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ACTA VŠFS

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Ekonomické studie a analýzy

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The Beta-convergence Analysis and Regional Disparities in EU-28
Analýza beta-konvergence a regionální rozdíly v EU-28



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Editorial

Editorial

MOJMÍR HELÍSEK

Dear Readers,

The second edition of scientific journal ACTA in 2014 contains five articles.

The article written by authors Jaroslav Daňhel and Eva Ducháčková is entitled Behavioural and Empirical Topics for Discussion on Economic Science Paradigms. They claim that the theory of economics fails to clarify critical situations related to the current financial and economic crisis. The controversial mathematical modelling cannot be considered a helping tool. It is necessary to find a new concept for today's global era in the sense of behavioural and empirical approaches. The article includes criticism of fair insurance premium.

The authors of the following three articles are the winners of prof. František Vencovský Award competition for young economists which is announced by the University of Finance and Administration every two years.

Tomáš Konečný focuses with his article on Linkages between the Financial and Real Sectors across Interest Rate Regimes: The Case of the Czech Republic. The study compounds the information on aggregate credit and non-performing loans (NPL) to come to the conclusion that the pro-cyclicality of financial sector tends to vary across interest rate regimes. While the responses to credit shocks are roughly similar across regimes, the reactions to the NPL shocks differ both in size and timing.

Barbara Pertold-Gebicka called her article Job Market Polarization and Employment Protection in Europe. She analyses job polarization of national labour markets in twelve EU countries using an occupational skill-intensity measure. Findings suggest large cross-country differences in the extent of polarization, which corresponds to variation in educational attainment growth, industrial structure, and dissimilarities in employment protection legislation.

The article written by Jan Zápál entitled Consumption Tax Incidence: Evidence from Natural Experiment in the Czech Republic focuses on the incidence of changes in the VAT rates in the Czech Republic in 2004. The author discovered that some goods and services that had experienced decline of the VAT rate from 22% to 19% had shown no evidence of decrease in prices. On the other hand, goods and services belonging to the group that experienced VAT rate increase from 5% to 19% show lasting increase in prices by up to 6%.

The author of the last article The Beta-convergence Analysis and Regional Disparities in EU-28 is Mihaela Simionescu. There was a faster increase in GDP per capita in poor EU economies in the period from 2001 to 2012. The rate of convergence has a low value of 0.46% for EU-28. The catching-up process seems to be mostly a national phenomenon in EU-28. The results of the estimates suggest there is no significant convergence within EU-28 members.

I hope you will take interest in these articles, which are the product of an original research, and as readers you will remain faithful to us.



Mojmír Helísek

Executive Editor

University of Finance and Administration

Vážení čtenáři,

druhé číslo vědeckého časopisu ACTA v roce 2014 obsahuje pět statí.

Stať autorů Jaroslava Daňhela a Evy Ducháčkové se nazývá Behaviorální a empirické náměty do diskuse o paradigmatech ekonomické vědy. Konstatují, že ekonomická teorie postrádá vysvětlení kritických situací v současné finanční a hospodářské krizi. Pomoc nelze hledat v kontroverzním matematickém modelování. Je nutno najít nový koncept pro dnešní globální éru ve smyslu behaviorálních a empirických přístupů. Článek obsahuje kritiku teorie spravedlivé pojistky.

Autory dalších tří statí jsou vítězové soutěže o Cenu prof. Františka Vencovského pro mladé ekonomy, kterou Vysoká škola finanční a správní vyhlašuje ve dvouletých intervalech.

Tomáš Konečný zkoumá ve své stati Vazby mezi finančním a reálným sektorem v různých režimech úrokových sazeb: případ České republiky. Studie používá data o celkových úvěrech a nesplácených úvěrech a dochází k závěru, že procykličnost finančního sektoru se mění v rámci režimů úrokových sazeb. Zatímco reakce na úvěrové šoky jsou zhruba podobné bez ohledu na konkrétní režim, reakce na šoky do nesplácených úvěrů se liší co do velikosti i načasování.

Barbara Pertold-Gebicka nazvala svou stať Polarizace trhu práce a ochrana zaměstnanosti v Evropě. Analyzuje polarizaci na národních trzích práce ve dvanácti zemích EU pomocí míry náročnosti zaměstnání na dovednosti. Dochází k závěru o velkých rozdílech mezi zeměmi v rozsahu polarizace, což koresponduje s rozdíly v míře vzdělanosti, v průmyslové struktuře a s mírou ochrany zaměstnanosti.

Stať Jana Zápala Přenos spotřebních daní: Studie přirozeného experimentu v České republice zkoumá dopady změny sazeb DPH v České republice v roce 2004. Autor zjistil, že zboží a služby, u nichž došlo ke snížení sazby DPH z 22 % na 19 %, nevykazovaly žádné změny v koncových cenách. Oproti tomu zboží a služby, u kterých došlo k navýšení sazby DPH z 5 % na 19 %, vykazují trvalé zvýšení cen až o 6 %.

Autorkou závěrečné stati Analýza beta-konvergence a regionální rozdíly v EU-28 je Mihaela Simionescu. V období 2001-2012 byl rychlejší růst HDP na obyvatele v chudých ekonomikách EU. Míra konvergence pro EU-28 má nízkou hodnotu 0,46 %. Proces dohánění je v zemích EU-28 většinou národním fenoménem. Výsledky odhadů naznačují, že neexistuje významná konvergence v rámci zemí EU-28.

Věřím, že vás tyto statě, které jsou výsledkem originálního výzkumu, zaujmou a ponecháte nám svou čtenářskou přízeň.



Mojmír Helísek

výkonný redaktor

Vysoká škola finanční a správní, o.p.s.

Behavioural and Empirical Topics for Discussion on Economic Science Paradigms

Behaviorální a empirické náměty do diskuse o paradigmatech ekonomické vědy

JAROSLAV DAŇHEL, EVA DUCHÁČKOVÁ

Abstract

The authors of the article point out that the theory of economics has failed to yield a solid theoretical background in such critical situations of the current financial and economic crisis. Theorists cannot look to controversial mathematical modelling for help, especially in regulatory projects. The challenge for today's theoretical economists is to find a new concept for today's global era in the sense of behavioural and empiric attitudes. The criticism of fair insurance premium is included.

Keywords

paradigm of economics, financial and economic crisis, controversial regulatory projects, ethics of economic interaction, malfunction of mathematical models, behavioural and empiric attitude, unchained randomness, criticism of fair insurance premium

Abstrakt

Autoři článku poukazují na to, že teorii ekonomiky se nepodařilo přinést solidní teoretický základ v kritických situacích současné finanční a hospodářské krize. Teoretici nemohou hledat pomoc v kontroverzním matematickém modelování, a to zejména u regulačních projektů. Výzvou pro dnešní teoretiky v oblasti ekonomie je najít nový koncept pro dnešní globální éru ve smyslu behaviorálních a empirických přístupů. Článek obsahuje kritiku teorie spravedlivé pojistky.

Klíčová slova

paradigma ekonomie, finanční a hospodářská krize, kontroverzní regulační projekty, etika hospodářské interakce, selhání matematických modelů, behaviorální a empirický přístup, nespoutaná nahodilost, kritika teorie spravedlivé pojistky

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Introduction

It was demonstrated in the course of the financial and economic crisis of the past decade that affected both the global economy as well as most national economies that economic paradigms applicable so far evidently fail. If the problem is inspected from extreme angles of the historical spectrum of opinion trends, we must state that both Liberal and Keynesian approaches to economic policy failed to indicate in time and later to identify the

occurrence of significant imbalances, i.e. to prevent the gradual growth of critical events or at least to mitigate their destructive force. It is thus apparent that the contemporary economic science currently does not provide the necessary set of theoretical instruments that would make it possible to identify and cognitively embrace the complexity of the complicated economic world with considerable random elements. In reality, the existing global world, which is subject to unprecedented changes from the perspective of dynamics, is well ahead compared to the production of theoretical and methodological paradigms of social sciences, particularly of economic sciences. We believe this fact is one of the key reasons for the existing socioeconomic problems.

At the same time, paradoxically, theoretical economists started to consider their discipline as a privileged one within the social sciences in the past decades, as the most formalized one of the social sciences. There have been some opinions that economics may be viewed as imperial science (for discussion on this topic, see Stigler 1984, for example). There was a major shift towards higher formalization and mathematization of economics, particularly in the 1990s; such approaches were to ensure higher level of scientism, rigorousness (maximization or optimization), and consequently higher effectiveness of normative prediction. P. A. Samuelson is believed to be the main representative and guru of this movement.

However, mathematizing economists unfortunately demanded mathematics, as a non-dialectic social science discipline¹, to function within the social science in a manner that is not immanent by nature. After all, advocates of this opinion trend evidently failed in such tasks as the application of the apparatus of model algorithms to economic reality. However, we do not mean to dispute the fundamental role of mathematics within the modern type of thinking: model formalization may significantly assist in suitably structuring economic problems under review and create adequate logical framework for such problems, under which it is possible to qualitatively interpret the quantitative results correctly.

However, from the perspective of the authors of this article, the fact that the economists of this opinion trend absolutely disregarded ethical dimension of economics in their respective mathematical models is extremely important. This has resulted in the currently pathetically low level of ethics of economic interactions, with negative selection and moral hazard currently being some of the most pressing practical problems. The lowered bar of ethics then creates ideological room for increasing regulation in terms of the fundamental idea of Friedman (1993) that "freedom is a tenable objective only for responsible individuals". According to some theoreticians, the financial crisis was caused by uncontrolled hunger for profit maximization, considerably exceeding the "critical frame of mind of capitalism" by J. Schumpeter (1987). From this point of view, one of the most important tasks theoretical economists are faced with is to reinstate the ethical dimension within economic categories and strengthen the methodological foundation thereof.

1 *Mathematics does not comply with the dialectic requirement for each event to also comprise its own opposite: mathematical definitions that contain a statement "it is valid if and only if" rule out any existence of opposites.*

This paper aspires to draw attention to some current aspects of new views of the cognition methods of the present complex world in terms of potential solutions for the modification of economic paradigms as well as to some current problems of human decision-making under uncertainty, thereby contributing to the general discussion concerning the need for conjunction of the mainstream economics with soft², cognitive sciences.

1 Solutions to the Latest Economic Problems Lack Theoretical Foundation

In spite of the relatively long period of time since the emergence of the latest global financial and economic crisis, economists have yet to reach consensus on the causes for its emergence and development, on the method of therapy, and even on the theoretical implications for the economic science paradigms, and particularly on practical consequences for the future economic policy. Certainly, one of the reasons for this is, among others, the fact that the last crisis brought some absolutely new specific features (run of banks on banks, role of innovative structured instruments, failures of rating agencies), whereas the recession was also “different” (extremely low interest rates, nonfunctional credit market, nonfunctional standard monetary stabilization of aggregate demand). We have not been able to scientifically absorb these new aspects and the question remains, whether the theory would ever be able to do so. The changes of the socioeconomic environment induced by the crisis even erode the globalization trend, which seemed unambiguous until recently; current symptoms at least suggest its fragmentation.

A separate chapter of the current era is the development of the financial market, which had originally been intended as the servicing system for the real economy; however, this market was dominant within the global economy at the time the financial crisis emerged, posing immediate threat to the real economy due to its high level of autonomy and virtual nature; moreover, the market has lost its ability to restore balance after deflections due to the high level of autonomy and virtual nature.

The financial and economic crisis later transformed into fatal debt crisis in Europe. This partly results from the selected curative actions, with subsequent need for consolidation, and partly from the selected model of economic and social system in the European Union. The EU invests significant financial funds in ensuring the cohesiveness of individual member states; however, the Union as a whole is becoming increasingly heterogeneous – the heterogeneity of the Northern and Southern branches of the euro area is extremely dramatic. Outlooks of solution are rather pessimistic; according to the outlook of the rating agency Fitch, published in *Finanční noviny* (2013) last year, Europe is already over the worst part of the debt crisis; however, this is in contrast with the existing trends, which suggest (provided they continue) that the euro area will still be the slowest growing economy in the world, in spite of the remarkable performance of the German export superpower. Full recovery of the integrated unit a whole is likely to take most of the next decade. With regard to the euro area, the first decade of the new millennium was char-

2 *The sociologist N. W. Storer (1967) believes the key criterion for classifying scientific disciplines as hard and soft discipline is the tightness of their most important findings. The terms hard and soft sciences are commonly used in sociology, but, above all, they have been adopted by the general scientific methodology.*

acterized by weak economic activity and thus ever increasing government expenditure compared to revenue; therefore, the fall into the debt trap is a logical implication of such significantly controversial trends.

The long-term recession results from the fact that affected economies are currently in a vicious circle: the banking crisis cannot be resolved fiscally, because the public finance has also been affected by the crisis; the crisis of the public finance could be resolved through fiscal restriction; however, this would only lead to deeper recession; monetary expansion would be a solution to the recession; however, it cannot be implemented due to the banking crisis, and so on. The cocktail prepared by combining the banking crisis, public finance crisis, and commercial/monetary imbalance, still represents systemic risk for the entire economic and thus financial system, which cannot be resolved by traditional monetary and fiscal policy instruments. Particularly the high indebtedness level continues to be an impediment to restoring demand. In terms of the monetary policy for this year, the American FED has already declared its restriction by ending the controversial quantitative easing instrument, as the American economy is recovering more strongly. The ECB has different problems, as it is facing a serious dilemma for this year: whether its monetary policy should impair the Southern or the Northern branch of the euro area more.

The prior period of mass overconsumption in core global and European economies, with resulting imbalance of such degree that it was not possible to remedy it in any way other than by undergoing massive financial and economic crisis, was ideologically supported by the ideas of a welfare state, prioritizing short-term goals as if motivated by Keynes' bon mot "in the long run we are all dead"; consequently, the rising indebtedness level of economic entities was viewed more or less positively and this established the beginning of the later public finance crisis, associated with the rampant welfare state.

In this context, the EU's efforts aimed at paternalistic central control with significant bureaucratic elements, nearing the mere limits of state interventionism policy, seem to be inadequately costly. Some outputs of the European Union in this regard seem to be awkward, to say the least. In the strongly heterogeneous environment of the European integration unit, moreover with different interests of individual states even within the Northern and Southern branches, a controversial banking union project is being promoted (Daňhel 2013), with a view to unite the financial market supervision mechanism and the resolution mechanism for resolving banks' problems, including a single deposit insurance scheme. Instead, the strongly heterogeneous environment of the euro area, with predominant divergence trends, is in need of heterogeneous approach to regulation within individual member states.

Negative economic effects of the current global world escalate on the political level; with absence of adequate recommendations by economic theory, bureaucratic machinery seeks to impose higher level of state administration intervention in the life of the society, particularly in economic issues. The increasing difference in the income polarity, coupled with the consolidation that impairs social conciliation, radicalize a part of the political spectrum and, to some extent, dispute the democratic social model, also eroding the ideas of international and cross-sectoral integration. The fatigue from the relatively long period of the crisis further increases competition and intensifies income polarity, resulting

in social conflicts that are currently very common in core global and European economies as well.

In an environment of reduced possibility to apply instruments derived from expertly researched conservative economic prediction, the activity of politicians in the direction of non-systemic discretion interventions in the economy and subsequent expansion of regulation, in fear of chaos and failure to manage the complexity of the states of the world. In this regard, E. Kislingerová (2013) refers to the generally increasing aversion of societies in developed economies toward financiers, particularly bankers, who are described as some of the key culprits of the crisis by politicians and thus “punished” through higher regulation. Specific signs, often in the form of legal norms, frequently go against the business itself in many regards; we refer to the introduction of the controversial bank tax, inadequately increasing consumer protection elements, antidiscrimination measures in the insurance sector that contradict one of the principle of commercial insurance, etc. This leads to a practically insolvable antagonism: regulation measures motivated by client’s safety, exceeding any reasonable limits, ultimately increase the prices of financial services for clients, leading to their reduced effectiveness and thus having an absolutely opposite result to the desired one.

2 New Perspectives of Cognizing Economic States of the World and Decision-making under Uncertainty

The negatives described above mainly result from the validity of a universal axiom that the external world is unpredictable and from the illusion of our conviction that we understand economic events; this idea is then confronted with the fact that impending states of the world are increasingly more complicated and random. In this regard, methodologists refer to one important aspect: Some historically proven definitions of economic categories no longer fully describe the majority aspects of the defined terms under absolutely new conditions in the new environment; the terms “economic crisis” and “recession” represent a good example. Their latest “different” form evidently results from the failure of human cognitive abilities; consequently, their new comprehensive definition should perhaps exceed the economic science dimension, it should become a category of general methodology of science. The definition should reflect the fact that the passage of economic states of the world through the crisis is associated with a new quality of spontaneous solution of imbalances through autonomic fragmentation of the economic and financial system, allowing it to rise from the ashes and debris of the previous organization.

However, such knowledge must clearly be approached through other means than those taken by the economic science so far, including the abandonment of economists’ conviction about the privileged role of the economic science within the social sciences. P. Robejšek, a philosopher, economist, and political scientist, believes that it will be necessary to focus more on soft, cognitive sciences in this regard in the future, which have been predominantly rejected by the official orthodox economics so far; it has taken the opinions of empiricists and cognitive scientists with great reservations, if not with aver-

sion, thereby also contributing to the current unsatisfactory state of the social sciences.³ The authors of this article believe that the fluid economic categories of the current complex global world must be revised through the prism of “unchained” randomness, for the omnipresent implications of which we should be better prepared mentally.

It is symptomatic for the current economic science that – in seeking new paradigms that reflect the current complex global environment – the biggest contributions have recently come from representatives of psychological and empirical approaches to economics, particularly to decision-making of economic entities. Their outputs, including research results, corroborate that economic science insufficiently describes real states of the world – even those that unambiguously fall within its research repertoire; in particular, we refer to the actual behavior of economic entities on markets. In this regard, the works of N. Taleb and D. Kahneman, extraordinary personalities of modern nonconventional thinking, represent a significant and inspiring contribution to economic science. Above all, the aforementioned representatives of empirical and heuristic approaches that mostly apply instruments of soft scientific disciplines are very well aware of the basic fact that economic states of the world are unpredictable by nature; in their concept, social sciences, markets, politics, as well as the society as a whole are fundamentally unpredictable – all this in spite of tenacious efforts of economists, forecasters, mathematicians, statisticians, and other academicians and theoreticians.

The thesis regarding the need for conscious humility in absorbing the criticism of human cognition, emphatically declared by empiricists and representatives of behaviorism, is well noticeable in the following example: in the Taleb’s “library of Umberto Eco”, read books are far less valuable than unread ones. The way the interpretation of (anti)library should change in this regard, we should also try to absolutely change our approaches to cognition, which obviously applies – to the maximum extent possible – to economic science. The current hectic world, its volatility, occurrence of events corresponding to Taleb’s untamed, unchained randomness – all this results from incorrect understanding of probability judgments derived from our own knowledge from books we have already read, taken too seriously. Taleb (2011, p. 21) concludes altogether unambiguously: Just as we need to stand library logic on its head, we will work on standing knowledge itself on its head.

However, even more serious is the persisting effect of the already mentioned shift of economic theory, experienced in the past decades, in the direction of higher formalization and mathematization of economic sciences and, in addition to the ethical dimension, the

3 During a seminar, held at the University of Economics in Prague on 27 March 2012, on the topic of “Vicious circle of the European integration”, P. Robejšek referred to the failure of political power, as well as academic elites and to their contribution to existing economic problems. He gives the following causes for the situation: economics has been deafened by politics; idea that mathematics and other exact sciences are better than other disciplines; human technocracy is mere romantic illusion; anything that is mathematized and works in equations faces the limits of human abilities; and technical and technological progress faces limited potential of users. The IT elite or other discoverers no longer have sufficient audience that would be able to capitalize on the increasingly fragile progress.

idea of mastering the phenomenon of risk within economic interactions⁴. We believe the present image of the economic states of the world, including the ethical dimension, rather authentically reflects the ineffectiveness of general mathematization of economic theory and excessive emphasis on model formalization, particularly for the purpose of prediction. The intensive implementation of mathematical principles, currently into the market regulation models, with a view to maintain moderate market volatility and higher stability, has relied on the “risk based approach” concept in the past two decades, based on the (utopian) thesis regarding the possibility of managing the significant impact of randomness on economic states of the world. Robust database of historical data and extensive portfolio of sophisticated models were to serve as proper instruments.

However was the basis of this approach refuted by the latest financial and economic crisis, regulatory models for key financial market segments, moreover mutually inconsistent, continue to work with the premise about potential quantification and subsequent mitigation of risks on the basis of historical data. Kahneman uses relevant arguments to dispute the fundamental idea behind the risk based approach, i.e. that risk is objective.

According to representatives of heuristics, the concept of “risk” was invented by men so that they could more easily cope mentally with dangers and uncertainties that represent integral parts of life. Similar skeptical and anti-mathematical methodological concepts are also used by Taleb⁵ to embrace the term “risk”. Moreover, in spite of the omnipresent randomness in all human activities and forms, the occurrence of events with Gaussian prior probabilities is quite rare in economics. The present, enormously complex global economic world is rather characterized by occurrence of highly unlikely, unpredictable events of all types, which are not applied by mathematical model formalization due to their low probability; therefore, their implications are not envisaged at all.

4 In (2012), L. Pfeifer draws attention to a serious political aspect of the problem: “It results from the efforts aimed at using mathematical methods, for the purpose of which it was necessary to confine reality within mathematical models, specifically through unrealistic premises, such as the economic human, optimal level of information, perfect competition model, or focus on statistical economic balance. The acceptance of such unrealistic premises had several major economic and political implications... The acceptance of the said premises, and consequently of the idea of mathematization of economics, also considerably implicates the possibility to predict future economic developments. However, if people adopt the ability to predict the future, not only will they exceed the limits of their own understanding, but it also gives a strong argument to the advocates of central planning” (p. 19). P. Kohout in an interview for *Parlamentnilisty.cz* of 6 January 2014: “I have never overly trusted econometrics and prognostic models; however, recent findings have led me to categorically reject these things. Economic predictions cannot even be made for the next year.”

5 It is an expression of position on one of the most fundamental problems of the general methodology of sciences that has not been addressed systematically: relationship of dialectics as qualitative interpretation of the states of the world and mathematics as their quantitative interpretation. In this regard, mathematicians are ahead of methodologists; renowned economic journals and magazines still prefer the publication of articles by mathematizing economists – the scientific level of articles is thus derived from the number of formulas, tables, and charts; papers that only rely on empirics are somewhat handicapped in the eyes of publishers, regardless of their cognitive value.

Orthodox economics only perceives men as homo economicus, optimizing their economic utility. By this approach, economics has strived to become part of hard scientific disciplines. However, the assumption of rational choice under any circumstances currently seems as the principal limit to cognition under this trend⁶. In terms of the standard preference theory, economists considered, and some still consider, the heuristic approach to individual choice dependent on the context, under which a decision is made, as clear violation of the coherence doctrine, disputing the fundamental premise of the existing preference theory.

In this regard, especially Kahneman argues with the traditional economics about the decision-making nature, particularly in case of decision-making under uncertainty. Cognitive psychologists focused on examining situations, in which people are not endowed with rational probability thinking and optimal behavior. They discovered rules that even contradict human rationality, so-called heuristics, which considerably eroded the assumption of orthodox theory about the qualities of homo economicus, i.e. the premise that economic entities are always rational. However, the present situation regarding economic states of the world does not overly suggest justification of assumptions of high rationality and consistence of orthodox economic theory. Kahneman provides specific examples of choices made by people that dramatically vary from the orthodox rules of rationality.

The prospect theory of Kahneman and Tversky is crucial for the decision-making of economic entities under uncertainty. It is derived from the Bernoulli's psychological approach to assessing risky decision-making situations. Prior to Bernoulli, people believed that decision-making alternatives were assessed based on mathematical "expected mean value of payoff in random experiment". D. Bernoulli demonstrated on the basis of his famous St. Petersburg paradox (people who are presented with a risky game with infinite mean amount of payoff, are only willing to pay small amounts on such game) that people do not abide by the mean value of payoffs in their decision-making when faced with a problem with random variable. Therefore, rigorous scientific disciplines will not provide much assistance to economic entities with regard to decisions relating to uncertain situations with results generated through random mechanism. People are poorly equipped for this type of prediction; moreover, the decision-making components include elements of soft scientific disciplines, such as psychology, sociology, etc. It is apparent from the aforementioned that each person usually has a very clear-cut individual relation to situations with random results as well as his/her own individual utility function.

3 Dilemmas of Decision-making Problems Associated with Insurance Markets and Contribution of Empiricists and Representatives of Heuristic to Insurance Theory

It is possible to objectively apply the dilemmas resulting from the above mentioned discussion to decision-making problems relating to a special financial market segment, the

⁶ In this context, L. Mlčoch refers to the work of A. Bašta, who formulated the concept of internal model of the decision maker's world in the 1960s; the model complies, to a significant extent, with the principles of behavioral economics and conclusions of empiricists and prof. Mlčoch (2010) believes it is a much more interesting genotype compared to the homo economicus.

objective of which is to financially eliminate economic consequences of randomness, i.e. to examples of decision-making situations relating to commercial insurance. By its nature, the business segment works with randomness. If we stated that decision-making problems with prior probabilities are rare in economics, then there is no other economic sector other than the commercial insurance sector, where the connection of business results and randomness would be so crystal-clear.

Arrangement of insurance as financial solution to consequences of randomness is irrational from the mathematical perspective, with negative "mean value of payoffs" (in addition to indemnification of damages, an insurance company must cover its administrative costs and generate profit for shareholders); in spite of this, economic entities take out insurance. Therefore, the motivation for arranging insurance is closely related with subjective human qualities: preferences and aversions (risk aversion) – i.e. with the domain of soft scientific disciplines.

Most decision-making situations relating to insurance (a problem of a potential client – whether he/she would take out insurance against certain risks; a problem of an insurance company in setting the correct price – insurance premium – for the provided coverage of negative consequences of such risks) represent the type of decision-making problems with ambiguous results. Experimental identification of individual risk preferences or aversions suggests that the majority of human population shows risk aversion. The utility function of Bernoulli thus explained why – in simple terms – poor people purchase insurance coverage and why wealthier people sell such coverage to them; Bernoulli's analysis of approach to risk in terms of property preferences is still applicable 300 years later, only being practically improved in the modern area by the prospect theory of Kahneman and Tversky. Risk aversion relies on the verified fact that, in general, people tend to prefer small losses, which are known in advance, to a chance of unknown (in terms of their scope), but much greater losses – incidental damage.

The generator of random events currently leads to significant changes in the nature of insurable risks and resulting damages (e.g. flood risks in Central Europe, hurricanes in the US) and emergence of absolutely new risks (e.g. SARS disease, mega-terrorism, computer piracy, environmental risks). The term "unknown unknowns" has been used in the insurance industry for these newly emerging risks, some of which are ultimately in the form of risks that have been insured so far (explosion and fire following an act of terrorism). Insurers fear such events the most, because they have never occurred and no prior probabilities exist that could be used in mathematical models, on condition we admit they actually work. Unknown unknowns represent the future states of the world and, so far, no actuary has been able to take previous conditions, under which past claims occurred, and predict the future.

We have already mentioned the fact that, with the exception of life insurance, the Gaussian, arranged randomness is relatively rare in the insurance business. To demonstrate: The effects of "sterilized" randomness could include motor vehicle accident insurance, where the interval of potential financial indemnification is limited by the purchase price of a vehicle and there are probabilities regarding the amount of individual damages pursuant to the statistical distribution of frequencies; this area could perhaps include accident insur-

ance as well. On the other hand, insurance coverage against potential fatal consequences of, for example, natural disasters or third-party liability (damage caused by earthquakes or liability of a motor vehicle for initiating railway accident due to driver's fault at a railroad crossing), show signs of an unlimited interval of damage (in respect of its maximum).

The result of insurance for both the insurer and the client in these insurance segments with high variability of claims depends on the generator of events of "unchained" Taleb's randomness. In the utility theory of the current official microeconomics, a postulate of the so-called fair insurance premium is formulated, defined as the amount of insurance premium identical with the expected loss and certain income equals to expected income – i.e. an insured entity is guaranteed the same income, irrespectively of whether the loss is incurred or not. Sections about fair and maximum insurance premium, in terms of mathematical elegance, tend to be included in sections about decision-making under risk in macroeconomics textbooks. However, we did not find any warning in this regard that the majority of nonlife business shows signs of decision-making under uncertainty, i.e. that postulates about fair and maximum insurance coverage only apply to marginal part of the issue, with tamed, sterilized randomness, expressed through probability, and that this postulate does not apply to the majority and, in particular, more important part of the insurance business. It will be no easy task for the advocates of this theory to refute Taleb's arguments and to construct fair insurance coverage by definition, e.g. against the consequences of, for example, a hurricane - such as future modification of Hurricane Sandy.

However, the consequences of unchained randomness of Taleb, demonstrated by enormous increase in financial losses during catastrophic events, and thereby the determination of the correct insurance premium amount start to hit the barrier of the commercial operation of insurance. The combination of disaster damage to ever increasing property values and fragility of technological progress (e.g. tsunami in the Fukushima Nuclear Power Plant) brings another important dilemma: whether commercial insurance should continue in its historical mission and seek financial elimination of the consequences relating to unchained randomness or even accept "new challenges" in addressing financial consequences relating to new types of damage to environment or cyber hazards, etc., with any and all implications for assessing correct insurance premium amounts; the second alternative is to stick to its historic "core business" or even limit the insurance coverage amount of risks that have been insured so far. In this regard, the lower propensity of commercial insurance companies with traditional structure of insurance product portfolio to sudden default, even in lower amplitudes of the economic cycle, is a significant historical experience. In spite of this fact, government regulators currently prefer pressures on reinforcing the stability of the commercial insurance sector, as part of the financial market balance, as a result of continuing sentiment aimed at preventing excessive volatility or even default of financial markets. However, this necessarily takes place to the detriment of the mission of insurance and insurance business.

The regulatory project Solvency II, which relies on mathematical modeling and the first pillar of which sets down acceptable ratio of nonlife underwriting risks for insurance and capital resources and is to distinguish insurance companies according to the risk level of products offered by them, ultimately leads to the fact that insurance companies only offer limited indemnification for catastrophic events. This leads to "sterilization" of randomness

for such construction of insurance coverage and simplifies the calculation of the correct insurance premium amount. However, the fact that the amount of damage in excess of the indemnification limit is not systematically addressed is a serious negative aspect. This considerably limits the effectiveness of insurance as traditional instrument for eliminating financial consequences of randomness – e.g. in case of natural disasters.

After the crisis-related psychosis subsides, the insurance theory will be faced with a task of finding balanced position between the original mission and objective of the insurance business and the potential of the commercial insurance industry, operating in assessing the correct insurance premium amount on the principle of equivalency between revenue and expenditure. However, the capital adequacy analysis under the first pillar relies on the research of the past. In case we admit it actually works in principle, then solely on condition the future continues to evolve under the same conditions. And this is the key problem of all similar regulatory models. No one has been able to take previous conditions and predict the future. Regulatory instruments that are devised with the sole purpose of ensuring that institutions overcome crises only work well during “normal” times, free of any major economic shocks. However, in Taleb’s style, we must acknowledge a real possibility of economic states of the world that are absolutely beyond the framework of predictability, and thereby the mathematically perceived certainty; consequently, if we fail to sufficiently sterilize randomness, e.g. by an indemnification limit, it is perhaps an unsolvable problem to construct scalar representing “nonlife underwriting risks” by an insurance company. Although the Solvency II project implementation has been repeatedly postponed, it is still planned to be applied in practice, in spite of the aforementioned clear illogicalities. The point of its implementation is no longer discussed and enthusiastic regulators continue in the preparation of other extensive directives.

Conclusions

A Hayekian question of whether it is not necessary to start all over in the scientific economy, from elementary philosophical and methodological categories, springing from the most fundamental and undisputable axiom of Descartes: “I think, therefore I am”, reemerges in connection with the issues relating to the determination of the current states of the world and reduced applicability of existing economic paradigms.

The current global era of the world economy is associated with continuing instability and volatility of markets, particularly of financial markets, low level of ethics in economic interactions, and low support of theory in solving pressing problems of economic states of the world. The absence of any clear theoretical concept for today’s complex global economic world increases the room for improvisation of politicians, who prefer short-term, pragmatic, and often also non-fundamental and paternalistic solutions based on interventionism, particularly extensive regulation. Political representations (whether right-wing or left-wing) do not have any conceptual solutions for some critical problems of negative selection and moral hazard.

The hectic present of the global economy clearly evidences the ineffectiveness of “exact” approaches to controlling or even eliminating risks; there is simply no “insurance policy” against uncertainty and instability of the economic states of the world. The truth and ap-

plicability of the basic methodological ambivalences relating to unpredictability of the external world has been repeatedly confirmed, similarly as the very limited potential of men to make prediction, as well as the already mentioned basic methodological contradiction relating to exact approaches to examining future states of the world. These dilemmas are clear when it comes to decision-making problems of a specific financial market sector, such as the commercial insurance industry. In terms of behavioral and empirical approaches, problematic factors include, but are not limited to the following: official and strongly controversial microeconomic doctrine of the so-called fair policy; regulation of commercial insurance companies through a requirement imposed under the Solvency II project, the implementation of which relies on a speculative term "insurer's nonlife underwriting risk" within a controversial mathematical model. With regard to these problematic areas, we believe that the approach of Taleb and Kahneman refute the fair insurance coverage doctrine for the majority of commercial insurance companies' nonlife business. We believe that Taleb's publications should be on the mandatory reading lists for government supervisors and regulators.

It generally applies to any theory that, even if it is accepted by the majority, the practical application thereof is always delayed; mental inertia of top professionals also contributes to this phenomenon. Theoreticians and research workers still believe the assumptions of economics as an imperial science and opinions of potential higher formalization of economic science, whereas the idea schemes by Taleb and Kahneman are accepted with reservations and often with prejudicial unwillingness. However, it has been more and more apparent that, without transforming our attitude to learning about economic states of the world, particularly humbleness to unchained randomness, which is the decisive factor of political and economic developments, we will not make much progress to principal solutions to prevailing problems. It is necessary to fully realize that we can only manage what we can control.

In order to find solution to problems that are historically unprecedented, to search for new paradigms of economic science, it will be necessary to apply new methods of cognition that will have to be approached differently than in the past, including the abandonment of economists' conviction about the privileged role of the economic science within the social sciences. In the future, it will be necessary to focus more on soft, cognitive sciences in this regard in the future, which have been predominantly rejected by the official orthodox economics so far; it has taken the opinions of empiricists and cognitive scientists with great reservations, if not with aversion, thereby also contributing to the current state of the social sciences. The fluid economic categories will have to be revised through the prism of "unchained" randomness, for the implications of which we should be better prepared mentally to ensure that economic science is cognitive enough and thus enables the positive coping with economic states of the world better.

References

- DAÑHEL, J., DUCHÁČKOVÁ, E., BLAHOVÁ, N.** (2013) The EU's Banking and Insurance Market is Trying to Solve Serious Financial Problems without the Support of Theory. *Journal of Emerging Trends in Economics and Management Science (JETEMS)*. 2013. Vol. 4, No. 2.
- DAÑHEL, J., DUCHÁČKOVÁ, E.** (2010) Problémy obecné metodologie věd ovlivňují neuspokojivý stav ekonomické vědy, *Politická ekonomie*, Vol. 58, No. 5.

- DAŇHEL, J.** (2012) Kniha, kterou by si ekonomové rozhodně měli přečíst, (Rec. Taleb, N., Černá labuť, Praha: Paseka 2011), *Politická ekonomie* 2012, Vol. 60, No. 4.
- DAŇHEL, J.** (2013) Eseje o skryté roli náhody na trzích i v životě, (Rec.: Taleb, N. Zrádná nahodilost: o skryté roli náhody na trzích a v životě. Praha: Paseka, 2013.) *Politická ekonomie* 2013. Vol. 61, No. 6.
- DAŇHEL, J.** (2013) Dilemata bankovní unie EU, *Bankovní unie Morální hazard evropských rozměrů, Ekonomika, právo, politika* No. 100/2013, published by Centrum pro ekonomiku a politiku.
- FINANČNÍ NOVINY**, Ekonomický a finanční server ČTK, [Access 14 January 2013].
- FRIEDMAN, M.** (1993) *Svoboda volby*, Liberální institut, Praha.
- HAYEK, F. A.** (1995) *Kontrarevoluce vědy*, Liberální institut, Praha.
- KAHNEMAN, D.** (2012) *Myšlení rychlé a pomalé*, Jan Melvil publishing, Brno.
- KAHNEMAN, D., TVERSKY, A.** (1979) *Prospekt Theory: An Analysis of Decision under Risk*, *Econometrica* 47(2), 1979. pp. 263 – 291.
- KEYNES, J. M.** (1963) *Obecná teorie zaměstnanosti, úroku a peněz*, Nakladatelství ČSAV, Praha.
- KISLINGEROVÁ, E.** (2013) Banky, absurdní boj s poplatky, *Hospodářské noviny* No. 54, 18 April 2013.
- MLČOCH, L.** (2010) Sociální ekonomika a sociální chování: nástin cest k rozšířenému paradigmatu ekonomie, Konference 20 let IES, Praha.
- PFEIFER, L.** (2012) Nereálné předpoklady ekonomie hlavního proudu jako podmínka matematizace ekonomie, E – LOGOS, *Electronic Journal for Philosophy*, VŠE No. 15.
- SCHUMPETER, J.** (1987) *Teória hospodárskeho vývoja*, Pravda, Bratislava.
- SEDLÁČEK, T.** (2009) *Ekonomie dobra a zla*, Nakladatelství 65. Pole, Praha.
- STIGLER, G. J.** (1984) Economics – The Imperial Science? *Scandinavian Journal of Economics*, Vol. 86, No. 3.
- STORER, N. W.** (1967) Hard Sciences and Soft: Some Sociological Observations, *Bulletin of the Medical Library Association*, 5 (1).
- TALEB, N. N.** (2011) *Černá labuť*, Paseka, Praha – Litomyšl.
- TALEB, N. N.** (2013) *Zrádná nahodilost*, Paseka, Praha – Litomyšl.

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Linkages between the Financial and Real Sectors across Interest Rate Regimes: The Case of the Czech Republic

Vazby mezi finančním a reálným sektorem v různých režimech úrokových sazeb: případ České republiky

TOMÁŠ KONEČNÝ

Abstract

I employ the threshold Bayesian VAR with block restrictions to evaluate the nonlinear dynamics across different interest rate regimes using the example of the Czech Republic. The study compounds the information on aggregate credit and non-performing loans (NPL) to find that the procyclicality of financial sector tends to vary across interest rate regimes. The impulse responses of real economy to shocks to the credit and NPL provide a mixed picture. While the responses to credit shocks are roughly similar across regimes, the reaction to the NPL shocks differ both in size and timing and can be likely aligned with the cyclical factors. The direct impact of foreign factors on lending seems to be rather limited given that the financial sector in the Czech Republic is largely bank-based and funded predominantly by domestic deposits. The measured responses to foreign shocks instead seem to reflect the convergence path of the Czech economy over a longer time horizon.

Keywords

credit, small open economy, non-linearities

Abstrakt

Práce prostřednictvím prahového bayesovského VARu zkoumá nelineární dynamiku v různých režimech úrokových sazeb na příkladu České republiky. Studie používá data o celkových úvěrech a nesplácených úvěrech (NPL) a dochází k závěru, že procykličnost finančního sektoru se mění v rámci režimů úrokových sazeb. Impulsní odezvy reálné ekonomiky vůči šokům na objemu úvěrů a NPL poskytují smíšený obraz. Zatímco reakce na úvěrové šoky jsou zhruba podobné bez ohledu na konkrétní režim, reakce na šoky do NPL se liší co do velikosti i načasování. Přímý vliv zahraničních faktorů na úvěry se zdá být poměrně omezený vzhledem k tomu, že finanční sektor v České republice je z velké části založený na bankách a financovaný převážně z tuzemských vkladů. Naměřené reakce na zahraniční šoky proto spíše odráží konvergenci české ekonomiky v delším časovém horizontu.

Klíčová slova

úvěr, malá otevřená ekonomika, nelinearita

JEL Codes

E51, C15, C32

Introduction

The protracted period of low interest rates and postponed economic recovery, combined with the persisting climate of financial market vulnerability in Europe, has raised imminent questions about the viable options for monetary policy and the operability of “traditional” transmission mechanisms. Given the recent crisis and post-crisis experience, the momentum of the debate has from the outset centred on the interactions between monetary policy, the real sector and finance. The efforts by researchers, industry experts and policymakers have ultimately transformed into a number of both theoretical and empirical studies (for a detailed survey see, for example, BIS 2011) which either build upon existing channels or develop novel ones linking the real and financial sides of the economy. The influential balance sheet or “financial accelerator” framework of Bernanke and Gertler (1995) emphasizes capital-market frictions, including moral hazard, asymmetric information and imperfect contract enforcement problems, and the subsequent need for collateral to access credit. As a result, shocks to collateral value arising in the real economy might in turn feed back from the banking sector into real economic activity.¹ The bank lending and bank capital channels instead focus on banks’ asset and liability structure. The former channel relies on the inability of banks to fully substitute for lost liabilities in the event of a monetary contraction (Bernanke and Blinder, 1988), while the latter reflects banks’ incentives given exogenous shocks to capital and interactions of capital with regulatory requirements. In such a setting, adverse changes to bank capital can have a pronounced impact on the lending of less capitalized banks (Van den Heuvel, 2002; Meh and Moran, 2010). The literature on capital requirements has identified additional feedback effects of regulation through shifts in risk-weighted assets in the capital-asset ratio (Borio et al., 2001; Goodhart et al., 2004). The liquidity channel, as discussed, for example, by Brunnermeier and Pedersen (2009), has received considerable attention, especially due to the spillover mechanisms amplifying the recent financial crisis.²

The interactions between the real sector and the financial sector are not necessarily linear. The endogeneity of credit markets in the financial accelerator mechanism, the propagating sectoral dynamics of the liquidity channel and, for example, the relevance of the bank capital channel for a subset of (less capitalized) banks each point to the potential importance of non-linearities in applied work.

The contribution of this paper is threefold. First, the present study aims to gauge the non-linear interactions both within and between the real sector and the financial sector. I estimate a standard monetary policy model for a small open economy augmented by financial sector aggregates as a Bayesian threshold VAR. By allowing for endogenous high- and low-interest rate regimes, I impose greater flexibility than in the case of a linear system, so that the impact of shifts in the policy rate and the implicit non-linearities in the

1 Given the dominant position of bank credit in the financing of Czech corporates and households, the authors use the terms banking sector and financial sector interchangeably.

2 Other studies on market and funding liquidity include Wagner (2010) and Strahan (2008).

transmission of shocks from the financial system can be evaluated. The second contribution is methodological, as I extend the single-equation Bayesian threshold model by Chen and Lee (1995) into the multiple-equation setting with block restrictions to account for external factors in a small open economy. Third, given that most of the related empirical studies have focused on developed economies (Çatik and Martin 2012 being the sole exception), the study provides complementary evidence on the role of non-linearities for a small emerging economy.

The remainder of the paper is organised as follows. The next section provides a brief overview of the empirical evidence on real sector-finance linkages. Section 3 describes the data and methodology. Section 4 presents estimated generalized impulse responses for key variables of interest and discusses the results. Section 5 concludes.

1 Empirical Literature

The empirical links between the real economy and the financial sector have been studied extensively within distinct analytical frameworks and from different perspectives. Most empirical studies on feedback effects rely on the vector autoregression (VAR) methodology, which links key macroeconomic variables with a selected indicator, or selected indicators, of financial sector performance. These studies typically emphasize the link from the real sector to the financial sector using aggregate-level data within standard (possibly cointegrated) vector autoregressions.³

The literature, oriented largely on credit risk, emphasizes the role of macroeconomic aggregates in the modelling of default rates or other dimensions of credit risk, and addresses possible feedback effects from banks to the real sector with more or less frequent reference to stress-testing. Alves (2005) and Åsberg Sommar and Shahnazarian (2008) employ cointegration techniques to find a significant relationship between the expected default frequencies published by Moody's and selected macro-variables. Aspachs et al. (2007) use panel VAR techniques to measure the impact of banks' default probabilities on the GDP variables of seven industrialized economies, while global VAR studies by Pesaran et al. (2006) and Castrén et al. (2008) establish links between global macroeconomic and financial factors and firm-level default rates.

A literature building upon standard monetary policy framework augmented by financial sector variables typically investigates the transmission channels from finance to the real economy. This includes Gilchrist and Zakrajšek (2011), Helbling et al. (2011) and Meeks (2012), who model the links from credit spreads to business cycle indicators, and de Bondt (1998, 1999), Favero et al. (1999), Altunbas et al. (2002), Hristov et al. (2012) and Milcheva (2013), who focus on the bank lending channel in Europe. Research on Central European economies includes Franta et al. (2011), who study the monetary transmission mechanism in the Czech Republic using a time-varying parameters VAR model, and Vilagi and Tamási (2011), who use Hungarian data and rely on a Bayesian structural VAR model to consider

3 As DSGE models have only recently moved away from a highly stylized treatment of the financial sector, the present section does not provide a detailed treatment of the DSGE literature (for a survey see Brázdik et al., 2011).

different types of credit shocks. Égert and MacDonald (2009) provide a detailed survey covering the Central and Eastern European region.

While the empirical literature spans a long list of macro-studies on feedback effects between the real economy and the banking sector, the role of non-linearities has been studied to a somewhat lesser extent. As the precise nature of the non-linearities in most situations is not known, authors have opted for different estimation frameworks. Among the most prominent are the threshold and Markov-switching VAR models (TVAR and MS-VAR respectively). A frequently cited study by Balke (2000) adopts a structural TVAR model with tight and regular credit regimes using the quarterly U.S. GDP data over 1960–1997. It finds a larger effect of monetary policy shocks on output in the “tight” credit regime and a more pronounced effect of contractionary monetary shocks compared to expansionary ones. Atanasova (2003) in a similar TVAR exercise for the UK supports the evidence on the asymmetry of monetary policy effects in credit constrained and unconstrained regimes as well as different output effects of monetary contractions and expansions. Finally, Calza and Sousa (2006) employ Balke’s framework to investigate the role of credit shocks in the euro area and conclude that while present, the non-linearities and asymmetric responses seem to be less pronounced than those found by Balke (2000) for the U.S.

Kaufmann and Valderrama (2007), on the other hand, estimate an MS-VAR model for the euro area and the U.S. Depending on the regime, credit shocks have either a positive or an insignificant effect on the sector for both the euro area and the U.S. In another comparative study by Kaufmann and Valderrama (2008), focusing on German and UK bank lending, the authors apply the MS-VAR model to corporate and household sector data and conclude that shocks to real variables and interest rates impact differently on lending both across regimes within countries and across countries for a given regime.

Studies outside the TVAR and MS-VAR framework include higher-order approximation of a non-linear VAR by Drehmann et al. (2006). The authors relate aggregate credit risk in the UK to macroeconomic variables and find that credit risk responds strongly to macro developments, especially for large shocks. De Graeve et al. (2008) introduce an integrated micro-macro framework at the bank level based on German bank data linked to macroeconomic variables. Utilizing the parameters from a micro-based logit model in a macro VAR, the authors identify feedback effects between the banking sector and the real economy which are absent from the standard linear specification. A study of the euro area by Gambacorta and Rossi (2010) employing the asymmetric vector error correction model addresses possible asymmetries in the transmission mechanism and concludes that the effect of a monetary policy tightening on credit, GDP and prices is larger than the effect of a monetary policy easing.

A common feature of all the above-mentioned studies allowing for non-linearities is their focus on developed market economies. To the best of our knowledge, Çatik and Martin (2012) is the only published study focusing on the non-linear feedback effect from the real economy to the financial sector in an emerging market economy. Using TVAR, the study investigates changes to the macroeconomic transmission mechanism in Turkey after a change of monetary policy regime in the early 2000s and finds sharp changes in transmission mechanisms after 2004, when the reforms were implemented.

2 Methodology and Data

2.1 Threshold Bayesian VAR

The potentially non-linear nature of the feedback effects between the real and financial sectors is addressed within the threshold VAR framework.⁴ The advantage of TVAR is that it allows for endogenous switching between different regimes as a result of shocks to the modelled variables. Furthermore, the framework is a convenient and straightforward tool for the treatment of certain types of non-linearities, such as regime switching or multiple equilibria (Balke, 2000). The selection of the threshold variable provides an intuitive reference to the source driving the non-linearities. Potential disadvantages include the omission of other drivers, especially in cases where the nature of the non-linearity is uncertain, and the linearity restriction within a given regime.

Given the limited length of the time series, I assume the existence of a single threshold value. Nonetheless, despite the available evidence of distinct feedback effects between regular and “tight” or “crisis” regimes, one should note that it is still not clear to what extent models allowing for single switching of parameters (ie. a unique threshold) capture the actual nature of the non-linearities.

The model contains three blocs of variables: (i) the domestic real sector and domestic monetary policy, as represented by the volume of industrial production, the price level and the short-term interest rate, (ii) the domestic financial sector, as measured by the volume of aggregate credit and the share of non-performing loans (NPL), and (iii) the external sector, proxied by the nominal exchange rate, the volume of foreign industrial production and the foreign interest rate. I use the threshold Bayesian VAR (TBVAR) framework with block restrictions on exogenous foreign industrial production and the CPI to account for the small open economy assumption.

$$y_t = \Pi_1 x_t I[y_{t-d}^{thr} < r] + \Pi_2 x_t I[y_{t-d}^{thr} \geq r] + \varepsilon_t$$

$$t = 1, \dots, T \quad \varepsilon_t \approx NI_p(0, \Omega),$$

where x_t stands for a $p \times 1$ vector of endogenous variables, $x_t = [1, y_{t-1}^1, \dots, y_{t-1}^p, \dots, y_{t-k}^1, \dots, y_{t-k}^p]$ is a $p(k+1)$ vector of lagged endogenous variables, and Π_i is a $p \times (1+pk)$ matrix of coefficients with block exogeneity restrictions such that for n foreign and m domestic variables I have

$$\Pi_i = \begin{bmatrix} \Pi_{nn} & 0 \\ \Pi_{nm} & \Pi_{mm} \end{bmatrix}.$$

The block exogeneity assumption postulates that domestic shocks should not impact upon foreign covariates and has been employed by a number of studies on small open economies (e.g. Cushman and Zha, 1997; Zha, 1999; Maćkowiak, 2006; Havránek et al.,

4 One possible alternative is the MS-VAR framework, which examines the exogenous (random) transitions between regimes. Time-varying coefficient VARs, on the other hand, are more suited to tracking gradual changes in transmission over time (Boivin et al., 2010).

2010). The threshold selection in TBVAR accounts for potential volatility shifts across regimes, replacing a restrictive assumption of constant volatility in the TVAR model by Balke (2000) and his successors. Neglecting heteroscedasticity of shocks might cause changes in the magnitude of shocks to be confused with changes in the transmission mechanism (Franta et al., 2011).

The identification of shocks relies on recursive (Cholesky) decomposition. The ordering of the variables proceeds from a measure of economic activity, the price level, the interest rate, the exchange rate and a measure approximating the Czech financial sector (Goodhart and Hofmann, 2008; Havránek et al., 2010). For the foreign variables I assume ordering from output to the interest rate. I adopt normal-diffuse priors for the autoregressive coefficients following Kadiyala and Karlsson (1997):

$$\pi_i \approx N(\tilde{\pi}_i, \tilde{V}_i^{pr}) \text{ and } p(\Sigma_i) \propto \Sigma_i^{-(p+1)/2} \text{ for } i=1,2,$$

where π_i is a vector of stacked coefficients of the matrix Π_i , $\tilde{\pi}_i$ is a zero column vector with $p(1+pk)$ rows, \tilde{V}_i^{pr} are matrices with elements corresponding to the coefficients on their own lags equal to ϕ_0/l^2 and elements on other lags equal to $\phi_0\phi_1\sigma_{i,q}^2/(l^2\sigma_{i,r}^2)$. $\sigma_{i,q}^2$ corresponds to the standard error of an AR(1) process of a variable q estimated separately for each variable. The values of the hyperparameters are set to $\phi_0 = 0.2$, $\phi_1 = 0.5$ and $\phi_2 = 10$.⁵ The prior on the residual variance-covariance matrix is diffuse and independent of the priors on the autoregressive coefficients.

The prior on the threshold parameter is assumed to follow a uniform distribution on the interval $[r_{q=0.1}, r_{q=0.9}]$. Finally, the prior for the delay parameter follows a multinomial distribution with the probability of a particular delay equal to $1/d_0$. The likelihood function and the conditional posterior distributions for the individual parameters can be found in the Appendix. For the analysis of feedback between the real sector and the banking sector I computed generalized impulse response functions (GIRFs) based on Koop, Pesaran and Potter (1996). The non-linear GIRFs abandon the symmetry and history independence properties of linear impulse response functions and take into account the size (and sign) of the shock, as well as its evolutionary path (for more details see also Atanasova, 2003). There would be little justification for applying the threshold model if no statistically significant evidence of non-linearities was present. Before embarking on the TBVAR estimation, I tested for non-linearities using the bootstrapping procedure by Hansen (1996). I ran 1,000 realizations of the standard F_n statistic and then obtained its empirical distribution by collecting the statistics over the grid space of the threshold values.⁶

2.2 Data

The sample has a monthly frequency spanning 2002m1–2012m3. The choice of model variables was guided by similar studies on a small open economy (e.g. Borys et al., 2009; Havránek et al., 2010; Franta et al., 2011). I prefer industrial production as a proxy for the level of economic activity given that more traditionally used measures such as real GDP

5 For details see Canova (2007).

6 The original code for the testing procedure was obtained from Atanasova (2003).

and the output gap are available only at quarterly frequency.⁷ In the literature on real sector-finance feedback, industrial production was used, for example, by Atanasova (2003). The 3-month Pribor approximates the monetary policy rate and the cost of funds in the economy. The remaining variables in the standard monetary policy model for a small open economy include the price level and the nominal exchange rate. Aggregate nominal credit and non-performing loans represent alternative measures of banking sector performance. To save on degrees of freedom, each indicator is employed in a separate model. As the Czech Republic is a small open economy, one needs to control for the external environment. I do so by using the 3-month Euribor and the real GDP index of the 17 members of the European Union as of end-2002.

While empirical studies relying on the TVAR framework use a measure of the credit spread (Balke, 2000; Atanasova, 2003) or credit growth (Calza and Sousa 2006) as a threshold variable to gauge credit market conditions, the present study focusing on interest rate regimes instead employs the 3-month Pribor. The 3-month Pribor is a key determinant of the pricing of loans to the corporate sector and thus represents an approximate measure of credit market conditions as well as the overall state of the economy.^{8,9}

All level variables, i.e. industrial production, the price level, the exchange rate, credit and EU GDP, are expressed in natural logarithms and seasonally adjusted at the source where necessary. For the aggregate data on the real economy I use the information published by the Czech Statistical Office and the ARAD database maintained by the Czech National Bank. Variables capturing the external environment are from Eurostat and Bloomberg. Plots of all the series are available in the Appendix.

3 Empirical Results

The results of Hansen's (1996) procedure indicate a strong presence of non-linearities for both specifications with credit and the non-performing loan ratio (see Table 1). The estimated thresholds correspond to a 3-month Pribor of roughly 1.8% irrespective of specification.¹⁰ As the 3-month Pribor has followed a decreasing trend since the early 2000s, the standard (or *high* hereafter) and accommodative (*low*) interest rate regimes also roughly divide the sample into two unequal time periods. The first period covers the economic expansion and sustained growth of the Czech banking and financial sector. The second (shorter) period spans the years when the post-Lehmann economic and financial crisis began to materialize in the Czech economy. Accordingly, this period has been marked by a steady decline in economic activity, by perturbations to the banking sector surrounded

7 Borys, Horváth and Franta (2009) originally used quarterly data transformed into monthly frequency using the Hodrick-Prescott filter.

8 Kaufmann and Valderrama (2008) employ the MS BVAR framework and thus do not need to consider a threshold variable. Nonetheless, they likewise relate the two regimes identified to the general economic conditions.

9 A threshold VAR model with the credit spread as an alternative threshold variable developed by Konečný and Babecká-Kucharčuková (forthcoming) provides a parallel perspective on the interaction between the real and financial sector.

10 The mean of the 3-month Pribor totals 2.4%.

by a high degree of uncertainty about future developments, and by extensive accommodative policies by the Czech National Bank.

Table 1: Threshold estimates and test for nonlinearity

Model	Estimated r	Hansen (1996)'s chi-square p-value
Credit	1.879	0.008
NPLs	1.803	0.013

The figures containing the empirical results present generalized impulse response functions conditional on the initial state (*high* or *low*) and the impulse response functions from a constant BVAR model without a threshold (*sym*). The size of shocks is defined as a positive standard deviation at time $t = 0$ and evaluated over a period of 36 months. I do not report results for a negative shock, as our estimates do not find significant asymmetry in the impulse responses, i.e. the impulse responses have broadly the same magnitude in the case of positive and negative shocks.^{11,12} An increase in industrial production, the domestic price level and the 3-month Pribor are the domestic shocks, and an increase in EU industrial production, a rise in the 3-month Euribor and exchange rate depreciation are the external shocks.

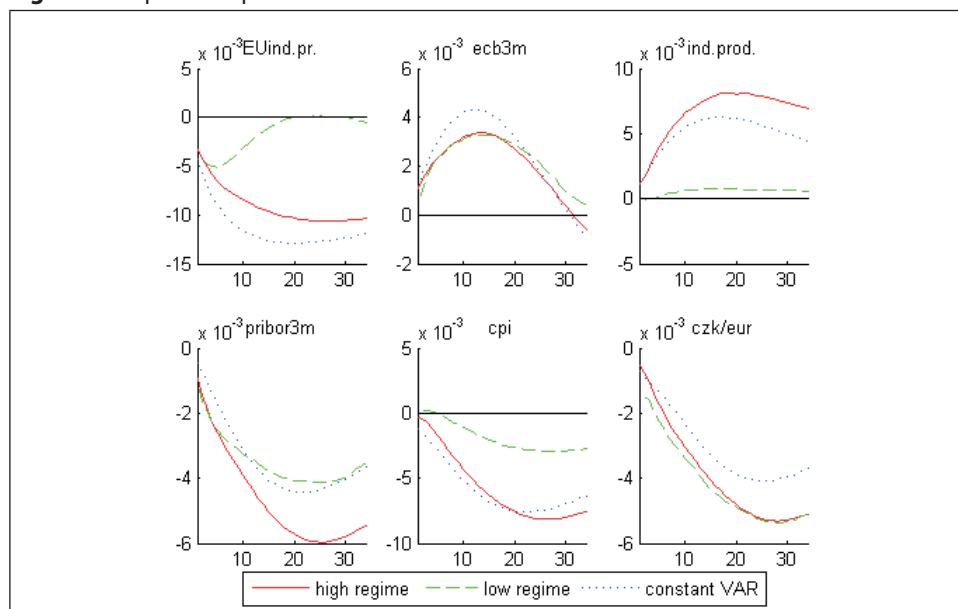
3.1 Responses of the Financial Sector

Figure 1 plots the impulse responses of credit to the three domestic and three external shocks. The responses in the low regime are in general subdued or at most roughly identical to the responses conditioned by the initial state in the *high* regime. The subdued response of aggregate credit to a positive shock to industrial production in the low regime might be partly due to the high uncertainty about the net present value of potential investment projects of firms and/or the future income streams of households and a resulting unwillingness to take on loans except during periods of above-average growth. The negative impact on credit of an increase in the price level and the interest rate in the *high* regime may be related to the tightness of firms' and households' budget constraints. An increase in the domestic price level might raise input costs more than revenues in a small open economy with a large proportion of exporting companies. Similarly, a higher price level reduces households' ability to service debt and reduces banks' willingness to lend. The more pronounced negative impact on credit in the *high* regime may relate to the initial conditions, given that the shock occurred at times when interest rate was already high.

¹¹ The impulse responses for a negative shock can be provided upon request.

¹² Our results are consistent with Atanasova (2003), who did not find asymmetric responses for UK data. Balke (2000) and Gambacorta and Rossi (2010), on the other hand, find asymmetric effects for the U.S. and the euro area respectively.

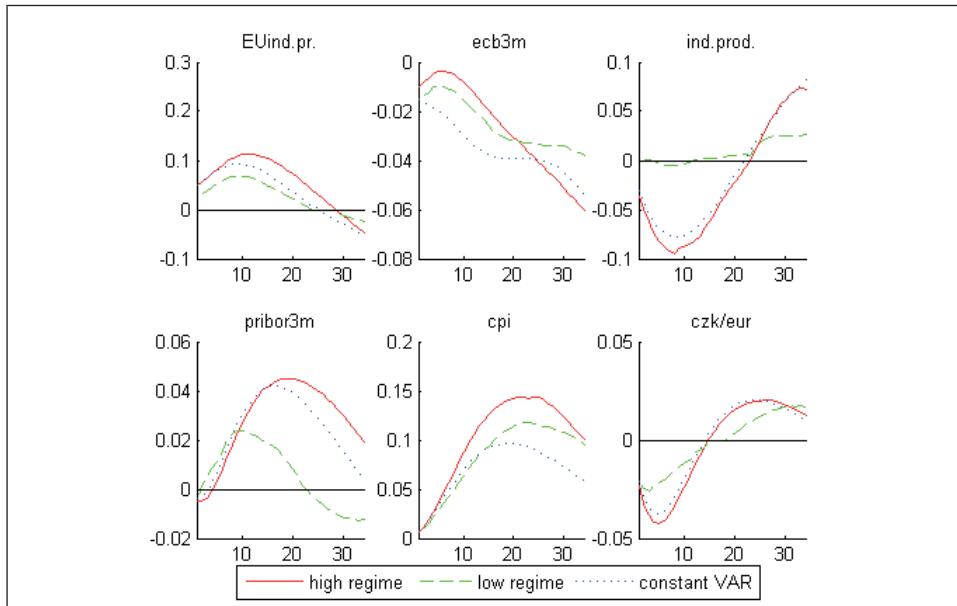
Figure 1: Impulse response functions from real sector variables to credit.



The negative response of credit to a positive shock to foreign industrial production reflects a negative correlation between European industrial production and domestic industrial output (and hence also credit) over the sample length. While Czech domestic industrial production caught up dramatically between 2002 and the end of 2007 against a background of stagnating industrial production in the EU17, the link has changed sharply in the wake of the recent financial crisis, with the correlation switching from -0.13 over 2002–2007 to 0.70 for the period 2008–2012m3. The negative response of aggregate credit to the exchange rate depreciation is largely similar across regimes and can be explained by the convergence process of the Czech economy, marked by steady appreciation of the Czech koruna, expansion of the Czech financial sector and corresponding growth of credit. Finally, given that the overwhelming majority of loans in the Czech financial system are denominated in domestic currency, the positive response to an increase in the Euribor is probably due to mechanisms other than the immediate costs of funds. As the response does not differ across regimes, the explanation might relate to convergence factors (similarly to the currency depreciation) rather than any irregularity in the functioning of the transmission mechanism.

Figure 2 plots the impulse responses of non-performing loans to the remaining model variables. The responses of non-performing loans in the low regime are again either similar to or less pronounced than those in the *high* regime. A one-time positive shock to industrial production might not lead to a stronger decline in NPLs in the *low* regime, a result possibly driven by the insufficient size of the economic upturn and the uncertainty about the length of the recovery. The behaviour of NPLs in the *high* regime, on the other hand, corresponds to the procyclical behaviour of NPLs in the financial system (Borio et al. 2001), where risks begin to materialize at the peak of the financial cycle, i.e. roughly two years after the positive output shock.

Figure 2: Impulse response functions from real sector variables to non-performing loans.



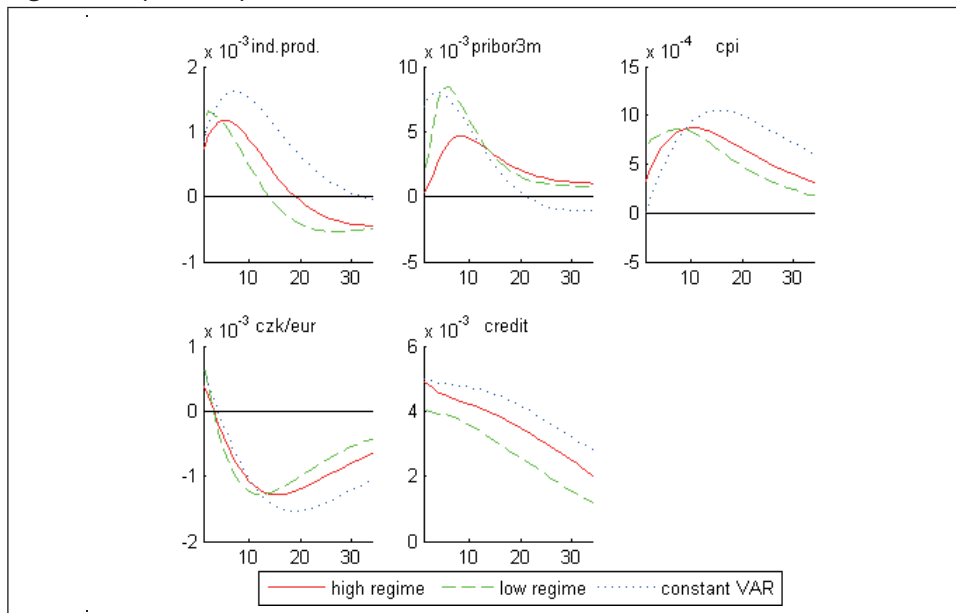
Price and interest rate increases impact upon the financial sector's performance not only through the extensive margin (the amount of credit extended), but also through the intensive margin (the debt service capacity of existing lenders). Complementing the picture from the response of the credit aggregates, the NPLs react more distinctly in the *high* regime. The EU17 industrial production index raises the NPLs of the financial sector along the argument of the relationship between the Czech and EU17 industrial production cycles discussed in Figure 1. The depreciation of the domestic currency boosts the profits of exporters and connected supply chains for an initial period of 15 months. The transitory impact of the shock is nonetheless not strong enough to support all the beneficiaries of the depreciation, and NPLs start to rise again in the second half of the response period.

3.2 Responses of the Real Economy

The response of the domestic economy and the exchange rate to the shocks to credit and NPLs are shown in Figure 3 and Figure 4. The impulse responses for credit in Figure 3 are of similar size and shape irrespective of regime, perhaps with the exception of the interest rate response. A positive shock to credit initially boosts industrial production over the first year and a half. The procyclical effect evaporates thereafter and the overall impact becomes zero or even slightly negative depending on the model specification (linear or threshold VAR). The negative impact from the TBVAR on industrial production might be linked to the misallocation of resources during the period of credit expansion, as banks' perceptions of credit risk are biased downwards (Borio et al. 2001), or could simply be a result of sampling variability, which is ignored in the construction of the generalized impulse responses. While not directly comparable, our finding differs from Balke (2000), who finds that a credit spread shock approximating credit market conditions has substantially larger effects on output growth when the system is in the tight credit regime. Calza

and Sousa (2006) likewise report the response of real GDP to a positive shock to real loan growth to be somewhat bigger but less persistent in the low credit growth regime than in the high credit growth regime. While the impulse response from credit to industrial production in Figure 3 slightly resembles the story by Calza and Sousa (2006), I do not find the differences to be convincing enough to reach a similar conclusion.

Figure 3: Impulse response functions from credit to real sector variables.



The price level increases as more credit flows into the economy. The positive response of the interest rate tends to reflect the efforts of the monetary authority to curb the inflationary pressures spurred by the credit inflows. The policy response is smaller in the *high* regime, where the initial interest rate is already elevated, than it is in the *low* regime, where the rate is more favourable and there is more scope for monetary policy reaction. The exchange rate appreciation following a positive shock to credit can be explained by the convergence process of the Czech economy, similarly to the reverse direction from the exchange rate to credit.

Figure 4: Impulse response functions from non-performing loans to real sector variables.

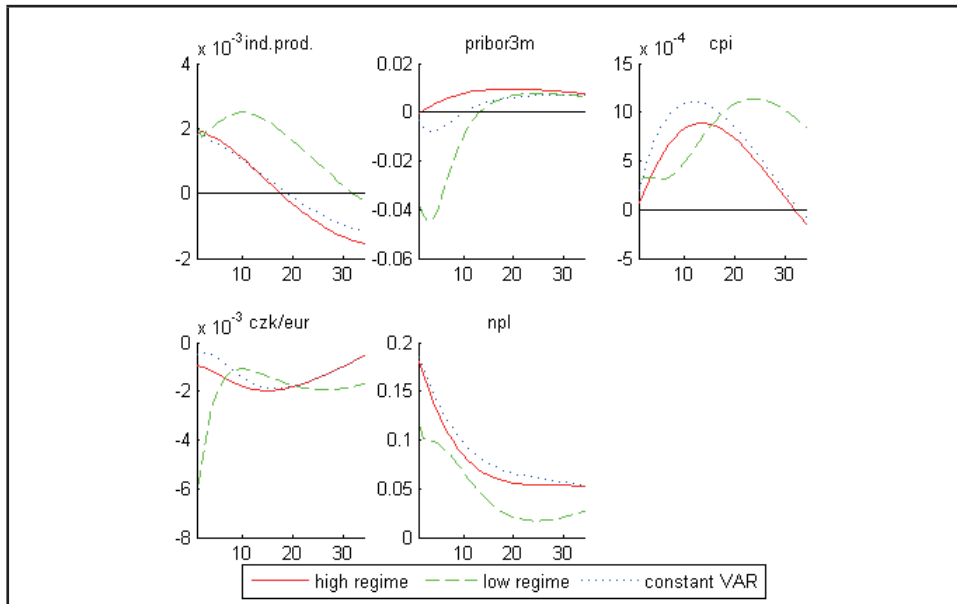


Figure 4 reports the impulse responses for a one-time positive shock raising NPLs by one standard deviation. Contrary to the impact of the credit shock, the initial state impacts upon both the size and timing of the impulse responses. The increase in industrial production and the gradual rise in prices might be explained by cyclical considerations as output and prices rebound from a cyclical trough. In the *low* regime, the responses tend to be more pronounced and the output recovery more delayed. In the low regime, uncertainties and agents' confidence in the future prospects of the economy come into play and the monetary policy response thus needs to be more vigorous.¹³ The exchange rate depreciation is also consistent with the cyclical explanations of the NPL shock.

Conclusions

Our results indicate that the omission of non-linearities might lead to an imprecise understanding of the interactions and transmission mechanisms between the real economy and the financial sector. I combine the TBVAR framework with information on credit and non-performing loans as measures of the stance of the financial sector in an attempt to provide a more general picture of the feedback in the specific setting of a small open economy. Despite the absence of asymmetries in the effects of positive and negative shocks, the magnitude and, less frequently, the timing of the impulse responses differ in the standard and accommodative interest rate regimes. The uncertainty and lack of confidence in the accommodative (*low*) regime weakens the incentives for economic agents to take on loans and reduces the cyclicity of the financial sector. As the financial sector in the Czech Republic is largely bank-based and funded predominantly by domestic deposits, the di-

¹³ The positive yet relatively small increase in the interest rate in the high regime is somewhat surprising and is perhaps a result of sampling variability.

rect impact of foreign factors on lending seems to be rather limited and credit volumes tend to be affected indirectly through the situation within the production sector of the economy. The responses to foreign shocks thus appear to reflect the convergence path of the Czech economy over the longer term. The complementary investigation of non-performing loans indicates that the procyclicality of NPLs in the *low* regime (represented mostly by the economic environment of the current crisis) is lower. The recovery from the low regime thus needs to be sufficiently robust to translate into lower NPLs.

While the financial sector feeds back into the real sector, the responses to credit shocks are roughly similar across regimes, with the exception of the policy reaction of the monetary authority, which is more pronounced in the low regime. This finding differs from the results of other studies employing the threshold VAR framework, which report asymmetric feedback from credit to the real economy. Asymmetries are nonetheless present in the responses of the real economy to shocks to NPLs, which differ in both size and timing and are probably aligned with cyclical factors.

References

- ALTUNBAS, Y., O. FAZYLOV, and P. MOLYNEUX** (2002) Evidence on the Bank-lending Channel in Europe. *Journal of Banking and Finance* 26/11:2093-2110.
- ALVES, I.** (2005) Sectoral Fragility: Factors and Dynamics. In *Investigating the Relationship Between the Financial and Real Economy*, BIS Papers 22: 450–480.
- ÅSBERG SOMMAR, P., and H. SHAHNAZARIAN** (2008) Macroeconomic Impact on Expected Default Frequency. *Sveriges Riksbank Working Paper Series* 219.
- ASPACHS, O., C. A. E. GOODHART, D. P. TSOMOCOS, and L. ZICCHINO** (2007) Towards a Measure of Financial Fragility. *Annals of Finance* 3/1: 37–74.
- ATANASOVA, C.** (2003) Credit Market Imperfections and Business Cycle Dynamics: A Non-linear Approach. *Studies in Nonlinear Dynamics & Econometrics* 7/4, Article 5.
- BALKE, N. S.** (2000) Credit and Economic Activity: Credit Regimes and Nonlinear Propagation of Shocks. *Review of Economics and Statistics* 82/2: 344–349.
- BERNANKE, B. S., and A. S. BLINDER** (1988) Credit, Money, and Aggregate Demand. *American Economic Review* 78/2: 435–439.
- BERNANKE, B. S., and M. GERTLER** (1995) Inside the Black Box: The Credit Channel of Monetary Policy Transmission. *Journal of Economic Perspectives* 9/4: 27–48.
- BIS** (2011) The Transmission Channels Between the Financial and Real Sectors: A Critical Survey of the Literature. *BIS Working Paper* 18.
- BOIVIN, J., M. T. KILEY, and M. S. MISHKIN** (2010) How Has the Monetary Transmission Mechanism Evolved Over Time? *NBER Working Paper* 15879.
- BORIO, C. E. V., C. FURFINE, and P. W. LOWE** (2001) Procyclicality of the Financial System and Financial Stability: Issues and Policy Options. In *Marrying the Macro and Microprudential Dimensions of Financial Stability*, BIS Papers 1, Basel.
- BORYS, M., R. HORVÁTH, and M. FRANTA** (2009) The Effects of Monetary Policy in the Czech Republic: An Empirical Study. *Empirica* 36/4: 419–443.
- BRÁZDIK, F., M. HLAVÁČEK, and A. MARŠÁL** (2011) Survey of Research on Financial Sector Modeling Within DSGE Models: What Central Banks Can Learn from It. *Czech National Bank Research and Policy Note* 3/2011.
- BRUNNERMEIER, M. K., and L. H. PEDERSEN** (2009) Market Liquidity and Funding Liquidity. *Review of Financial Studies* 22/6: 2201–2238.

- CALZA, A., and J. SOUSA** (2006) Output and Inflation Responses to Credit Shocks: Are There Threshold Effects in the Euro Area? *Studies in Nonlinear Dynamics & Econometrics* 10/2: 1–21.
- CANOVA, F.** (2007) *Methods for Applied Macroeconomic Research*. Princeton University Press. Princeton University Press.
- CASTRÉN, O., S. DÉES, and F. ZAHER** (2008) Global Macro-Financial Shocks and Expected Default Frequencies in the Euro Area. *ECB Working Paper* 875.
- ÇATIK, A. N., and C. MARTIN** (2012) Macroeconomic Transitions and the Transmission Mechanism: Evidence from Turkey. *Economic Modelling* 29/4: 1440–1449.
- CHEN, C. W. S., and J. C. LEE** (1995) Bayesian Inference of Threshold Autoregressive Models. *Journal of Time Series Analysis*, 16/5: 483–492.
- CUSHMAN, D. O., and T. ZHA** (1997) Identifying Monetary Policy in a Small Open Economy under Flexible Exchange Rates. *Journal of Monetary Economics* 39/3:433–448.
- DE BONDT, G. J.** (1998) Credit Channels in Europe: Bank-level Panel Data Analyses, *De Nederlandsche Bank Research Memorandum WO&E* 567.
- DE BONDT, G. J.** (1999) Credit Channels in Europe: Cross-country Investigation, *De Nederlandsche Bank Research Memorandum WO&E*, 569.
- DE GRAEVE, F., T. KICK, and M. KOETTER** (2008) Monetary Policy and Financial Instability: An Integrated Micro-Macro Approach. *Journal of Financial Stability* 4/3: 205–231.
- DREHMANN, M., A. PATTON, and S. SORENSEN** (2006) Corporate Defaults and Large Macroeconomic Shocks. Bank of England, mimeo.
- ÉGERT, B., and R. MACDONALD** (2009) Monetary Transmission Mechanism in Central and Eastern Europe: Surveying the Surveyable. *Journal of Economic Surveys* 23: 277
- FAVERO, C. A., F. GIAVAZZI, and L. FLABBI** (1999) The Transmission Mechanism of Monetary Policy in Europe: Evidence from Banks' Balance Sheets. *NBER Working Paper* 7231.
- FRANTA, M., R. HORVÁTH, and M. RUSNÁK** (2011) Evaluating Changes in the Monetary Transmission Mechanism in the Czech Republic. *CNB Working Paper* 13.
- GAMBACORTA, L., and C. ROSSI** (2010) Modelling Bank Lending in the Euro Area: A Non-linear Approach. *Applied Financial Economics* 20/14: 1099–1112.
- GILCHRIST, S., and E. ZAKRAJŠEK** (2011) Monetary Policy and Credit Supply Shocks. *IMF Economic Review* 59: 195–232.
- GOODHART, C., and B. HOFMANN** (2008) House Prices, Money, Credit, and the Macroeconomy. *Oxford Review of Economic Policy* 24/1:180–205.
- GOODHART, C. A. E., B. HOFMANN, and M. SEGOVIANO** (2004) Bank Regulation and Macroeconomic Fluctuations. *Oxford Review of Economic Policy* 20/4: 591–615.
- HAVRÁNEK, T., R. HORVÁTH, and J. MATĚJŮ** (2010) Do Financial Variables Help Predict Macroeconomic Environment? *CNB Working Paper* 6.
- HELBLING, T., R. HUDROM, M. A. KOSE, and C. OTROK** (2011) Do Credit Shocks Matter? A Global Perspective. *European Economic Review* 55/3: 340–353.
- HRISTOV, N., O. HÜLSEWIG, and T. WOLLMERSHÄUSER** (2012) Loan Supply Shocks During the Financial Crisis: Evidence for the Euro Area. *Journal of International Money and Finance* 31/3: 569–592.
- KADIYALA, K.R., and S. KARLSSON** (1997) Numerical Methods for Estimation and Inference in Bayesian VAR-Models. *Journal of Applied Econometrics* 12:99–132.
- KAUFMANN, S., and M. T. VALDERRAMA** (2007) The Role of Credit Aggregates and Asset Prices in the Transmission Mechanism: A Comparison Between the Euro Area and the US. *ECB Working Paper* 816.

- KAUFMANN, S., and M. T. VALDERRAMA** (2008) Bank Lending in Germany and the UK: Are There Differences between a Bank-Based and a Market-Based Country? *International Journal of Finance and Economics* 13: 266–279.
- KONEČNÝ, T., and O. BABECKÁ-KUCHARČUKOVÁ** (2013) Evaluating Feedback Links Between the Financial and Real Sectors in a Small Open Economy: The Case of the Czech Republic *ČNB Working Paper*, forthcoming.
- KOOP, G., M. PESARAN, and S. POTTER** (1996) Impulse Response Analysis in Nonlinear Multivariate Models, *Journal of Econometrics*, 74:119-148.
- MAČKOWIAK, B.** (2006) How Much of the Macroeconomic Variation in Eastern Europe is Attributable to External Shocks? *Comparative Economic Studies* 48/3: 523-544.
- MEEKS, R.** (2012) Do Credit Market Shocks Drive Output Fluctuations? Evidence from Corporate Spreads and Defaults. *Journal of Economic Dynamics and Control* 36:568–584.
- MEH, C., and K. MORAN** (2010) The Role of Bank Capital in the Propagation of Shocks. *Journal of Economic Dynamics and Control* 34:555–576.
- MILCHEVA, S.** (2013) A Bank Lending Channel or a Credit Supply Shock? *Journal of Macroeconomics*, accessed April 20, <http://dx.doi.org/10.1016/j.jmacro.2013.03.004>.
- PESARAN, M. H., T. SCHUERMANN, B.-J. TREUTLER, and S. M. WEINER** (2006) Macroeconomic Dynamics and Credit Risk: A Global Perspective. *Journal of Money, Credit, and Banking* 38/5: 1211–1261.
- STRAHAN, P.** (2008) Liquidity Production in 21st Century Banking. *NBER Working Papers* 13798.
- VAN DEN HEUVEL, S. J.** (2002) Does Bank Capital Matter for Monetary Transmission? *Federal Reserve Bank of New York Economic Policy Review* 8/1: 259–265.
- VILAGI, B., and B. TAMÁSI** (2011) Macroprudential Shocks in an SVAR Framework in Hungary. Work in progress.
- WAGNER, W.** (2010) Diversification at Financial Institutions and Systemic Crises. *Journal of Financial Intermediation* 19: 373-386.
- ZHA, T.** (1999) Block Recursion and Structural Vector Autoregressions. *Journal of Econometrics* 90:291-316.

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Appendix

The likelihood function for the threshold BVAR follows Kadiyala and Karlsson (1997):

$$\begin{aligned}
 L(\Pi_1, \Pi_2, \Sigma_1, \Sigma_2, r, d | Y) &\propto |\Sigma_1|^{-\frac{n_1}{2}} |\Sigma_2|^{-\frac{n_2}{2}} \exp\left\{-\frac{1}{2} \text{tr}\left[\sum_{i=1}^2 (Y_i - X_i \Pi_i) \Sigma_i^{-1} (Y_i - X_i \Pi_i)'\right]\right\} = \\
 &= |\Sigma_1|^{-\frac{n_1}{2}} |\Sigma_2|^{-\frac{n_2}{2}} \\
 &\exp\left\{-\frac{1}{2} \sum_{i=1}^2 (\pi_i - \pi_i^{OLS})' (\Sigma_i^{-1} \otimes X_i' X_i) (\pi_i - \pi_i^{OLS}) - \frac{1}{2} \text{tr}\left[\sum_{i=1}^2 \Sigma_i^{-1} (Y_i - X_i \Pi_i^{OLS}) (Y_i - X_i \Pi_i^{OLS})'\right]\right\} \\
 &= N(\pi_i | \pi_i^{OLS}, \Sigma_i \otimes (X_i' X_i)^{-1}) \times iW(\Sigma_i | (Y_i - X_i \Pi_i^{OLS}) (Y_i - X_i \Pi_i^{OLS})', n_i - 1 + pk - 1),
 \end{aligned}$$

where $n_1 = \sum_{t=1}^{T-k} I_{\{Y_t \geq r\}}$ and $n_2 = T - k - n_1$ are parameters dependent on the threshold value r .

For the estimation of the autoregressive coefficients and the residual variance-covariance matrix I employ the Gibbs sampler:

1) AR coefficients:

$$\pi_i | \Sigma_i, r, d, Y \approx N\left(\pi_i^{post}, \left((V_i^{prior})^{-1} + \Sigma_i^{-1} \otimes X_i' X_i\right)^{-1}\right),$$

$$\text{where } \pi_i^{post} = \left(\left(V_i^{prior}\right)^{-1} + \Sigma_i^{-1} \otimes X_i' X_i\right)^{-1} \left(\left(V_i^{prior}\right)^{-1} \pi_i^{prior} + \left(\Sigma_i^{-1} \otimes X_i' X_i\right) \pi_i^{OLS}\right)^{-1}$$

2) Residual variance matrix

$$\Sigma_i^{-1} | \pi_i, Y, r, d \approx W\left(\left[\left(Y_i - X_i \Pi_i^{OLS}\right)' (Y_i - X_i \Pi_i^{OLS}) + (\Pi_i - \Pi_i^{OLS})' X_i' X_i (\Pi_i - \Pi_i^{OLS})\right]^{-1}, n_i\right)$$

3) Threshold value

For the estimation of the conditional posterior probability of the threshold r I employ the Metropolis-Hastings algorithm following Chen and Lee (1995):

4) Delay parameter

The conditional posterior follows a multinomial distribution with probability.

$$p(d | \Pi_1, \Pi_2, \Sigma_1, \Sigma_2, r, d, Y) = \frac{L(\Pi_1, \Pi_2, \Sigma_1, \Sigma_2, r, d | Y)}{\sum_{d=1}^{d_0} L(\Pi_1, \Pi_2, \Sigma_1, \Sigma_2, r, d | Y)}.$$

Tables and Figures:

Table 1: Threshold estimates and test for nonlinearity

Model	Estimated r	Hansen (1996)'s chi-square p-value
Credit	1.879	0.008
NPLs	1.803	0.013

Figure 1: Impulse response functions from real sector variables to credit.

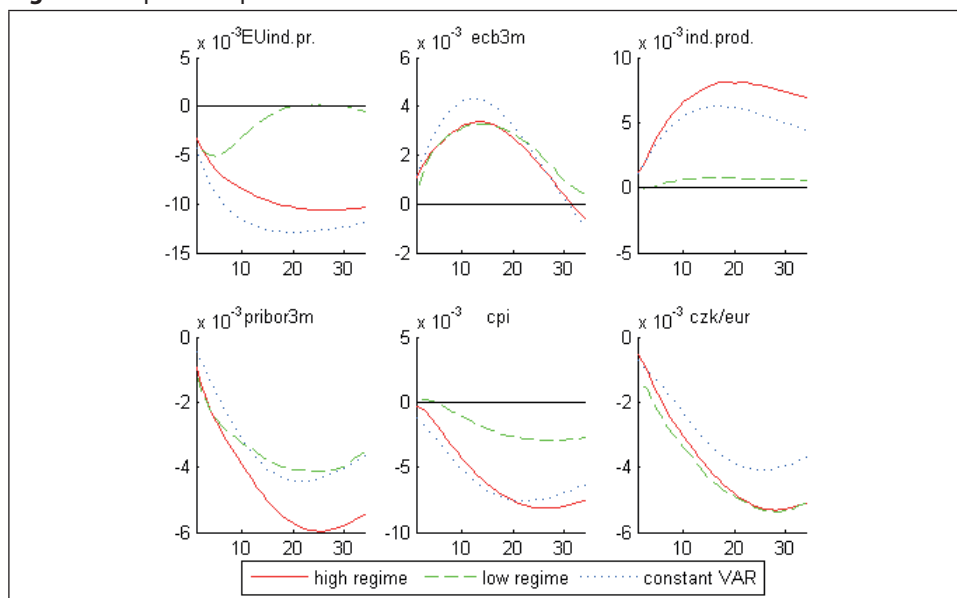


Figure 2: Impulse response functions from real sector variables to non-performing loans.

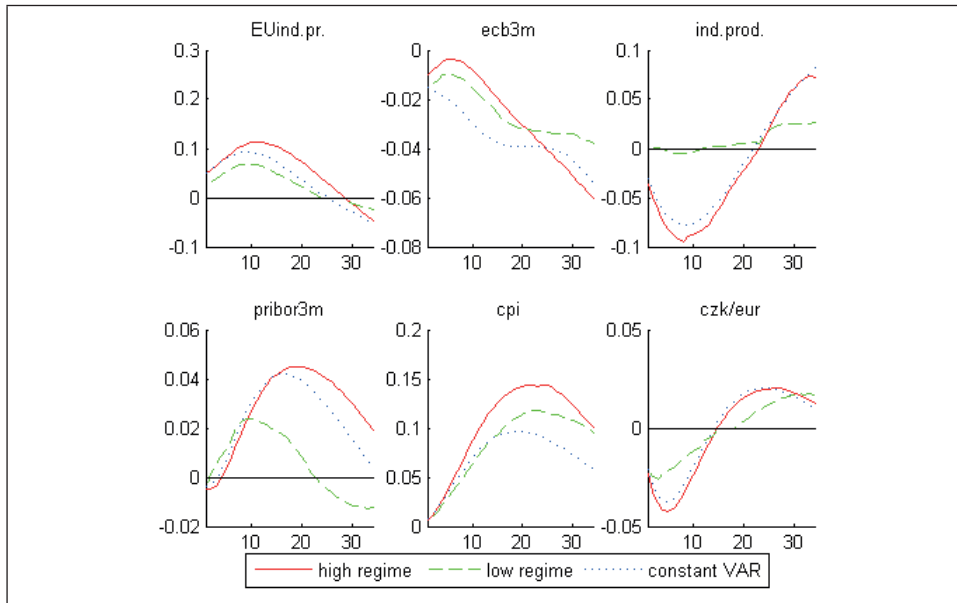


Figure 3: Impulse response functions from credit to real sector variables.

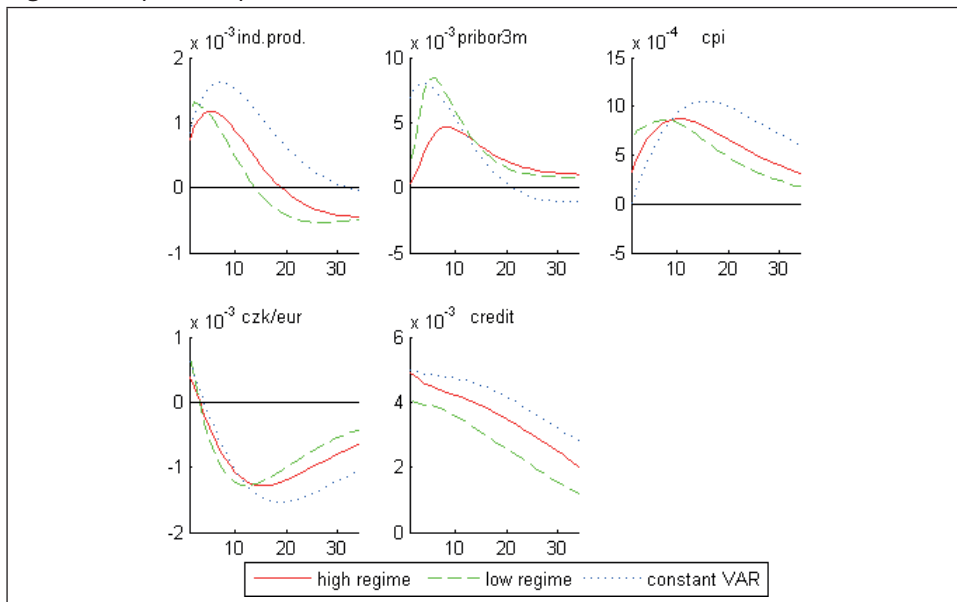
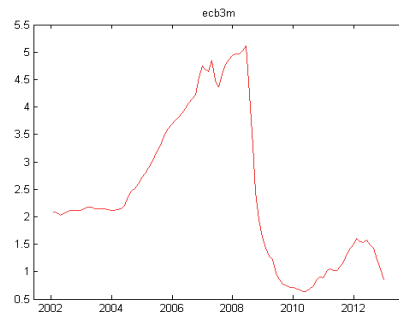
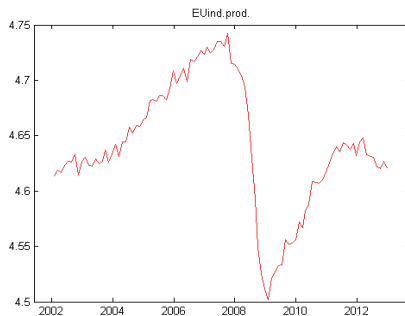
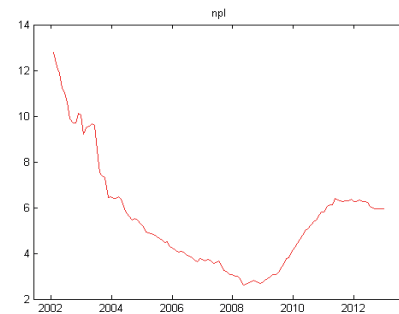
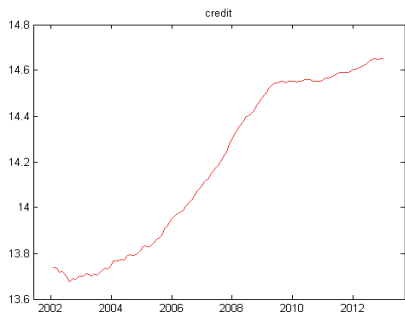
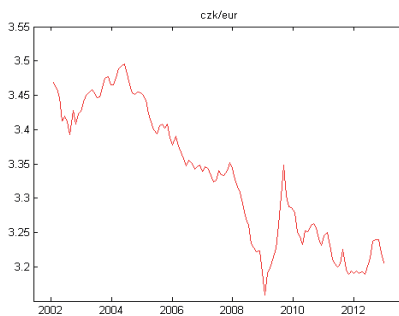
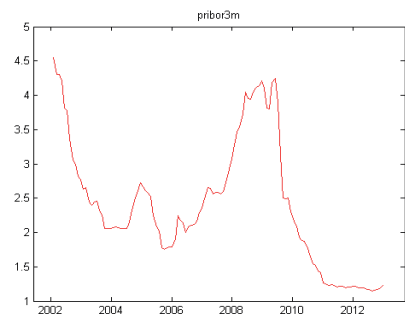
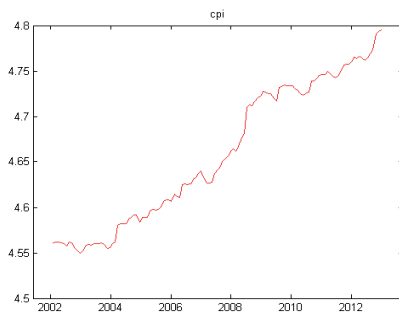
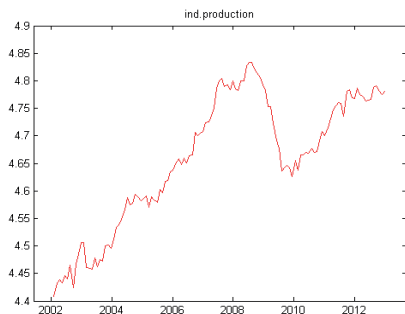


Figure 1A: Plots of model variables.



Job Market Polarization and Employment Protection in Europe

Polarizace trhu práce a ochrana zaměstnanosti v Evropě

BARBARA PERTOLD-GEBICKA

Abstract

There is increasing evidence about polarization of national labor markets with employment and wage growth occurring in low- and high-skill occupations, but not in middle-skill occupations. As polarization has been documented mainly for Anglo-Saxon countries, there is little evidence and discussion on cross-country differences in this process. I fill this gap by analyzing job polarization in 12 European countries using an occupational skill-intensity measure. Findings suggest large cross-country differences in the extent of polarization, which correspond to variation in educational attainment growth, industrial structure, and dissimilarities in employment protection legislation. The latter is particular important, as employment protection limits the possibility to adjust workforce in response to technological change and thus dampens the polarization effect. This finding indirectly confirms existing theories explaining polarization: routinization and off-shoring. Finally, it provides prediction for policy makers about future development of social and labor market inequalities, if policies toward more flexible labor market regulation are implemented.

Keywords

polarization, employment protection, skill requirements, occupational structure

Abstrakt

Existující empirická evidence stále více poukazuje na polarizaci národních trhů práce, která se projevuje zvyšující se zaměstnaností a mzdami u neodborných a vysoce odborných zaměstnání, ale ne u středně odborných zaměstnání. Polarizace je zdokumentovaná v řadě anglosaských zemí, nicméně srovnání trendů mezi zeměmi není zatím analyzováno. V tomto výzkumu zaplňuji tuto mezeru a analyzuji polarizaci v 12 zemích EU pomocí míry náročnosti zaměstnání na dovednosti. Moje zjištění ukazují velké rozdíly mezi zeměmi v rozsahu polarizace, což koresponduje s rozdíly v míře vzdělanosti, v průmyslové struktuře a s mírou ochrany zaměstnanosti. Poslední faktor je zejména důležitý, protože míra ochrany zaměstnanosti limituje možnosti přizpůsobit pracovní sílu technologickým změnám a tím tlumí efekt polarizace. Tato zjištění nepřímou potvrzují existující teorie vysvětlující fenomén polarizace: rutinizace a tzv. off-shoring. Moje zjištění jsou také důležitá pro tvůrce hospodářské politiky, jelikož predikují budoucí vývoj nerovností na trhu práce, pokud se budou implementovat flexibilnější regulace trhu práce.

Klíčová slova

polarizace, ochrana zaměstnanosti, nároky na odbornosti, struktura zaměstnání

Introduction

Polarization of labor market, defined as employment and wages growth in low- and high-skill occupations at the cost of middle-skill occupations, was first documented by Goos and Manning(2007) in the UK.¹ Further analyses of the British and American labor markets confirm this trend and suggest some explanations of its causes. Autor et al. (2006) propose that the labor market polarization observed since the 1990's can be accounted for by the so called routinization, i.e., the substitution of routine job tasks by modern technologies.² Firpo et al. (2009) suggest that offshoring certain job tasks to low-wage countries can also be partially responsible for polarization in the US. Finally, Acemoglu and Autor (2010) note that the allocation of workers to occupational tasks might be influenced by labor market imperfections and institutions, thus challenging the polarization pattern in some countries.

This has raised the question of whether labor market polarization is unique within the Anglo-Saxon countries, among which the US is known as the pioneer in technological progress and the largest outsourcer of manufacturing and remote consumer service jobs. In answer to this question, recent research suggests that polarization can be observed across the majority of developed economies. For example, studies by Spitz-Oener (2006) and Dustmann, Ludsteck and Schonberg (2009) show that polarization is present in another leading economy, Germany. Most importantly, Goos, Manning and Salomons (2009) provide evidence of this phenomenon across 16 European countries.³

Nevertheless, the international analysis of labor market polarization is not complete. First, the European evidence is based on a rough measure of the skill requirements of occupations -- the average wage. As argued in Pertold-Gebicka (2010), this approach implicitly assumes that within occupations differently skilled workers are perfect substitutes, which is likely not to be the case. Second, cross-country differences in the shape of employment change distribution (which is used to picture polarization), while documented, have not been given much attention. These differences might be driven by cross-country heterogeneity in the supply of skills, variation in economic cycles, different industrial structure, or distinct labor market legislations. As Acemoglu and Autor (2010) point out, labor market institutions have strong potential to influence employment adjustments and thus they should not be ignored in the polarization literature. Finally, while in the US polarization has been measured in employment changes as well as in earnings changes, the existing international analysis is focusing only on employment changes, i.e., it documents the

1 *Goos and Manning first used the term polarization to describe employment growth in low- and high-skill occupations at the cost of middle-skill occupations in the 2003 Working Paper version of this publication.*

2 *The term routinization was introduced by Autor et al. (2003).*

3 *These countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden and the UK.*

so-called job polarization as opposed to wage polarization.⁴ Studying wage polarization would give additional insight into the structure of the European labor market.

This paper addresses the first two issues. I use the European Union Labor Force Survey (EULFS) to report differences in the extent of job polarization across European countries, adopting the measure of skill requirements of occupations inspired by Pertold-Gebicka (2010). This measure is more flexible than the average wage, as it puts less strict assumptions on occupation-specific production functions. Additionally, occupational skill requirements are derived with the use of U.S. data, so this measure is independent of labor market conditions in European countries. This assures cross-country comparability. With the use of the skill requirements measure, I provide extensive evidence on cross-country differences in the extent of polarization. Specifically, one can observe that polarization is the strongest in Denmark, Finland, and Ireland, while it is the weakest in the Netherlands, Norway and Sweden. As a potential explanation of this observation, I suggest differences in countries' industrial structure, economic growth, and educational attainment of their populations. The remaining cross-country variation in the extent of polarization is shown to be partially driven by dissimilarities in labor market institutions.

The major contribution of this study is to pin down the relationship between labor market institutions and employment adjustments to the prevailing economic conditions. The results presented in this paper suggest that strong employment protection might impede or slow down the market mechanisms observed in non-regulated countries, such as substitution of certain job tasks by computers Acemoglu and Autor (2010), which flatters the polarization patterns.

The rest of the paper is organized as follows: Section 2 describes the skill-intensity measure used to order occupations according to their skill requirements and analyze polarization patterns. Section 3 pictures the incidence of labor market polarization in Europe using the skill-intensity measure and compares it to the results obtained using alternative measures of occupational skill requirements. The next section documents cross-country differences in the extent of polarization and discusses the role of country-specific economic conditions, with special attention given to employment protection legislation, in explaining these differences. Finally, conclusions are presented in Section 6.

1 The Measure of Skill Requirements of Occupations

The term job polarization is used in the literature to indicate growth of employment in high- and low-skilled occupations with a simultaneous decrease (or stagnation) of employment in middle-skilled occupations (Goos and Manning, 2007). Thus, the key ingredient of any analysis of labor market polarization is a measure of the skill requirements of occupations.

⁴ *Wage polarization is known as the pattern of earnings growth in the bottom and top percentiles of earnings distribution with a simultaneous decrease of earnings in the middle of the earnings distribution. Job polarization is known as growth of employment in high- and low-skilled occupations with simultaneous decrease (or stagnation) of employment in middle-skilled occupations. See Acemoglu et al. (2010) for a summary of the terminology used in the polarization literature.*

Recent literature uses several alternative measures of the skill requirements of occupations. The most often encountered are the average educational achievement of workers employed within an occupation (Autor et al., 2006, for the US; Goos and Manning, 2007, for the UK) and the average occupational wage (Firpo, Fortin and Lemieux, 2009; Goos et al., 2009), although both approaches are based on implicit assumptions that are likely to be violated. For the educational structure of occupations to correctly reflect their skill requirements, we need to face zero within-occupation substitutability between workers of different skills (as proxied by education levels). On the other hand, wages are good predictors of occupational skill requirements when differently skilled workers are perfect substitutes. With imperfect substitutability between skill types, occupation-specific educational structures are driven not only by skill requirements (i.e. the demand for skills) but also by the supply of differently skilled workers. In this case wages are the equilibrium outcome of the interaction between these two forces. Thus, neither wages nor education structure alone can be used to identify occupational skill requirements.

To deal with this lack of identification, I use the measure of skill requirements of occupations (called the skill-intensity of occupations) inspired by Pertold-Gebicka (2010). This alternative measure corresponds to the relative productivity of more and less skilled workers employed within each occupation. Thus, it measures how crucial workers' skills are for the tasks performed within a specific occupation. I propose that each occupation uses a relatively general labor aggregating technology of the constant elasticity of substitution (CES):

$$Y_j = \left(\alpha_{Hj} L_{Hj}^{\gamma_j} + \alpha_{Lj} L_{Lj}^{\gamma_j} \right)^{1/\gamma_j},$$

where Y_j is the output of occupation j , L_{Hj} is the amount of high-skilled labor and L_{Lj} is the amount of low-skilled labor employed in occupation j , α_{Hj} and α_{Lj} are productivities of these two labor types, and γ_j is a parameter describing substitutability between these two labor types (the elasticity of substitution is $\sigma_j = \frac{1}{1-\gamma_j}$). In this context, $\frac{\alpha_{Hj}}{\alpha_{Lj}}$ describes the occupation-specific relative productivity of differently skilled workers.

Under perfect competition, occupation-specific employment (L_{Hj} and L_{Lj}) and equilibrium wages (w_{Hj} and w_{Lj}) have to satisfy

$$\frac{\alpha_{Hj}}{\alpha_{Lj}} = \frac{w_{Hj}}{w_{Lj}} \left(\frac{L_{Hj}}{L_{Lj}} \right)^{1-\gamma_j} = \frac{w_{Hj}}{w_{Lj}} \left(\frac{L_{Hj}}{L_{Lj}} \right)^{-1/\sigma_j}.$$

Thus, in the setup where more and less skilled workers are imperfect substitutes (i.e. where $0 < \sigma_j < \infty$), it is necessary to combine the relative employment of differently skilled workers (the educational structure), relative wages, and the elasticity of substitution between more and less skilled workers to determine occupation-specific relative productivity. The skill requirements measure based on the relative productivity defined above is independent of the supply of skills (i.e. the supply of differently skilled workers) and purely reflects technologies employed by individual occupations. This property is not shared by the average wage measure. Average wage is high in occupations adopting modern technologies that increase workers' productivity. It is also high in occupations where the supply of workers is low, even if they are not technologically advanced. Independence of the skill

requirements measure of the supply of skills is crucial for documenting job polarization. To correctly measure polarization, one needs to distinguish between occupational skill requirements, which are used to identify low-, middle-, and high-skilled occupations, and the supply of workers, which influences changes in employment levels.

In order to calculate occupation-specific skill requirements, one needs to measure relative employment of differently skilled workers, relative wages, and the elasticity of substitution between more and less skilled workers for each analyzed occupation. While relative wages and employment can be easily retrieved from worker-level data, estimating occupation-specific substitution elasticities requires additional identifying assumptions (Pertold-Gebicka, 2010). This can be avoided when applying a uniform elasticity of substitution for all occupations. Its value can be inferred from numerous studies estimating the economy-wide substitutability between more and less skilled workers (Katz and Murphy, 1992; Krusell et al., 2000; Ciccone and Peri, 2005). As Ciccone and Peri (2005) summarize, the estimates for the U.S. vary from 1.34 to 1.66, which is a relatively small interval. I choose to apply the middle value, i.e., I assume that $\sigma_j = 1.5$ for all occupations.

It remains to be determined which labor market(s) should be used to measure occupational skill requirements. One could measure them in each European country separately. This might result in different categorization of occupations into low-, middle-, and high-skilled across countries. An occupation j might be classified as a middle-skilled occupation in Country A and as a high-skilled occupation in Country B because of different technologies used in these two economies. While Country A still uses old, labor-intensive technology relying on middle-skilled workers, Country B has adopted modern automated technology requiring highly-skilled workers to operate the machines. In this case differences in occupational skill requirements also capture differences in polarization patterns: in Country B middle-skilled workers have been substituted by machines and high-skilled workers.

To disentangle these two stories one needs to apply a uniform definition of occupational skill-requirements for all countries. This could be the average European skill requirements or skill requirements measured in another economy. In this paper I chose to measure skill requirements for the U.S. labor market. This approach guarantees that the classification of occupations is uniform across all analyzed countries and is not asymmetrically influenced by any of their economies (i.e., it assures exogeneity of the skill requirements measure). The choice of the U.S. is driven by two arguments. First, this country is believed to be a leader in technological development, what assures that the estimated skill requirements capture recent technologies. With today's extent of globalization and spillover of technologies one can assume that these technologies are (with possible delays) also adopted in Europe. Second, the the elasticity of substitution between more and less skilled workers, used to retrieve the skill-intensity measure, is based on U.S. estimates.

The data used to measure skill requirements of occupations come from the March Supplement to the Current Population Survey (March CPS). A detailed description of these data and procedures used to estimate skill requirements are outlined in the appendix.

2 Data and Measurement Issues

Throughout this paper I use the 1993-2001 waves of the EU LFS microdata for scientific purposes. This is a collection of harmonized labor force surveys conducted at national levels in all EU member states and the associated countries. The availability of this dataset for all European economies, its comparability across countries and over time, and its representativeness on 2-digit occupation level makes it the best applicable for this study.

The chosen time span corresponds to the time period when polarization has been documented (Goos and Manning, 2007) and to the availability of the skill-intensity measure. Due to the limited time consistency of the occupational coding in the US CPS data, I could only estimate occupation-specific elasticities of substitution between more and less educated labor for the 1983-2001 period.

Given limitations in data availability for some countries, this study investigates 12 Western European economies: Denmark, Finland, Greece, Ireland, Iceland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom. The Central and Eastern European countries are not analyzed, because the assumption about the similarity of occupations' characteristics between these countries and the US is likely to fail. This study covers the whole working population of the above-mentioned 12 countries.

In the anonymized version of the EULFS occupations are coded using 2-digit ISCO codes, while the estimates of the substitution elasticities and thus the estimates of occupation-specific skill-intensities) are available at the 3-digit level of the US Census occupational classification. To merge the EULFS data with the US occupational characteristics, 3-digit occupations from both datasets are matched according to an algorithm based on Elliott and Gerova (2005)⁵ and skill intensities are averaged at the 2-digit level. This procedure leaves me with 20 occupations listed in Table 1. Throughout the paper occupation-specific employment is measured as the usual weekly man-hours worked. For countries with shorter time spans,⁶ man-hours worked in each of the 20 2-digit occupations were extrapolated on the basis of average annual growth rates in occupation-specific employment.

3 Job Polarization in Europe

Documenting job polarization consists of two steps. First, one needs to classify occupations into different levels of skill requirements (usually low-, middle-, and high-skilled occupations); second, for each group of occupations measure employment changes. In this study occupational skill requirements are measured as the relative productivity of more and less skilled workers in a setup with imperfect substitutability of skills, which is a novel approach. Employment changes are measured in relative terms as changes in the share of employed working in a given occupation, which is in line with Goos et al. (2009).

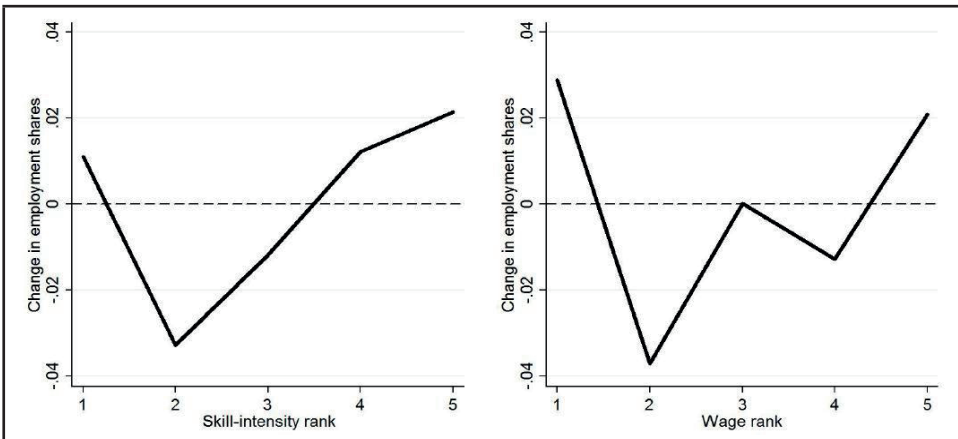
5 Elliott and Gerova (2005) propose a crosswalk between the 2000 Census occupational classification and 88-ISCO, while the skill-intensity measure is available for the 1990 Census occupational classification.

6 Finland has data available from 1997, Iceland from 1995, Norway from 1996, Sweden from 1997, and Spain till 2000.

Following Goos et al. (2009), I use the European Union Labour Force Survey⁷ (EU LFS) to picture job polarization in Europe. This is the largest available dataset offering a reasonable coverage of the last decade of 20th century⁸ and assuring cross-country consistency in terms of variable definitions. In the anonymized version of the EU LFS occupations are aggregated at 2-digit level of ISCO-88 classification, which after the elimination of public and agricultural sectors⁹ leaves me with 21 distinct occupations.

Each of the 21 occupations is matched with the respective estimate of occupational skill requirement and then classified into one out of five skill groups: low, middle-low, middle, middle-high, and high. Classification into skill groups is done on the basis of 1993 skill requirements and employment shares. Occupations with the lowest skill requirements employing 20% of the European workforce are classified into the low skill group, occupations further on the skill requirements scale employing the next 20% of European workforce are classified into the middle-low skill group, and so on. The reason for analyzing five instead of three skill groups stems from the goal of this paper to capture detailed cross-country differences in the shape of job polarization. In this context I introduce the notion of the extent of polarization understood as the difference between employment change in middle-skilled occupations and low- or high-skilled occupations.

Figure 1: Changes in employment share in Europe between 1993-2001 by occupational skill-intensity and wage rank



Note: Both graphs were obtained using the European Union Labour Force Survey. For countries with shorter time spans (Finland, Iceland, Norway, Spain and Sweden), man-hours worked were imputed on the basis of average annual growth rates. Skill-intensity rank corresponds to the position of each occupation in the skill-intensity distribution (5 = the most skilled); the wage rank corresponds to the position of each occupation in the US wage distribution (5 = the highest wage).

7 The EU LFS data used in this research project have been provided by Eurostat. A detailed description of this dataset is provided in the appendix.

8 The last decade of the 20th century is when polarization was first observed and documented.

9 Public and agricultural sectors are removed from the analysis because these are strongly protected and highly regulated in Europe.

Using the above-described approach and pooling all countries together, Figure 1 depicts job polarization in Europe with high- and low-skilled occupations experiencing employment expansion and middle-skilled occupations experiencing a decrease or stagnation of employment between 1993 and 2001. For comparison, the two panels of this figure use different measures of skill requirements of occupation: the left panel employs the skill-intensity measure described in Section 2 and the right panel employs average wage.¹⁰

Polarization is present in each graph, although there are significant differences between them. While in both graphs we observe the minimum change in employment shares for the group of middle-low-skilled occupations, the behavior of other middling occupations depends on the measure used to capture skill requirements of occupations. Starting at middle-low-skilled occupations, the change in employment shares grows monotonically with increasing skill requirements when the skill-intensity measure is used, but varies irregularly under the average wage measure. These differences are driven by the characteristics of the two measures used to capture skill requirements of occupations. The average wage measure captures not only the technologies used by different occupations but also depends on the supply of workers. Specifically, high (low) supply of workers to certain occupations results in relatively low (high) wages and these occupations being classified as less (more) dependent on skills than they actually are. This causes shifts in the classification of occupations according to their skill requirements. Note that the use of CES occupation-specific production function to derive occupation-specific relative productivity makes the skill-intensity measure independent of supply factors and thus disentangles the labor supply effects from demand-driven job polarization.

To better understand the differences between the two measures of skill requirements of occupations, Table 1 documents the ranking of 2-digit ISCO occupations obtained using the skill-intensity and the average wage measures. Note that, while the rankings of occupations prepared according to the two alternative skill requirement measures are highly correlated,¹¹ there are well visible differences between them. These concern occupations such as managers of small enterprises, which in 1993 paid higher wages than many professional occupations because of the short supply of workers educated in management; or sales and service occupations, which paid relatively low wages due to the high supply of potential workers.

In the rest of this paper I use the skill-intensity measure to rank occupations according to their skill requirements. All figures and tables obtained using the wage measure can be obtained from the author on request.

¹⁰ Occupations are ordered according to the 1993 average US wage to ensure consistency with ordering according to the skill-intensity. Nevertheless, there are only minor differences between ordering of occupations according to the US and European average wage.

¹¹ The coefficient of correlation between the skill-intensity measure and the average wage measure is 0.657 and is statistically significant at 1% level.

Table 1: Comparison of occupational ranking using the 1993 skill-intensity and 1993 average wage measures

Skill-intensity rank	Wage rank	Occupation
5	5	Physical, mathematical and engineering science professionals
5	4	Other professionals
5	5	Life science and health professionals
5	5	Corporate managers
4	4	Other associate professionals
4	4	Models, salespersons and demonstrators
4	5	Managers of small enterprises
4	3	Life science and health associate professionals
3	4	Physical and engineering science associate professionals
3	1	Sales and services elementary occupations
3	1	Personal and protective services workers
2	2	Office clerks
2	1	Customer service clerks
2	2	Precision, handcraft, craft printing and related trades workers
2	3	Stationary plant and related operators
2	3	Metal, machinery and related workers
2	1	Other craft and related trades workers
1	2	Machine operators and assemblers
1	3	Extraction, shot rers, stone cutters and carvers
1	1	Laborers in mining, construction, manufacturing and transport
1	3	Drivers and mobile plant operators

Note: The skill-intensity rank is obtained using the occupation-specific skill-intensity measure derived from the U.S. March CPS data; the wage rank is obtained using the occupation-specific average wage as observed in the U.S. March CPS.

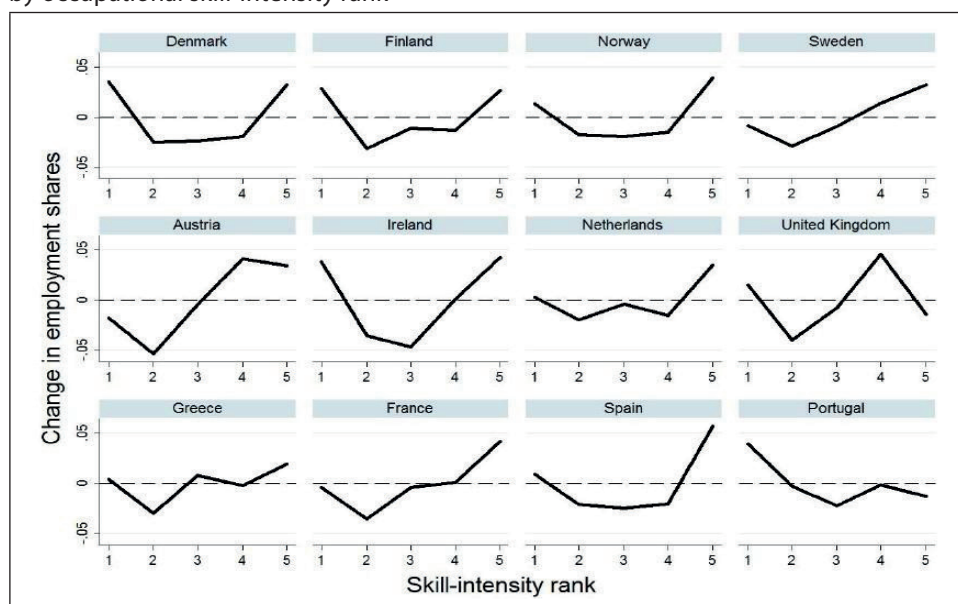
4 Explaining Cross-country Differences in the Extent of Polarization

The aggregate picture of job polarization presented in Figure 1 hides significant cross-country differences in polarization patterns. As Goos et al. (2009) show, job polarization was stronger in some countries than other. To illustrate these differences, Figure 2 plots changes in employment shares against the skill-intensity rank for 12 European economies over the 1993-2001 period.

Although all the presented countries experienced job polarization over the analyzed time interval, the differences across them are striking. In the majority of Nordic countries (Sweden is an exception here) all three middling occupation groups experience signifi-

cant drop in employment share at the benefit of the low- and high-skilled occupations between 1993 and 2001. On the other hand, in the majority of southern countries (Spain being an exception) only one group of middling occupations shrunk, while the other two did not experience any significant employment changes. One can also observe variation in the extent of polarization measured as the difference between the lowest change in employment share for middle-skilled occupations (skill intensity rank 2 to 4) and the highest change in employment share for low-skilled occupations (skill intensity rank 1). According to this measure, polarization was the strongest in Denmark, Finland, and Ireland and the weakest in the Netherlands and Sweden. Linking these cross-country differences in polarization patterns with country economic and social characteristics can shed some light on factors influencing employment adjustments at national levels.

Figure 2: Changes in employment share across European countries between 1993-2001 by occupational skill-intensity rank



Note: Source: European Union Labour Force Survey. For countries with shorter time spans (Finland, Iceland, Norway, Spain and Sweden), man-hours worked were imputed on the basis of average annual growth rates. Skill-intensity rank corresponds to the position of each occupation in the skill-intensity distribution.

The polarization literature discusses two main sources of polarization. First, the decrease of employment in middle-skilled occupations is attributed to routinization (Autor et al., 2006), i.e., substitution of routine job tasks by modern technologies. Since machines carry out routine, precision tasks previously performed by administrative clerks or production workers, the demand for workers in occupations involving these tasks drops. The second hypothesized reason for the contraction of employment in middle-skilled occupations lies in offshoring (Acemoglu and Autor, 2010). The development of communication and transport technologies makes it cheaper to outsource certain job tasks to low-wage countries, which decreases the demand for occupations involving these tasks in the developed

economies. Additionally, Goos et al. (2009) show that routine tasks content¹² has a negative influence on occupation-specific employment changes, while abstract tasks content has a positive influence on occupation-specific employment changes. Although Goos et al. (2009) do not find any effects of offshorability¹³ on employment changes in the UK, Firpo et al. (2009) show that offshorability¹⁴ is a strong determinant of the development of occupational wages in the US.

The channels through which routinization and offshorability affect allocation of labor across occupations might be strongly influenced by the economic and social situation of a country. For example, in low wage countries firms have less incentives to offshore or to substitute workers with sophisticated machines, hence we expect polarization to be less visible in these countries. Also changes in the average educational attainment of a country's workforce might affect polarization. If more people obtain college education on cost of high school education, strong polarization effects are expected due to drop in the labor force in low to middle-skilled occupations. On the other hand, if more people obtain high school education on cost of primary education, the opposite effect might be observed because of short supply of workers to low-skilled occupations. But most of all, the extent to which polarization is observed depends on the industrial structure of an economy. As production firms are the ones which can potentially benefit the most from introduction of labor-saving technologies, countries with strong manufacturing industry are more prone to be affected by routinization and offshoring than countries relying on service industry.

In addition to the above-discussed forces, the extent to which routinization and offshoring are expected to affect the shape of job polarization might be influenced by labor market institutions. In countries with high employment protection, it is more difficult to adjust employment to the prevailing technological conditions (Samaniego, 2006; Kugler and Pica, 2008) and thus the possibility of substituting workers with machines might be limited there. On the other hand, in countries with flexible labor markets employment adjusts to the changing structure of occupational skill-requirements. Additionally, as employment protection has affected the process of adjusting the labor market to economic and technological conditions also before the analyzed period, we might observe different initial shares of occupation-specific employment across countries with different employment protection policies. As the initial conditions also determine the extent of polarization, the total effect of employment protection policies on polarization is not clear.

Exploring the cross-country differences in polarization patterns presented in Figure 2, one can identify country-level factors affecting the strength of employment adjustments. To do so, first, I quantify the extent of polarization as the difference between the lowest change in employment share for middle-skilled occupations (skill intensity rank 2 to 4) and the highest change in employment share for low-skilled occupations (skill intensity rank 1). At this stage it is crucial that occupations are classified into the respective skill

¹² The routine tasks index is reported in the Occupational Information network dataset (ONET).

¹³ Goos et al. (2009) measure offshorability as the number of occurrences in the European Restructuring Monitor.

¹⁴ Firpo et al. measure offshorability as an index based on ONET information about the necessity of face-to-face contact on site work, and decision-making for each occupation.

requirement ranks using a measure of occupational skill-intensities which is exogenous to the European labor market and uniform for all the analyzed countries. This assures that the classification is not driven by any of the observed or unobserved country-specific variables affecting the extent of polarization. Second, I regress the extent of polarization on country characteristics such as the growth in educational attainment, industrial structure and the extent of employment protection. Due to the limited number of observations, also the number of explanatory variables had to be reduced to a minimum. The chosen variables concisely describe the structure and organization of countries' labor markets, which is expected to have the strongest effect on polarization patterns.

Table 2: The relationship between the extent of job polarization (1993-2001) and country characteristics

	Extent of polarization
Growth in educational attainment	-2.128** (0.496)
Share of employment in manufacturing sector	0.080** (0.016)
Employment protection index	-0.027** (0.006)
Adjusted R-squared	0.75

Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

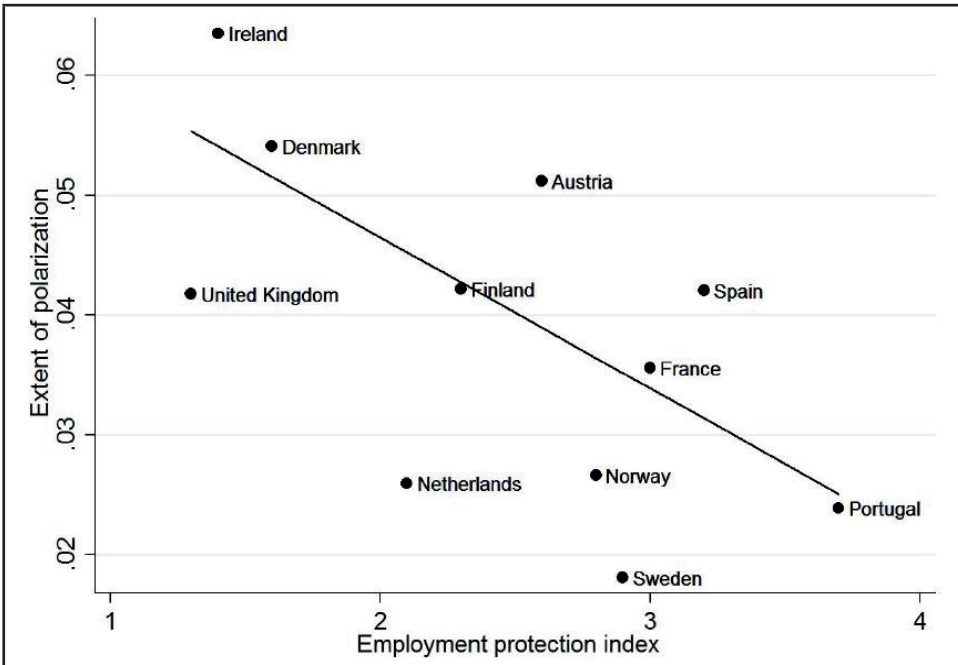
Note: The extent of polarization is measured as the difference between the lowest change in employment share (occurring at 2nd, 3rd, or 4th quintile of the occupational skill-intensity distribution) and the highest change in employment share (occurring 1st quintile of the occupational skill-intensity distribution). Industrial structure is measured as of 1993. The employment protection index is an index decreasing on the <0, 5> range developed by Allard (2005) on the basis of the OECD methodology and updated by the author.

The results of the simple regression analysis, aimed at revealing the correlation between the characteristics of countries' labor markets and the extent of polarization, are presented in Table 2. As expected, the initial share of employment in manufacturing sector has a positive effect on polarization. On the other hand, I find that growth in educational attainment has a negative effect on the extent of polarization. This suggests that the falling number of low-skilled workers acts against the trend of increasing employment at the low end of occupational-skill distribution. Finally, the extent of polarization appears to be negatively correlated with the strength of employment protection, which implies that restrictive employment protection legislation slows down the process of adjusting the labor market to current economic and technological conditions. Despite the limited number of observations, all estimates are statistically significant, which suggests that the estimated correlations are strong.

To visualize the relationship between employment protection and polarization, Figure 3 plots the correlation between the extent of polarization (after controlling for country-specific average educational achievement growth and industrial structure) and employment protection. It is evident in the figure that countries with strong employment protection (the Southern European and some Scandinavian countries) experience stronger

polarization than other countries. Specifically, the conditional correlation between the Allard's employment protection index and the extent of polarization is -0.58 .

Figure 3: The relationship between the extent of job polarization (1993-2001) and employment protection



Note: This graph is constructed controlling for country-specific average educational achievement and GDP growths as well as the share of employment in manufacturing sector as of 1993. The extent of polarization is measured as the difference between the lowest change in employment share (occurring either at 3rd or 4th fifth of the occupational skill-intensity distribution) and the highest change in employment share (occurring either at 2nd or 3rd fifth of the occupational skill-intensity distribution). The employment protection index is an index decreasing on the $<0, 5>$ range developed by Allard (2005) on the basis of the OECD methodology and updated by the author. This index is unavailable for Iceland and Luxembourg.

Conclusions

Polarization of the labor market is a new phenomenon and there is still a lot of research needed to better understand its causes and draw conclusions for the future development of the labor market, as Acemoglu and Autor (2010) sum up in their recent chapter of the Handbook of Labor Economy. This study applies a new measure of the skill requirements of occupations, which is independent of local labor market conditions, to analyze job polarization across Europe and reveals extensive cross-country differences in polarization patterns. Specifically, one can observe that polarization is the strongest in Denmark, Finland, and Ireland, while it is the weakest in the Netherlands, Norway and Sweden. Exploring these cross-country differences and taking advantage of the exogeneity of the skill requirements measure, I show that these differences in the extent of polarization are

not only correlated with country-specific educational attainment growth and industrial structure, but also with the strength of employment protection.

Documenting the negative relationship between the strength of employment protection and the extent of polarization is especially interesting, as it indirectly confirms the existing theories explaining polarization – the routinization and offshoring hypotheses. According to these theories, polarization is driven by workers employed in middle-skill occupations being substituted by modern technologies or by cheaper workforce in distant locations. Employment protection limits the possibility of adjusting firms' workforce in response to technological change and thus dampens the polarization effect. This finding suggests that employment structure of an economy is highly persistent under strong employment protection. If policymakers aim at reducing low-end inequality, they should consider relaxing some of the employment protection legislation and let the low-skill employment expand.

The analysis presented above is the first step towards documenting and understanding cross-country differences in polarization patterns. The natural next step in the development of the polarization literature in the context presented in this paper would be to explicitly model the interaction between labor market institutions and occupational allocation of workers (Goos et al., 2010).

Acknowledgment

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References

- ACEMOGLU, D., AUTOR, D.** (2010) Skills, tasks and technologies: implications for employment and earnings. In Ashenfelter, O., Card, D. (Eds.), *Handbook of labor economics*, vol. 4, Amsterdam: Elsevier.
- ALLARD, G.** (2005) *Measuring Job Security over Time: In Search of a Historical Indicator*. *Instituto de Empresa Working Paper WP-05*.
- AUTOR D., KATZ L., KEARNEY M.** (2006) The Polarization of the U.S. Labor Market, *American Economic Review*, 96(2): 189–194.
- AUTOR D., LEVY F., MURNANE R.** (2003) The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics*, 118(4): 1279–1334.
- BARRO, R., LEE, J-W.** (2010) *A New Data Set of Educational Attainment in the World, 1950–2010*. NBER Working Paper No. 15902.
- CARD D., LEMIEUX T.** (2001) Can falling supply explain the rising return to college for younger men? A cohort-based analysis, *The Quarterly Journal of Economics*, 116(2): 705–746.
- CICCONE, A., PERI, G.** (2005) Long-run substitutability between more and less educated workers: Evidence from U.S. states, 1950–1990. *The Review of Economics and Statistics* 87(4): 652–663.

- DUSTMANN, C., LUDSTECK, J., SCHONBERG U.** (2009) Revisiting the German Wage Structure, *The Quarterly Journal of Economics*, 142(2).
- ELLIOTT, J., GEROVA V.** (2005) *Translation from US OCC \-2000 to ISCO-88*, Center for Longitudinal Studies.
- FIRPO, S., FORTIN, N., LEMIEUX, T.** (2011) *Occupational Tasks and Changes in the Wage Structure*. IZA Discussion Paper No. 5542.
- GOOS M., MANNING A.** (2007) Lousy and Lovely Jobs: The Rising Polarization of Work in Britain, *The Review of Economics and Statistics*, 89(1): 118--133.
- GOOS, M., MANNING A., SALOMONS A.** (2009) Job Polarization in Europe, *American Economic Review Papers and Proceedings*, 99(2): 58--63.
- GOOS, M., MANNING A., SALOMONS A.** (2010) *Explaining Job Polarization in Europe: The Roles of Technology, Globalization and Institutions*, CEP Discussion Paper No. 1026.
- KATZ, L., MURPHY, K.** (1992) Changes in relative wages, 1963-1987: Supply and demand factors. *The Quarterly Journal of Economics* 107(1): 35--78.
- KRUSELL P., OHANIAN L., RIOS-RULL J-V., VIOLANTE G.** Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis, *Econometrica*, 68(5): 1029--1053.
- KUGLER A., PICA G.** (2008) Effects of Employment Protection on Worker and Job Flows: Evidence from the \-1990 Italian Reform, *Labour Economics*, 15(1): 78-95.
- LAMBERT P.** (2003) A crosswalk between US90 SOC and ISCO-88 category, retrieved on May 22, 2012 at <http://www.camsis.stir.ac.uk/occunits/us90toisco88v2.sps>
- LARRIMORE J., BURKHAUSER R., FENG S., ZAYATZ L.** (2008) Consistent cell means for topcoded incomes in the public use March CPS (1976-2007), *Journal of Economic and Social Measurement*, 33(2-3): 89-128.
- PERTOLD-GEBICKA B.** (2010) *Measuring Skill Intensity of Occupations with Imperfect Substitutability across Skill Types*, CERGE-EI Working Paper No. 421.
- SAMANIEGO R. M.** (2006) Employment protection and high-tech aversion, *Review of Economic Dynamics*, 9(2): 224--24.
- SPITZ-OENER A.** (2006) Technical Change, Job Tasks, and Rising Educational Demands: Looking Outside the Wage Structure, *Journal of Labor Economics*, 24(2): 235--270.

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Appendix

1 Estimation of Occupation-specific Skill-intensity

The data used to estimate 1993 skill-intensity measure come from the 1993-1995 March Supplement to the U.S. Current Population Survey (March CPS), which means that I observe earnings for the years 1992 through 1994. Due to the limited number of observations offered by each wave of March CPS, three consecutive years had to be merged to obtain sample size large enough to allow the data-hungry occupation-level analysis to be conducted. This means that data used to analyze year t are composed of $t - 1$, t and $t + 1$ March CPS samples.

Only male and female workers with at least a high school diploma and no more than a college degree are included in the sample. I do not construct college equivalents and high school equivalents, as many studies do. Instead, I focus on occupational allocation of college graduates with no higher degree as compared to high school graduates not having a college diploma. To avoid the issue of imperfect substitutability between experience groups, as discussed by Card and Lemieux (2001), I concentrate on recent school leavers defined as individuals with 10 or fewer years of potential labor market experience.¹⁵ Both full-time and part-time workers are included in the sample to ensure a sufficient number of observations. However, self-employed individuals are excluded from the sample as are those with reported working hours per week of zero or above 98. The earnings measure used in this analysis is the log of weekly earnings defined as yearly wage and salary income divided by weeks worked last year. Earnings are expressed in 2000 dollars. I deal with earnings censoring by assigning the cell-means of earnings to the top-coded individuals. The value of cell-means are taken from Larrimore et al. (2008). Occupations coded according to 1990 U.S. Census occupational classification are matched with ISCO-88 counterparts according to Lambert (2003) and aggregated at 2-digit level of the ISCO classification.

Regression-adjusted wages of individuals are used to calculate the relative wages of college and high school graduates. The controls included in the log-wage regressions, widely used to estimate returns to college, are experience, gender, race, education, full-time work status, and dummies for years $t - 1$ and $t + 1$.

Relative employment is calculated as the ratio of the numbers of college and high school graduates observed in a given occupation in a given year weighted by individual sample weights.

The skill-intensity measure is calculated by substituting occupation-specific relative wages and employment to equation (2) together with $\sigma_j = 1.5$.

¹⁵ The potential labor market experience is calculated as $\text{age} - \text{years of schooling} - 6$

2 European Union Labor Force Survey Data

To analyze job polarization in Europe, I use the 1993-2001 waves of the EULFS microdata for scientific purposes. This is a collection of harmonized labor force surveys conducted at national levels in all EU member states and associated countries. The availability of this dataset for all European economies, its comparability across countries and over time, and its representativeness on 2-digit occupation level makes it the best applicable for this study. The chosen time span corresponds to the time period when polarization has been documented (Goos and Manning, 2007).

Given limitations in data availability for some countries, this study investigates 12 Western European economies: Austria, Denmark, Finland, France, Greece, Ireland, Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom. Employment is measured as men-hours worked. For countries with shorter time spans, 17 man-hours worked in each of the 21 2-digit occupations were extrapolated on the basis of average annual growth rates in industry-occupation-specific employment using the procedure prepared by Goos et al. (2009). This study covers the whole working population of the above-mentioned 12 countries.

Consumption Tax Incidence: Evidence from Natural Experiment in the Czech Republic

Přenos spotřebních daní: Studie přirozeného experimentu v České republice

JAN ZÁPAL

Abstract

This paper estimates incidence of consumption taxation. We use data from natural experiment that took place in 2004 in the Czech Republic. Not only the value added tax (VAT) rates applicable to a range of goods and services changed but also the classification into the standard vs. reduced rate group has been modified. Most importantly, some goods and services experienced no change. This allows us to use difference-in-differences estimation to assess the extent to which taxes are shifted on consumers. Our estimates indicate that those goods and services that experienced decline of the VAT rate from 22% to 19% show no evidence of decrease in prices. We interpret this as evidence of producers and vendors taking the full advantage of the tax decline. On the other hand, goods and services belonging to the group that experienced VAT rate increase from 5% to 19% show lasting increase of prices by up to 6%. This indicates that the higher tax is at least partially shifted on consumers.

Keywords

tax incidence, value added tax, difference-in-differences estimation, natural experiment

Abstrakt

Cílem této studie je odhad dopadu spotřebních daní na základě dat z přirozeného experimentu, který proběhl v České republice v roce 2004. Tehdy došlo nejen ke změně sazeb DPH u celé řady služeb a zboží, ale také k úpravám klasifikace běžné a snížené sazby daně. Co je ale nejdůležitější, některé služby a zboží nepodléhaly žádným změnám. Díky tomu bylo možné použít metodu rozdílů v rozdílech a odhadnout tak, v jaké míře je zdanění přenášeno na spotřebitele. Naše odhady ukazují, že zboží a služby, u nichž došlo ke snížení sazby DPH z 22 % na 19 %, nevykazovaly žádné změny v koncových cenách. Tento fakt si vysvětlujeme tím, že výrobci a prodejci plně využili snížení sazby daně. Oproti tomu zboží a služby, u kterých došlo k navýšení sazby DPH z 5 % na 19 %, vykazují trvalé zvýšení cen až o 6 %. To naznačuje, že vyšší zdanění je alespoň částečně přeneseno na spotřebitele.

Klíčová slova

přenos zdanění, daň z přidané hodnoty, metoda rozdílů v rozdílech, přirozený experiment

JEL Codes

H22

Introduction

Tax incidence comprises one of the core topics in public economics. Distinction between those who merely collect the taxes and send the revenue to the government and those who's income changes as a result of a tax has fascinated generations of economists. Focusing only on indirect taxation, the question becomes of how imposition or change in the relevant tax affects the price of the commodity in question.

On the theoretical level the answer is far from clear. Existing models on the topic deal either with ad valorem taxation, where the amount of the tax is expressed as a percentage of producer's price, or with specific (excise) taxation, where the amount of the tax is expressed per unit of relevant commodity. In either case, some models predict over-shifting, i.e. price of the taxed commodity rises by more than the full amount of the tax, while some models predict under-shifting, i.e. price of the taxed commodity rises by less than the full amount of the tax (see Fullerton and Metcalf, 2002, for survey of the theory). Factors that influence these results usually include assumed market structure, degree of product differentiation or elasticity of the demand and supply.

At the same time empirical literature estimating the degree to which indirect taxes are shifted on consumers is rather scant. Several studies support the idea of over-shifting. Brownlee and Perry (1967) find evidence of full-shifting following 1965 excise tax reduction in the US. Using the same natural experiment, Woodward and Siegelman (1967) analyse changes in the prices of automotive replacement parts concluding with less than full-shifting. Barzel (1976) and Johnson (1978) find evidence of over-shifting using cigarette price data in the US (Sumner and Ward, 1981, refute their results). Poterba (1996) finds over-shifting of sales taxes (American version of ad valorem tax) using clothing prices followed over the 1925-39 and 1947-77 periods in the series of US cities. Estimates in Besley and Rosen (1998) support over-shifting of sales taxes for at least half out of the 12 commodities used in the study covering 155 US cities in 1980's.

On the other hand some empirical evidence supports under-shifting. Delipalla and O'Donnell (2001) analyse European cigarette industry and conclude that both ad valorem and specific taxes tend to be under-shifted. Carbonnier (2007) reaches similar conclusion using value added tax (European version of ad valorem tax) reforms in France focusing on housing repair services and new car market.

Given the importance of the question no more than a dozen studies is rather surprising. Further discounted by the indefiniteness of their results, economists have little to offer both to public and interested policy-makers. Yet, the extent to which consumption taxes are shifted on consumers via prices is of prime concern to both monetary and fiscal policy-makers. To what extent taxes change prices is of utmost importance to all inflation targeting central banks. For the fiscal policy, to what extent taxes are shifted on consumers is central to the distributive and revenue effect of any tax change.

We contribute to the topic by analysing Czech value added tax (VAT) reform of 2004. Not only the standard rate declined from 22% to 19% but also the composition of groups of commodities to which the standard and reduced rates apply has changed. Most impor-

tantly, certain commodities experienced no change at all and serve a purpose of control group against which we can measure the effect of the reform.

The paper proceeds as follows. Next part explains in detail the nature of the Czech VAT reform and describes the data we use. Part 3 describes the methodology used to estimate the extent of tax shifting that followed the reform. Here we also check whether the data are consistent with the assumptions we need in order to proceed with the estimation. Ensuing part 4 shows the main results of the paper while part 5 concludes. In the appendix, we further check robustness of the reported results.

1 Natural Experiment Design and Data

The natural experiment we exploit for the research purposes is the Czech VAT reform of 2004 with all measures coming to force on May 1st 2004. There were two main reasons for the VAT change. The first one was the requirement to align the Czech VAT legislation with the European sixth directive which prescribes rules for the VAT legislation in the EU member states. The second reason for the reform was an attempt to bring down increasing public budget deficit.

The reform had two main component. First, the existing standard rate of 22% was reduced to 19%. We call commodities that experienced this type of change 'treated 1' or $T1$ for short. Second, many commodities to which the reduced VAT rate of 5% applied previously were relocated to the category to which the new standard rate of 19% would apply. We use 'treated 2' or $T2$ for this group. Commodities that were previously in the reduced VAT rate group and were not relocated subsequently experienced no change at all. This is our 'control' group.

To give examples of the commodities in the different groups, the control group includes most of the food, medications, personal transportation, press and books and items previously exempt. $T2$ includes veterinary services, vitamins, contraception, sport and cultural activity entrance fees, food served in restaurants and certain services. Rest comprises the $T1$ group, which includes for example electronics, housewares, cosmetics, alcohol or tobacco.

The data we use are monthly price observations of commodities included in the consumption basket used for calculation of the consumption price index (CPI) by the Czech Statistical Office. The data span the entire 2004 year and include 790 different commodities.¹ Consumption basket is chosen to be representative of household consumption composition. This fact increases relevance of our results, which are already based on large number of diverse commodities.

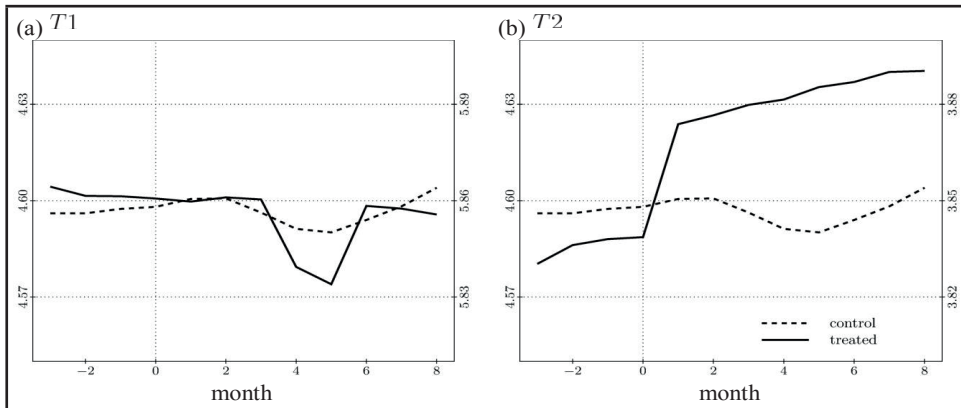
With respect to the VAT reform, we classified 322 commodities into the control group, 408 commodities into the $T1$ group and the remaining 60 into the $T2$ group. In what follows

1 See www.czso.cz for the data collection methodology. 790 is more than 730 actually used for CPI. The discrepancy comes from the fact that as some items are being introduced and some phased out the data include more items than is needed.

we use logarithms of the observed prices. This brings additional advantage in that our econometric estimates have simple interpretation, they represent percentage changes. Since April 2004 is the last month before the reform, we denote it as 'month 0' with the negative values denoting months before the reform decreasing to 'month -3', January 2004. 'Month 1' is the first month of the new tax regime, May 2004, and the positive values denote months after the reform going up to 'month 8', December 2004.

As the first look at the data, we calculated mean log-price for each month and each of the three groups. Figure 1 shows the results.

Figure 1: Mean log-price, control vs. treated



Note: Left axis control, right axis treated.

Close inspection of the left panel shows that, at least graphically, there is little evidence of tax shifting in the $T1$ group. Full-shifting would require sustained decrease of the solid curve by 0.03 since the prices are in logarithms. On the other hand, the right panel reveals increase of the mean log-price of $T2$ commodities by more than 0.03, i.e. more than 3% increase in prices on average. Although compelling, this is far from 14% increase required for full-shifting.

Figure 1 makes another important point. As will become clear shortly, validity of our estimates rests heavily on the assumption that the development in the control and treated group prior to the policy change is the same. In other words, for the estimates to be valid, we need to assume that the mean log-price in the control and treated group had the same trend prior to the reform. This allows us to conjecture that, absent the reform, the difference between the mean log-price in the control and treated group would remain the same into the future. Whereas it is impossible to test conjecture regarding the developments absent the reform, we can test hypothesis that difference in the mean log-price between the groups remained stable in the four months prior to the reform. Inspection of figure 1 then shows that the hypothesis is unlikely to be rejected.

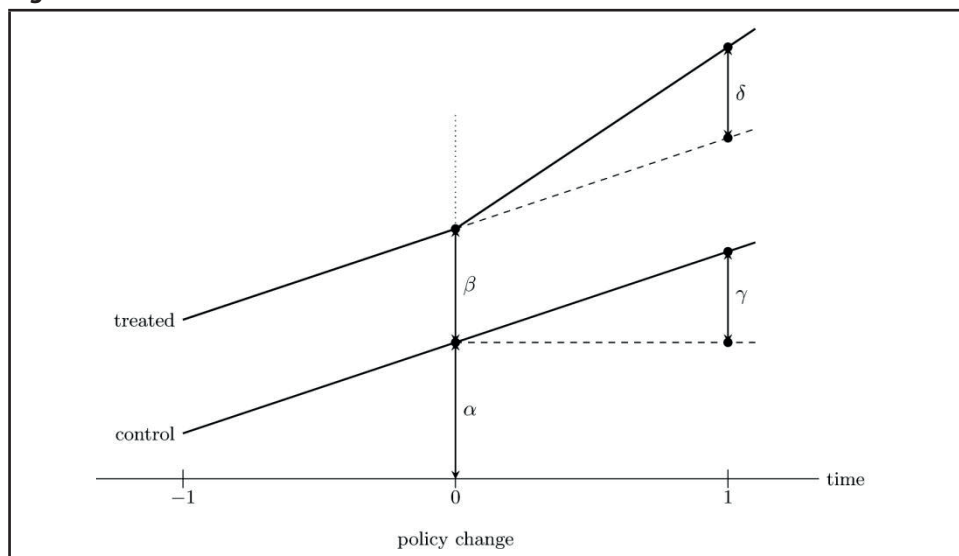
2 Methodology

This section explain difference-in-differences (DiD) estimation methodology we are about to use to estimate the extent to which VAT has been shifted following the 2004 reform.²

Suppose a researcher is asked to assess the effect of certain, either natural or controlled, experiment on the variable of interest. She is presented with the data about this variable. Furthermore, each observation indicates whether it has been made before or after the experiment and whether it comes from the control or treated group. In general, DiD estimation acknowledges any difference in the variable of interest between the treated and control groups and uncovers the effect of the experiment as the difference in these differences before and after the experiment, hence its name.

Figure 2 shows stylized example. Development of the variable of interest in both groups is captured by the solid lines. Straight line for the control group indicates steady trend due to the absence of any experiment related change. On the other hand change in the slope of the treated group line captures the effect of the experiment on the variable of interest.

Figure 2: Difference-in-differences estimation



Uncovering the effect of the experiment means estimating δ from the available data. There are numerous ways to do so. One of them is to compute the mean of the variable of interest. For the control group before the experiment this gives α , for the control group after the experiment $\alpha + \gamma$ (effect of time), for the treated group before the experiment $\alpha + \beta$ (effect of group heterogeneity) and finally for the treated group after the experiment $\alpha + \beta + \gamma + \delta$ (combined effect of time, group heterogeneity and of the experiment). δ is then simply calculated from the estimated means.

² See Angrist and Krueger (1999) for more in-depth discussion of DiD and Meyer (1995) for the discussion of its possible pitfalls.

Rather more convenient way of estimating δ , which also readily provides standard errors of the estimates, is running the following regression

$$\ln(p_i) = \alpha + \beta T_i + \gamma A_i + \delta (T_i \cdot A_i) + \epsilon_i \quad (1)$$

where we already use notation relevant to our data. The dependent variable, $\ln(p_i)$, denotes log-price of commodity i , dummy variable T_i indicates whether the observation comes from the control or treated group (unity for treated), dummy variable A_i indicates whether the observation comes from before or after the experiment (unity for after) and ϵ_i is the error term.

Notice that use of the same α , β , γ , and δ in figure 2 and equation (1) is not coincidental. For observations from the control group before the experiment, both dummy variables will always be zero and the estimate of α from the regression will be simply mean of $\ln(p_i)$ in this group. Similarly, estimated $\alpha + \beta$ from the regression is mean of $\ln(p_i)$ in the treated group before the experiment as only T_i dummy is unity. Exactly the same logic applies to both groups after the experiment. The advantage of regression based estimation is that it provides standard errors of the estimated δ , which allows for standard hypothesis testing.

We must stress that validity of DiD heavily rests on the assumption that absent the reform, the difference between the control and treated group would remain the same. With reference to figure 2, this assumption is equivalent to assuming that the solid control group line and the dashed treated group line *after* the policy change are parallel, just as the solid lines for both groups are parallel *before* the policy change.

While there is no way to test this equal trend assumption after the policy change, we can infer how likely is it to hold from the development before the policy change. In order to do so, we estimate β 's for the four months before the VAT reform and test whether they are equal. Table 1 shows the results of the test and conveys the message that the assumption we need in order to proceed with the DiD estimation is likely to hold in our data for both treated groups.

Table 1: Test of equal trends hypothesis

<i>T</i> ₁	January	February	March
February	0.00 (1)		
	0.990		
March	0.00 (1)	0.00 (1)	
	0.985	0.995	
April	0.00 (1)	0.00 (1)	0.00 (1)
	0.980	0.990	0.995
<i>T</i> ₂	January	February	March
February	0.00 (1)		
	0.979		
March	0.00 (1)	0.00 (1)	
	0.978	0.998	
April	0.00 (1)	0.00 (1)	0.00 (1)
	0.978	0.998	1.000

Note: Test of the null hypothesis of equal trends in the treated and control group before the treatment. Comparing the difference between mean log-price in the treated and control group in column vs. row months. χ^2 and (degrees of freedom) of the test in the upper part of each cell. *p*-value of the test in the lower part (probability that the null hypothesis is the correct one).

Our empirical strategy warrants few further comments. In general, DiD estimation does not require panel data. In other words, observations on the variable of interest before and after the experiment can come from different individuals as long as they can be unambiguously classified into control and treated groups.

When data indeed do have panel structure and include observations from before and after the experiment for each individual, as our data do, standard errors estimated by conventional methods can be invalid due to possible correlation of unobservable error for each individual. To overcome this problem, when computing standard errors we cluster on individual commodities of the consumption basket.

Lastly, up to now we have distinguished only before and after the experiment periods. Although sufficient for the DiD estimation, our data have the added advantage that for each commodity they include four monthly observations from before the reform and eight monthly observations from after the reform. This leads to the question of which observations to choose for the actual estimation. For the benchmark results we present in the next

section, we use April 2004 as the base month for the period before the reform. Individual columns then correspond to different months used for the period after the reform, giving us eight estimates of the extent of tax shifting. Additional advantage of this approach is that we are able to see its development over time. In the appendix, we include similar tables with different base months for the period before the reform.

3 Results

We are now in position to present our main results. Table 2 depicts the results for the first treated group $T1$ and table 3 for the second treated group $T2$. Each column in both tables estimates model from (1) where A_i becomes A_{it} for $t \in \{1, \dots, 8\}$ and denotes different months after the reform used in the estimation. For example, the fifth column of table 2 estimates the degree of tax shifting for the commodities from the first treated group $T1$. In doing so the regression includes log-price observations from April 2004, our base month for the whole table representing the period before the reform, and from September 2004, fifth month after the reform.

The estimates have straightforward interpretation explained in detail in the previous section. Since we have converted all the data into logarithms, the estimated coefficients have interpretation of percentage changes. Estimate of δ , which we call *tax effect*, of, say, 0.03 means that prices of relevant commodities increased by 3% as the result of the reform.

Inspection of table 2 reveals that for the commodities experiencing VAT rate decrease from 22% to 19%, the resulting change in prices is rather marginal. Largest decrease in table 2 can be found in the fifth column. Yet it still reaches only -1.9% and is not statistically significant. Inspection of other columns reveals similar picture. All the estimated tax effects are insignificant. We interpret this result as evidence of producers and vendors taking the full advantage of the VAT rate decrease.

On the other hand table 3 reveals completely different set of results for the commodities experiencing VAT rate increase from 5% to 19%. The estimated tax effect ranges from 3.3% in the first month after the reform to 5.5% in the fifth month after the reform. Furthermore, all the tax effect estimates are statistically significant indicating that the effect lasts well after the reform. Taking the 5.5% increase at its face value means that approximately 40% of the tax increase has been shifted on consumers (5.5 percentage points out of 14 percentage points).

Our results thus point to asymmetry in tax shifting since increase in the VAT rate has been reflected in prices while decrease in the VAT rate left prices unchanged. While certainly influenced by the extent of the change, we suspect this to be manifestation of a more general pattern.

Table 2: Estimates of tax incidence with April 2004 as a base month, first treated group $T1$

	Dependent variable: log of price							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
tax effect	-0.003 (0.003)	-0.002 (0.005)	0.001 (0.008)	-0.014 (0.020)	-0.019 (0.021)	0.002 (0.010)	-0.003 (0.008)	-0.011 (0.008)
$T1$	1.263*** (0.162)	1.263*** (0.162)	1.263*** (0.162)	1.263*** (0.162)	1.263*** (0.162)	1.263*** (0.162)	1.263*** (0.162)	1.263*** (0.162)
$A1$	0.002 (0.002)							
$A2$		0.003 (0.004)						
$A3$			-0.002 (0.007)					
$A4$				-0.007 (0.009)				
$A5$					-0.008 (0.010)			
$A6$						-0.004 (0.009)		
$A7$							0.000 (0.007)	
$A8$								0.006 (0.007)
constant	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)
N	1460	1460	1460	1460	1460	1460	1460	1460
R^2	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Note: $T1$ is dummy variable for treated group. A_t is dummy for t -th month into the treatment. Tax effect in t -th column is interaction term between $T1$ and A_t . Full tax shifting would require tax effect estimates of -3% or -0.03. Robust clustered standard errors (on individual commodities) in parentheses. ***, **, * denotes significance on 1%, 5% and 10% respectively.

Table 3: Estimates of tax incidence with April 2004 as a base month, second treated group *T2*

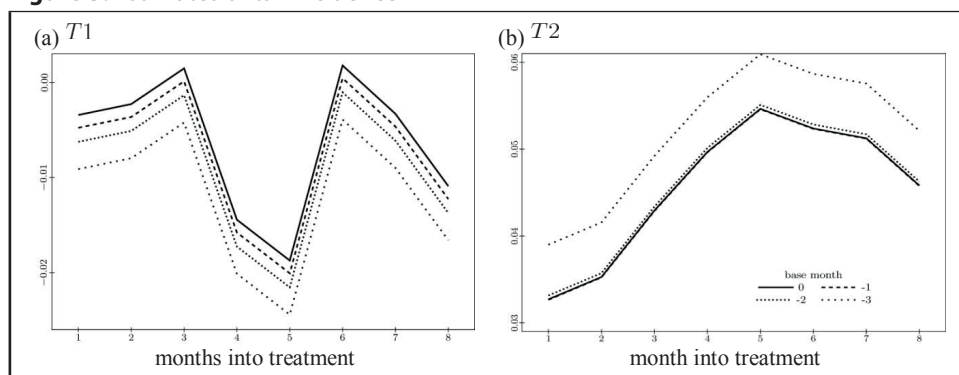
	Dependent variable: log of price							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
tax effect	0.033*** (0.004)	0.035*** (0.006)	0.043*** (0.009)	0.050*** (0.010)	0.055*** (0.011)	0.052*** (0.010)	0.051*** (0.009)	0.046*** (0.009)
<i>T2</i>	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)
<i>A1</i>	0.002 (0.002)							
<i>A2</i>		0.003 (0.004)						
<i>A3</i>			-0.002 (0.007)					
<i>A4</i>				-0.007 (0.009)				
<i>A5</i>					-0.008 (0.010)			
<i>A6</i>						-0.004 (0.009)		
<i>A7</i>							0.000 (0.007)	
<i>A8</i>								0.006 (0.007)
constant	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)	4.598*** (0.094)
<i>N</i>	764	764	764	764	764	764	764	764
<i>R</i> ²	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

Note: *T2* is dummy variable for treated group. *At* is dummy for *t*-th month into the treatment. Tax effect in *t*-th column is interaction term between *T2* and *At*. Full tax shifting would require tax effect estimates of +14% or +0.14. Robust clustered standard errors (on individual commodities) in parentheses. ***, **, * denotes significance on 1%, 5% and 10% respectively.

We further note that the extent of tax shifting indicated by our results, even for the T^2 group, belongs to the lower range, compared to the empirical results briefly surveyed in the introduction. Hence, our results are more in line with the studies supporting under-shifting, Delipalla and O'Donnell (2001) and Carbonnier (2007). Coincidentally, the very same studies deal with the VAT rather than the sales or specific taxes, which are focus of the studies supporting over-shifting.

As already hinted, we re-ran all the estimations using different base months to check robustness of our findings. Although detailed tables are included in the appendix, we summarize the results using figure 3. It shows the estimated tax effects. Different lines represent different base months used and the horizontal axis denotes the month after the reform used in the estimation. With reference to figure 3, we note the robustness of our findings.

Figure 3: Estimates of tax incidence



Note: Full tax shift is -3%. Note: Full tax shift is +14%.

Conclusions

This paper tries to assess the extent of tax shifting of the VAT. For this purpose we use natural experiment, Czech 2004 VAT reform. Using monthly data on prices of almost eight hundred commodities included in the CPI basket we use difference-in-differences estimation.

Two main conclusions emerge. First, for the commodities that experienced decrease in the applicable VAT rate from 22% to 19%, there is no evidence of reform effect on prices. Second, for the commodities for which the VAT rate increased from 5% to 19%, there is evidence of less than full tax shifting. Increase in the VAT rate by 14 percentage points translates into at most 6% increase in the prices of the affected commodities. The estimates are statistically and, we believe, economically significant.

References

- ANGRIST, J. D. and A. B. KRUEGER** (1999) Chapter 23: Empirical strategies in labor economics. In O. C. Ashenfelter and D. Card (Eds.), *Handbook of Labor Economics*, Volume 3, part 1, pp. 1277-1366. New York, NY: Elsevier.
- BARZEL, Y.** (1976) An alternative approach to the analysis of taxation. *Journal of Political Economy* 84 (6), 1177-1197.
- BESLEY, T. J. and H. S. ROSEN** (1998) *Sales taxes and prices: An empirical analysis*. National Bureau of Economic Research Working Paper Series No. 6667.
- BROWNLEE, O. and G. L. PERRY** (1967) The effects of the 1965 federal excise tax reduction on prices. *National Tax Journal* 20 (3), 235-249.
- CARBONNIER, C.** (2007) Who pays sales taxes? Evidence from French vat reforms, 1987-1999. *Journal of Public Economics* 91 (5-6), 1219-1229.
- DELIPALLA, S. and O. O'DONNELL** (2001) Estimating tax incidence, market power and market conduct: The European cigarette industry. *International Journal of Industrial Organization* 19 (6), 885-908.
- FULLERTON, D. and G. E. METCALF** (2002) Chapter 26: Tax incidence. In A. J. Auerbach and M. Feldstein (Eds.), *Handbook of Public Economics*, Volume 4, pp. 1787-1872. New York, NY: Elsevier.
- JOHNSON, T. R.** (1978) Additional evidence on the effects of alternative taxes on cigarette prices. *Journal of Political Economy* 86 (2), 325-328.
- MEYER, B. D.** (1995) Natural and quasi-experiments in economics. *Journal of Business & Economic Statistics* 13 (2), 151-161.
- POTERBA, J. M.** (1996) Retail price reactions to changes in state and local sales taxes. *National Tax Journal* 49 (2), 165-176.
- SUMNER, M. T. and R. WARD** (1981) Tax changes and cigarette prices. *Journal of Political Economy* 89 (6), 1261-1265.
- WOODWARD, F. O. and H. SIEGELMAN** (1967) Effects of the 1965 federal excise tax reduction upon the prices of automotive replacement parts, a case study in tax shifting. *National Tax Journal* 20 (3), 250-257.

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Appendix

This appendix checks robustness of the results from the main part of the paper. Tables 4, 5 and 6 differ from Table 2 only in using different base month for the estimation. Similar difference links Tables 7, 8, 9 and Table 3. The tax effect estimates are summarized in Figure 3.

Table 4: Estimates of tax incidence with March 2004 as a base month, first treated group T_1

	Dependent variable: log of price							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
tax effect	-0.005 (0.004)	-0.004 (0.005)	0.000 (0.009)	-0.016 (0.021)	-0.020 (0.021)	0.000 (0.010)	-0.005 (0.008)	-0.012 (0.008)
T_1	1.264*** (0.162)	1.264*** (0.162)	1.264*** (0.162)	1.264*** (0.162)	1.264*** (0.162)	1.264*** (0.162)	1.264*** (0.162)	1.264*** (0.162)
A1	0.003 (0.002)							
A2		0.003 (0.004)						
A3			-0.001 (0.008)					
A4				-0.006 (0.009)				
A5					-0.007 (0.010)			
A6						-0.003 (0.009)		
A7							0.001 (0.007)	
A8								0.007 (0.006)
constant	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)
N	1460	1460	1460	1460	1460	1460	1460	1460
R^2	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Note: T_1 is dummy variable for treated group. A_t is dummy for t -th month into the treatment. Tax effect in t -th column is interaction term between T_1 and A_t . Full tax shifting would require tax effect estimates of -3% or -0.03. Robust clustered standard errors (on individual commodities) in parentheses. ***, **, * denotes significance on 1%, 5% and 10% respectively.

Table 5: Estimates of tax incidence with February 2004 as a base month, first treated group $T1$

	Dependent variable: log of price							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
tax effect	-0.006 (0.004)	-0.005 (0.006)	-0.001 (0.009)	-0.017 (0.021)	-0.022 (0.021)	-0.001 (0.010)	-0.006 (0.009)	-0.014* (0.008)
$T1$	1.265*** (0.162)	1.265*** (0.162)	1.265*** (0.162)	1.265*** (0.162)	1.265*** (0.162)	1.265*** (0.162)	1.265*** (0.162)	1.265*** (0.162)
$A1$	0.004 (0.003)							
$A2$		0.005 (0.004)						
$A3$			0.000 (0.008)					
$A4$				-0.005 (0.009)				
$A5$					-0.006 (0.010)			
$A6$						-0.002 (0.009)		
$A7$							0.002 (0.008)	
$A8$								0.008 (0.007)
constant	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)
N	1460	1460	1460	1460	1460	1460	1460	1460

Note: $T1$ is dummy variable for treated group. A_t is dummy for t -th month into the treatment. Tax effect in t -th column is interaction term between $T1$ and A_t . Full tax shifting would require tax effect estimates of -3% or -0.03. Robust clustered standard errors (on individual commodities) in parentheses. ***, **, * denotes significance on 1%, 5% and 10% respectively.

Table 6: Estimates of tax incidence with January 2004 as a base month, first treated group T_1

	Dependent variable: log of price							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
tax effect	-0.009** (0.005)	-0.008 (0.006)	-0.004 (0.009)	-0.020 (0.023)	-0.024 (0.023)	-0.004 (0.010)	-0.009 (0.009)	-0.017** (0.008)
T_1	1.268*** (0.162)	1.268*** (0.162)	1.268*** (0.162)	1.268*** (0.162)	1.268*** (0.162)	1.268*** (0.162)	1.268*** (0.162)	1.268*** (0.162)
A1	0.004 (0.004)							
A2		0.005 (0.005)						
A3			0.000 (0.009)					
A4				-0.005 (0.010)				
A5					-0.006 (0.011)			
A6						-0.002 (0.010)		
A7							0.002 (0.008)	
A8								0.008 (0.007)
constant	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)
N	1460	1460	1460	1460	1460	1460	1460	1460

Note: T_1 is dummy variable for treated group. A_t is dummy for t -th month into the treatment. Tax effect in t -th column is interaction term between T_1 and A_t . Full tax shifting would require tax effect estimates of -3% or -0.03. Robust clustered standard errors (on individual commodities) in parentheses. ***, **, * denotes significance on 1%, 5% and 10% respectively.

Table 7: Estimates of tax incidence with March 2004 as a base month, second treated group T_2

	Dependent variable: log of price							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
tax effect	0.033*** (0.005)	0.035*** (0.006)	0.043*** (0.009)	0.050*** (0.011)	0.055*** (0.011)	0.052*** (0.010)	0.051*** (0.009)	0.046*** (0.009)
T_2	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759*** (0.160)	-0.759** (0.160)
A1	0.003 (0.002)							
A2		0.003 (0.004)						
A3			-0.001 (0.008)					
A4				-0.006 (0.009)				
A5					-0.007 (0.010)			
A6						-0.003 (0.009)		
A7							0.001 (0.007)	
A8								0.007 (0.006)
constant	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)	4.597*** (0.094)
N	764	764	764	764	764	764	764	764

Note: T_2 is dummy variable for treated group. A_t is dummy for t -th month into the treatment. Tax effect in t -th column is interaction term between T_2 and A_t . Full tax shifting would require tax effect estimates of +14% or +0.14. Robust clustered standard errors (on individual commodities) in parentheses. ***, **, * denotes significance on 1%, 5% and 10% respectively.

Table 8: Estimates of tax incidence with February 2004 as a base month, second treated group *T2*

	Dependent variable: log of price							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
tax effect	0.033*** (0.005)	0.036*** (0.007)	0.043*** (0.009)	0.050*** (0.011)	0.055*** (0.012)	0.053*** (0.011)	0.052*** (0.010)	0.046*** (0.009)
<i>T2</i>	-0.760*** (0.160)	-0.760*** (0.160)	-0.760*** (0.160)	-0.760*** (0.160)	-0.760*** (0.160)	-0.760*** (0.160)	-0.760*** (0.160)	-0.760*** (0.160)
<i>A1</i>	0.004 (0.003)							
<i>A2</i>		0.005 (0.004)						
<i>A3</i>			0.000 (0.008)					
<i>A4</i>				-0.005 (0.009)				
<i>A5</i>					-0.006 (0.010)			
<i>A6</i>						-0.002 (0.009)		
<i>A7</i>							0.002 (0.008)	
<i>A8</i>								0.008 (0.007)
constant	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)
<i>N</i>	764	764	764	764	764	764	764	764

Note: *T2* is dummy variable for treated group. *At* is dummy for *t*-th month into the treatment. Tax effect in *t*-th column is interaction term between *T2* and *At*. Full tax shifting would require tax effect estimates of +14% or +0.14. Robust clustered standard errors (on individual commodities) in parentheses. ***, **, * denotes significance on 1%, 5% and 10% respectively.

Table 9: Estimates of tax incidence with January 2004 as a base month, second treated group T^2

	Dependent variable: log of price							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
tax effect	0.039*** (0.006)	0.042*** (0.007)	0.049*** (0.010)	0.056*** (0.012)	0.061*** (0.012)	0.059*** (0.011)	0.058*** (0.010)	0.052*** (0.009)
T^2	-0.766*** (0.160)	-0.766*** (0.160)	-0.766*** (0.160)	-0.766*** (0.160)	-0.766*** (0.160)	-0.766*** (0.160)	-0.766*** (0.160)	-0.766** (0.160)
A1	0.004 (0.004)							
A2		0.005 (0.005)						
A3			0.000 (0.009)					
A4				-0.005 (0.010)				
A5					-0.006 (0.011)			
A6						-0.002 (0.010)		
A7							0.002 (0.008)	
A8								0.008 (0.007)
constant	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)	4.596*** (0.094)
N	764	764	764	764	764	764	764	764

Note: T^2 is dummy variable for treated group. A_t is dummy for t -th month into the treatment. Tax effect in t -th column is interaction term between T^2 and A_t . Full tax shifting would require tax effect estimates of +14% or +0.14. Robust clustered standard errors (on individual commodities) in parentheses. ***, **, * denotes significance on 1%, 5% and 10% respectively.

The Beta-convergence Analysis and Regional Disparities in EU-28

Analýza beta-konvergence a regionální rozdíly v EU-28

MIHAELA SIMIONESCU

Abstract

The main objective of this research is to analyse the beta-convergence in European Union (EU-28), showing the regional income disparities. There was a faster increase of GDP per capita in poor economies in the period from 2001 to 2012. The absolute convergence was assessed using the approach based on spatial lag dependence. The rate of convergence has a low value of 0.46% for EU-28 during 2001-2012. The catching-up process is mostly in EU-28 a national phenomenon. The results of the estimations suggest not significant convergence within EU-28 members.

Keywords

convergence, regional disparities, Moran's I, spatial lag model, spatial error model

Abstrakt

Hlavním cílem tohoto výzkumu je analyzovat beta-konvergenci v Evropské unii (EU-28) a poukázat na regionální rozdíly v příjmech. V období 2001-2012 byl rychlejší růst HDP na obyvatele v chudých ekonomikách. Absolutní konvergence byla hodnocena pomocí přístupu založeného na prostorové zpožděné závislosti. V letech 2001-2012 má míra konvergence pro EU-28 nízkou hodnotu 0,46 %. Proces dohánění je v zemích EU-28 většinou národním fenoménem. Výsledky odhadů naznačují, že neexistuje významná konvergence v rámci zemí EU-28.

Klíčová slova

konvergence, regionální rozdíly, Moranovo I, prostorový intervalový model, prostorový chybový model

JEL Codes

C21, C12, F43

Introduction

Many authors were interested of income disparities in the context of convergence analysis (Barro and Sala-i-Martin (1995), Cuadraro-Roura (2001), Tondl (2001), Baumont et al. (2003), Meliciani and Peracchi (2006), Paas and Schlitte (2006), Anagnostou et al. (2008)). There are some studies for EU, the research importance being major. For example, Hallet (2002) criticized the current that showed that there is a slow regional convergence in Europe in the last decades. The main determinates of income convergence are considered to

be the stylized facts of disparities. Future challenges regarding the policies in Europe are presented. Bosker (2009) analysed for Europe the evolution of regional income disparities. The disparities in Western Europe regions tend to decrease in time, while a large number of regions from Eastern Europe catch up slowly with the Western Europe neighbours. In the East part of Europe the specific factors of the countries are more important than the regional conditions. Maza, Hierro, and Villaverde (2012) examined the spatial influence on the regional income evolution in Europe during 1980-2005. According to mobility index, the regional disparities have decreased. The approach based on a new mobility index has put into evidence that poor regions that are surrounded by rich ones are more likely to become rich than the other poor regions.

The main aim of this study is to evaluate the regional income disparities in the context of convergence process in EU-28 in the period from 1995 to 2013. There is a low level of regional aggregation, the research using NUTS3 level regions in EU-28. The beta-convergence is analysed in this context, the spatial effects being controlled by the use of spatial econometric methods.

The paper is structured in 4 sections. In the second section there is a description of data and methodology related to the convergence analysis and also the recent results regarding the regional income disparities in EU. The third section consists in a presentation of beta-convergence analysis considering the problem of spatial dependence in EU regions and countries. In the end some conclusions are drawn.

1 Data and Methodology

The approach for estimating the regional income convergence is based on the observations of Sala-i-Martin (1992) that made a distinction between conditional and absolute convergence.

Under the assumption of structurally identical economies, the absolute convergence is checked using a regression for economic growth and initial level for certain regions/countries. Unconditional β -convergence assumes that all economies are structurally identical (same steady state). The absolute beta-convergence existence supposes that less developed countries have a faster catch-up tendency than the developed ones while the conditional beta-convergence supposes that each economy tends to go to its steady state. The absolute beta-convergence is present if there is a significant and negative relationship between economic growth for income per capita and the initial level of the same indicator. Quah (1996) showed that the conditional convergence can be tested using the club convergence concept (the steady state varies across groups of relatively homogenous economies). Cuadraro Roura (2001) emphasized that the differences between countries regarding legislation, countries policy, tax system have an important impact regarding the convergence and regional growth.

Regional economic developments might underlie spatial dependence or interaction. If economic events in neighboring regions are not independent, but influence each other, there is spatial dependence. In addition, regional data might have shortcomings such as a bad quality due to measurement problems or inadequately defined regional units,

what is reflected in spatial autocorrelation. Standard regressions do not account for spatial dependence or autocorrelation thus leading to inefficient inference or even biased estimates in case of significant spatial processes. In addition to the use of classical econometric methods presented so far, we therefore refer to models of spatial econometrics in this section, which explicitly take account of spatial interaction. The structure of spatial interconnectedness is usually imposed by so-called spatial weights matrices (W). Wy , e.g., thus displays the spatially weighted average of y in nearby regions. A number of different spatial econometric models – as well as combinations of those – can be formulated: spatial correlation of the error term in e.g. a spatial autoregressive error model, of the endogenous variable itself in a spatial lag model as well as of explanatory variables in a spatial cross-regressive model.

The regional beta-convergence is assessed in two variants. The first alternative uses the common OLS approach for cross-sections, where the independent variable is the initial level of income while the dependent one is the growth in income per capita). In the second variant dummy variables are introduced to take into consideration the country-specific effects. The both types of convergence were assessed (absolute and conditional convergence). According to Barro (1995) we start from the following model:

$$\ln\left(\frac{y_{i0+T}}{y_{i0}}\right) = \alpha_0 + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^N \alpha_{2j} c_{ji} + \varepsilon_i \quad (1)$$

y_{i0} - the initial value of GDP per capita in the i -th region

T - number of years in the mentioned period

$\alpha_0, \alpha_1, \alpha_{2j}$ - parameters

$$c_{ji} = \begin{cases} 1, & \text{if region } i \text{ is in country } j \\ 0, & \text{else} \end{cases}$$

c_{ji} - a dummy variable

ε_i - the error (normal distribution, independently distributed)

If α_1 has a negative value, the less developed economies have the tendency to grow faster than the rich countries. If T is the length of the time period, the annual convergence rate is computed as:

$$\beta = -\ln \frac{1-\alpha_1}{T} \quad (2)$$

Half-life (the necessary period for half of the initial GDP per capita inequalities to disappear) is another indicator for evaluating the convergence speed:

$$\tau = \frac{\ln(2)}{\beta} \quad (3)$$

Most of the convergence analyses considered that growth rates are independent across regions, but this assumption is not realistic. The economic growth of a region has many chances to be influenced by the economic situation of the neighbouring regions. Abreu et al. (2005) showed that many errors are made by ignoring spatial interdependencies between regions. The authors proposed two models that solve this problem: Spatial Lag Model (SLM) and Spatial Error Model (SEM). The spatial dependence suppresses the use of

a spatial weight matrix denoted by W . This matrix shows the intensity of spatial dependence and the spatial structure. Ertur and Le Gallo (2003) showed that the spatial weigh has a random design. The binary contiguity supposes that elements of matrix $w_{ij}=1$ if the two regions (i and j) are within a certain distance or if these regions have a common border. If W is the distance based weight matrix, the distance is computed as the squared inverse of the best circle distance between the regions' geographic regions. It is made the assumption that the spatial interaction is null and a critical distance cut-off is used. Le Gallo et al. (2003) showed that the functional form of the squared inverse distances is seen as gravity function. The rows of the distance matrix are standardized.

$$W: w_{ij} = 0, \text{ if } i = j$$

$$W: w_{ij} = \frac{1}{d_{ij}^2}, \text{ if } d_{ij} \leq D \quad (4)$$

$$W: w_{ij} = 0, \text{ if } d_{ij} > D$$

d - the distance between centres of the two regions (i and j)

w_{ij} - spatial weight

D - the critical distance cut-off

Anselin (2001) defined the spatial autocorrelation like spatial clustering of the close values of the parameters. There is a positive autocorrelation if the values of the parameters are spatially clustered.

For a certain set of characteristics and a certain attribute that is associated to it, the Moran's I statistic sets if the pattern is random, dispersed or clustered.

The Moran's I statistic measures the global spatial autocorrelation that is characterized by correlation in sign among nearby spaces. Spatial correlation is multi-directional and multi-dimensional. The formula for this statistic is:

$$I = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_i (X_i - \bar{X})^2} \quad (5)$$

X - analysed variable

\bar{X} - the average of X

N - number of units

w_{ij} - element in the matrix of spatial weights

The null hypothesis states the lack of spatial autocorrelation. The expected value of the statistic is computed as: $(I) = \frac{1}{1-N}$.

Moran's I takes values between -1 and $+1$, the extreme values indicating the perfect dispersion (-1) and perfect correlation ($+1$). The null value shows random spatial pattern. The Moran

Its statistic values are transformed to Z-scores. At a significance level of 5%, the values outside the interval [-1.96; 1.96] imply spatial autocorrelation.

The spatial autocorrelation presents two forms: nuisance form (restricted to error) and the substantive one.

If the nuisance dependence is ignored, the estimates are inefficient. Therefore, Anselin (1988) proposed two types of model specifications estimated using maximum likelihood method (ML method). The spatial error model (SEM) is suitable for nuisance form.

$$\ln\left(\frac{y_{i0+T}}{y_{i0}}\right) = \alpha_0 + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^N \alpha_{2j} c_{ji} + \varepsilon_i \quad (6)$$

λ is the spatial autocorrelation coefficient.

$[W \cdot \varepsilon]_i$ - the i -th element of weighted errors vector

c_{ji} is 1 if the i -th region is inside the country j

u_i, ε_i - errors term (independently and normally distributed)

On average the growth in GDP per capita is explained by the convergence assumption.

If there is a substantive form of spatial dependence, the spatial lag model (SLM) should be used. In this case, the regional growth in the regions around influences the regional growth in that certain region.

$$\ln\left(\frac{y_{i0+T}}{y_{i0}}\right) = \alpha_0 + \rho[W \cdot \ln\left(\frac{y_{0+T}}{y_0}\right)]_i + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^N \alpha_{2j} c_{ji} + \varepsilon_i \quad (7)$$

$[W \cdot \ln\left(\frac{y_{0+T}}{y_0}\right)]_i$ - the i -th element of weighted growth rates vector

ρ - spatial autocorrelation coefficient

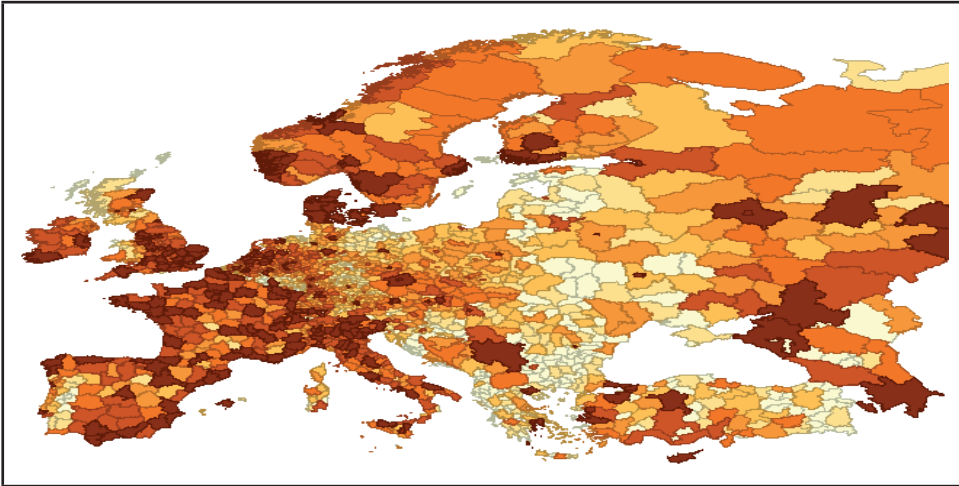
2 The Convergence in EU-28

The aggregation level influences the results of regional convergence study. Arbia (2006) showed that if different spatial scales are used will generate distinct results. The use of large spatial units in constructing the models usually hides problems like spatial autocorrelation and heterogeneity.

In this study it was chosen a low aggregation level, because there could be spillover effects that are not detected at higher levels as Brauninger and Niebuhr (2005) explained. NUT-3 level is chosen for EU-28.

The data is represented by the adjusted GDP per capita for purchasing power standards (in PPS), being provided by Eurostat. The data in PPS has the advantage of being adjusted for differences in national price levels.

Figure 1: Regional GDP per capita levels relative to the EU-28 average



The values for groups:

≤ 50

(50;75)

(75;100)

(100;125)

(125;150)

(150;175)

≥ 175



≤ 50

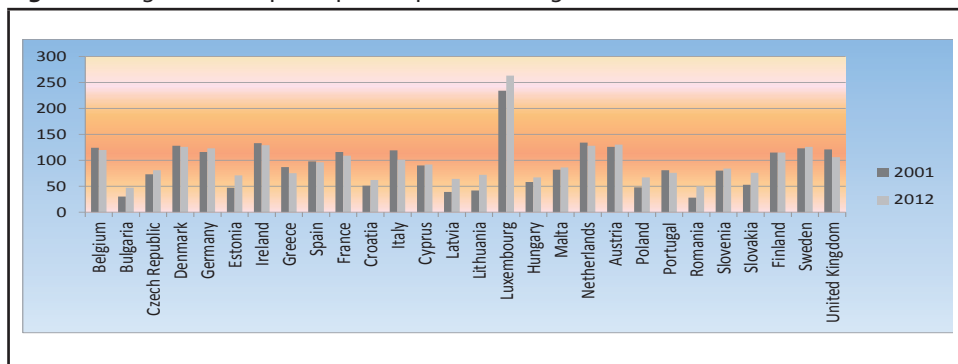


≥ 175

Source: author's computations based on Eurostat database

Many regions from Spain, Greece, Finland, Ireland, Croatia, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Portugal, Slovenia, Slovakia, Czech Republic, Romania and Bulgaria had growth rates under the average rate of EU-28. Only few regions from “blue-banana”, mostly from Netherlands and England, had rates above the average. In the regression the data for Russia were not used.

Figure 2: Regional GDP per capita disparities and growth in EU-28



Source: author's computations based on Eurostat database

The second figure indicates that there are significant GDP per capita disparities between EU-28 countries. There was a faster increase of GDP per capita in poor economies. According to the spatial distribution there is a centre-periphery structure.

The beta-convergence analysis is more suitable for the various regions in EU-28. Fischer and Stirbock (2004) identified two convergence clubs represented by rich countries in Northern and Central Europe and poor countries of new members of EU plus southern periphery in the Western Europe. Feldkircher (2006) found country-specific effects on GDP increase in EU.

The values of coefficient I are highest with a cut-off distance of hundred kilometres. In this study we used a critical cut-off distance of 500 km. The three types of models are built: classical model using OLS, Spatial Lag Model (SLM) and Spatial Error Model (SEM). The Moran's I coefficients indicated the existence of relevant spatial autocorrelation of the errors. Therefore, this indicator did not provide reliable information regarding the spatial dependence. Therefore, LM tests are used to check the form of the spatial autocorrelation.

The results of the estimations suggest no significant convergence with-in EU-28 members. The catching-up process is mostly in EU-28 a national phenomenon.

Regarding the absolute convergence, the LM tests indicated an option of spatial lag dependence in the EU-28. The estimated rate of convergence was 0.46% in the EU-28. OLS tends to be biased, the substantive form of spatial autocorrelation being obvious for the data. OLS estimation results indicated absolute convergence at an annual rate of 1.85% between 2001 and 2012. The rate of absolute convergence is higher than that based on spatial lag model, the auto-correlation being obvious. The rich neighbouring regions tend faster to convergence than the poor ones.

In the poor countries a faster convergence speed was observed compared to rich countries even during the economic crisis. Some countries experienced relatively high mean rates of real per capita GDP growth, such as Malta, Bulgaria, Luxembourg, and Romania, but most highly developed countries (e.g., Denmark, Netherlands, and Sweden) have been

growing at a slower rate on average. The process of real convergence of the Romanian economy continued in the years of crisis, with the GDP per capita rate by more than 2 percentage points above the rate of the European Union in 2009 – 2013.

Conclusions

The issue of whether European regions show convergence in income levels has been a major concern in the EU during the last decades and thus has geared a considerable amount of research work in the field. From a methodological point of view, a number of related econometric concepts were applied and developed. Nevertheless, critical arguments can be brought forward even against the most recently applied econometric frameworks.

The spatial approach in the convergence context brought us to the conclusion that there is not significant convergence within EU-28 countries. Our results show that ignorance of the spatial correlation leads to potentially misleading results. There was a faster increase of GDP per capita in poor economies.

Under the assumption of structurally identical economies, the absolute convergence is checked using a regression for economic growth and initial level for certain regions/countries. The rate of convergence was 0.46% in the EU-28. The absolute convergence is at an annual rate of 1.85% between 2001 and 2012. The economic context should take into account the effects of recent economic crisis that determined an obvious decrease in convergence. Surprisingly, in the crisis period the poor countries registered a real convergence surpassing the EU-28 average. The process of real convergence of the Romanian economy continued in the years of crisis, with the GDP per capita rate by more than 2 percentage points above the rate of the European Union in 2009 – 2013. Moreover, Croatia was admitted as member of EU in 2013, evident efforts for achieving the regional convergence being observed after 1990. After an initial drop in the late 1990s, the difference between potential output and actual output narrowed systematically in Croatia, and output growth rates have been close to or above the estimated growth in potential output since then.

References

- ABREU, M., DE GROOT, H. L., & FLORAX, R. J.** (2005) Space and growth (No. 04-129/3). Tinbergen Institute discussion paper.
- ANAGNOSTOU, A., ARTELARIS, P., PETRAKOS, G., & PSYCHARIS, Y.** (2008) Growth and Convergence-Divergence Trends in the European Union. *Scienze Regionali. Italian Journal of Regional Science*, 7(2), 9-28.
- ANSELIN, L.** (1988) *Spatial econometrics: methods and models* (Vol. 4). Springer.
- ANSELIN, L.** (2001) *Spatial Econometrics. A companion to theoretical econometrics*, 310330.
- ARBIA, G.** (2006) *Spatial econometrics: statistical foundations and applications to regional convergence*. Springer.
- BARRO, R. J., & SALA-I-MARTIN, X.** (1990) *Economic growth and convergence across the United States* (No. w3419). National Bureau of Economic Research.
- BARRO, R. J. & SALA-I-MARTIN, X.** (1995) *Economic growth*. McGraw Hill Amsterdam.

- BAUMONT, C., ERTUR, C., & LE GALLO, J.** (2003) Spatial convergence clubs and the European regional growth process, 1980–1995. In *European regional growth* (pp. 131-158). Springer Berlin Heidelberg.
- BOSKER, M.** (2009) The spatial evolution of regional GDP disparities in the 'old' and the 'new' Europe. *Papers in Regional Science*, 88(1), 3-27.
- BRÄUNINGER, M., & NIEBUHR, A.** (2005) *Agglomeration, spatial interaction and convergence in the EU* (No. 322). HWWA Discussion paper.
- CUADRADO-ROURA, J. R.** (2001) Regional convergence in the European Union: From hypothesis to the actual trends. *The Annals of Regional Science*, 35(3), 333-356.
- ERTUR, C. & LE GALLO, J.** (2003) Exploratory spatial data analysis of the distribution of regional per capita GDP in Europe, 1980–1995. *Papers in regional science*, 82(2), 175-201.
- FELDKIRCHER, M.** (2006) Regional convergence within the EU-25: a spatial econometric analysis. In *OeNB Workshop Series* (Vol. 9).
- FISCHER, M. M., & STIRBÖCK, C.** (2004) *Regional income convergence in the enlarged Europe, 1995-2000: a spatial econometric perspective* (No. 04-42). ZEW Discussion Papers.
- HALLET, M.** (2002, August) Income convergence and regional policies in Europe: results and future challenges. In *ERSA conference papers* (No. ersa02p080). European Regional Science Association.
- LE GALLO, J., ERTUR, C., & BAUMONT, C.** (2003) A spatial econometric analysis of convergence across European regions, 1980–1995. In *European regional growth* (pp. 99-129). Springer Berlin Heidelberg.
- MAZA, A., HIERRO, M., & VILLAVEVERDE, J.** (2012) Income distribution dynamics across European regions: Re-examining the role of space. *Economic Modelling*, 29(6), 2632-2640.
- MELICIANI, V., & PERACCHI, F.** (2006) Convergence in per-capita GDP across European regions: a reappraisal. *Empirical Economics*, 31(3), 549-568.
- PAAS, T., & SCHLITTE, F.** (2006) *Regional income inequality and convergence processes in the EU-25* (No. 355). HWWA Discussion Paper.
- QUAH, D. T.** (1996) Empirics for economic growth and convergence. *European economic review*, 40(6), 1353-1375.
- TONDL, G.** (2001) *Convergence after divergence? Regional growth in Europe*. Springer.

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Appendix

Figure 3: The results of OLS estimation

Intercept	2.3007 (33.89)*
	-0.298(-7.95)*
R-square adjusted	0.4762
AIC	3331.72
Jarque-Bera	94103.06 (prob.=0.00)
Koenker-Bassett test	109.11 (prob.=0.00)
White test	401.33 (prob.=0.00)
Moran's I	22.42 **

*Significant level of 0.05 level; in brackets there are standard errors

** Significant level of 0.01 level

Figure 4: SLM estimation results

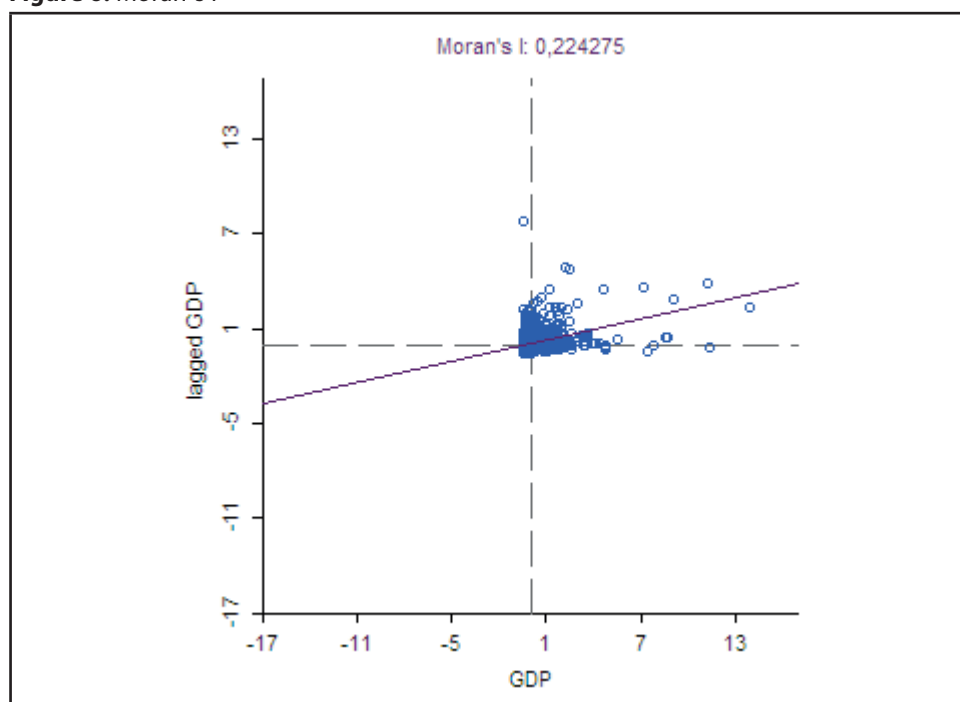
Intercept	2.453 (37.28)**
	-0.163(-6.25)**
R-square adjusted	0.5451
AIC	3314.64
LM- test	176.994 (0.00)

** Significant level of 0.01 level

Figure 5: SEM estimation results

Intercept	2.498 (40.23)**
	-0.363(-5.03)**
Λ	0.6262 (29.65)**
LM test	540.9586 (0.00)

Figure 6: Moran's I



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The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every receipt, invoice, and bill should be properly filed and dated. This not only helps in tracking expenses but also provides a clear audit trail for tax purposes.

In the second section, the author outlines the various methods for recording financial data. From traditional paper-based ledgers to modern digital accounting software, different options are presented to suit various business sizes and needs. The benefits of automation and cloud storage are highlighted.

The third section delves into the importance of regular reconciliation. It explains how comparing bank statements with internal records can help identify discrepancies early on, preventing larger issues down the line. The author provides a step-by-step guide on how to perform a reconciliation effectively.

Finally, the document concludes with advice on how to organize and secure financial records. Recommendations include using fireproof safes for physical documents and strong encryption for digital files. The author also suggests periodic reviews of record-keeping practices to ensure they remain efficient and compliant with current regulations.