

6TH WORKSHOP EURO AREA BUSINESS CYCLE NETWORK (EABCN)
Productivity and the Business Cycle: Evidence for Europe and the US
Helsinki, 28-29 November 2005

REPORT

The sixth EABCN Workshop focused on the comparative analysis of productivity changes over the business cycle in the Euro-area and in US and was held in Helsinki on 28th and 29th November, hosted by the Bank of Finland in the magnificent House of Estates. The workshop was organized by **Juan Dolado** (Universidad Carlos III and CEPR), **Gerard Korteweg** (European Central Bank) and **Jouko Vilmunen** (Bank of Finland). The workshop's program was divided into five sessions, during which three invited talks were held and ten papers were presented. Each presentation was followed by a discussion and a round of comments. **Sinikka Salo**, member of the board of the Finnish Central Bank in charge of monetary policy and research, opened the Workshop with a short speech. She underlined the importance of research for Central Banks and stressed that for small Central Banks of the Eurosystem excelling in research is also a mean of being relevant within the ESCB. Sinikka Salo also gave details on the House of Estates, the building hosting the workshop and the historical context during which it was built. **Juan Dolado** finally gave some information regarding the EABCN and its activities.

Session 1

Robert Inklaar (University of Groningen) opened the first session presenting the paper 'Cyclical Productivity in Europe and the United States: Evaluating the Evidence on Returns to Scale and Input Utilization'. The goal of Inklaar's paper is to study the causes of the procyclical behavior of productivity and, in particular, to evaluate the role of increasing returns to scale and unmeasured output utilization in explaining procyclical productivity growth. The author tests the ability of the Basu/Fernald cyclical productivity model to reduce the positive correlation between output growth and TFP growth outside of the US and at industry level. Production functions are estimated to allow for non-constant returns to scale and unmeasured input utilization using downstream indicators instead of Hall-Ramey instruments in estimating the production function. Inklaar finds that the Fernald/Basu model works for the aggregate US economy and to some extent also in France and Germany. However, the author also finds that in many sectors, in particular non-manufacturing and services, technological change is still highly procyclical, even in US. He further states that, since the Basu/Fernald theoretical model tries to explain firm behavior, the fact that the empirical model fails in many industries, and that it is less successful also at an aggregate level for many European countries, is worrisome.

Silva Sgherri (European Central Bank) acted as discussant for Robert Inklaar's paper. She found paper was interesting and obtained plausible results, but also suggested an important *caveat* regarding the use of hours as a proxy for unmeasured input utilization. Inklaar's paper risks "throwing the baby with the dirty water". That is, maybe it is not true that unmeasured input utilization does not explain procyclical productivity growth at industry level and in European countries; it's just that the available measures of hours per person in European countries and at sectoral level are bad proxies for unmeasured input utilization. Therefore, Sgherri suggests assessing the robustness of the finding by looking for alternative proxies for input utilization and checking for alternative estimation strategies, e.g. multivariate unobserved component methods.

Several further comments confirmed the concern for the quality of the estimates of hours. It was also proposed to use other possible proxies for input utilization coming from the Euler equation as employment growth or investment.

On the topic measurement of labor input, **Jarkko Turunen** (European Central Bank) then presented the paper 'Growth in Euro Area Labour Quality', co-authored with Guido Schwerdt (European University Institute). The key point of their paper is that raw measures of labor input, such as total hours worked or employment, provide biased measures of actual labor input, because the composition of the workforce changes overtime. Measures of labor input should therefore be adjusted for labor quality. The authors construct an estimate of labor quality adjusted labor input in the euro area combining information from microdata of individuals with official aggregate data. In particular, they first use data on individual wages and personal characteristics as age, gender and level of education to construct weights for worker groups (share each worker group gets of total labor compensation),

and then use these weights to obtain quality-adjusted measures of labor input and a labor quality index. Using these measures they find that there has been consistent growth in euro area labor quality but with variation in labor quality growth, more specifically they show evidence of lagged countercyclicality of labor quality. A further implication of their work is the possibility of accounting for labor quality growth when decomposing labor productivity, thus not overestimating TFP.

The paper was discussed by **Lauri Kajanoja** (Bank of Finland). The discussant stated the paper had the important merit of allowing, from now on, dividing labor productivity growth not only in capital deepening and TFP growth, but also in a labor quality growth term. He then highlighted a possible contradiction in the paper. On the one hand wages are assumed to perfectly reflect productivity, while on the other relative rigidity of wages is used as a possible justification for the assumption that the weights for different groups of workers are fixed. Kajanoja also expressed concerns regarding the interaction between gender and labor quality, since gender is possibly correlated with the mismeasurement in work experience.

Further comments regarded the possible endogeneity of education, while in the paper it is considered exogenous, and the possibility of refinement of the index by also analyzing the relation between labor quality and sectoral changes.

Susanto Basu (Boston College) then presented the paper 'Sector-Specific Technical Change', co-authored with John Fernald and Miles Kimball. Basu briefly went through the literature that studies the relation between output growth, TFP and hours and underlined the discrepancy existing between the theoretical results of standard RBC models – that advocate procyclical hours – and the empirical finding, mainly of the SVAR literature, that hours are countercyclical. He then stressed that models incorporating “final-use” sectors (as the one used in the paper) can possibly help mending such discrepancy, since theory suggests that the sector in which the technology shock occurs matters for the dynamic response to those shocks. In particular, technology changes that affect the consumption-producing sector alone have no impact on employment or capital accumulation; all the dynamic of hours and investment comes from shocks affecting the investment sector alone. The reason is that the effects of an “investment-specific” shock on the intertemporal substitution of current leisure and future consumption are strong, while consumption sector shocks have a very small effect on it and therefore also have a very small effect on decision rules. The speaker pointed out that this dichotomy typically does not hold in sticky price models and that therefore the economy’s response to consumption- and investment-specific shocks can be used to test the degree of price stickiness of the macroeconomy. Basu then passed to describing approach used in this paper to produce preliminary evidence on the biases of technological change in favor of producing durable goods. The authors follow an augmented growth-accounting approach, instead of the frequently used relative-price approach: they estimate technology at a disaggregated industry level and then use input-output tables to aggregate these changes. Results, though preliminary, suggest that short-run dynamic responses are inconsistent with the simple “two-sector” model used. Basu therefore concluded indicating that further research needs to be done to investigate the implications of alternative models.

A short round of comments followed Susanto Basu’s talk. The effective empirical distinction between consumption-technology and investment-technology was questioned. It was also proposed use SVAR to recover the consumption-technology and investment-technology shocks.

Session 2

The second session of the workshop was opened by **Assaf Razin** (Tel Aviv University and Cornell University), presenting his paper 'Bilateral FDI Flows: Threshold Barriers and Productivity Shocks', written with Efraim Sadka (Tel Aviv University) and Hui Tong (Bank of England). Razin stated that this paper is motivated by the well-known fact that frequently bilateral FDI flows between source-host country pairs are in fact zero. This is related to the “Lucas Paradox”, i.e. the fact that capital does not flow from rich to poor countries, even though theory predicts it should (due to higher marginal productivity of capital in poor labor-abundant countries). The authors propose an explanation based on thresholds barriers to M&A and Greenfield investment FDI flows. In particular, the authors construct a model comprising setup costs of investment that are a function of costs incurred at source and of costs incurred in utilizing host inputs (proxied by fix input of host labor). In such a framework, a rise in productivity in the host country generates conflicting effects: marginal productivity grows, but also wages go up and therefore setup costs will increase and a foreign firm may decide not to invest. If the firm then decides to invest, it still faces the decision regarding how much to invest. These two decisions are described, respectively, by a selection equation and a flow (or gravity) equation. Razin finally summarized the empirical results, obtained using the Heckman selection method. In particular, a positive productivity shock seems to affect aggregate flows of FDI positively, while reducing the likelihood of positive FDI.

Mariam Camarero (Jaume I University) discussed Razin's paper. She welcomed the theoretical approach of the paper, because it is innovative with respect to the "trade theory" approach and because it allows using the data that is available (e.g., OECD only has very aggregate bilateral FDI data). Camarero then highlighted a problem often related to the gravity approach to FDI, namely that the variables commonly used as explanatory and the endogenous variable can have different orders of integration, and therefore suggested using FDI stocks instead of FDI flows. This would also avoid the necessity of smoothing, which can create many problems with $I(1)$ variables, as for example spurious cyclicalities. The discussant also pointed out to the possible presence of a bias in the analysis, due to the fact of not accounting for plausibly endogenous trade flows, and mentioned the possibility of threshold effects in the investment decision.

Further comments focused on the issue of the identification of the selection equation, given the presence in the equation of a dummy indicating the existence of past FDI flows. There were also suggestions to account for the fact that ex-colonizers on the frequency of FDI table and for the fact that, although the model rests on a general equilibrium framework, many of countries considered would not fit in such framework.

Domenico J. Marchetti (Banca d'Italia) presented the paper 'Pricing Behaviour and the Response of Hours to Productivity Shocks', written with Francesco Nucci (La Sapienza University of Rome). The motivation underlying the paper is to investigate the widely debated issue of how productivity shocks affect labor input and, in particular, to investigate if the co-movement between productivity shocks and labor input is significantly affected by the degree of price stickiness of firms. The presenter highlighted the extraordinary informational content of the very detailed firm-level panel dataset they use, which also comprises information on the typical frequency of price reviews, directly provided by each firm. He subsequently reported evidence on frequency of price reviews and on the patterns of price rigidities across different sectors and degrees of market concentration. Using this information and several measures of TFP growth, the authors estimate the relationship between technology shock and labor input, and verify whether it is affected by the degree of price stickiness by using two subsamples, with firms with, respectively, "more rigid" and "less rigid" prices. Marchetti reported that, while the instantaneous response of hours to TFP growth is negative in the subsample of firms with "more rigid" prices, it is generally positive or not statistically significant in the subsample of firms with "less rigid" prices. This supports the idea that price stickiness plays an important role in driving the contractionary effect of productivity shocks.

The paper was discussed by **Martial Dupaigne** (CREMAQ, Université Toulouse I). After a brief summary of the paper, Dupaigne focused his discussion on two main issues. First of all he questioned the relevance of analyzing the issue at a firm-level, suggesting instead that the focus should be at aggregate level. He pointed out that the authors depart from the literature because they assume an AR(2) process for the shocks instead of having permanent shocks. The second point made by the discussant regards the fact that the authors use unconditional frequency of price-reviews, while it would be interesting to have an indicator measuring conditional price changes (conditional on the specific firm receiving or not the shock).

During the brief roundtable discussion that followed, the main issue brought up was the problem of endogeneity, together with the possible problems induced by the presence of generated regressors.

Session 3

Frank Portier (Université Toulouse) opened the third session of the workshop, presenting the paper 'The "News" View in Economic Fluctuations: Evidence from Aggregated Japanese Data and Sectoral U.S. Data', co-authored with Paul Beaudry. Portier introduced the paper as an attempt to further characterize technology shocks by examining their properties, in terms of surprise and degree of diffusion, and their impact on aggregate variables, by exploring the properties of the joint behavior of stock prices and TFP. The authors run a bi-variate Structural VAR of a measure of TFP and a forward-looking economic decision variable, i.e. stock prices. They use two orthogonalization schemes sequentially: one with an impact restriction requiring that the shock on the stock market has no instantaneous effect on TFP growth and one with a long-run restriction requiring that the shock on the stock market has no long run impact on TFP. Using sequentially impact and long-run restrictions for identification allows evaluating different theories of business cycles, by comparing the correlations between the innovations that drive long-run movements in TFP and the stock price innovation, which is contemporaneously orthogonal to TFP in the data with the ones implied by different models. The empirical analysis confirms the idea that stock prices innovations contain most of the information regarding the long run movement of TFP and are responsible for short run business cycle fluctuations.

Max Gillman (Cardiff University) discussed the paper also referring to two other papers by Beaudry and Portier, which are closely related to the current one. He expressed appreciation for the approach to specify exactly how

the shocks in the business cycle models translate into shocks in the time series econometrics. Gillman then pointed out an inconsistency present in the paper: the theoretical model used in the current paper has dropped profits and that, hence, their model is of bond prices rather than stock prices, but the authors use data for stock prices in the empirical analysis. The discussant suggested mending the model by following an approach that combines the fixed factor approach of a previous paper with a more standard production function. He finally highlighted the policy implications of the paper, which seems to favor a monetary policy of strict inflation targeting.

Further comments mainly regarded the econometric approach. The importance of accounting for features of the data, as fat tails in the distribution of the stock prices and the presence of crashes, was stressed. The possible presence of a causality problem, due to the fact that news in productivity could cause the stock prices, was pointed out.

In 'Technology Shocks and Jobs Flows' **Claudio Michelacci** (CEMFI) and David Lopez-Salido (Bank of Spain) examine the short-run response of employment and output to investment-specific vs. neutral technological shocks, but departing from the widely used assumption that technology shocks instantaneously affect every firm's production technology. In fact, micro-evidence suggests that firm technologies exhibit remarkable persistence and that job creation plays a role in technology adoption. Thus, the authors introduce search frictions in the Solow model, which leads to sluggish reallocation of workers, and assume that technologies persist over time, in order to model imperfect technological upgrade. The authors calibrate the model so that, in the short run, neutral technology shocks prompt a wave of creative destruction, where job creation, job destruction and unemployment simultaneously increase, while investment-specific technology shocks are neoclassical. They provide support to the key dynamic implications of their model using Structural VARs. In contrast with Gali's (1999) finding that a (unique) technology shock leads to a decrease in hours worked in the short-run, Michelacci and Lopez-Salido find that investment-specific technological shocks lead to an expansion in employment, output and investment also in the short-run, whereas neutral technological shocks lead to jobless recovery, since technologically obsolete jobs are destroyed while new technologically advanced ones are created.

Sumru Altug (Koç University) carried out an atypical discussion: using food as a metaphor, she compared the paper to a Big Mac. She found the paper had too many ready-made features (Solow growth model, the Mortensen-Pissarides search model, Blanchard-Quah type of long run restrictions of VAR, Gali's hours-technology result) and that "throwing a bit of micro evidence [...] to macro models [...] is like putting a bit of lettuce in a Big Mac and making people think they are eating healthy." Altug nevertheless found insightful the decomposition of labor productivity used to identify the structural VAR and the consequent empirical results. She concluded noting the calibration of the parameters of the model derives from plant-level studies and wondered whether it was sound to pluck such parameter values in an aggregate model.

During the following roundtable discussion it was suggested to investigate the link between the investment-specific and neutral shocks presented in this paper vis-à-vis the investment- and consumption-technology shocks presented previously by Susanto Basu.

Rachel Griffith (Institute for Fiscal Studies and UCL) concluded the third session with a talk on 'Product and Labour Market Regulations and Patenting Activity', where she examined the effects of regulatory reforms to product and labor markets on the level of innovation of firms, proxied by their patenting behavior. The study is motivated by the attempt to explain slower growth in Europe compared to the US. The discrepancy between Europe's and US growth seems to be mainly due to lower levels of innovation and lower rates of adoption of the latest technologies in Europe. In the literature, product market deregulation is deemed to have conflicting effects on patenting behavior. If, on the one hand, it enhances competition, therefore increasing the possibility of entry for technologically superior entrants, on the other hand it reduces firms' ability to mark-up prices: this could discourage entry, but possibly also increase innovative effort by incumbents. There is debate also on the effects of employment protection legislation on the level of innovation of firms and, in particular, on the interaction between product and labor market institutions. In this paper, the author uses individual level data on patenting activity of firms in ten OECD countries and performs an empirical analysis aimed at studying the relative importance of the conflicting effects of product market deregulation on patenting behavior and the eventual interaction with employment protection legislation. Results suggest that tougher competition (proxied by a lower markup) increases innovation by incumbents while discouraging entrants. Moreover a decrease in employment protection increases patenting by both entrants and incumbents. Finally, evidence also suggests that the impact of increased competition is dampened by the presence of employment protection legislation.

The comments following the presentation by Rachel Griffith mainly focused on two aspects. First, starting from the observation that patents are an “intermediate good” leading to higher TFP, how can we reconcile this evidence with the fact that growth is lower in Europe even if in the recent period it has had far better competition institutions? A possible answer was given by Juan Dolado who suggested that it could be due to the fact that labor market reforms are still at a very early stage, but that once they will be done we will catch up. The second point regarded econometrics issue such as problems with the measurement of the markup and with the possible weakness (using Wright Yogo tests) of the instruments used to tackle the problem of the endogeneity of the mark up.

Session 4

The paper ‘Stochastic Capital Depreciation and the Hours-Productivity Correlation’ by Michael J. Dueker (Federal Reserve Bank of St. Louis), **Andreas M. Fischer** (Swiss National Bank) and Robert Dittmar (Federal Reserve Bank of St. Louis) explores whether stochastic depreciation shocks have to be unrealistically large in order to obtain a low hours-productivity correlation, as suggested in the literature. The authors analyze sectoral US data and find that depreciation rates are quite persistence, fluctuate in a relatively narrow band and do not appear to be very procyclical. They suggest that these features of depreciation rates can be well captured by modeling it as a two-state Markov switching process and verify what type of implications a depreciation rate process of such type would have in terms of hours-productivity correlations. They augment a baseline RBC model with a Markov switching process for the depreciation rate. The presence of nonlinearity in the DSGE generates problems for traditional solution techniques, thus the authors use Judd’s Projection Method and finally calibrate it. They then present correlations between productivity and hours stemming from the model, where the depreciation rate is first fixed, then modeled as a white noise and finally modeled as a Markov switching process. Indeed, the model with Markov switching depreciation is able to replicate the low hours-productivity correlation found in the data using shocks with a low variance, relative to the one that would be required having with noise depreciation shocks.

Susanto Basu acted as a discussant for this paper. Following Rotemberg and Woodford (1996), Basu evaluated the model on the basis the consistency of its forecasts of predictable transitory fluctuations with business cycle facts, and in particular with the finding that transitory components of investment, consumption and hours are all highly positively correlated over short- and medium horizons, a feature not predicted by standard RBC models. He found however that the response of the model to a depreciation shock was similar to the response of a standard RBC to a technology shock, although comovements may differ during the initial high depreciation phase. Basu expressed appreciation for the complex non-linear model developed by the authors, but found that it was probably a potentially more appealing framework for modeling the slow growth in GDP and TFP following the introduction of a new General Purpose Technology.

A further comment was made regarding the calibration of the model. In particular it was noted that the switch considered in the model is huge compared to the general empirical findings.

Klaus Neusser (University of Bern) presented the paper ‘Interdependencies of U.S. Manufacturing Sectorial TFP’s: A Spatial VAR Approach’, where he investigates degree of interconnectedness between sectors using spatial VARs. The consideration that there is little evidence of empirical relevance of aggregate shocks – while theoretical models suggest they should be large and persistent – and that identified aggregate shocks do not have good business cycle properties has led to a renewal of interest in alternative sources of economic fluctuations. In particular several researchers have investigated whether, and under which conditions, idiosyncratic sectoral- or firm-level shocks do not cancel out in the aggregate, as the law of large would instead suggest, but instead determine non-trivial aggregate effects. It has been suggested that interconnectedness between sectors, and in particular the presence of externalities and input-output linkages, can determine such amplification. Neusser estimates a semi-parametric spatial VAR for 458 sectors, in which the interrelationship between sectors is a function of the “economic distance” between sectors (proxied by comparison of factor input shares and input-output table). Compared with the existing literature on spatial VAR, he uses a bigger number of sectors and allows for autocorrelation and lagged effects across sectors. The author also computes TFP from gross rather than value-added output and quantifies the importance of Marshallian between sectors, estimating the coefficient of capital intensities. However, the main result of the paper is that sectoral TFP growth rates are not influenced by lagged TFP growth rates in other sectors, nor by growth rates of capital intensities in other sectors.

The discussion of **Hanna-Lenna Männistö** (Bank of Finland) started from the observation that indeed the results obtained by the author were in contradiction with the motivation of the paper and the author’s intuition, and

suggested a couple of papers (Eaton & Kortum, IER 40(3), 1999 and Maliranta, J Industry, Competition and Trade 5(1) 2005) to reconcile them with the literature on technology diffusion. The discussant then pointed out to the possible presence of measurement errors and suggested checking robustness with different types of measures both for TFP and for the “economic distance”.

The round of comments that followed the discussion mainly focused on alternative measures of economic distance.

Session 5

The fifth and last session of the Workshop was opened by **Luca Benati** (Bank of England), who presented the paper ‘Drift and Breaks in Labour Productivity’. In this paper, which is focused on low frequency rather than business cycle analysis, he investigates the presence of changes in the equilibrium labor productivity growth over the post-World War II era using data from US, the Eurozone, UK, Australia and Japan. The presenter stressed the importance of studying long-run productivity, since it key for crucial policy issues, like the future solvency of pensions systems or the definition of an accurate monetary policy. The author used tests for multiple breaks at unknown points in the sample and the Stock-Watson time-varying parameters median-unbiased estimation methodology. This empirical analysis evidenced a U-shaped productivity growth in the US, with the acceleration starting from the mid-1990s. In the UK there was a marked slowdown since the 1960s and some evidence of further deceleration in recent years. A gloomy picture was presented for the Eurozone, which experienced a continuous slowdown in productivity growth since the beginning of the 1980s, with trend productivity growth falling from around 2.4% to 1.1% in the last quarter of 2004. Benati also estimated the ‘size of the unit root’ in labor productivity growth, that is he evaluated what fraction of quarter-on-quarter change in labour productivity should be regarded as permanent, based on the Cochrane’s variance ratio. He obtains that the quarter-on-quarter change in productivity is about 3-4% in the US and about 4-5% in the UK, however large uncertainty surrounds these estimates (large confidence bands).

Attila Rátfai (Central European University) opened the discussion highlighting the contributions of the paper, namely the study of a key issue for public policy, such as the dynamics in productivity growth, the use of international data and the construction of confidence intervals via spectral bootstrapping for the variance ratio statistic. He then pointed out to the fact that the paper performs a univariate, unconditional in-sample analysis and suggested possible extensions of the paper, in particular out of sample forecasts and the search for explanatory variables for the time-varying productivity growth.

During the following round of comments, it was mentioned that that the Perron-Bai methodology used by the author could possibly have low power.

Productivity was again, as in the previous paper, analyzed as a variable in the paper ‘Analysing Productivity Cycles in the Euro area, US and UK Using Wavelet Analysis’ by **Patrick M. Crowley** (Texas A&M University), Douglas Maraun (University of Potsdam) and David Mayes (Bank of Finland). However, here, the authors make use of frequency-domain rather than time-domain techniques. More specifically, they use wavelet analysis, a technique with two very appealing features: it is both time and frequency resolved and recent developments allow extraction of cycles at various frequencies. The authors use three variations of wavelet analysis (a discrete wavelet transform, a continuous wavelet transform and Hilbert wavelet pairs) to further study the frequencies of the growth cycles of productivity and compare them between Euro area, US and UK. The main findings are the following. First, cyclical behavior in productivity growth is established as a stylized fact and the strongest component of this growth occurs at higher frequencies than that of the traditionally measured business cycle. Second, there seems to be a weak cycle at frequencies lower than the business cycle. Furthermore, coherence at business cycle frequencies was high and significant in the 1970s, but during the 1980s there was a dip in this coherence, followed by some rebound. Finally, euro area productivity cycles tend to lag those of the US and of the UK, to a lesser extent, while US cycles lead only slightly UK cycles. These last results however are not consistent across frequencies.

Gonalo Camba-Mendez (European Central Bank), discussant for the paper above, opened his talk by questioning the need for wavelet analysis in Economics. Indeed, although the technicality of standard spectral domain methods makes them not ideal for communication, decomposing the series’ evolution in periodic contributions allows a more insightful view of its structure and of its cyclical behavior and makes such tools indispensable for economics. But what about wavelet analysis? Camba-Mendez stressed, using an example of a music trio, that the two main advantages are the possibility of showing not only what frequency components are present, but also when they happen, and their usefulness with non-stationary data.

Some comments following the discussion further pointed out the need to better highlight what can be done with new techniques that cannot be done with standard ones. Other questions regarded the treatment of differencing and seasonality and issues related with the length of the sample.

The last talk of the workshop was held by **John Fernald** (Federal Reserve Bank of San Francisco) on 'Trend Breaks, Long-Run Restrictions, and the Contractionary Effects of Technology Improvements'. In this paper, the author explores the short-run response of the economy to a technology shock, using a Structural VAR approach for identifying technology shocks (only technology shocks change the level of productivity) rather than with "direct measures" as in Basu-Fernald-Kimball. Fernald finds that that Structural VARs are extraordinarily sensitive to low frequency correlations, and explores this sensitivity analytically and via simulations. In light of this result, he explains the reasons for the discrepancy between the results in Gali' (1999) and in Christiano, Eichenbaum, Vigfusson (2004). Using differenced hours, Gali' finds contractionary effects of technology improvements in the short-run, while CEV use hours in levels and find that hours worked rise also at impact. Fernald finds that the level/differences puzzle becomes unimportant (i.e. the two formulations give the same results in line with Gali'), if labor productivity growth is modeled as having trend breaks. The conclusion that competing empirical specifications yield a consistent answer, once one allows for trend breaks in the series, holds in bivariate and larger systems, and when estimated over sub-periods that correspond to break dates. During the talk, Fernald presented a simplified case in which he analytically showed that low-frequency correlation dominated the relevant covariances in the VAR and consequently that the CEV levels specification led necessarily to a positive impulse response. He then presented further simulation results confirming the finding. Concluding, if one allows for trend breaks in labor productivity, SVARs with long-run restrictions uniformly imply that hours fall following a technology shock, independently of their specification in levels or differences.

During the roundtable discussion, concerns were expressed regarding the fact that cutting out breaks may remove the most interesting dynamics. Therefore, also short-run restrictions or Beveridge-Nelson type of decomposition, which takes into account the low frequency movement and distinguishes it from business cycle, were suggested.