



**Evangelisches
Studienwerk e.V. Villigst**



*Schriftenreihe des Promotionsschwerpunkts
Globalisierung und Beschäftigung*

Nr. 49/2016

**Demographic Change and Regional
Convergence in Canada**

von

Vincent Geloso, Vadim Kufenko, Klaus Prettnner

**Stuttgart-Hohenheim
ISSN 1618-5358**

Unemployment is persistently high in many European countries. It is frequently attributed to 'functional deficiencies of labor markets', even though to a large extent caused by demand and supply shifts in goods markets and financial markets. The PhD program *Globalization and Employment* therefore focuses on the employment effects of structural change and macroeconomic developments and encourages research by granting scholarships. The dissertation projects address topics such as new technologies, processes of internationalization and system transformation, endogenous finance constraints and various strategies of fiscal and monetary policy.

Work and supervision in the PhD program follows the structures of a standard graduate school. Coordinators and *editors of the discussion paper series* are the following professors:

Prof. Dr. Harald Hagemann harald.hagemann@uni-hohenheim.de
Department of Economics (520H)
University of Hohenheim
D-70593 Stuttgart

Prof. Dr. Heinz-Peter Spahn peter.spahn@uni-hohenheim.de
Department of Economics (520A)
University of Hohenheim
D-70593 Stuttgart

Prof. Dr. Hans-Michael Trautwein michael.trautwein@uni-oldenburg.de
Department of Economics and Statistics
Carl von Ossietzky University Oldenburg
D-26111 Oldenburg

PhD projects in the program can be funded by grants of the *Evangelisches Studienwerk e.V. Villigst*. Application forms can be ordered from:

Evangelisches Studienwerk e.V.
Promotionsförderung
Iserlohner Str. 25
D-58239 Schwerte Phone: +49 (2304) 755-215, Fax: +49 (2304) 755-250

For further information about the PhD program *Globalization and Employment* as well as the PDF-files of the discussion papers see:

<http://www.globalization-and-employment.de>

Demographic Change and Regional Convergence in Canada

Vincent Geloso

(London School of Economics)

Vadim Kufenko

(University of Hohenheim)

Klaus Prettner

(University of Hohenheim)

Abstract: *We examine the role of demographic change for regional convergence in living standards in Canada. Due to economies of scale within a family, decreasing household size has an impact on convergence in living standards, while per capita income convergence remains unaffected. We find that, by relying on per capita income, the dispersion of living standards between Canadian regions is overestimated prior to the 1990s and underestimated thereafter. As a consequence, relying on income per capita results in overestimating the speed of convergence in living standards.*

JEL CODE: O47, J12, N12.

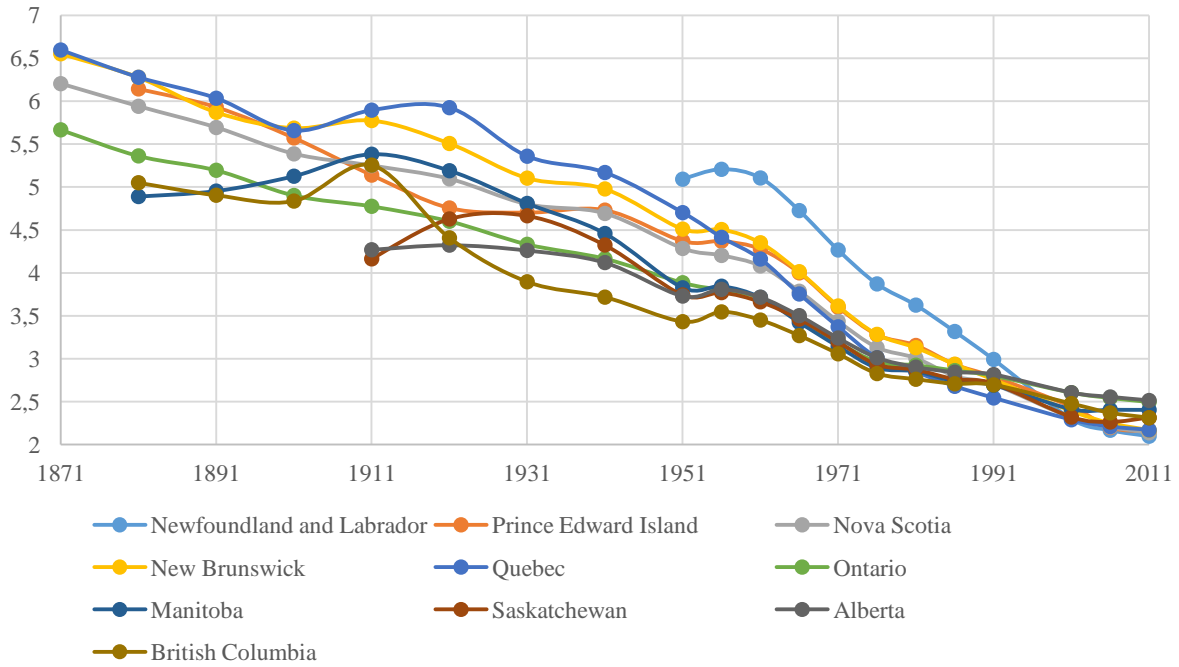
KEYWORDS: Regional convergence, living standards, demographic change, household size.

Introduction

Within western countries, poorer regions have typically been catching up with richer regions since the 19th century. The same is true for Canada (Brown and Macdonald 2015; Macdonald 2015; Gunderson 1996; Coulombe and Lee 1995; DeJuan and Tomljanovich 2005). Since larger households command economies of scale and household sizes have changed considerably over the last century, calculating convergence in living standards by relying on *per capita* income might be misleading (Deaton, 1997; Deaton and Muellbauer 1980; Deaton and Paxton 1998). Buhmann et al. 1988 and Citro and Michael 1995 have suggested using equivalence scales instead of *per capita* measures, where household income is divided by the square root of the number of household members to calculate an adult equivalent (AEQ). We follow this approach and show that such an adjustment for household size leads to substantial changes in the calculated dispersion of living standards at various points in time and, consequently, also results in substantial changes in the calculated rate of convergence.

In the Canadian census of 1871, the initial four provinces (Ontario, Quebec, Nova Scotia, and New Brunswick) had substantially different dwelling sizes. The richest province, Ontario, saw a precipitous and continuous decline in the average number of persons per dwelling, while poorer provinces such as Quebec saw that proportion fall at a much lower rate until the 1950s. This is illustrated in Figure 1, which shows that the average number of persons per dwelling in the Canadian provinces varied widely from a historical point of view, but eventually converged over time.

Figure 1: Average Dwelling Size in Canadian Provinces, 1871 to 2011



Source: Various editions of Canadian censuses, consulted at the Bibliothèque et Archives Nationales du Québec

Data and Methods

Economic theory implies that regional incomes tend to converge. Seminal empirical studies have shown that this is indeed the case for the United States (Barro and Sala-i-Martin 1991, 1992; Lindert and Williamson 2016). In our study, we rely on the concept of sigma-convergence, i.e. the reduction in the dispersion of income levels between regions, to quantify convergence processes. The connection between sigma-convergence and beta-convergence is given by

$$1) \sigma_t^2 = (1 - \beta)^2 \sigma_{t-1}^2 + \sigma_u^2,$$

where σ_t^2 is the variance of regional income, β is the speed of beta-convergence, and σ_u^2 is the variance of exogenous shocks to income. Note that beta-convergence is a necessary but not sufficient condition for sigma-convergence (Durlauf, Johnson and Temple 2005), as sigma-convergence is the stronger concept.

For the purposes of our paper, we relied on the output series of Irwin and Inwood (2002) for the years 1871, 1891, and 1911. Their paper includes the initial four provinces of Canada

(Quebec, Ontario, New Brunswick, and Nova Scotia) but does not include the other provinces that joined Canada later (Manitoba, British Columbia, Prince Edward Island, Saskatchewan, and Alberta). Consequently, we have to rely on Green (1971) for the years 1891, 1911, and 1921. After 1926, we can rely on the dataset provided by Brown and Macdonald (2015a and 2015b), which computes personal income *per capita* and per province from 1926 to 2013, particularly for the purposes of analyzing regional convergence.

The estimates of population and dwelling sizes were compiled from the volumes of the different censuses of Canada. From 1871 to 1951, censuses were decadal. After 1956, they were undertaken on a quinquennial basis. We use the number of dwellings as a measure for the number of households because, over long periods of history, it was not uncommon for younger families to share a household with another family. Using the number of families instead of dwellings would have been misleading for two reasons: First, economies of scale extend to two families in the same dwelling – both families would benefit from this arrangement. Second, the number of families per dwelling was not the same across provinces in earlier periods. Using families instead of dwellings as the unit for capturing economies of scale would therefore introduce another dimension of convergence (convergence in the number of families per dwelling).

It is well known that the variance is affected by a proportional change to the observed variable. Sheret (1984) notes that the unweighted coefficient of variation is biased in the case of changes in the sample size. Therefore, we use the weighted coefficient of variation as proposed by Sheret (1984, p. 290):

$$2) CV_w = \frac{[\sum_{i=1}^n (w_i x_i - \bar{x}_w)^2 / (n-1)]^{1/2}}{\bar{x}_w},$$

where CV_w is the weighted coefficient of variation, $w_i x_i$ is the weighted value of the observation, x_i , \bar{x}_w is the weighted average over all observations, and n is the sample size. The weights are assigned according to the share of regional income in aggregate income, and the time series of the weighted coefficient of variation is calculated for each year for which the data is available.

Results

From the beginning onwards, the most populous province, Ontario, was also Canada's richest region, followed by British Columbia. Alberta, Saskatchewan and Manitoba are close to the national average, while Quebec, Prince Edward Island, Nova Scotia, New Brunswick and Newfoundland find themselves below the national average. The poorer provinces also had substantially larger households. Due to economies of scale, one dollar of income goes further in a larger household than in a smaller one. Over time, incomes converged across provinces. However, the differences between household sizes also narrowed. Against this backdrop, we expect that income differences measured in terms of adult equivalents are lower than those measured in *per capita* terms. We also expect a more modest convergence trend over time: as poorer provinces catch up with richer provinces in *per capita* income terms, the accompanying reductions in household size imply that the economies of scale effect dissipates.

Figures 2 and 3 confirm that there is an impact of shifting from *per capita* measures to adult-equivalent measures. Figure 2 shows convergence in total income, while figure 3 addresses disposable income. Both figures confirm our reasoning, as the AEQ lines are lower than the lines associated with *per capita* income until the 1990s. It is only after 1990 that the AEQ measure of dispersion is higher than the *per capita* measure. This signals divergence, once households are considered in the denominator.

The increasing divergence between Canadian provinces up to the end of the first half of the 20th century is consistent with the historiography of living standards in Canada (McInnis 1968; Altman 1988, 1995, 2003; Inwood and Irwin 2002; Green 1971; Geloso 2013; Brown and Macdonald 2015). In the early decades of political unification, the eastern provinces diverged from the populous province of Ontario, while the new western provinces of Alberta, British Columbia, Saskatchewan, and Manitoba tended to exhibit income levels close to those of Ontario. The convergence of the post-war era (De Juan and Tomljanovich 2005) is visible, but its magnitude is reduced. While *per capita* figures show continued convergence until 2013, the adult-equivalent figures suggest a different pattern after the 1980s – a slight increase in dispersion.

Figure 2. Income: WCV, all regions

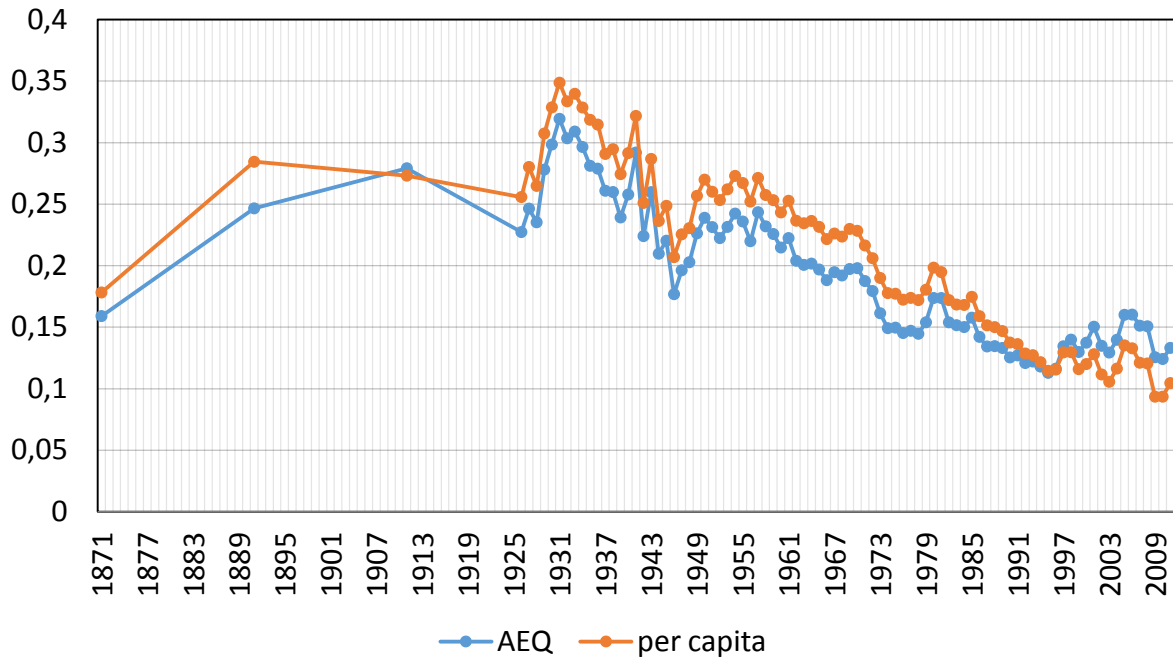
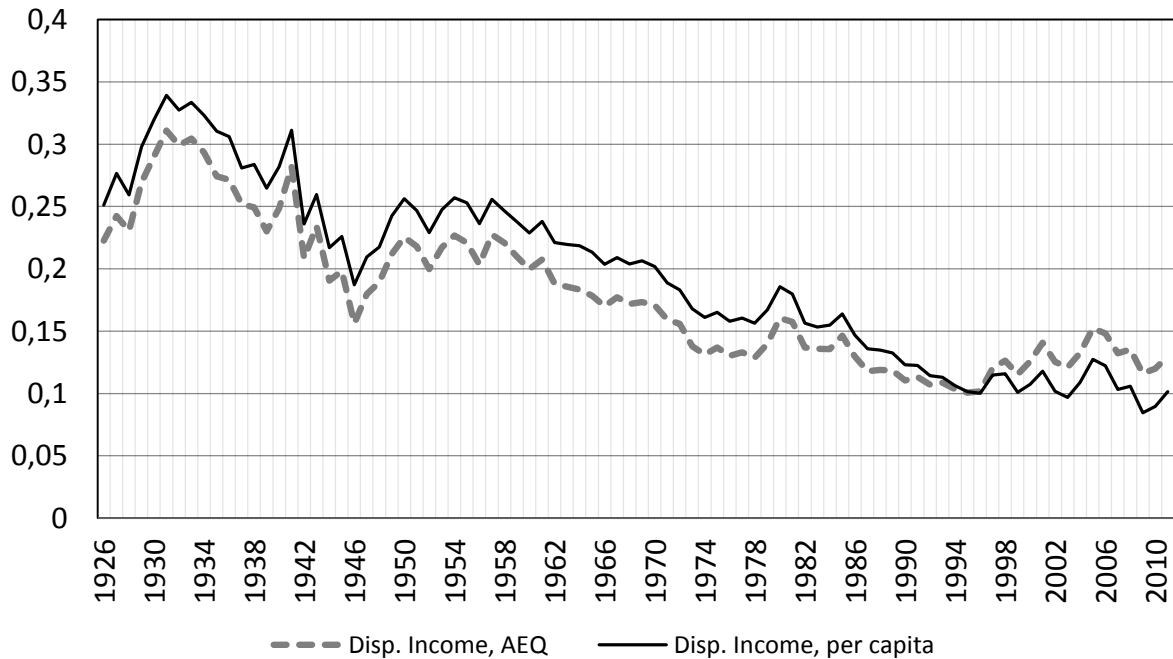


Figure 3. Disposable Income: WCV, all regions



When analyzing convergence, it is important to consider the role of intergovernmental transfers as well. Under the guise of equalization payments and federal transfers to the provinces,

poorer provinces gain at the expense of richer provinces (Coiteux 2009). Figure 3 shows that fiscal transfers across provinces have a weak impact on reducing income disparities. Our conclusions about divergence hold for Figure 3 as well.

Conclusion

We show that convergence is affected considerably by shifting to a measure that adjusts for differences in household size. Most notably, the convergence of living standards is slower when measured in adult equivalent units instead of *per capita* units. Our results suggest an important venue for convergence studies. The differences in household sizes within Canada are small relative to those between different countries. In the late 20th century, household sizes in OECD countries hovered around 3 persons per household, while developing countries had average household sizes closer to 5 persons (Boongaarts 2001). This is a significant difference to account for, which could have sizeable effects on estimates of living standards and convergence rates.

REFERENCES

Primary Sources:

Census of Canada, 1881, Volume 1

Census of Canada, 1901, Volume 1

Census of Canada, 1921, Volume 3

Census of Canada, 1931, Volume 5

Census of Canada, 1951, Volume 3

Census of Canada, 1991, Catalogue 93-311, Dwellings and Households: The Nation

Census of Canada, 2006, Catalogue no. 92-200-XPB, A National Overview: Population and Dwelling Counts

Census of Canada, 2011, Population and Dwelling Count Highlight Tables – available online at <http://www12.statcan.ca/census-recensement/2011/dp-pd/hltfst/pd-pl/Table-Tableau.cfm?LANG=Eng&T=101&S=50&O=A>

Secondary Sources

- Altman, Morris. "Economic development with high wages: An historical perspective." *Explorations in Economic History* 25.2 (1988): 198-224.
- Altman, Morris. "Labor productivity in late nineteenth-century Quebec and Ontario manufacturing: explaining Ontario's advantage." *American Review of Canadian Studies* 25.2-3 (1995): 219-249.
- Altman, Morris. "Staple theory and export-led growth: constructing differential growth." *Australian Economic History Review* 43.3 (2003): 230-255.
- Barro, Robert, and Xavier Sala-i-Martin. "Convergence across States and Regions." *Brookings Papers on Economic Activity* 22.1 (1991): 107-182.
- Barro, Robert J., and Xavier Sala-i-Martin. "Convergence." *Journal of Political Economy* 100.2 (1992): 223-51.
- Bongaarts, John. "Household size and composition in the developing world in the 1990s." *Population studies* 55.3 (2001): 263-279.
- Brown, Mark and Ryan Macdonald. *Provincial Convergence and Divergence in Canada, 1926 to 2011*. Statistics Canada, 2015.
- Buhmann, Brigitte, Rainwater, Lee, Schmaus, Guenther, and Smeeding, Timothy M. "Equivalence scales, well-being, inequality, and poverty: Sensitivity estimates across ten countries using the Luxembourg Income Study (LIS) database." *Review of Income and Wealth*, 34.2 (1988): 115-142
- Citro, Constance F., and Robert T. Michael, eds. *Measuring Poverty: A New Approach*. National Academies Press, 1995.
- Coiteux, Martin. *Le Point sur les Écarts de Revenu entre les Québécois et les Canadiens des Autres Provinces*. Centre sur la Productivité et la Prospérité, 2012.
- Coulombe, Serge, and Frank C. Lee. "Convergence across Canadian provinces, 1961 to 1991." *Canadian Journal of Economics* (1995): 886-898.

- Deaton, Angus. *The analysis of household surveys: a microeconomic approach to development policy*. World Bank Publications, 1997.
- Deaton, Angus, and John Muellbauer. *Economics and consumer behavior*. Cambridge university press, 1980.
- Deaton, Angus, and Christina Paxson. "Economies of scale, household size, and the demand for food." *Journal of political economy* 106.5 (1998): 897-930.
- DeJuan, Joseph, and Marc Tomljanovich. "Income convergence across Canadian provinces in the 20th century: Almost but not quite there." *The Annals of Regional Science* 39.3 (2005): 567-592.
- Durlauf, Steven, Paul Johnson and Jonathan Temple. "Growth Econometrics," *Handbook of Economic Growth, Volume 1, Part A*. Ed. Philippe Aghion and Steven Durlauf. Amsterdam: Elsevier, 2005 : 555-677.
- Geloso, Vincent. *Du Grand Rattrapage au Déclin Tranquille : Une histoire économique et sociale du Québec de 1900 jusqu'à nos jours*. Accent Grave, 2013.
- Green, Alan G. *Regional Aspects of Canada's Economic Growth*. University of Toronto Press, 1971.
- Gunderson, Morley. "Regional productivity and income convergence in Canada under increasing economic integration." *Canadian Journal of Regional Science* 19.1 (1996): 1-24.
- Inwood, Kris, and Jim Irwin. "Land, income and regional inequality: New estimates of provincial incomes and growth in Canada, 1871-1891." *Acadiensis* 31.2 (2002): 157-184.
- Lindert, Peter H., and Jeffrey G. Williamson. *Unequal Gains: American Growth and Inequality since 1700*. Princeton University Press, 2016.
- McInnis, Marvin. "The trend of regional income differentials in Canada." *Canadian Journal of Economics/Revue canadienne d'Economique* 1.2 (1968): 440-470.
- Sheret, Michael. "The coefficient of variation: Weighting Considerations." *Social Indicators Research* 15.3 (1984): 289-295.

Zhang, Wei-Bin. "Economic Growth with Heterogeneous Households, Gender Division of Labor, and Elastic Labor Supply." *Journal of Income Distribution* 21.2 (2012): 15-37.

**SCHRIFTENREIHE DES
PROMOTIONSSCHWERPUNKTS
GLOBALISIERUNG UND BESCHÄFTIGUNG**

- Nr. 1/1998 Bernhard Holwegler und Hans-Michael Trautwein, *Beschäftigungswirkungen der Internationalisierung, eine Studie aus- und einfließender Direktinvestitionen der Metall- und Elektroindustrie im Raum Stuttgart*
- Nr. 2/1998 Heinz-Peter Spahn, *Heterogeneous Labour, the Unemployment Equilibrium, and the Natural Rate*
- Nr. 3/1998 Philip Arestis, Iris Biefang-Frisancho Mariscal and Harald Hagemann, *Capital Shortage Unemployment in Germany and the UK*
- Nr. 4/1999 Theo Schewe, *Full Employment in the Age of Globalisation? Political-Economic Analysis of Effective Employment Policies in the Nineties. The Case of Norway.*
- Nr. 5/1999 Hagen Krämer, *Dienstleistungen: Motor für Wachstum und Beschäftigung in Deutschland?*
- Nr. 6/1999 Jürgen Kromphardt, *Lohnbildung und Beschäftigung*
- Nr. 7/1999 Ewald Walterskirchen, *Beschäftigungspolitik in Österreich*
- Nr. 8/1999 Reiner Franke, *Lohnzurückhaltung, Beschäftigung und (zu) einfache empirische Zusammenhänge*
- Nr. 9/1999 Peter Kalmbach, *Implications of Integration for Wage Formation and Employment*
- Nr. 10/2000 Arne Heise, *Theoretische Grundlagen einer Verhaltensabstimmung der makroökonomischen Politikträger*
- Nr. 11/2000 Eckhard Hein und Carsten Ochsen, *Monetary Interest Rates, Income Shares, and Investment: Theory and Empirical Evidence for France, Germany, the UK, and the USA*
- Nr. 12/2000 Guntram R. M. Hepperle, *Airbus – ein gelungenes Beispiel für beschäftigungsorientierte Industriepolitik?*
- Nr. 13/2000 Bernhard Holwegler, *Implikationen der Technologiediffusion für technologische Arbeitslosigkeit*
- Nr. 14/2000 Markus Schreyer, *Wachstum und Beschäftigung vor dem Hintergrund des Solowschen Produktivitätsparadoxons*
- Nr. 15/2000 Mauro Boianovsky, *Some Cambridge Reactions to The General Theory: David Champernowne and Joan Robinson on Full Employment*
- Nr. 16/2001 Marc-Peter Radke, *Law and Economics of Microsoft vs. U.S. Department of Justice: A New Economic Paradigm for Antitrust in Network Markets or Inefficient Lock-in of Antitrust Policy?*
- Nr. 17/2001 Daniel Hartmann, *Taylor-Regel und amerikanische Geldpolitik*

- Nr. 18/2002 Jutta Maute, *Stabilization via Currency Board*
- Nr. 19/2002 Daniel Hartmann, *The Fed Strategy: Successful but Out-of-Date?*
- Nr. 20/2004 Dirk H. Ehnts, *Spatial Decisions of Multinational Enterprises and their Effect on Local Firms*
- Nr. 21/2004 Theo Schewe, *Makroökonomische Probleme des extensiven Rohstoffexports in einer entwickelten Volkswirtschaft – analysiert am Beispiel der norwegischen Erdölwirtschaft*
- Nr. 22/2005 Georg Erber & Aida Sayed-Ahmed, *Offshore Outsourcing - A global shift in the present IT industry*
- Nr. 23/2006 Deborah Schöller, *Service Offshoring: A Challenge for Employment? Evidence from Germany*
- Nr. 24/2007 Ralf Rukwid, *Arbeitslosigkeit und Lohnspreizung - Empirische Befunde zur Arbeitsmarktsituation gering Qualifizierter in Deutschland*
- Nr. 25/2007 Julian P. Christ, *Varieties of Systems of Innovation: A Survey of their Evolution in Growth Theory and Economic Geography*
- Nr. 26/2008 Andreja Benković & Juan Felipe Mejía, *Tourism as a Driver of Economic Development: The Colombian Experience*
- Nr. 27/2009 Julian P. Christ & André P. Slowak, *Standard-Setting and Knowledge Dynamics in Innovation Clusters*
- Nr. 28/2009 Constanze Dobler, *The Impact of Institutions, Culture, and Religion on Per Capita Income*
- Nr. 29/2009 Julian P. Christ & André P. Slowak, *Why Blu-ray vs. HD-DVD is not VHS vs. Betamax: The Co-evolution of Standard-setting Consortia*
- Nr. 30/2009 Patricia Hofmann, *Die neue neue Außenhandelstheorie: das Melitz-Modell*
- Nr. 31/2010 Julian P. Christ, *The Geography and Co-location of European Technology-specific Co-inventorship Networks*
- Nr. 32/2010 Julian P. Christ, *Geographic Concentration and Spatial Inequality: Two Decades of EPO Patenting at the Level of European Micro Regions*
- Nr. 33/2011 Finn Marten Körner, *An Equilibrium Model of 'Global Imbalances' Revisited*
- Nr. 34/2011 Constanze Dobler & Harald Hagemann, *Economic Growth in the Post-Socialist Russian Federation after 1991: The Role of Institutions*
- Nr. 35/2011 Constanze Dobler, *Instability, Economic Stagnation and the Role of Islam in the North Caucasus*
- Nr. 36/2012 Georg Erber und Harald Hagemann, *Wachstums- und Investitionsdynamik in Deutschland*
- Nr. 37/2012 Ralf Rukwid, *Grenzen der Bildungsexpansion? Ausbildungsinadäquate Beschäftigung von Ausbildungs- und Hochschulabsolventen in Deutschland*
- Nr. 38/2012 Vadim Kufenko, *Empirical Analysis of Regional Economic Performance in Russia: Human Capital Perspective*

- Nr. 39/2013 Harald Hagemann und Vadim Kufenko, *The Political Kuznets Curve for Russia: Income Inequality, Rent Seeking Regional Elites and Empirical Determinants of Protests during 2011/2012*
- Nr. 40/2014 Danila Raskov und Vadim Kufenko, *The Role of Old Believers' Enterprises: Evidence from the Nineteenth Century Moscow Textile Industry*
- Nr. 41/2014 Harald Hagemann, Georg Erber, Niels Geiger, Johannes Schwarzer und Oliver Zwiessler, *Wachstums- und Investitionsdynamik in Deutschland*
- Nr. 42/2015 Vincent Geloso und Vadim Kufenko, *Malthusian Pressures: Empirical Evidence from a Frontier Economy*
- Nr. 43/2015 Christine Clement, *The Formal-Informal Economy Dualism in a Retrospective of Economic Thought since the 1940s*
- Nr. 44/2015 Niels Geiger, *The Rise of Behavioural Economics: A Quantitative Assessment*
- Nr. 45/2015 Vadim Kufenko und Niels Geiger, *Stylized Facts of the Business Cycle: Universal Phenomenon, or Institutionally Determined?*
- Nr. 46/2015 Niels Geiger und Vadim Kufenko, *Business Cycles in the Economy and in Economics: An Econometric Analysis*
- Nr. 47/2015 Alex Arsenault Morin, Vincent Geloso und Vadim Kufenko, *Infant Mortality and the Role of Seigneurial Tenure in Canada East, 1851*
- Nr. 48/2016 Vadim Kufenko, *Spurious Periodicities in Cliometric Series: Simultaneous Testing*
- Nr. 49/2016 Vincent Geloso, Vadim Kufenko und Klaus Prettnner, *Demographic Change and Regional Convergence in Canada*

Die Ursachen der gegenwärtig hohen Arbeitslosigkeit in einigen europäischen Ländern sind nicht allein in 'Funktionsproblemen des Arbeitsmarktes' zu suchen, sondern auch in Nachfrage- und Angebotsentwicklungen auf Güter- und Finanzmärkten. Im Promotionsschwerpunkt *Globalisierung und Beschäftigung* werden daher Dissertationsvorhaben gefördert, in denen die Beschäftigungseffekte gesamtwirtschaftlicher Entwicklungen untersucht werden - beispielsweise von neuen Technologien, von Prozessen der Internationalisierung und Systemtransformation, von marktseitigen Finanzierungsbeschränkungen oder von unterschiedlichen Strategien der Fiskal-, Geld- und Währungspolitik.

Die Betreuung und Vernetzung der Arbeiten im Promotionsschwerpunkt entspricht der Arbeitsweise eines Graduiertenkollegs. Betreuer des Schwerpunkts und *Herausgeber der Schriftenreihe* sind folgende Hochschullehrer:

Prof. Dr. Harald Hagemann
Institut für Volkswirtschaftslehre (520H)
Universität Hohenheim
D-70593 Stuttgart

harald.hagemann@uni-hohenheim.de

Prof. Dr. Heinz-Peter Spahn
Institut für Volkswirtschaftslehre (520A)
Universität Hohenheim
D-70593 Stuttgart

peter.spahn@uni-hohenheim.de

Prof. Dr. Hans-Michael Trautwein
Fakultät II – Institut für Volkswirtschaftslehre
Carl von Ossietzky Universität
D-26111 Oldenburg

michael.trautwein@uni-oldenburg.de

Dissertationsprojekte im Schwerpunkt können durch Promotionsstipendien des *Evangelischen Studienwerks e.V. Villigst* gefördert werden. Bewerbungsunterlagen können unter folgender Adresse angefordert werden:

Evangelisches Studienwerk e.V.
Promotionsförderung
Iserlohner Str. 25
58239 Schwerte

Tel.: 02304/755-215, Fax: 02304/755-250

Weitere Informationen zum Promotionsschwerpunkt sowie die Diskussionsbeiträge der Violetten Reihe im PDF-Format finden sich im Internet unter der Adresse:

<http://www.globalization-and-employment.de>