Essays on Applied Econometrics of Macro-Financial Panel Data with Cross-Sectional Dependence

Inaugural-Dissertation

zur Erlangung des akademischen Grades eines

Doktors der Wirtschafts- und Sozialwissenschaften

der Wirtschafts- und Sozialwissenschaftlichen Fakultät

der Christian-Albrechts-Universität zu Kiel

vorgelegt von

MSc.

Danvee Floro

aus Manila, Philippinen

Kiel, 2019

Gedruckt mit Genehmigung der
Wirtschafts- und Sozialwissenschaftlichen Fakultät
der Christian-Albrechts-Universität zu Kiel

Dekan: Prof. Dr. Till Requate
Erstbegutachtung: Prof. Dr. Matei Demetrescu
Zweitbegutachtung: Prof. Dr. Maik H. Wolters

Tag der Abgabe der Arbeit: 31.07.2018
Tag der mündlichen Prüfung: 07.02.2019

Acknowledgments

My sincere gratitude first goes out to the Deutsche Forschungsgemeinschaft for the funding received towards my PhD under the project entitled “Time-varying volatility in panel data sets and stochastic trends”.

I have been most privileged to work under the guidance of my supervisor Matei Demetrescu. Matei was always there to talk and to offer advice, his patience never-ending and is always available to answer each and every e-mail within minutes no matter what time of the day it is. I always felt extremely lucky for being supervised by him.

I am deeply indebted to Maik H. Wolters for the tremendous support he has provided me all these years. He always provided me constant feedback and encouragement so that I could mature and progress as a researcher. I also thank the chair of my PhD defense committee Kai Carstensen for the generous support and guidance that he extended me throughout my time at the Institute of Statistics and Econometrics (ISÖ), my colleagues at the ISÖ, Frau Reinmüller, the Kiel Institute for the World Economy, the Doctoral Program in "Quantitative Economics" and my co-authors Joselito R. Basilio and Björn van Roye.

Lastly, I thank my late grandmother Agapita, Martin and my children Nathan Lucas and Marvee Emma for being my greatest motivation.

Contents

Chapter 1

Introduction

Applied research in macroeconomics and finance using multi-country and multi-firm panel data is a trend that has gained significant momentum in recent years. Because the panel route has the well-known advantage of potentially having more power to reject the null hypothesis– a natural consequence of pooling the time and cross-sectional dimensions of individual units in a panel–panel data models are the perfect response to the concern of insufficient historical time-series found in most macroeconomic data. It is a well-known fact however, that any procedure applied to panel data models quickly sets up specific difficulties (see Breitung (2015) for a comprehensive review of the treatment of panel data in macroeconomics). In particular, the problem of cross-sectional dependence is a mainstay of macro-panel data: some countries or firms are naturally more connected than others. Likewise, a common shock such as the global financial crisis sometimes results in correlated responses of countries or firms. The dependence across units in the panel naturally translates to cross-correlated residuals, giving rise to invalid inference, e.g. biased standard errors (Phillips and Sul, 2003).[1]

In the last decade, the econometric literature has often been addressing the practical difficulty of cross-sectional dependence by taking a common factors approach (see Coakley et al., 2006; Bai, 2009).[2] That is, one estimates panel regressions with a built-in factor error structure, where the factors are estimated and included in the panel regression model as an additional regressor.[3] These so-called factor-augmented panel regressions have become immensely popular in recent years, owing to the flexibility of the common factors approach in accommodating both the presence of local and global spillovers from common unobserved shocks (Bai and Ng, 2002; Pesaran, 2006; Bai, 2009; Kapetanios et al., 2011; Eberhardt

[1] Estimator inefficiency is also a by-product of cross-sectional correlation, but this problem is mitigated given the typically large number of observations in a panel data set.

[2] In this thesis, the terms *common factors* and *common components* will be used interchangeably.

[3] This is based on the assumption that the regressors are correlated with the factors, a stylized fact in many economics and financial data. In such a case, there may be loss of consistency. However, if the factors and the regressors are independent of each other, then the least squares estimator is enough to achieve consistency, even if the factor is unobserved and thus can be excluded in the estimation (Greenaway-McGrevy et al., 2012).

and Teal, 2011).[4] Moreover, the impact of these factors is allowed to vary over time and is heterogeneous across units in the panel. This is important, because imposing homogenous effects of unobserved common shocks across units when the true impact is heterogeneous may result in endogeneity and biased coefficient estimates (Dell'Erba and Sola, 2016).

The estimation of factor-augmented panel regressions can be grouped into two categories. One is to consider the principal components (PC) approach (see Bai, 2009; Greenaway-McGrevy et al., 2012) and the other is the common-correlated effects (CCE) estimator proposed by Pesaran (2006). For the former approach, the factors are calculated either directly from residuals or indirectly from the regressors and the regressand. The latter approach calculates cross-section averages of the dependent and independent variables as proxies for the factors and is mainly motivated by its ease of computation. The PC approach may be a preferred choice if it is believed that the common factor represents an "omitted" variable, say for example the technological progress in a Cobb-Douglas production function (Eberhardt and Teal, 2011). In the case of financial time series like stock returns that follow a multi-factor asset pricing model, the PC approach also presents itself suitably in this situation, as multiple (risk) factors can be directly extracted. However, if the objective is to just remove the effect of cross-sectional dependence without having to deal with the (lack of) interpretability of the factors, then the CCE approach would be ideal, as one can also simply treat the CAs as nuisance parameters.[5]

A growing number of empirical studies have employed factor-augmented panel regressions in the macroeconomics and macro-financial linkages literature. The papers of Dell'Erba and Sola (2016); Memmel et al. (2015); Henry et al. (2013); Beckmann et al. (2012) to name a few, investigate the relationships between interest rates and fiscal policy, nationwide credit loss rates and bank credit risk and exchange rates and the macroeconomy, respectively. They account for cross-sectional dependence via the PC estimator. Using the CCE approach, Eberhardt and Presbitero (2015) and Chudik et al. (2017) study the relationship between debt and growth for a panel of countries. Recent work by Afonso and Jalles (2014) and Gantman and Dabós (2013) examine the fiscal position-growth and finance-growth nexuses, respectively. On consumption models, Fuleky et al. (2018) analyze the sensitivity of international consumption risk sharing, while Everaert and Pozzi (2014) develop a mean-group variant of the CCE estimator (CCEMG) in testing the predictability of consumption growth on a group of OECD countries. Adema and Pozzi (2015) adopt Everaert and Pozzi (2014)'s CCEMG estimator and investigate the determinants of household savings-to-disposable income ratio of a panel of advanced countries.

[4] By contrast, spatial econometric tools require an *a priori* assumption on the spillover mechanisms between countries or units.

[5] Westerlund and Urbain (2015) conduct a theoretical investigation of the relative performance of the PC and cross-sectional average (CA) approaches and find that if the number of cross-sections N and T are equal, then the properties of the two estimators are shown to differ and could lead to dissimilar results in applied work.

Another alternative, which is a much less common but altogether equally promising approach to dealing with cross-sectional dependence in panel tests, is the adoption of meta-analysis of p-value combinations. Meta-analysis is the standard technique in clinical trials to synthesize treatment effects of several experiments done on a single clinical study. In econometrics, p-value combinations have already been extensively used in the context of panel unit root and cointegration testing (see Maddala and Wu, 1999; Demetrescu et al., 2006; Hanck, 2009, 2013; Hassler and Werkmann, 2014; Örsal and Arsova, 2017; Demetrescu and Hanck, 2017). In unit root testing for example, the idea is to form a joint significance test for parameter values from combined individual units in testing the null hypothesis that all units in the panel have a unit root. Different from pooled panel methods, p-value combinations offer a flexible approach to test a panel hypothesis which allows the researcher to conduct inference on each individual in the panel, without having to worry immediately about cross-sectional dependence and across-heterogeneity. Exhaustive Monte Carlo simulations on the appropriateness of p-value combinations show good size control and increased power in the presence of unbalanced and cross-sectionally dependent panels and whose innovation variances are time-varying (see Hanck and Czudaj, 2015; Demetrescu and Hanck, 2017).

Despite the explosion of papers on panel data models with cross-sectional dependence in recent years, there is still very limited applied work employing these methods to two important strands of the applied panel econometrics literature: a) predictive regressions and b) dynamic panel threshold regression models. This thesis is concerned with bridging this substantial gap. Specifically, I employ state-of-the-art robust panel inference methods in accounting for cross-sectional dependence in a) and b) to focal areas of macro-finance research. The thesis is comprised of three self-contained chapters. The first two chapters focus on panel predictive regressions, while the last chapter is centered on dynamic panel threshold regression models.

The first focus is on panel predictive regression models. Predictive regressions are a staple tool in macro-financial studies. A core research area of predictive regression is evaluating the predictability of stock returns by various lagged financial and economic variables. The extant literature however, presents mixed evidence on predictability of stock returns. This is attributed to firm-specific characteristics, model specification and econometric approach. With respect to model specification and econometric approach, there are at least three important concerns apart from cross-sectional dependence in the panel variant of predictive regressions.

First is that most financial time series exhibit some form of unknown persistence, by which this induces a small-sample bias in the usual OLS estimator (see Stambaugh, 1999). Moreover, the standard normal distribution is shown to perform poorly in the presence of very persistent predictors, leaving the researcher to resort to near-integrated asymptotic approx-

imations (Campbell and Yogo, 2006; Elliott and Stock, 1994).[6] Second, Cavanagh et al. (1995) show that when the innovation processes in the regressors are correlated with the predictand, the tests can be size-distorted especially if the regressors are highly persistent, with the size distortions leading to a tendency to incorrectly reject the null of no predictability. More recently, time-varying volatility in the innovation processes has been found to introduce a form of distortion on statistical inference (see for example Cavaliere and Taylor, 2008, for a discussion of related issues.). Addressing these issues in the panel context is essential because these statistical features, which have a compounding effect in macroeconomic and financial time series panel data, lead to potentially spurious inference as the number of the units in the panel increase.

In **Chapter 2**, I quantify the extent of cross-sectional dependence in panel predictive regressions via factor augmentation and show that it is relevant enough to be included in the regression model as it materially affects the outcome of the study. **Chapter 2** builds on the overidentifed IV-based test of Breitung and Demetrescu (2015) that deal with three key features of time series panel data, namely, unknown persistence of the regressors, endogeneity and time-varying volatility of the error variances. I extend Breitung and Demetrescu (2015)'s test to a panel setting and explicitly model cross-sectional dependence by extracting factors from stock returns as the dependent variable via PC. I showcase this novel procedure in investigating whether monetary policy surprises predict firm-level stock returns for 228 US firms listed on the New York Stock Exchange and grouped according to industry (see Ehrmann and Fratzscher (2004) for a similar study on industry-effects of monetary policy on stock returns).

One of the important considerations in the analysis of stock return predictability is the extent to which stock returns are interconnected. Westerlund and Urbain (2013) consider two factors extracted via PC in the prediction of Chinese stock returns by financial ratios. Westerlund et al. (2017) account for cross-sectional dependence in the prediction of global stock returns by a single common factor structure, as proxied by the the CA approach. In this chapter, firms' stock return interconnectedness is encapsulated within the arbitrage pricing theory of Ross (1976), which assume factor representations with more than one common factor. I find that accounting for cross-sectional dependence by means of (estimated) factors considerably alters the predictive significance of monetary policy surprises depending on the sample period being studied. Concretely, during the period 1990-2000, monetary policy has no influence on future stock returns when cross-sectional dependence is accounted for by means of common factor augmentation. By contrast, the predictive power of monetary policy is even boosted when introducing common factors into the model when the period of analysis covers 2002-2007. This chapter is published in "Applied Economics Letters".

[6] This option however, requires an *a priori* knowledge of the exact persistence of the predictor, which may prove to be computationally inconvenient in many cases.

By contrast, **Chapter 3** illustrates how one may address the case where across-heterogeneity is suspected and one does not have a strong assumption on the exact form of dependence among units in the panel predictive regression model. In specific, the researcher may resort to meta-analytic approaches using p-value combinations. Thus, in **Chapter 3**, I relax the assumption of the presence of a functional form of cross-sectional dependence in panels. In obtaining inference from Breitung and Demetrescu (2015)'s overidentified IV-based test in the panel context, I employ p-value combinations and multiple testing methods, which is rarely applied in the panel predictive regression framework. P-value combinations are straightforward to implement, accommodates unbalanced panels and there is no need to explicitly model the type of error cross-correlation. Furthermore, unlike the pooled test statistic of the Breitung and Demetrescu (2015) test in **Chapter 2**, p-value combinations from individual t-statistics testing the null of no predictability enable the researcher to draw inference on individual countries that make up the panel.

As an application, I evaluate the predictive ability of bubbles in housing markets on various proxies of macroeconomic performance for a panel of eighteen advanced countries. The key results of this study are 1) house price bubbles consistently predict an increase in government expenditures, even in the presence of structural change, different testing horizons and sample periods, as well as the inclusion of credit bubbles as as an additional predictor, and 2) I find greater evidence that house price bubbles enhance macroeconomic performance in the identified countries for which evidence of predictability exists. This chapter is published in the "International Review of Financial Analysis" journal.

The second focus of the thesis is on accounting for cross-sectional dependence in dynamic panel threshold regression models. There is reason to believe that many macro-finance relationships are better captured by non-linear models due to a myriad of economic "tipping points". These "tipping points" could be the result of switches in macroeconomic behavior or policy changes. In this regard, dynamic panel threshold regression models have been extensively used to study regime changes in macroeconomic relationships (Bick, 2010; Kremer et al., 2013; Proaño et al., 2014; Kurul, 2017; Chao et al., 2017). However, existing studies involving DPTRs have not properly accounted for cross-sectional dependence, which is central to estimation consistency and unbiasedness. Omitting the unobserved common component is non-negligible. For instance, an "omitted" variable in a non-linear panel regression model may mislead the researcher into concluding that a regime shift has occurred or evidence of a "threshold effect" exists.

One of the unique contributions of this thesis therefore, is to carefully account for the omitted factor within the framework of dynamic panel threshold regression models, which **Chapter 4** will later show, plays a significant role in obtaining robust inference from the given results. Hence, the overarching theme in **Chapter 4** is to robustify inference in dynamic panel threshold regression models by means of common (estimated) factor augmentation. I apply

this unique method in examining whether monetary policy behavior depends on certain phases of financial market stress for a panel of advanced and emerging market countries.

The main finding in this chapter is that on the one hand, advanced economy central bank interest rate policies most of the time do not respond to stock market and banking sector stress, but react in an aggressively accommodative manner when financial markets are in a state of high volatility. On the other hand, evidence of threshold effects in emerging market economies are generally weak.

An equally important finding is that when cross-sectional dependence is accounted for, the size of the interest rate response of advanced and emerging market economy countries is generally reduced (or even become statistically insignificant) in some specifications and increased in others. Thus, given that global shocks account for much of the propagation of financial crises across economies, assuming independence in the resultant series could give the illusion of threshold effects or nonlinear effects of financial stress on monetary policy settings. This chapter is a joint work with Björn van Roye of the European Central Bank. My contribution is the empirical design, implementation of econometric methods, programming of the code and writing of the draft. This chapter is published in "International Review of Economics and Finance".

Chapter 2

Monetary policy surprises and firm-level stock return predictability: evidence from a new panel-based approach

Abstract

We employ a new panel-based testing procedure that is robust to the uncertain persistence of regressors, time-varying volatility and cross-sectional error dependence in studying the predictive dynamics between conventional U.S. monetary policy surprises and firm-level stock returns. We find that accounting for cross-sectional dependence by means of (estimated) factors considerably alters the predictive significance of monetary policy surprises depending on the sample period being studied. Concretely, during the period 1990-2000, monetary policy has no influence on future stock returns when cross-sectional dependence is accounted for by means of common factor augmentation. By contrast, the predictive power of monetary policy is even boosted when introducing common factors into the model when the period of analysis covers 2002-2007.

JEL classification: C12, C33, E31, E44, G15
Keywords: monetary policy surprises, predictive regression, heterogeneous panel, cross-sectional dependence, factor-based model

Chapter 3

Testing the predictive ability of house price bubbles for macroeconomic performance: A meta-analytic approach

Abstract

This study tests for the predictive ability of bubbles in housing markets on several proxies of macroeconomic performance using a panel of eighteen advanced countries. We use robust inference methods to address the bias resulting from the unknown persistence of our house price bubble measure. Evidence of predictability is analyzed by using a meta-analytic p-value combination approach for an overall joint significance, a method that is rarely applied in the panel predictive regression framework. The advantages are that heterogeneous panels are accommodated, and one can make inference on the individual unit for which the null hypothesis of no predictability is rejected. Our findings reveal the following: First, house price bubbles consistently predict an increase in government expenditures, even in the presence of structural change, different testing horizons and sample periods, as well as the inclusion of credit bubbles as as an additional predictor. Second, we find greater evidence that house price bubbles enhance macroeconomic performance in the identified countries for which evidence of predictability exists.

JEL classification: E31, E44, E52, E58, C23, C24
Keywords: House price bubbles, heterogeneous panels, panel predictive regressions, combinations of p-values, meta-analysis

Chapter 4

Threshold effects of financial stress on monetary policy rules: A panel data analysis

Abstract

This study tests for the state-dependent response of monetary policy to increases in overall financial stress and financial sector-specific stress across a panel of advanced and emerging economy countries. We use a factor-augmented dynamic panel threshold regression model with (estimated) common error components to deal with cross-sectional dependence. We find strong evidence of advanced economy countries' aggressive monetary policy loosening in response to stock market and banking stress but only in times of high financial market volatility. By comparison, evidence of threshold effects of financial stress is generally weak for emerging market countriesâ interest rate decisions.

JEL classification: E31, E44, E52, E58, C23, C24
Keywords: Financial stress, monetary policy, factor-augmented dynamic panel threshold regression, cross-sectional dependence

This study is joint work with Björn van Roye.

https://doi.org/10.1016/j.iref.2017.07.023

Bibliography

Adema, Y. and L. Pozzi (2015). Business cycle fluctuations and household saving in OECD countries: A panel data analysis. *European Economic Review 79*, 214–233.

Afonso, A. and J. T. Jalles (2014). Fiscal composition and long-term growth. *Applied Economics 46*(3), 349–358.

Bai, J. (2009). Panel data models with interactive fixed effects. *Econometrica 77*(4), 1229–1279.

Bai, J. and S. Ng (2002). Determining the number of factors in approximate factor models. *Econometrica 70*(1), 191–221.

Beckmann, J., A. Belke, and F. Dobnik (2012). Cross-section dependence and the monetary exchange rate model–a panel analysis. *The North American Journal of Economics and Finance 23*(1), 38–53.

Bick, A. (2010). Threshold effects of inflation on economic growth in developing countries. *Economics Letters 108*(2), 126–129.

Breitung, J. (2015). The analysis of macroeconomic panel data. *The Oxford Handbook of Panel Data*.

Breitung, J. and M. Demetrescu (2015). Instrumental variable and variable addition based inference in predictive regressions. *Journal of Econometrics 187*(1), 358–375.

Campbell, J. Y. and M. Yogo (2006). Efficient tests of stock return predictability. *Journal of Financial Economics 81*(1), 27–60.

Cavaliere, G. and R. A. Taylor (2008). Time-transformed unit root tests for models with non-stationary volatility. *Journal of Time Series Analysis 29*(2), 300–330.

Cavanagh, C. L., G. Elliott, and J. H. Stock (1995). Inference in models with nearly integrated regressors. *Econometric theory 11*(5), 1131–1147.

Chao, C. C., M. Hu, Q. Munir, and T. Li (2017). The impact of {CEO} power on corporate capital structure: New evidence from dynamic panel threshold analysis. *International Review of Economics and Finance 51*, 107 – 120.

Chudik, A., K. Mohaddes, M. H. Pesaran, and M. Raissi (2017). Is there a debt-threshold effect on output growth? *Review of Economics and Statistics 99*(1), 135–150.

Coakley, J., A.-M. Fuertes, and R. Smith (2006). Unobserved heterogeneity in panel time series models. *Computational Statistics & Data Analysis 50*(9), 2361–2380.

Dell'Erba, S. and S. Sola (2016). Does fiscal policy affect interest rates? evidence from a factor-augmented panel. *The BE Journal of Macroeconomics 16*(2), 395–437.

Demetrescu, M. and C. Hanck (2017). Multiple testing for no cointegration under nonstationary volatility. *Oxford Bulletin of Economics and Statistics*.

Demetrescu, M., U. Hassler, and A.-I. Tarcolea (2006). Combining significance of correlated statistics with application to panel data. *Oxford Bulletin of Economics and Statistics 68*(5), 647–663.

Eberhardt, M. and A. F. Presbitero (2015). Public debt and growth: Heterogeneity and non-linearity. *Journal of International Economics 97*(1), 45–58.

Eberhardt, M. and F. Teal (2011). Econometrics for grumblers: a new look at the literature on cross-country growth empirics. *Journal of Economic Surveys 25*(1), 109–155.

Ehrmann, M. and M. Fratzscher (2004). Taking stock: Monetary policy transmission to equity markets. *Journal of Money, Credit and Banking*, 719–737.

Elliott, G. and J. H. Stock (1994). Inference in time series regression when the order of integration of a regressor is unknown. *Econometric theory 10*(3-4), 672–700.

Everaert, G. and L. Pozzi (2014). The predictability of aggregate consumption growth in OECD countries: a panel data analysis. *Journal of Applied Econometrics 29*(3), 431–453.

Fuleky, P., L. Ventura, and Q. Zhao (2018). Common correlated effects and international risk sharing. *International Finance 21*(1), 55–70.

Gantman, E. R. and M. P. Dabós (2013). Finance and economic growth: new evidence from time series analysis (1961–2009). *Applied Economics Letters 20*(9), 893–896.

Greenaway-McGrevy, R., C. Han, and D. Sul (2012). Asymptotic distribution of factor augmented estimators for panel regression. *Journal of Econometrics 169*(1), 48–53.

Hanck, C. (2009). A meta analytic approach to testing for panel cointegration. *Communications in Statistics-Simulation and Computation 38*(5), 1051–1070.

Hanck, C. (2013). An intersection test for panel unit roots. *Econometric Reviews 32*(2), 183–203.

Hanck, C. and R. Czudaj (2015). Nonstationary-volatility robust panel unit root tests and the great moderation. *AStA Advances in Statistical Analysis 99*(2), 161–187.

Hassler, U. and V. Werkmann (2014). Multiple comparisons and joint significance in panel unit root testing with evidence on international interest rate linkage. *Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik) 234*(1), 23–43.

Henry, J., C. Kok, A. Amzallag, P. Baudino, I. Cabral, M. Grodzicki, M. Gross, G. Halaj, M. Kolb, M. Leber, et al. (2013). A macro stress testing framework for assessing systemic risks in the banking sector. *Available at SSRN*.

Kapetanios, G., M. H. Pesaran, and T. Yamagata (2011). Panels with non-stationary multifactor error structures. *Journal of Econometrics 160*(2), 326–348.

Kremer, S., A. Bick, and D. Nautz (2013). Inflation and growth: new evidence from a dynamic panel threshold analysis. *Empirical Economics 44*(2), 861–878.

Kurul, Z. (2017). Nonlinear relationship between institutional factors and {FDI} flows: dynamic panel threshold analysis. *International Review of Economics and Finance 48*, 148 – 160.

Maddala, G. S. and S. Wu (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics 61*(S1), 631–652.

Memmel, C., Y. Gündüz, and P. Raupach (2015). The common drivers of default risk. *Journal of Financial Stability 16*, 232–247.

Örsal, D. D. K. and A. Arsova (2017). Meta-analytic cointegrating rank tests for dependent panels. *Econometrics and Statistics 2*, 61–72.

Pesaran, M. H. (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica 74*(4), 967–1012.

Phillips, P. C. and D. Sul (2003). Dynamic panel estimation and homogeneity testing under cross section dependence. *The Econometrics Journal 6*(1), 217–259.

Proaño, C. R., C. Schoder, and W. Semmler (2014). Financial stress, sovereign debt and economic activity in industrialized countries: Evidence from dynamic threshold regressions. *Journal of International Money and Finance 45*, 17–37.

Ross, S. A. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory 13*(3), 341–360.

Stambaugh, R. F. (1999). Predictive regressions. *Journal of Financial Economics 54*(3), 375–421.

Westerlund, J., H. Karabiyik, and P. Narayan (2017). Testing for predictability in panels with general predictors. *Journal of Applied Econometrics 32*(3), 554–574.

Westerlund, J. and J.-P. Urbain (2013). On the implementation and use of factor-augmented regressions in panel data. *Journal of Asian Economics 28*, 3–11.

Westerlund, J. and J.-P. Urbain (2015). Cross-sectional averages versus principal components. *Journal of Econometrics 185*(2), 372–377.

Eidesstattliche Erklärung

Ich erkläre hiermit an Eides Statt, dass ich meine Doktorarbeit "'Essays in Applied Econometrics of Macro-Financial Panel Data with Cross-Sectional Dependence" selbstständig und ohne fremde Hilfe angefertig habe und dass ich alle von anderen Autoren wörtlich übernommenen Stellen, wie auch die sich an die Gedanken anderer Autoren eng anlehnenden Ausführungen meiner Arbeit, besonders gekennzeichnet und Quellen nach den mir angegebenen Richtlinien zitiert habe. Im Fall der Abschnitte, die auf einzelnen Aufsätzen basieren, welche ich in Zusammenarbeit mit anderen Autoren verfasst habe, erkläre ich, dass ich eine angemessene anteilige Leistung beim Verfassen der jeweiligen Aufsätze erbracht habe.

[Danvee Floro]