointegration tests have examined whether a long-run equilibrium relationship exists. Though the results are not totally clear-cut, we employ the Fully Modified Least Squares (FMOLS) estimator, suggested by Pedroni (2000) that allows to profit from the non-stationarity and that corrects the regular pooled OLS estimator for cointegration between the different series and for endogeneity among variables.

Although the series length should be long enough to avoid small sample bias[10], we also estimate for robustness with Dynamic Ordinary Least Squares (DOLS), which shows slightly better finite-T handling in the presence of endogenous feedback (Kao and Chiang, 2000) and outperforms the FMOLS estimator. The DOLS estimator uses parametric adjustment to the errors by including leads and lags of the differenced I(1) regressors. It is obtained from the following equation:

$$y_{i,t} = \alpha_i + \beta_1 T_t + \beta_2 X'_{i,t} + \sum_{j=-q_1}^{j=q_2} c_{ij} \Delta X_{i,t+j} + \epsilon_{i,t}, \qquad (2)$$

where c_{ij} is the coefficient of lead or lag values of the differenced explanatory variables $X_{i,t}$ and T_t represents a time trend. Inflation enters the regression as a deterministic regressor due to not being integrated. Leads and lags are based on the AIC criterion.

Table 5 and 6 below present the estimation results on the long-run economic growth relationships for the EU-core and transition subsamples computing DOLS and FMOLS estimators.

Table 5: The Long-Run Determinants of Economic Growth (EU-Core Countries)

Variables	Fully Modified Least Squares			Dynamic Least Squares		
	Coef.	Std. Error	p-Value	Coef.	Std. Error	p-Value
Investment	0.187	0.027	0.000	0.249	0.051	0.000
Labor Force	0.812	0.175	0.000	0.721	0.247	0.004
Trade Integration	0.334	0.050	0.000	0.365	0.065	0.000
Gov Consumption	-0.539	0.093	0.000	-0.513	0.126	0.000
No. Countries	15			15		
No. Observations	784			759		

Remarks: Estimations based on Fully Modified Least Squares (FMOLS) and Dynamic Least Squares (DOLS) estimators. Sample: EU core countries, quarterly data from 1995Q1 - 2010Q4.

[10] Both EU core and transition countries have at least a sample length of 63 periods with a total of 486 panel observations.

Table 6: The Long-Run Determinants of Economic Growth (Transition Countries)

Variables	Fully Modified Least Squares			Dynamic Least Squares		
	Coef.	Std. Error	p-Value	Coef.	Std. Error	p-Value
Investment	0.220	0.022	0.000	0.392	0.033	0.000
Labor Force	0.322	0.140	0.022	0.233	0.129	0.072
Trade Integration	0.024	0.008	0.006	0.012	0.008	0.138
Gov Consumption	-0.269	0.061	0.000	-0.098	0.081	0.229
No. Countries	11			11		
No. Observations	502			486		

Remarks: Estimations based on Fully Modified Least Squares (FMOLS) and Dynamic Least Squares (DOLS) estimators. Sample: Transition countries, quarterly data from 1995Q1 - 2010Q4.

Estimation results for EU core countries with both specifications are shown in Table 5. All coefficients of the employed explanatory variables are highly significant and bear, according to theory, the expected signs. Investment has a positive impact on long-run economic output, what is consistent with early results on growth determinants by Barro (1991) and Barro and Lee (1994). Following the growth literature as well, the size of the labor force has by far the largest explanatory power among all variables included. The positive coefficient of the trade integration variable is particularly for core members of the European Union not really surprising. The tight integration in trade of goods and services has since the early set-up of the European Economic Community fostered exports within the EU and thus tremendously contributed to overall economic growth. The coefficient associated with government consumption is negative, indicating a negative relationship between government expenditure, what is considered a government burden, and economic output (Fajnzylber et al., 2005; Rancière and Loayza, 2006; Lopez-Villavicencio and Mignon, 2011).

Comparing the results between the EU core countries and their transition counterparts, we find in Table 6 a stronger contribution of investment to economic output in the transition countries regression. This result echoes the basic theory of decreasing marginal productivity in the growth literature, finding an ever-decreasing marginal impact of any extra unit of capital with respect to advancing economic development (Barro and Sala-i-Martin 2000). Hence, it represents the different levels of economic development in the country subsamples. Whereas the level of capital accumulation is apparently of higher importance for transition countries, labor force size seems to matter far less for long-term economic output, whose impact is diminished by almost two thirds. These results follow two out of the seven stylized transition facts recorded by Campos and Coricelli (2002): that “labor moved”, not geographically but from activity to unemployment, inactivity, and from public to private sector, restoring its contribution to GDP growth, and that investment shrank, from a situation where it was abundant but completely inefficient. The reduction in significance of the trade openness variable compared to the EU core, at least partially in the DOLS estimation framework, may point to some limitations in the unequivocal view of overall beneficent trade openness. Recent literature, for instance, finds a negative effect of export concentration, most likely the case for our transition countries (Lederer and Maloney, 2003). Others stress the importance of policy complementation in non-trade areas with regard to trade liberalization, particularly in emerging countries (Chang et al. 2009). For what regards transition countries, the trade collapse was caused by the dismantling of the Council for Mutual Economic Assistance (CMEA) and trade re-orientation. Trade is considered as the main factor, driving the initial huge output losses, and strong subsequent recoveries. Even though negative and significant at least in the FMOLS specification, government consumption seems to be less an issue for transition countries, probably driven by comparably lower Debt-to-GDP levels (Boone and Maurel, 1999).

We continue by estimating a standard linear Panel Error-Correction Model (Panel ECM) in order to inspect the different convergence forces working on economic growth in either the core EU or transition countries. As recently well explained by Eberhardt and Presbitero (2015), employing an error correction model (ECM) representation in macro panel offers three advantages over static models and restricted dynamic specifications: (i) readily distinguishing short-run from long-run behaviours; (ii) investigating the error correction term and deducing the speed of adjustment for the economy to the long-run equilibrium; and (iii) testing for cointegration in the ECM by closer investigating the statistical significance of the error term.

Our equations include as short-run fundamentals the previously used variables and the Kocenda et al. (2013) exchange rate flexibility measure computed as the mean of percent exchange rate changes vis-à-vis the anchor currency Deutsch Mark/Euro. Government consumption has been discarded. The subsequent equation has the following form:

$$\Delta y_{i,t} = \mu_t + \theta z_{i,t-1} + \beta \Delta X'_{i,t} + \varepsilon_{i,t}, \qquad (3)$$

where $z_{i,t-1}$ represents the residual of the either FMOLS or DOLS long-run growth regressions. What we are most interested in is the respective coefficient θ that describes in a linear way the adjustment speed to the long-term trend. $\Delta X_{i,t}$ is the vector of short-run controls.

In addition, to check the robustness of our results and considering the mixed results in favor of cointegration – especially in the case of transition countries – and also the potential presence of common factors in the dynamics of the series, we also compute 2FE, PMG and CMG regressions (work in progress).

Tables 7 and 8 below show for both country subsamples error-correction coefficients as residuals derived from above FMOLS and DOLS estimations respectively.

Table 7: Linear Panel Error-Correction Model (EU-Core Countries)

Variables	Fully Modified Least Squares			Dynamic Least Squares		
	Coef.	Std. Error	p-Value	Coef.	Std. Error	p-Value
Err. Corr. Coef.	-0.154	0.023	0.000	-0.143	0.027	0.000
Short-run Coefficients						
Δ Investment	0.047	0.007	0.000	0.037	0.007	0.000
Δ Labor Force	0.126	0.082	0.126	0.077	0.083	0.352
Δ Trade Int.	0.275	0.024	0.000	0.259	0.025	0.000
ER Flexibility	-0.178	0.108	0.100	-0.198	0.111	0.074
Intercept	0.002	0.001	0.017	0.003	0.001	0.010
Durbin-Watson	1.995			2.022		
No. Countries	15			15		
No. Observations	725			715		

Remarks: Fully Modified Least Squares and Dynamic Least Squares indicate the models from the previous step where the error correction coefficients have been derived from.

Table 8: Linear Panel Error-Correction Model (Transition Countries)

Variables	Fully Modified Least Squares			Dynamic Least Squares		
	Coef.	Std. Error	p-Value	Coef.	Std. Error	p-Value
Err. Corr. Coef.	-0.248	0.029	0.000	-0.171	0.043	0.000
Short-run Coefficients						
Δ Investment	0.047	0.007	0.000	0.0233	0.007	0.001
Δ Labor Force	0.365	0.084	0.000	0.363	0.089	0.000
Δ Trade Int.	0.041	0.007	0.000	0.041	0.007	0.000
ER Flexibility	-0.400	0.096	0.000	-0.380	0.101	0.000
Intercept	0.012	0.002	0.000	0.012	0.002	0.000
Durbin-Watson	1.612			1.729		
No. Countries	11			11		
No. Observations	477			471		

Remarks: Fully Modified Least Squares and Dynamic Least Squares indicate the models from the previous step where the error correction coefficients have been derived from.

The main result taken from Tables 7 and 8 is the difference in speed of adjustment to the long-term growth trend, where the transition group converges faster than EU core countries. Consequently, whereas the developed EU economies show highly significant error-correction coefficients of -0.154 from the FMOLS estimator and -0.143 from DOLS, transition countries report coefficients of -0.248 and -0.171 respectively. In the short run, for both country groups, except for exchange rate flexibility, controls are positively related and in the majority significant for long-run growth. Even though showing the same importance for both EU core and transition countries in the FMOLS estimates, DOLS points at a higher relevance of investment for transition economies. Also the size of the labor force plays a far greater role. Conversely, trade integration plays a more important role for the EU core than for growth in emerging Europe; both coefficients are highly significant, what is in line with neoclassical growth theory and endogenous theory. This result may again reflect the close and long-lasting interconnectedness of western European economies, while European integration is still ongoing for Eastern Europe. As for exchange rate flexibility, the opposite is true as apparently higher flexibility in the short run means lower long-term growth for transition countries. The latter findings contrast somewhat with Kocenda et al. (2013) who find mildly positive short-run effects of exchange rate flexibility, though a negative impact over the longer term.

Panel Smooth Transition Regression Error-Correction Model (PSTR-ECM)

Results from the previous section suggest that convergence among countries towards their long-run growth trend in the two different country groups is not homogenous, but may rather depend on other specific factors, such as the controls examined before. We further assume, that the relation between these factors and the speed of convergence may be nonlinear in nature or may contain a nonlinear adjustment mechanism for different country groups and economic fundamentals, a feature the previous linear models would be unable to capture.

In order to further disentangle these relationships, we extend the previous linear error-correction framework and employ a panel smooth transition regression model developed by González et al. (2005) and Fok et al. (2005), following the work of Granger and Teräsvirta (1993) in a time series context. Panel smooth transition regression models allow for the modeling of different regimes and inherent nonlinear and time-varying convergence processes across countries and over time. In this particular model specification, the transition from one regime to the other is smooth and not discrete, as in the predecessor models of panel threshold regressions (PTR) developed by Hansen (1999).

Methodology

The approach follows the three-step strategy by González et al. (2005) for PSTR models: (i) identification, (ii) estimation, and (iii) evaluation. In the identification step, homogeneity is tested against the nonlinear PSTR alternative and upon confirmation of non-linearity, a transition function either specified as $m = 1$ (logistic) or $m = 2$ (exponential) is to be selected[11]. The second step involves estimation of the model by multivariate non-linear least

[11] From an empirical point of view, González et al. (2005) mention that only cases of $m = 1$ and $m = 2$ suffice to capture nonlinearities due to regime switching.

squares (NLS) once the data have been demeaned. In the evaluation step validity of the estimated model is verified along with a determination of the number of regimes, i.e. testing for non-remaining linearity.

First, the linear specification of our growth equation is tested against a PSTR alternative with threshold effects. We do so by testing the null hypothesis $\gamma = 0$. Due to the presence of unidentified nuisance parameters under the null, the transition function $g(s_{i,t-j};\ \gamma, c)$ is replaced by its first-order Taylor expansion around zero, following Luukonen et al. (1988) and González et al. (2005).

Two tests are usually identified in the literature to test for the linearity hypothesis $\gamma = 0$, or equivalently $\beta_1^* = \cdots = \beta_m^* = 0$, namely the *LM*, the *pseudo LRT*, and the LM_F statistics[12]. Since Van Dijk et al. (2002) report better size properties in small samples for the F-statistic than the χ^2 based statistic, we only report results for the F-version.

The adequate testing confirms the logistic function against the exponential alternative.
The function $g(s_{i,t-j};\ \gamma, c)$ is a transition function of the observable variable $s_{i,t-j}$, which is continuous, normalized, and bounded between 0 and 1. Its logistic specification can be defined as follows:

$$g(s_{i,t-j};\ \gamma, c) = \left(\frac{1}{1 + e^{-\gamma \prod_{j=1}^{m}(s_{i,t-j} - c_j)}}\right) \text{ with } \gamma > 0,$$

where $s_{i,t}$ denotes the transition variable, γ the speed of transition, and c the threshold parameter ($c_1 \leq c_2 \leq \ldots \leq c_m$). In our case of m = 1, the PSTR model reduces to a PTR model (Hansen, 1999) if $\gamma \to \infty$, and collapses into a linear regression model with fixed effects if $\gamma \to 0$.

The Model

Combining the long-run growth model approach from above with the modeling of the short-term dynamics from the linear panel ECM step, our PSTR-EC model can be written as follows:

$$\Delta y_{i,t} = \mu_t + \theta^0 z_{i,t} + \beta_0 \Delta X'_{i,t} + (\theta^1 z_{i,t} + \beta_1 \Delta X'_{i,t}) g\big(s_{i,t-j};\ \gamma, c\big) + \varepsilon_{i,t}, \qquad (4)$$

where θ^0 and $\theta^0 + \theta^1$ are the error-correction coefficients of two regimes and $X_{i,t}$ is a vector of time-varying (regime dependent) variables that are expected to influence economic growth. To this end we employ again the same controls as for the linear error-correction model. Depending on the realization of the transition variable γ, the link between $y_{i,t}$ and $s_{i,t-j}$ is

[12] The LM and pseudo-LRT statistics have a χ^2 distribution with mK degrees of freedom; the F statistic has a *F(mK, TN-N-K(m+r+1))* distribution.

specified by a continuum of parameters. The two extreme regimes in our non-linear estimation are β_0 under Regime 1 when $g(s_{i,t-j};\ \gamma, c) = 0$, and $\beta_0 + \beta_1$ under Regime 2, when $g(s_{i,t-j};\ \gamma, c) = 1$.

Results of the PSTR-ECM

The results of the model for both EU core countries and their transition counterparts are summed up in Table 9 and 10. For an interpretation, the main parameters of interest in our model are the coefficients of the error-correction term $z_{i,t}$ in the two extreme regimes, θ^0 and θ^0+ θ^1, the threshold parameter c, as well as the speed of transition parameter γ.

Table 9. Estimated PSTR with Two Regimes and m=1

Regime 1		Regime 2		Transition	
θ^0	T stat	θ^1	T stat	γ_{euro}	c_{Core}
0.206***	2.78	-0.356***	-4.54	412.23	-0.062

Remarks: Model chosen according to AIC, BIC criteria and the lowest p-value in the linear tests

Table 10. Estimated PSTR with Two Regimes and m=1

Regime 1		Regime 2		Transition	
θ^0	T stat	θ^1	T stat	γ_{euro}	$c_{Transition}$
0.141	0.65	-0.316	-1.41	170.63	-0.084

Remarks: Model chosen according to AIC, BIC criteria and the lowest p-value in the linear tests

Several variables have been tried as transition parameters and we achieve significant results using the mean change of the PPI[13]. Table 9 shows that, in the case of the advanced EU countries, linearity is strongly rejected. The transition parameter estimate is large, reducing the transition function to an indicator function with a sharp and abrupt switch from one regime to the other. For EU core countries a threshold estimate of -0.062 (corresponding to a mean change in the PPI of 6.2% per quarter) splits adjustment to the long-term growth trend into two regimes, where for the regime below the threshold a positive and highly significant loading coefficient (0.206) is obtained. This implies that countries do not converge to their long-term growth trend but diverge instead.

However, when the price flexibility surpasses its threshold value and enters the second regime, the loading coefficient turns to be 0.206 + (-0.356) and thus becomes significantly negative. Hence, within the second regime there is a strong tendency that the growth rate of

[13] Calculated as described above following Schnabl (2009) and Maurel and Schnabl (2012)

output converges towards its long run equilibrium. Therefore, the more flexible pricing and wage setting in the market is, the faster economies are expected to recover from shocks.

This nonlinearity found for advanced EU economies does not show up in the transition country group. Even though the threshold estimate and the speed of transition are lower, the different loading coefficients are not significant, i.e. growth rates do neither converge above -0.084, nor do they diverge below the threshold. The convergence process to the long-run growth rate is thus independent of the price flexibility level and nonlinearity for the group of Eastern European countries can thus be rejected.

This importance of price and wage flexibility for the EU core countries, which are either part of the Euro zone or have their currencies pegged to the Euro, to close in on their normal growth trend, follows the arguments on the architecture of optimal currency areas and monetary integration in general. Without the possibility or only under high costs to devalue a currency, international competitiveness needs to be restored in a different way. High factor mobility, especially labor mobility, to equilibrate asymmetric economic developments has been the main proposition by Mundell (1961) for Europe. Yet, even though improvements on labor mobility have been achieved due to the Schengen Agreement, the subsequent introduction of the Euro, and during the recent crisis, migration still remains sluggish and underlines language or institutional barriers across European countries compared to the US (Beine et al. 2013; Dao et al. 2014; Beyer and Smets, 2015). According to our results, the primary push for a recovery from asymmetric shocks may thus come from falling wages and prices in the crisis countries to a degree of above the threshold identified. This development can currently be observed in Greece, Italy, Ireland, Portugal, and Spain, which have undergone drastic adjustments in the context of the crisis.

Conclusion

In this paper, we have studied the long-term convergence of economic growth among Western and Eastern European transition countries using a linear panel error-correction model framework as well as a panel smooth transition regression model. We have shown that the convergence process differs in velocity for the two sample groups and EU core economies are outpaced by transition countries over the long run. Regarding the results from the PSTR models, a non-linear two-regime development in adjustment speed depending on price and wage flexibility exists in Western European countries. Below the lower bound of a 6.2% average change in the producer price index, deviations from the long run growth trend are not corrected and are even enlarging. Above the threshold, countries converge at a rather fast pace. Transition countries on the other hand do not seem to encounter nonlinearities in their convergence process to their long-term growth rate.

Given the common currency or pegged exchange rates and the still partly subdued labor mobility in Europe, the recovery from asymmetric shocks apparently needs to come from rather sharp declines in wages and prices in order to make up for the high costs of a proper currency depreciation. Hence, results suggest that policy makers should break down labor market rigidities during a crisis and allow for fast and strong price adjustments to alleviate the lost international competitiveness through internal measures and pave the way for recovery.

References:

Aghion, P., and Howitt, P. (1992). A Model of Endogenous Growth through Creative Destruction. *Econometrica*, Vol. 60: 323-351.

Aghion, P. and Saint-Paul, G. (1991). On the virtues of bad times. Working Paper No. 578. CEPR, London.

Aghion, P. and Saint-Paul, G. (1993). Uncovering some causal relationships between productivity growth and the structure of economic fluctuations: A tentative survey. Working Paper d 4603. NBER, Cambridge, MA.

Barro, R. J. (1991). Economic Growth in a Cross-Section of Countries. *Quarterly Journal of Economics*, Vol. 106: 407-443.

Barro, R. J., and Lee, J. W. (1994). Sources of economic growth. *Carnegie-Rochester Conference Series on Public Policy*, Vol. 40: 1-46.

Beine, M., Bourgeon, P., and Bricongne, J. C. (2013). Aggregate Fluctuations and International Migration. CESifo Working Paper No. 4379.

Beyer, R. C. M., and Smets, F. (2015). Regional Labour Market Adjustments in Europe and the US: How Different?. *Economic Policy*, forthcoming.

Beyer, R. C. M., and Stemmer, M. (2015). From progress to nightmare: European regional unemployment over time. Working Paper No. 458, De Nederlandsche Bank.

Bianchi, F., and Kung, H. (2014). Growth, Slowdowns, and Recoveries. Working Paper 20725, National Bureau of Economic Research.

Bicaba, Z. T., Kapp, D., and Molteni, F. (2014). Stability periods between financial crises: The role of macroeconomic fundamentals and crises management policies. *Economic Modelling*, Vol. 43: 346-360.

Blanchard, O. (2014). Where Danger Lurks. *Finance & Development*, Vol. 51(3): 28-31.

Boone, L. and Maurel M. (1999). L’ancrage de l’Europe centrale et orientale à l’Union européenne, *Revue économique*, Vol. 50(6): 1123-1137.

Bordo, M. D., and Haubrich, J. G. (2012). Deep Recessions, Fast Recoveries, and Financial Crises: Evidence from the American Record. NBER Working Paper No. 18194.

Bruno, M., and Easterly, W. (1998). Inflation crises and long-run growth. *Journal of Monetary Economics*, Vol. 41(1): 3-26.

Carrion-i-Silvestre, J. L., Barrio-Castro, T. D. and Lopez-Bazo, E. (2005). Breaking the panels: an application to the GDP per capita, *Econometrics Journal*, Vol. 8 : 159–75.

Campos, Nauro F., and Coricelli, F. (2002). Growth in Transition: What We Know, What We Don't, and What We Should. *Journal of Economic Literature*, Vol. 40(3): 793-836.

Cerra, V., and Saxena, S. C. (2005). Eurosclerosis or Financial Collapse: Why did Swedish Incomes Fall Behind?. IMF Working Paper 05/29.

Cerra, V., and Saxena, S. C. (2008). Growth Dynamics: The Myth of Economic Recovery. *American Economic Review*, Vol. 98(1): 439-457.

Cerra, V., Panizza, U., and Saxena, S.C. (2013). International Evidence On Recovery From Recessions. *Contemporary Economic Policy*, Vol. 31(2): 424-439.

Chang, R., Kaltani, L., and Loayza, N. V. (2009). Openness is Good for Growth: The Role of Policy Complementarities. *Journal of Development Economics*, Vol. 90: 33-49.

Choi, I. (2001). Unit root tests for panel data. *Journal of International Money and Finance*, Vol. 20: 249-272.

Comin, D., and Gertler, M. (2006). Medium Term Business Cycles. *American Economic Review*, Vol. 96(3): 523-551.

Ciccone, A., and Jarocinski, M. (2010). Determinants of Economic Growth: Will Data Tell?. *American Economic Journal: Macroeconomics*, Vol. 2(4): 223-247.

Coricelli, F., and Maurel, M. (2011). Growth and Crisis in Transition : A Comparative Perspective. *Review of International Economics*, Vol. 19(1): 49-64.

Dao, M., Furceri, D., and Loungani, P. (2014). Regional Labor Market Adjustments in the United States and Europe. IMF Working Paper No. 14/27.

DeLong, J., and Summers, L. (1991). Equipment Investment and Economic Growth. *Quarterly Journal of Economics*, Vol. 106: 445-502.

Durlauf, S., Johnson, P., and Temple, J. (2005). *Growth Econometrics*. In: Handbook of Economic Growth, by P. Aghion and S. Durlauf (eds). Amsterdam: North Holland.

Durlauf, S., Kourtellos, A., and Tan, C. (2008). Are Any Growth Theories Robust?. *Economic Journal*, Vol. 118: 329-346.

Eberhardt, M. and Presbitero, A. F. (2015). Public debt and growth: Heterogeneity and non-linearity. *Journal of International Economics*, Vol. 97: 45-58.

Fajnzylber, P., Loayza, N. V., and Calderon, C. (2005). *Economic Growth in Latin America and the Caribbean: Stylized Facts, Explanations, and Forecasts*. Washington, D.C.: World Bank Publications.

Fatas, A. and Mihov, I. (2006). The macroeconomic effects of fiscal rules in the US states. *Journal of Public Economics*, Vol. 90(1-2): 101-117.

Fok, D., van Dijk, D., and Franses, P. (2005). A multi-level panel STAR model for US manufacturing sectors. *Journal of Applied Econometrics*, Vol. 20(6): 811-827.

González, A., Teräsvirta, T., and van Dijk, D. (2005). Panel Smooth Transition Regression models. Research Paper 165, Quantitative Finance Research Centre, University of Technology, Sidney.

Granger, C. W. J., and Teräsvirta, T. (1993). *Modelling Nonlinear Economic Relationships.* Oxford, UK: Oxford University Press.

Hansen, B. (1999). Threshold effects in non-dynamic panels: estimation, testing, and inference. *Journal of Econometrics*, Vol. 93(2): 345-368.

Hlouskova, J., and Wagner, M. (2006). The Performance of Panel Unit Root and Stationarity Tests: Results from a Large Scale Simulation Study. *Econometric Reviews*, Vol. 25 (1): 85–116.

Im, K. S., Pesaran, M. H., and Shin, Y. (2003). Testing for unit roots in heterogenous panels. *Journal of Econometrics*, Vol. 115: 53-74.

Kao, C., and Chiang, M. H. (2000). On the Estimation and Inference of a Cointegrated Regression in Panel Data. *Advances in Econometrics*, Vol. 15: 179-222.

Kocenda, E., Maurel, M., and Schnabl, G. (2013). Short- and Long-term Growth Effects of Exchange Rate Adjustment. *Review of International Economics*, Vol. 21(1): 137-150.

Keynes, J. M. (1936). *The General Theory of Employment, Interest, and Money*. London: Macmillan and Co., Ltd.

Hayek, F. von (1937). *Monetary Nationalism and International Stability*. London: Longmans, Green.

Lederer, D., and Maloney, W. F. (2003). Trade Structure and Growth. World Bank Policy Research Working Paper No. 3025.

Levin, A., Lin, C. F., and Chu, C. (2002). Unit root test in panel data: Asymptotic and finite sample properties. *Journal of Econometrics*, Vol. 108: 1-25.

Levine, R., and Renelt, D. (1992). A Sensitivity Analysis of Cross-Country Growth Regressions. *The American Economic Review*, Vol. 82: 942-963.

López-Villavicencio, A., and Mignon, V. (2011). On the impact of inflation and output growth: Does the level of inflation matter?. *Journal of Macroeconomics*, Vol. 33: 455-464.

Luukonen, R. Saikkonen, P., and Teräsvirta, T. (1988). Testing Linearity against Smooth Transition Autoregression Models. *Biometrika*, Vol. 75: 491-499.

Martin P. and Rogers, C. A. (2000). Long-term growth and short-term economic instability. *European Economic Review*, Vol. 44(2): 359-381.

Maurel, M., and Schnabl, G. (2012). Keynesian and Austrian Perspectives on Crisis, Shock Adjustment, Exchange Rate Regime and (Long-Term) Growth. *Open Economies Review*, Vol. 23(5): 847-868.

Maddala, G. S., and Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics*, Vol. 61: 631-652.

Moscone, F., & Tosetti, E. (2009). A Review And Comparison Of Tests Of Cross-Section Independence In Panels. *Journal of Economic Surveys*, Vol. *23*(3) : 528-561.

Mundell, R. (1961). A Theory of Optimum Currency Areas. *American Economic Review*, Vol. 51(4): 657-665.

Moral-Benito, E. (2012). Determinants of Economic Growth: A Bayesian Panel Data Approach. *The Review of Economics and Statistics*, Vol. 94(2): 566-579.

Orsal D. K. (2008). Comparisons of Panel Cointegration Tests, *Economics Bulletin*, Vol. 3(6): 1-20.

Papell, D. H., and Prodan, R. (2012). The Statistical Behavior of GDP after Financial Crises and Severe Recessions. *The B. E. Journal of Macroeconomics (Special Issue: Long-Term Effects f the Great Recession)*, Vol. 12(3).

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. University of Cambridge, Faculty of Economics, Cambridge Working Papers in Economics No. 0435.

Pedroni, P. (1999). Critical values for cointegration tests in heterogenous panels with multiple regressors. *Oxford Bulleting of Economics and Statistics*, Vol. 61: 631-652.

Pedroni, P. (2000). Fully modified ols for heterogeneous cointegrated panels. *Advances in Econometrics*, Vol. 15: 93–130.

Pedroni, P. (2004). Panel Cointegration: Asymptotic And Finite Sample Properties Of Pooled Time Series Tests With An Application To The Ppp Hypothesis. *Econometric Theory*, Vol. 20(3): 597-625.

Rancière, R., and Loayza, N. V. (2006). Financial Development, Financial Fragility, and Growth. *Journal of Money, Credit, and Banking*, Vol. 38(4): 1051-1076.

Sachs, J., and Warner, A. (1995). Economic reform and the process of global integration (with discussion). *Brookings Papers on Economic Activity*, Vol. 1:1-118.

Schnabl, G. (2009). Exchange Rate Volatility and Growth in Emerging Europe and East Asia. *Open Economies Review*, Vol. 20: 565-587.

Schumpeter, J. (1911). *Theorie der Wirtschaftlichen Entwicklung*. Berlin.

Van Dijk, D., Teräsvirta, T., and Franses, P. H. (2002). Smooth Transition Autoregressive Models: A Survey of Recent Developments. *Econometric Reviews*, Vol. 21: 1-47.

Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*, Vol. 68: 101-132.