Do Those Who Stay Work Less?

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18th April, 2008

Abstract

The experience of the transforming economy is analyzed through the lenses of the efficiency wage model. Two apparently distinct issues are analyzed in the coherent framework. The evolution of the Polish economy from a highly dynamic environment, with excessive transitions between labour market states, to the relatively stable one and the consequent transition into a heavily depleted source country of European migration after the EU accession. With these developments in the background the key observation which is exploited in the paper is the slowdown of the TFP growth from around 4% in the second half of the 90 ties to only around 2% in recent years. The efficiency wage model which accounts for quits from the labour market and emigration gives some insight into the dynamics of the TFP. The model is fitted to the data using Bayesian methods and used to estimate the magnitude of the effect of the labour market transition at around by around 1 ppt. on average in the second half of the 90 ties. Fading of transition factors may explain part of the sluggish TFP growth in the recent years. Still, part of the slowdown may be ascribed to intensification of emigration after 2004.

Preliminary version

JEL Classification: C11, J30, J61, J64, F22

Keywords: emigration, labour market, EU enlargement, TFP, labour productivity

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1 Introduction

In the last decade Polish economy has evolved from a highly dynamic economic system, with excessive transitions between labour market states, to the relatively stable environment with a record high unemployment rate and a meager labour market participation rate. Eventually, after Poland joined the European Union, labour force movements across national boarders have considerably gained on importance introducing new dynamics into Polish labour market. Polish experience is in any way distinctive. It more or less reflects changes on labour markets of the neighbouring or in the South-East European economies. Referring to the Polish experience the paper attempts to delineate to what extent labour market developments impact the growth rate of an economy. There are two particular issues touched upon in the analysis. First, I comment on the impact of transition on the labour market, foremost on labour productivity and as a result on the growth rate of the economy. Second, I try to assess labour market and productivity effects as well as a magnitude of the growth deceleration coupled with the increase in the emigration intensity after the EU accession.

The period under consideration starts up in 1995 and ends at the end of 2006. The beginning of the decade was distinguished by intensive flows between labour market states facilitated by structural changes in the economy: closures of inefficient plants, reduction of the labour hoarding and hidden unemployment in some of the sectors, introduction of generous benefit systems, reform of social contribution and tax policies and consequences of the break-up of eastern foreign trade resulting from Russian crises. These changes together with demographic factors led to a reduction of the labour market participation rate by more than 5 ppt. within ten years. Still, the intensity of labour market transitions in the period was gradually easing. When the economy slowed down between 2000 and 2003 mobility of workers between the labour market states ultimately lessened. The new developments on the labour market moved in the foreground. At the beginning of 2004 Poland joined the European Union. Following the introduction of an open-door policy by some of the former member countries propensity to emigrate increased sharply having pronounced impact on new member states' labour markets. Within three years following the accession almost 5% of Polish workers moved abroad (Budnik, 2007a). What remains a heart of the analysis, in line with these developments, the TFP growth rate dropped significantly after the EU accession to around 2% after it was oscillating around 4% in the second half of the 90 ties.

Here, the impact of structural changes, which are often jointly labeled as a transition, and emigration is analyzed within a framework of the efficiency

wage model. In general, efficiency wage models deliver an explanation of why employers may prefer to lay off workers rather than cut wages. The key aspect of these models is that in a world where effort cannot be perfectly monitored or workers care about their relative income, wages may be rigid and nonzero unemployment may persist in an equilibrium. Here, the efficiency wage model is employed foremost to decompose the Solow residual, which is used as a measure of the TFP, into two unobserved components: the one dependent on labour market dynamics and the second which is interpreted as a technology-driven growth. The efficiency model together with an assumption of a constant technology-driven growth rate within the period serves as identifying assumptions facilitating description of the productivity fluctuations in terms of labour market developments.

Efficiency wage models differ considerably in reasoning why effort of workers might depend on the wage rate. Two explanations which are supposed to work for developed economy are based on the sociological premises (workers compare themselves to other workers and elicit lower effort when paid below some „reference wage") and on the shirking motive (monitoring of workers' effort is costly and higher wages may hinder the motivation to shirk). First bunch of the literature originates in works of Weiss (1980) and Akerlof and Yellen (1989) and has been recently strongly supported by the experimental economics. The latter works refer to Shapiro and Stiglitz model (1984).

The effort-eliciting motivation present in Shapiro and Stiglitz model has been henceforth relatively weakly held up by the empirical evidence. The multifarious efficiency wages tests have more or less failed to provide strong support for the efficiency wage hypothesis mainly due to some identification problems. Krueger and Summers (1988) and Gibbons and Katz (1992) focused on the presence and persistence of inter-industry wage differentials which as they claim may arise from diverse monitoring efficiencies. Oh (2005) directly correlated the supervisory intensity with a wage premium across enterprises in Korea and challenged the negative relation between the wage premium and monitoring intensity. Cappelli and Chauvin (1991) chose the different strategy and looked for the statistical relation between the wage premium and the number of dismissals for disciplinary reasons in different regions of the UK. The common limitation of that evidence pertains however to ability to test the efficiency wage against positive selection or profit sharing hypothesis. Manning and Thomas (1997) looked at the implications of the shirking model from the different angle. They explored the differences between the wage and reservation wage of workers to find only narrow gap between therefore a moderate support of the relevance of the shirking model. Machin and Manning (1992) evaluated in turn the dynamic properties of the efficiency wage models

against the alternatives. The efficiency wage model with shirking motive were as well tested on their ability to mimic the rigidity of wages and volatility of employment or hours worked in the business cycle. Gomme (1999) and Burnside et al. (2000) solved the RBC equilibrium model with the efficiency wages labour market structure and found that the Shapiro and Stiglitz mechanism does not dampen the volatility of wages strong enough to fit the variation of the data. Alexopulus (2006a,2006b) departed from the standard Shapiro and Stiglitz framework assuming that shirking workers are punished by a bonus cut and not by dismissal from job. The outcomes he gets are consistent with high degree of wages rigidity and highly volatile employment. But as Burnside et al. showed the model imperfectly reflects reaction of the economy to fiscal expenditure impulse.

Still, Shapiro and Stiglitz model, even though it plausibly underperforms in reflecting the business cycle frequency dynamics, may give some insight into medium term developments of the labour market which are of interest in the analysis. The model is augmented to incorporate the empirical transition probabilities between three labour market states, namely employment, unemployment and non-participation, and the temporary emigration.[1] Later, the model is estimated employing Bayesian methods which leave a great deal of discretion to a researcher about parameters values but still enable to exert some knowledge about the parameters values from the data. Bayesian inference proves to be especially appreciable tool when conducting the analysis of the transforming economy as it is a natural device to join the knowledge about the „standard" parameter values from developed economies with noisy information about the economy from the short time series data.

Next, I focus on evolution of an average effort elicit by workers to illustrate the impact of structural factors on the measured TFP growth. It appears, that the transition factors could have acted as a transitional growth accelerator boosting the measured TFP growth rates at the end of the last decade. Results suggest that diminishing mobility of workers between labour market states contributed to a slowdown of the TFP growth rate by around 1 ppt. Furthermore, the failure of the productivity growth to come back to high levels after the economic slowdown in the period 2000-2003 may be attributed to the negative impact of an increased emigration propensity after 2004 on the labour market. Better migration opportunities pushed up the shadow wage of those workers who stayed and via this channel exerted negative impact on their effort at work. They have worked less.

[1] Permanent emigration (emigration which coincides with registration of departure at administrative unite) constitutes only negligible fraction of the total emigration in Poland. Immigration flows which are not return migration flows are not analyzed in the paper.

The efficiency wage interpretation of the Solow residual developments is in any way the only plausible one. In the model changes in the transition probabilities between different labour market states, variation of the replacement rates driven by changes in the generosity of the unemployment or social assistance benefits systems and the relative earnings abroad affect the shadow wage of employed workers and their motivation to elicit effort. However, the casual impact of these factors on the growth rate of the economy would hold in the other standard models of the labour market.

The structure of the paper runs as follows. First section describes the model used in the analysis. Second and third sections deal with the data and the methodology employed to estimate the model. Fourth section describes parameter estimates. Two next sections concern the key results of the paper. And the final section concludes.

2 Efficiency Wage Model with Migration

The backbone of the empirical analysis is Shapiro and Stiglitz (1982) model. The model hints at intrinsic reluctance of workers to elicit effort and imperfections of the monitoring technology as sources of labour market inefficiency. Unsupervised workers would not exert effort. On the other hand, employers are unable to perfectly observe their productivity. To countervail shortcomings of the monitoring technology firms would pay employed workers the wage above market clearing level. Higher wages would in turn act as a discipline device deteriorating relative welfare of workers who shirk and involuntarily separated from the job.

The model serves as a platform to illustrate how flows between distinct labour market states and temporary emigration affect labour productivity and wages. Compared to the standard Shapiro and Stiglitz framework, the shirking model with migration works as follows. Transition probabilities between distinguished states are treated as exogenous. Firm and worker face some probability of a job termination which depends, among other things, on transition rates of employed workers to non-participation and emigration. Moreover, unemployed worker can seek employment not only on the home labour market but she may as well quit the labour market or look for job abroad. Quit and emigration opportunities affect a fallback position of employed workers and via this channel their effort.

2.1 Workers

An instantaneous utility function of a worker depends on her income ω and her effort e. The utility function is assumed to have a log-linear form [2]:

$$U(\omega, e) = ln(\omega) - \beta ln(e) \tag{1}$$

An employed worker may elicit effort and then $e > 1$ or shirk. An effort level of a shirking, unemployed, inactive worker and emigrant worker is normalized to $e = 1$. Hence, I assume that shirking as well as non-employment cause no disutility. When natural logarithms of variables are denoted with tilde the 1 becomes:

$$U(\omega, e) = \tilde{\omega} - \beta \tilde{e} \tag{2}$$

An instantaneous income of employed worker is denoted by ω^E and is equal to the real wage corrected for the direct taxes and social contributions $w(1 - t^{EMP})$. Instantaneous incomes of unemployed, non-participants and temporary emigrants are denoted respectively by ω^U, ω^N and ω^M. It is assumed that ω^M fully accounts for disutility of exerting effort when working abroad.

Workers move between labour market states and emigration with probabilities given by the transition probability matrix P:

$$\begin{bmatrix} p_{EE} & p_{EU} & p_{EN} & p_{EM} \\ p_{UE} & p_{UU} & p_{UN} & p_{UM} \\ p_{NE} & p_{NU} & p_{NN} & p_{NM} \\ p_{ME} & p_{MU} & p_{MN} & p_{MM} \end{bmatrix} \tag{3}$$

First row of the matrix represents transition probabilities from employment to (in the sequence order) employment (E), unemployment (U), non-participation (N) and temporary emigration (M). The current status of a worker depends solely on her previous status and the transition probability matrix P describes the respective Markov process. To simplify further notation, I define $I \in \{E, U, N, M\}$ as an ordered set of all possible indexes representing the distinguished labour market states.

[2] Here, I depart from the additive utility function in the original model of Shapiro and Stiglitz. The log-linear form of the utility function, as shall be shown later, enables to get a solution where the average effort of workers in the equilibrium is described by a set structural factors and in an absence of structural shifts it may be described as a stationary process.

An employed worker may work or shirk. When she is shirking workers and caught with probability q she shall be fired. An asset equation 4 says that in an equilibrium cost of being a shirker must be equal to the wage rate corrected for a loss in the asset value of a shirking worker when she is involuntarily separated from a job (denoted by V_E^S). Additionally, a shirking worker may change her state to other labour market states with exogenous probabilities p_{EU} to unemployment, p_{EN} to non-participation and p_{EM} to temporary emigration.

$$rV_E^S = \tilde{w} - t^{EMP} + q(V_U - V_E^S) + \sum_{i \in I/E} p_{Ei}(V_i - V_E^S) \tag{4}$$

Asset values of unemployed, non-participants and temporary emigrants are denoted respectively as V_U, V_N and V_M. All workers and firms discount future income flows at a common discount rate r. The asset equation of a non shirking worker differs from 4 by presence of the term representing a disutility of effort and absence of the term corresponding with a change in the asset value of a worker when she is caught on shirking:

$$rV_E^N = \tilde{w} - t^{EMP} - \beta\tilde{e} + \sum_{i \in I/E} p_{Ei}(V_i - V_E^N) \tag{5}$$

2.2 Firms

Firms are not able to perfectly monitor an effort level exercised by their workers. Screening efficiency is reflected in a probability q that a worker is nailed when shirking and dismissed. Firms set the wage rate at a level which makes a job loss costly enough to prevent shirking of their workers. The established wage rate should therefore fulfill the condition that an asset value of a non shirking worker is higher than an asset value of a shirking worker (no shirking condition):

$$V_E^N > V_E^S \tag{6}$$

Let $b = \sum_{i \in I} p_E i$ and $\bar{V} = \sum_{i \in I/E} p_{Ei} V_i$. Then, referring to 4 and 5, the wage rate that satisfies the inequality 6 is:

$$\tilde{w} - t^{EMP} > (r + b)V_U - \bar{V} + \beta/q(r + b + q)\tilde{e} \tag{7}$$

The wage rate offered by a firm is positively related to the level of an exerted effort and negatively to the probability of being caught on shirking.

On the firm level, both the wage rate and supervision intensity play a role of a discipline device. Moreover, the better a fallback position of an employed worker represented by an asset value of an unemployed worker the higher the offered wage rate.

2.3 Market Equilibrium

In an equilibrium all employed workers elicit effort higher than one and $V_E = V_E^N$. Under that condition, a system of four asset equations for employed, unemployed, inactive and emigrant workers can be solved to find the equilibrium values of V_E, V_U, V_N and V_M:

$$rV_E = \tilde{w} - t^{EMP} - \beta\tilde{e} + \sum_{i \in I/E} p_{Ei}(V_i - V_E) \tag{8}$$

$$rV_U = \tilde{\omega}^U + \sum_{i \in I/U} p_{Ui}(V_i - V_U) \tag{9}$$

$$rV_N = \tilde{\omega}^N + \sum_{i \in I/N} p_{Ni}(V_i - V_N) \tag{10}$$

$$rV_M = \tilde{\omega}^M + \sum_{i \in I/M} p_{Mi}(V_i - V_M) \tag{11}$$

Let Z be a matrix defined as $Z = (1 + r)I - P$ where I is an identity matrix. Z_{ij} is a submatrix of elements of Z that are left when the $i - th$ row and the $j - th$ column are excluded from Z. Further, $\zeta_{ij} = (-1)^{i+j} detZ_{ij}/detZ$. Then V_U and $\bar{V}$ from 7 can be written as functions of instantaneous incomes of workers in distinguished labour market states and emigrants:

$$V_U = \sum_{i \in I} \zeta_{iU}(\tilde{\omega}^i - \beta\tilde{e}^i) \tag{12}$$

$$\bar{V} = \sum_{j \in I/E} \sum_{i \in I} \zeta_{ij}(\tilde{\omega}^i - \beta\tilde{e}^i) \tag{13}$$

where $e^i = 1$ for $j \in I/E$ and $e > 1$ otherwise. Putting 12 and 13 to 7 and rearranging the terms I get an upper bound for a worker's effort that she exercise in the equilibrium:

$$\tilde{e} < \frac{\theta_U \tilde{rr}_U + \theta_N \tilde{rr}_N + \theta_M \tilde{rr}_M}{\beta((1/q)(r + b + q) + \theta_E)} \tag{14}$$

where $\theta_i = -(r+b)\zeta_{iU} + \sum_{j \in I/E} p_{Ej}\zeta_{ij}$ for each $i \in I$. Replacement rates rr_i for $i \in I/E$ represent a relative instantaneous income of a worker in the state i to the net wage of employed workers $\omega_i/w(1-t^{EMP})$. The effort elicited by workers in the equilibrium is the higher the lower is the instantaneous income of non-employed or emigrants as compared to the wage rate. Higher probability of being caught on shirking q increases effort. In turn, higher probability of separation b negatively impacts motivation of workers.

Importantly, in the formula above, the average effort of workers do not depend directly on the wage rate. Fluctuations in the wage rate, as long as they are accompanied by proportional changes in the level of benefits or wage level abroad, do not affect the average effort. Hence, when there are no institutional changes on the labour market stationarity of the effort term is assured even though the wage rate is allowed to increase along with the productivity growth. To achieve stationarity of the unemployment rate (which condition corresponds with stationarity of the effort term in the Shapiro and Stiglitz model with exogenous transition probabilities) Alexopoulus (2003, 2004a, 2004b, 2006a, 2006b) introduces families that insure their unemployed members against loss of employment. As capital income that finance the insurance increases in line with the growth of the economy fallback position of shirking workers improves in line with earnings.

2.4 Wages and Labour Productivity

In the medium run the wage dynamics is driven by the labour productivity growth. Here, I assume that product is generated with the use of two inputs, labour and capital, with the Cobb-Douglas production function. Moreover, in an environment where effort is a discretionary choice variable for workers, product will depend on labour input (measured in worker hours) adjusted for an effort exerted by an average worker:

$$y = (Ael)^{\alpha} k^{1-\alpha} \tag{15}$$

where y is a product, A the labour productivity or technology index, k capital stock and l labour. The way the technology index enters the production function is consistent with the Harrod neutral technological progress. In a log-linear form:

$$\tilde{y} = \alpha(\tilde{e} + \tilde{l}) + (1-\alpha)\tilde{k} + c_0 + \alpha g trend \tag{16}$$

c_0 is a constant and g is the total factor productivity growth rate. The real

wage rate adjusted for the social contributions levied on employers is equal to the marginal product of labour. Therefore:

$$\tilde{w} + t^{CORP} = \alpha\tilde{e} + (1-\alpha)(\tilde{k} - \tilde{l}) + c_1 + \alpha gtrend \tag{17}$$

The wage rate increases in line with the productivity trend (labour to capital ratio fluctuations are tied to the total factor productivity growth rate). Anyhow, in the medium run the wage rate may deviate from long run trend. Presence of the efficiency term in both the product 16 and wage 17 equations suggests that an array of structural changes and emigration patterns may coincide with long term growth trend of wages.

In the setting presented here, unemployment rate in the equilibrium depends only on the exogenous transition probability matrix P. However, the wage rate - labour productivity relation in 17 delivers interesting interpretation of the effort term. The lower the average effort of workers, the less efficient the labour market and the higher the labour cost. Hence, the effort term may be regarded as an inverse of a specific wedge on wages.

2.5 Effort and Reservation Wage

On a labour market where effort of workers is only imperfectly observed by firms the labour productivity may be triggered or slackened by a plethora of institutional and cyclical factors. Moreover, lower effort levels signal greater inefficiency of the labour market. Still, the labour market flexibility may as well be assessed by a gap between the reservation wage and the equilibrium wage rate. In the competitive equilibrium workers earn just their reservation wage. In an environment with costly effort and imperfect monitoring the wage rate is however higher then the reservation wage and the gap becomes positive.

The reservation wage of an unemployed worker w_U^* is defined as the wage rate which makes her indifferent between being unemployed and employed (in the equilibrium):

$$V_E(w_U^*) = V_U \tag{18}$$

Solving the equality above the following relationship holds for w_U^*:

$$\tilde{w}_U^* - \tilde{w} = \beta\phi_E\tilde{e} + \phi_U\tilde{rr}_U + \phi_N\tilde{rr}_N + \phi_M\tilde{rr}_M \tag{19}$$

where $\sum_{i\in I/E}\phi_i = 1$ and ϕ_i is a function of the transition probability matrix

P and the discount rate r [3]. Hence, the wedge between the reservation wage and the wage rate prevailing at a labour market is proportional to the equilibrium effort of workers and to the weighted average of replacement rates of unemployed, inactive and relative income of temporary emigrants.

Relation between the ratio of the reservation wage to the wage rate (reservation wage gap) and the efficiency term along with the weighted replacement rates is an interesting result. On a perfectly competitive market, where workers are paid just their reservation wage, the ratio equals one. The larger the deviation of the ratio from unity, the higher the inefficiency of the labour market. The measure is independent of workers' preferences as the parameter controlling the disutility of exercising effort β does not influence the ratio [4].

3 Data

The model was estimated with quarterly, seasonally adjusted data on Polish economy covering period from 1995 to the end of 2006. The labour market flows and flows between labour market states and the temporary emigration were calculated with the labour force and household surveys data. The household survey is conducted quarterly, jointly with the LFS by the Central Statistical Office. Both data source were merged to deliver the emigration flows and the return migration flows. The exhaustive description of the data together with comments on some of the issues concerning their quality and applicability may be found in Budnik (2007a).

The LFS information was employed to calculate the reservation wage to the wage rate ratio and the share of employed on the fix term contracts to all employed. Important to mention, the data on the average reservation wage which constituted the basis for calculation of the reservation wage to the wage rate ratio were available only for the periods 1995-1998 and 2003-2006. Even though, the data on the reservation wages were collected for the period 2000-2001, they could not be used because of the imprecise definition of the reservation wage in the LFS questionnaire which was used in these years. At the beginning of 1999, in line with the introduction of the far-reaching social security sector reform, wages were grossed-up. Still, no change in the question about the reservation wage in the LFS questionnaire, which would better specify the expected an-

[3] Let $\lambda_E = -p_{EN} - p_{EM}$, $\lambda_U = p_{UN} + p_{UM}$, $\lambda_N = p_{EN} - p_{UN}$ and $\lambda_M = p_{EM} - p_{UM}$. Next for each $i \in I$ define the sum $\eta_i = \sum_{j \in I} \lambda_j \zeta_{ij}$. Then $\phi_E = 1 + \eta e$, $\phi_U = (1 - \eta_U)$, $\phi_N = -\eta_N$ and $\phi_M = -\eta_N$.

[4] Comparing 14 and 19, it may be seen that the higher disutility of effort the lower the labour productivity and wages. However, the relative minimum wage rate at which workers are ready to take up a job remains unaffected.

swer followed. In fact, the question could have been interpreted as addressing either a net wage or a gross wage. Therefore the data for that period were dropped from the sample.

Other variables were taken from the National Accounts and from the population data. Detailed description of the variables and data sources is given in a table at the end of the paper.

4 Empirical Model

An empirical model refers to the wage equation in 17, the reservation wage gap equation in 19 and the inequality specifying the level of elicited effort 14.System of two equations, the wage rate equation and the reservation wage gap equation, was jointly estimated to increase the identification of the model parameters.

4.1 Labour Market Flows

The Polish LFS data let compute gross flows between employment, unemployment and non-participation. Here, the gross flows between labour market states are complemented with gross flows of workers between employment, unemployment, non-participation and temporary emigration. The latter were calculated on the base of merged information from the LFS data and from the household questionnaire. The household questionnaire, among other data, contains information about members of the interviewed household who are temporarily (their departure is not registered by the administrative unit) abroad for no less than two months.

For each two consecutive quarters denoted by $t-1$ and t the gross flows matrix F has a form:

$$\begin{bmatrix} F_{EE,t} & F_{EU,t} & F_{EN,t} & F_{EM,t} \\ F_{UE,t} & F_{UU,t} & F_{UN,t} & F_{UM,t} \\ F_{NE,t} & F_{NU,t} & F_{NN,t} & F_{NM,t} \\ F_{ME,t} & F_{MU,t} & F_{MN,t} & F_{MM,t} \end{bmatrix} \tag{20}$$

where $F_{ij,t}$ denotes a number of individuals changing their state from i to j and $i, j \in \{E, U, N, M\}$ between the quarters.

The gross flows matrix was corrected for under-registration of household migration and long-term migrants in the data. The background for the correction

of migration outflows was their plausible downward bias because emigration of all households (or alternatively all family members) is rarely recoded in the data[5]. Second, the return migration probability was likely to be biased upward due to the fact that the long-term emigrants, who have lower individual return probability, are heavily undercounted. Hence, the gross flows to emigration from employment were corrected by $m_E\%$ upward, from unemployment by $m_U\%$ and from inactivity by $m_N\%$. The return migration probabilities to employment, unemployment and non-participation were scaled down respectively to $n_E\%$, $n_U\%$ and $n_N\%$ of an original magnitude. The corrected gross flows matrix F, denoted by $\hat{F}$, is of a form:

$$\begin{bmatrix} F_{EE,t} & F_{EU,t} & F_{EN,t} & m_E F_{EM,t} \\ F_{UE,t} & F_{UU,t} & F_{UN,t} & m_U F_{UM,t} \\ F_{NE,t} & F_{NU,t} & F_{NN,t} & m_N F_{NM,t} \\ n_E F_{ME,t} & n_U F_{MU,t} & n_N F_{MN,t} & F_{MM,t} \end{bmatrix} \tag{21}$$

The parameters in vectors $m = (m_E, mU, m_N)$ and $n = (n_E, nU, n_N)$ were estimated jointly with other statistical parameters of the model.

The empirical transition probability matrix corresponding with 3 was for each quarter t calculated on the base of $\hat{F}_t$. Therefore, it was a function of m and n and $P_t \equiv P(F_t; m, n)$. In the reference model an equality constraint on the elements of m and n was imposed.

4.2 Labour Input

Labour input was measured as hours worked. The level of employment was calculated on the base of population data multilied by the steady-state ratio of the number of employed to the total population of Poland pop_t and by the average hours worked per worker h_t. Hence, I departed from employing the original aggregate LFS data on the level of employment. Referring to the steady-state solution, I alleviated the problem of overestimation of the LFS population data by the Central Statistical Office originating incomplete accounting for an outflow of workers abroad after the EU accession (Budnik, 2007a). The use of the uncorrected data could lead to underestimation of labour productivity, particularly at the end of the sample period.

The steady-state level of employment for each period t was a solution of the following problem:

[5]There are no household members in a dwelling to report the departure.

$$p_{UE,t}U_t^{SS} + p_{NE,t}N_t^{SS} + p_{ME,t}M_t^{SS} = (p_{EU,t} + p_{EN,t} + p_{EM,t})E_t^{SS} \quad (22)$$

$$p_{EU,t}E_t^{SS} + p_{NU,t}N_t^{SS} + p_{MU,t}M_t^{SS} = (p_{UE,t} + p_{UN,t} + p_{UM,t})U_t^{SS} \quad (23)$$

$$p_{EN,t}E_t^{SS} + p_{UN,t}U_t^{SS} + p_{MN,t}M_t^{SS} = (p_{NE,t} + p_{NU,t} + p_{NM,t})N_t^{SS} \quad (24)$$

$$p_{EM,t}E_t^{SS} + p_{UM,t}U_t^{SS} + p_{NM,t}N_t^{SS} = (p_{ME,t} + p_{MU,t} + p_{MN,t})M_t^{SS} \quad (25)$$

where the fractions of workers in four states sum up to unity. Employment to total population ratio in the steady-state e_t^{SS} is a function of elements of the empirical transition probability matrix P_t. Hence $e_t^S S = e^{SS}(F_t; m, n)$. The steady-state employment level was calculated as $e_t^{SS} pop_t$ and the labour input l_t as $h_t e_t^S S pop_t$. In short $l_t = l(F_t, h_t, pop_t; m, n)$.

4.3 Model Assumptions

To account for impact of changes in employment regulation on wages within the sample period, the probability of being caught when shirking q was allowed to fluctuate in line with increasing share of fix term employment contracts. Namely, the probability of being caught q was assumed to be a linear function of the fraction of employed on fixed term contracts in the population of employed f_t according to the LFS:

$$q = q_0 + q_1 f_t \quad (26)$$

where q_0 and q_1 were estimated model parameters.

Three distinct replacement rates corresponding with two non-working labour market states and emigration state were used in the empirical model: rr_U, rr_N and rr_M. The replacement rates were approximated by ratio of the expected income when unemployed, inactive or emigrant to the net wage rate. Because relative income variables fail to account for plausible non-income factors which could have influenced welfare of non-employed or emigrant workers (like leisure time or social cost of emigration), the replacement rates were rescaled with estimated parameters ρ_U, ρ_N and ρ_M. I allowed for a jump change in emigration cost after the EU enlargement. The dummy variable eu_t equals one from the second quarter 2004 on was introduced to the wage and the reservation wage gap equations with a parameter τ which reflected a percentage change in the emigrants' expected relative income after the EU accession. In the effect, the relative income of emigrants can be expressed as:

$$rr^*_{M,t} = (1 + \tau eu_t) rr_{M,t} \quad (27)$$

4.4 Empirical Wage Equation

The estimated equations had a form:

$$\tilde{w}_t - t_t^{CORP} = \alpha\tilde{e}_t + \alpha(\tilde{l}(F_t, h_t, pop_t; m, n) - \tilde{k}_t) + c + \alpha gtrend + \varepsilon_{1,t} \quad (28)$$

and $\varepsilon_{1,t} \sim N(0, \sigma_1)$.

$$\begin{aligned}\tilde{w}^* - \tilde{w} = \beta\phi_E(F_t; m, n, r)\tilde{e}_t + \phi_U(F_t; m, n, r)\rho_U\tilde{rr}_U + \\ + \phi_N(F_t; m, n, r)\rho_N\tilde{rr}_N + \phi_M(F_t; m, n, r)(1 + \tau eu_t)\rho_M\tilde{rr}_M + \varepsilon_{2,t}\end{aligned} \quad (29)$$

and $\varepsilon_{2,t} \sim N(0, \sigma_2)$ where $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$ are independent. And finally:

$$\begin{aligned}\tilde{e}_t = \Big(\theta_U(F_t; m, n, r)\rho_U\tilde{rr}_{U,t} + \theta_N(F_t; m, n, r)\rho_N rr_{N,t} + \\ + \theta_M(F_t; m, n, r)\rho_M(1 + \tau eu_t)rr_{M,t}\Big) / \\ / \Big(\beta((1/q(f_t; q_0, q_1))(r + b(F_t; m, n) + q(f_t; q_0, q_1)) + \theta_E(F_t; m, n, r))\Big)\end{aligned} \quad (30)$$

The estimated equations correspond with 14, 17 and 19 where the functions of the transition probability matrix P and the discount rate r θ_E, θ_U, θ_N, θ_M, ϕ_U, ϕ_N, ϕ_M and b are replaced with corresponding functions of the empirical transition probability matrix P_t and a statistical parameter representing the discount rate. The reservation wage gap does not depend either on β nor on the technology parameters and trend productivity. Therefore, it was expected to increase identification of other model parameters.

In total, the empirical wage equation included 14 statistical parameters: q_0, q_1, β, α, ρ_U, ρ_I,ρ_N,ρ_M, τ, r, g, c, m, n and σ and 23 independent variables: the real wage rate corrected for the social security contribution, the wage rate to the reservation wage ratio, flows matrix variables, the average hours worked per employee, replacement rates, the population of Poland, the capital stock, the fraction of workers employed on the fix term basis, the time trend and the EU dummy.

5 Methodology

The system of equations 28 and 29 with condition in 30 imposed on the estimation process were estimated employing Bayesian methods. Bayesian inference

let consolidate a priori information about parameters values with information contained in data. That blend of information may be of particular advantage when structural parameters of the model are estimated with short time series that cover mostly transition period. An explicit incorporation of a priori knowledge in the estimation process proves as well helpful when dealing with over-parameterization of a system of equation.

5.1 A Priori Parameter Distributions

An a priori distribution of a monitoring efficiency parameter q_0 in 26 was set to a beta distribution with the expected value of 11% and the maximum value of 25%. A q_1 parameter had in turn triangular density concentrated around zero. The triangular density of the parameter reflected high a priori probability of no changes in the structural parameter q. Maximum value of q_0 was set to 0.5 which corresponds with a maximum increase in the monitoring intensity throughout the period by less than 20 ppt. A restriction that q is not higher than 1 was forced upon the estimation process.

An a priori distribution of a β parameter was established on the base of the description of a „natural experiment" at Ford company provided by Raff and Summers (1986) paper. Between 1913 and 1914 Henry Ford increased hourly wages of his workers almost twofold within three months (accounting for changes in working time). In fact, the pay rise not only did not lead to any loss of profits but the company registered significant gains in both productivity and profits in the following years.

The parameter β controls utility change caused by 1% increase in elicited effort. Or, stated otherwise, it measures an increase in wages which is required to induce 1% increase in effort exerted by a worker. Raff and Summers document that 140-180% rise in the wage rate that covered a lion's share of workers at the Ford company, led to a 40-65% increase in hourly labour productivity. The estimates of the β parameter based on the data provided by Raff and Summers remain in the range between 2.7 and 4.3. Therefore, an a priori beta distribution of the parameter was set within a broad range of between 2 and 6 with the expected value of 3.8.

High a priori variance of the parameter reflects the uncertainty of the estimates. The authors provide multifaceted arguments that the sharp increase in compensation was targeted at incentivizing the employed workers and not at attracting greater pool or higher quality employees. Moreover, the implemented methodology allowed them to separate impact of the Ford's wage policy from seasonal and trend factors. Still, the estimates may be biased downward

as the authors did not take account of the increased share of the value added that was generated inside the Ford plant. On the other hand, more severe supervision measures introduced between 1913 and 1914 at the Ford company as well as significant concurrent worsening of labour market conditions, mentioned by Raff and Summers and by later Raff (1988), seem to indicate at a risk of underestimation of the productivity increase.

An elasticity of product to labour input α was assumed to have the symmetrical beta distribution concentrated around 0.6773 fixed on the point corresponding with the share of wages in the GDP in 2003. According to Musso and Westerman (2005) the rate of growth of the potential product in the euro era amounts to around 2.1% which corresponds with the rate of TFP growth of around 1.5%. It can be expected that the rate of technology driven growth in the transition economy is higher than in developed countries. Taking the estimates of the TFP growth based on the Musso and Wasterman as a reference level, the expected a priori value of g was set at a higher level of 2.2% with higher probability of g taking values over the expected value than below the expected value. Feasible values of the parameter were fixed between 1.5% and 3.5%.

All parameters rescaling replacement rates ρ_U and ρ_N had symmetrical beta a priori distributions with the expected value of 1. The expected value of ρ_M was fixed at around 28%. Lower rescaling parameter let account for emigration cost and the upper limit of the beta distribution of 55% assured that the effective relative income of workers abroad is not higher that the income of employed. The τ parameter had uniform a priori distribution on $[0, 1]$.

The a priori expected value discount rate r was set to 5% which was close to the average level of the real interest rate in Poland in the period under consideration. For the constant c a t-Student distribution with high variance was chosen reflecting lack a priori assumptions about the minimum or maximum value of the parameter.

A priori distributions of the parameters rescaling migration flows n and m were set similarly to Budnik (2007b) as beta distributions with the expected values corresponding with values calibrated on the base of the Population Census 2002 (PC 2002) data. An additional restriction was imposed on the estimation procedure, that the steady-state emigration rate in 2002 (the share of temporary emigrants to total population of Poland) that solves the system in 22-25 should have been close to the corresponding figure in PC 2002.

Finally, the variance parameter σ_1 and σ_2 were assumed to have a gamma a priori distribution with the expected value of 1.

5.2 Estimation Strategy

A posteriori parameter distributions were established using the Random Walk Chain Metropolis-Hastings algorithm with the normally distributed increment random variable. CUSUM statistics were used to check the algorithm's convergence. The starting values were randomly drawn from the parameter density domains. 600 thousands draws were taken, out of which 20% were dropped. The acceptance probability ratio was close to 6%.

6 Results

This section summarizes the main results and describes model simulations. Four main points are made. First, the estimates of the model parameter suggest that bargaining power of workers in Poland is relatively low and abating in line with the liberalization of the EPL. Second, from the mid 90-ties both job destruction as well as job creation rate have been on a downward trend. It might indicate at weakening importance of transition factors in explaining dynamics of employment or wages. Third, the emigration rate (measured as a ratio of number of temporary emigrants to the total population) increased significantly after the EU accession. And finally, a rise in emigration, even if considerable, had only limited impact on wages.

6.1 A posteriori parameter distributions

Table 2 summarizes basic characteristics of a priori and a posteriori distributions of statistical parameters. The expected a posteriori value of q_0 is around $5ppt.$ higher than a priori. The expected value of q_1 in turn is significantly closer to zero then expected a priori. Taken together these estimates indicate at a high but greatly unaffected by institutional changes (as compared with a priori assumptions) screening efficiency in the period under consideration. The a posteriori modes of the parameters are respectively 16% and 0%.

The expected a posteriori value of β is roughly $1ppt.$ higher than assumed a priori. A priori and a posteriori modes differ even more significantly by almost $1.5ppt.$. This result translates into 1% wage rate hike that is necessary to compensate a worker's productivity increase by over 20%. It is still much less than 30% suggested by the mode of the a priori distribution.

An a posteriori distribution of the elasticity of product to labour input parameter α is slightly shifted to the left as compared to the a priori distribution. The mode value of the parameter is 70%.

Estimates of replacement rates rescaling parameters point at higher (by around 20%) than assumed a priori elasticity of the wage rate to an unemployed replacement rate, close to a priori assumptions elasticity of the wage rate to a non participants' replacement rate and lower (by around 10%) elasticity of the wage rate to temporary emigrants' relative income. The data indicate at rather moderate change in cost of emigration after the beginning of 2004. The corresponding reduction in an effective relative income of emigrants was 10-20%.

A priori and a posteriori distributions of the discount rate do not noticeably differ. There is however a stark difference between an a priori and an a posteriori distributions of a trend parameter g. The data support lower values of the parameter with a mode value closer to 1.7% than 2.2% assumed a priori. The expected a posteriori value of a constant in the wage equation is close to 0.1.

A posteriori distributions of parameters correcting migration flows, as compared to a priori distributions, are shifted to the right and left, respectively. In sum, these results point out at more severe underestimation problem in the emigration flows, less pronounced overestimation problem in the return migration probabilities and finally at higher emigration rate than assumed a priori.

6.2 Elasticities of the wage rate and the reservation wage

Table 3 sums up estimates of wage rate and reservation wage gap to changes in the key model variables and parameters. These elasticities depend in general on the whole range of other parameters and variables' values and in fact they are time varying. Therefore the table reports only elasticities for the last quarter of the sample period (4th quarter of 2006).

Lower monitoring efficiency on the macro level translates into a fall into workers' productivity and, in the effect, in the lower wage rate. The lower expected effort of worker on the job, the lower the compensating wage margin over the reservation wage and what follows the ratio of the reservation wage to the wage rate is reduced.

An increase in any of the replacement rates induces upward shift in the ratio of the reservation wage to the wage rate in line with improvement of a fallback position of workers. The higher the expected income when out of job, the lower an effort exercised be a worker. It leads to a drop in the labour productivity and reduction in the wage rate on the aggregate level.

An upsurge in number of workers (population) or number of hours worked

per worker without proportional increase in the stock of capital, lowers the labour productivity and leads to a decline in the wage rate. Similarly, higher capital accumulation with labour input lagging behind introduces proportional gain in the wage rate.

7 Labour Market and Transition

The model estimated in the previous sections facilitates description and understanding of changes on the labour market between 1995 and 2006. Figure 5 sketches evolution of the monitoring efficiency parameter within the period. In accordance with a low a posteriori probability of a shift in technology of detecting and punishing shirking workers, the q parameter increases only moderately at the end of the period (by less than 2 ppt.) and remains close to 15%.

Figure 7 depicts the probability of separation from a job. A gradual reduction in the probability of separation from a job between 1995 and beginning of 2002 corresponds with fading of transition factors. After 1995 significant cuts in a labour hoarding to curtail existing inefficiencies in production process were accompanied by generous social assistance and unemployment benefits policies. Strong outflow of workforce to inactivity compressed the employment and activity rates (compare Figure 9 and Figure 10). Even though, the unemployment rate fell significantly after 2003 in line with revival at the labour market (Figure 8), the labour force utilization remained low.

Around 2003, before the EU accession, there was a sharp increase in the emigration rate. In 2006 already around 8% of the Polish workers were resident abroad compared to over 2% in 2002. Apparently, that significant outflow of workers further reduced the labour supply and contributed to cyclical shortages on the labour market.

The average effort of workers increased between 1995 and 2006. Figure 12 illustrates the average effort of employed workers in logarithm. From 1995 to 2001 the average effort of workers displayed a stable upward trend. Between year 2002 and 2005 the effort leveled off at around 10% higher level than in 1995. Finally, in 2006 the level of the effort dropped by approximately 2% as compared to the earlier year.

To disentangle impact of institutional factors and labour market dynamics on the productivity of workers, counterfactual predictions of an effort term were simulated under assumption that variable of interest remained unchanged from the beginning of 1995. Next, difference between counterfactual predictions and

an actual prediction were interpreted as an influence of a given factor on the labour productivity (and wages).

Liberalization of employment protection coupled with increasing recognition of fix-term contracts contributed to an increase of the average effort and the measured labour productivity by around 1% (compare Figure 14). A significant factor behind built-up of the workers' productivity was a sharp reduction of the unemployment benefits system generosity in 1997, which has led to a pronounced depreciation of the replacement rate of unemployed. As figure 15 shows, that element caused a strong 4% upward shift in the effort term after 1997. Fluctuations of the two other replacement rates had only minor effect on the labour productivity. Variation in the replacement rate of non-participants squeezed effort of workers before 2000. From 2001 on, these were partly shifts in the non-participants replacement rate that accounted for moderation of the positive trend in the efficiency term (Figure 16 and Figure 17).

Finally, the last graph (Figure 18) uncovers the main driving force behind evolution of the effort term. In line with significant reduction in the intensity of flows between labour market states and the probability of separation before 2002 the average effort of workers increased by roughly 7%. Labour market and emigration flows explain as well a 4% plunge of the average effort of workers in 2006.

8 Labour Productivity Trends

Here I use earlier results to explain the downtrend in the TFP growth. Further, I employ the model to establish the magnitude of the potential GDP's reduction tied to intensification of emigration after the EU accession.

8.1 Effort and TFP growth

Figure 2 depicts the TFP yearly growth rates in the period 1995-2006. The TFP was calculated based on a Cobb-Douglas with capital and the labour input defined as a number of hours worked. The elasticity of the product to labour was set at the a posteriori expected value of α.

The calculated TFP growth rate falls gradually throughout the sample period. Some explanation of a slowdown of the TFP growth after the 90ties is a creeping reduction of the labour hording throughout the first half of the sample period. Firms were reducing excessive employment and inefficient companies were closed down. The process was fueled by the Russian crisis. After

2000, the economic growth slowed down and the TFP trend leveled off. Puzzlingly, after 2003 when the economy boosted and capacity utilization went up deepening of the TFP growth rate continued . The economic revival attenuated practically no reversal in a downward trend.

Budnik (2007a) looked for an explanation of the phenomena in the LFS employment statistics. The concept was based on the hypothesis that the LFS population might be inappropriately adjusted for a strong temporary emigrants outflow after 2002. However, even after accounting for a sharp increase in the emigration rate in the period 2003-2006 the TFP growth reflects downward trend. Figure 3 depicts the TFP growth rate calculated on the base of the steady-state LFS employment level corrected for the swell in the emigration rate. Because of high variability of the steady-state labour market figures, the TFP growth rate was also calculated on the non-farm employment level in larger enterprises (Figure 4). These data are less likely to be hindered by strong outflow of emigrants after 2002 than the LFS data.All in all, the potential bias in the LFS data may explain around half of the downtrend in the TFP growth rate.

Here, I deliver a complementary explanation of a deceleration of the TFP growth to the one mentioned above. The idea refers to the production function in 15. The measured TFP growth equals:

$$d(t\tilde{f}p) = \alpha g + \alpha d(\tilde{e}) \tag{31}$$

Hence, the measured TFP growth reflects not only changes in the rate of technological change but can as well vary with changes in the effort term. When changes in the effort wedge are not explicitly accounted for in the analysis, changes in the TFP growth rate may be misinterpreted as changes in the underlying parameter g.

Under assumption that the labour productivity gains tied to the technological progress followed the stable time trend, the medium term swings in the TFP dynamics may be explained by institutional changes the intensity of workers' flows on the labour market. Figure 15 reflects the TFP changes which may be contributed to fluctuations in an effort term. The data were constructed using a posteriori distributions of the model parameters and the steady-state employment level. Therefore the graph best corresponds with the TFP dynamics depicted in Figure 2.

Clearly, structural changes positively contributed to the observed TFP growth rate at the end of the transition period. Between the years 1995-2001 around 1 ppt. of the TFP growth rate on average may be explained by

transition changes. Stabilization of the effort level in the period 2002-2005 translated into lowering of the reported TFP growth. Still the model performs rather poorly explaining the TFP dynamics at the end of the period under observation. Strong deviation of the steady-state employment rate from the actual employment rate in 2006 (tied to strong outflows of workers into non-participation indicated by the LFS data) impairs the calculation and interpretation of the TFP dynamics.

8.2 Effects of Changes in Emigration Trends

An upsurge in the emigration propensity after 2003 let to a significant decline in the labour supply on the home labour market. Less apparently, for those who stayed, the EU enlargement and the open-door policy pursued by some of the former EU countries, broadened the spectrum of available opportunities when out of job. Therefore motivation of resident workers to work hard at a given wage rate could have attenuated. The analysis abstracts from the development of the average labour productivity tied to the compositional effects but its focus point is instead an influence of emigration on the labour market through the relative income (and its impact on „labour supply") and separation rate (and its impact on both „labour demand" and „labour supply"). In the efficiency wage model effort depends on the wage rate and on outside option of an employed worker. The dependency between the well-being of a worker in different labour market states and the equilibrium wage rate may be easily generalized on emigration state and welfare of emigrant workers.

The idea explored here was to identify changes in the TFP and the potential GDP level induced by the shift of the emigration propensity of workers and emigration cost after the EU accession. In practice emigration flows related directly to the EU accession are hard be identified in the observed gross flows. It is hard to disentangle effects of EU enlargement from cyclical movements or explicitly deal with substitution effects between different emigration directions in the aftermath of immigration policy liberalization in some of the European countries. Therefore, in the counterfactual scenarios the intensity of emigration flows was kept at the levels observed in 2002. In line with reduction of the emigration propensity I assumed proportional compensating increase in the persistency of employment, unemployment and non-participation.

Two counterfactual scenarios were constructed. Both scenarios described reduction of the potential GDP following the increase in the emigration propensity after 2002. The first scenario was prepared under an assumption that the high outflow of the labour force did not influenced capital accumulation. The second approximated a magnitude of the slump in the potential GDP resulting

from the higher hazard rate to emigration under assumption that higher outflow of labour force induced no changes in the capital to labour ratio. Clearly, these scenarios displayed the boundary outcomes for the reduction of the potential GDP. The first scenario corresponds with minimum impact of emigration on the potential GDP as the reduction of the GDP may by tied only to the decline in the number of workers at the home labour market and the impact on the effort of those who stay. In the second scenario, outflow of workers is coupled with proportionate cutback in the capital stock.

Still, it begs the question which of these two simulations is closer to an actual reduction of the GDP. Intuitively, the answer should depend on the relative speed of the capital adjustment as compared with the intensity of emigration outflows. In the longer run, the second scenario should give better description of an actual reduction of the potential GDP. However, if the swell in the emigration rate came as a surprise to enterprises the capital stock could not have been readjusted on the aggregate level at once. That fact, justifies running the first scenario as some optimistic reference point for the estimates.

The effects of the changes in the emigration trends and the emigration cost on the GDP level are depicted in Figure 19 (the first scenario) and Figure 20 (the second scenario). The estimated reduction of the GDP resulting from the outflow of the labour force by around 5%, is in the range of 5% to 7%. The lion share of an impact on the potential GDP is coupled directly with the outflow of the labour force. Still, Figure 22 shows that changes in the emigration propensity induced around 1% reduction in the effort level of those who stayed. That in turn could have led to lowering of the measured TFP growth and reduction of the potential GDP by around 0.7%.

9 Conclusions

The paper attempts to describe impact of transformation and of recent trends in emigration on the Polish labour market through the lens of the efficiency wage model. It refers foremost to information on the gross flows between labour market states and temporary migration calculated on the LFS and household survey data. Following issues are addressed:

- Downtrend in the TFP growth rate observed between the years 1995-2006 with a special focus on the cryptic sluggish TFP dynamics accompanying the recent economic revival
- Role of transition for labour market and the growth rate of the economy

- Impact of emigration on the labour market and reduction of the GDP tied to strong outflow of the workforce after 2003

Estimation of the set of two equations (wage and reservation wage equations) enabled interpretation of the above problems in the common framework. Results suggest that the slowdown in the TFP trend was linked to fading of transition dynamics of the labour market, and mostly in the recent years, to negative developments on the labour market triggered by high emigration. According to the estimates, the emigration trends contributed to a reduction of the potential GDP of the economy by around 5 to 7% and the employment level by around 8%. Emigration impacts the labour market not only by reducing labour force but as well it exerts negative influence on an effort of resident workers. The model the paper refers to do not answers these empirical questions in the only possible. Answers delivered in the paper are certainly model-specific. Other specifications of the model would plausibly deliver slightly different interpretations of the phenomena and estimates of the magnitude of the emigration impact on the economy. Especially, the promising models to be explored could include the models with fully endogenous natural unemployment rate instead of the effort term which approximates labour market efficiency in the model which was used in the paper, models extending the analysis to a full equilibrium and models with heterogeneous labour to account for compositional effects. However, with all the deficiencies of the partial equilibrium approach with a bunch of ad hoc assumptions imposed on the simulation of the EU effect the model is not only able to coherently explain a few relevant economic facts but also proves to be a flexible toolkit to analyze the labour market of an open economy.

Bibliography

[1] Akerlof G.A. and Yellen J.L. (1990), „The Fair Wage-Effort Hypothesis and Unemployment", The Quarterly Journal of Economics, Vol. 105, No. 2., pp. 255-285

[2] Alexopoulus M. (2006a), „Shirking in a Monetary Business Cycle Model", Canadian Journal of Economics 51 (2), pp. 277-298

[3] Alexopoulus M. (2006b), „A Monetary Business Cycle Model with Unemployment", manuscript

[4] Alexopoulus M. (2004a), „Unemployment and the Business Cycle", Journal of Monetary Economics, Vol. 36, No. 3

[5] Alexopoulus M. (2004b), „The Effects of Shocks in the Monetary Business Cycle Model with Unemployment", in Price Adjustment and Monetary Policy, Conference Proceedings, Bank of Canada, pp. 105-148

[6] Alexopoulus M. (2003), „Growth and Unemployment in a Shirking Efficiency Wage Model", Canadian Journal of Economics, Vol. 36, No. 3

[7] Aydemir A., Borjas G.J. (2006), „A Comparative Analysis of the Labour Market Impact of International Migration: Canada, Mexico, and the United States", NBER Working Paper No. 12327

[8] Barrell R., Fitzgerald J., Riley R. (2007), „EU enlargement and migration: assessing the macroeconomic impacts", NIESR Discussion Paper No. 292

[9] Blanchflower D.G., Saleheen J., Shadforth Ch. (2007), „The Impact of the Recent Migration from Eastern Europe on the UK Economy", Bank of England, manuscript

[10] Bleaney M. (2005), „Migration and Unemployment in an Efficiency Wage Model of a Small Open Economy", Economics Bulletin, Vol. 6, No. 21, pp.1-6

[11] Budnik K.B.(2007a), „Migration and Labour Market in Poland", NBP Working Paper No. 44

[12] Budnik K.B.(2007b), „Search Equilibrium with Migration: the Case of Poland", NBP Working Paper No. 45

[13] Burnside C., Eichenbaum M. and Fisher J. (2000), „Fiscal Shocks in an Efficiency Wage Model", NBER Working Paper No. 7515

[14] Cappelli P. and Chauvin K. (1991), „An Inter-Plant Test of Efficiency Wage Arguments", Quarterly Journal of Economics, Vol. 103, pp. 769-787.

[15] Card D. (2001), „Immigrant Inflows, Native Outflows, and the Local Labour Market Impacts of Higher Immigration", Journal of Labour Economics 19

[16] Diamond P.D. (1982), "Aggregate Demand Management in Search Equilibrium", Journal of Political Economy 90

[17] Drinkwater S.J., Eade J., Gerapich M. (2006), "Poles Apart? EU Enlargement and the Labour Market Outcomes of Immigrants in the UK", IZA Discussion Paper 241

[18] Dustman Ch.(1996), "Return Migration: the European Experience", Economic Policy: A European Forum 22

[19] Friedberg R.M. and Hunt J. (1995), „The Impact of Immigrants on Host Country Wages, Employment and Growth", The Journal of Economic Perspectives 9

[20] Gibbons R. and Lawrence K. (1991), „Layoffs and Lemons", The Journal of Labour Economics 9, pp. 351-380

[21] Gomme P. (1999), „Shirking, Unemployment and Aggregate Fluctuations", International Economic Review, Vol. 40, No. 1

[22] Gradzewicz M. and Kolasa M. (2004), „Szacowanie Luki Popytowej dla Polski przy Wykorzystaniu Metody VECM", Bank i Kredyt

[23] Hanson G.H. (2005), „Emigration, Labour Supply, and Earnings in Mexico", NBER Working Paper No. 11412

[24] Heinz F.F., Ward-Warmdinger M. (2006), „Cross-Border Labour Mobility within an Enlarged EU", European Central Bank Occassional Paper 52

[25] Klinthaell M. (1999), "Return Migration from Sweden to Germany, Grece, Italy and the Unitek States during the Period 1968-1993", Lund University Working Paper

[26] Koop G. (1990), „Bayesian Econometrics", Blackwell, Oxford

[27] Krueger A.B. and Summers L.H.(1988), „Efficiency Wage and the Inter-Industry Wage Structure", Econometrica 56, pp. 259-293

[28] Longhi S., Nijkamp P., Poot J. (2005), „A Meta-Analytic Assessment of the Effect of Immigration on Wages", Journal of Economic Surveys 19

[29] Longhi S., Nijkamp P., Poot J. (2006), „The Fallacy of 'Job Robbing' ", Tinbergen Institute Discussion Paper No. 2006-050/3

[30] "Migracje zagraniczne ludności" (2003), Central Statistical Office

[31] Mishra P. (2007), „Emigration and Wages in Source Countries: Evidence from Mexico", Journal of Development Economics 82

[32] Mortensen D. (1984), „Job Search and Labour Market Analysis", Northwestern University Discussion Paper No. 594

[33] Musso A. and Westermann T. (2005), „Assessing Potential Output Growth in the Euro Area. A Growth Accounting Perspective", ECB Occasional Paper Series No. 22

[34] Oh M.H.(2005), „A Study on the Trade-Off between Supervision and Wages: An Empirical Test of Effciency Wage Theory", Dissertation at University of Missouri-Columbia

[35] Pissaridies C.A. (1990), „Equilibrium Unemployment Theory", Blackwell, Oxford

[36] Raff D.M. and Summers L.H. (1986), „Did Henry Ford Pay Efficiency Wages?", Journal of Labor Economics, Vol. 5, No. 4, pp. S57-S86

[37] Raff D.M. (1988), „Wage Determination Theory and the Five-Dollar Day at Ford", Journal of Economic History, Vol. 48, No. 2, pp. 387-399

[38] Shapiro C. and Stiglitz J.E. (1984), „Equilibrium Unemployment as a Worker Discipline Device", The American Economic Review, Vol. 74, No. 3, pp. 433-444

[39] Wadhwani S.B. and Wall M. (1991), „A Direct Test of the Efficiency Wage Model Using UK Micro-Data", Oxford Economic Papers, New Series, Vol. 43, No. 4, pp. 529-548

[40] Weiss A. (1980), „Job Queues and Layoffs in Labour Markets with Flexible Wages", Journal of Political Economy 88, pp. 526-538

[41] Zaiceva A. (2006), „Reconciling the Estimates of Potential Migration into the Enlarged European Union", IZA Duscussion Paper No. 2519

Table 1: Data

Variable	Data	Source	Seasonal adjustment	Remarks
Product y_t	Real Gross Value Added	Quarterly National Accounts	seasonally adjusted (Tramo-Seats)	
	Gross Value Added Deflator	Quarterly National Accounts	seasonally adjusted (Tramo-Seats)	
Capital stock k_t	Gross Capital Stock	Gradzewicz and Kolasa (2004)		
	Average Gross Wages and Salaries	Central Statistical Office	seasonally adjusted (Tramo-Seats)	Wages are grossed-up from 1999 backward
Wage rate w_t	Real Average Gross Wages and Salaries	Own calculations		Based on average gross wages and salaries and gross value added deflator
Reservation wage w_t^*	Average reservation wage of unemployed	Own calculations		Based on the LFS data
Social contributions rate levied on employers t^{CORP}	Effective social contributions rate levied on employers	Own calculations	seasonally adjusted (Tramo-Seats)	Based on the Ministry of Finance and Central Statistical Office data
Hours worked per employed h_t	Average hours worked per employed	LFS	seasonally adjusted (Tramo-Seats)	
Population pop_t	Population 15+ in households	Own calculations		Based on the population data and the population and households forecasts of the Central Statistical Office

Variable	Data	Source	Seasonal adjustment	Remarks
Replacement rate for unemployed $rr_{U,t}$		Own calculations based on		Based on the LFS individual data and the Ministry of Finance and Central Statistical Office data
Replacement rate for inactive $rr_{N,t}$		Own calculations		Based on the LFS individual data and the Ministry of Finance and Central Statistical Office data
Replacement rate for emigrants $rr_{M,t}$		Own calculations		Details in the Appendix
Share of temporary employed f_t	Ratio of fix-term employed to the total employment	LFS		

Variable	Data	Source	Seasonal adjustment	Remarks
Labour market and migration flows F_t	Flows between employment, unemployment, inactivity and emigration	Own calculation based on the LFS and household questionnaire individual data	seasonally adjusted (Tramo-Seats)	Labour market flows were calculated as a number of surveyed individuals who changed their labour market states between consecutive quarters. Migration flows were calculated on the base of a merged sample of individuals being abroad for over two months according to the household survey and those filling the LFS survey. Flows between the temporary emigration and labour market states were calculated similarly to the flows between labour market states. For the year 1999 the flows data were imputed with the Tramo-Seats algorithm.

Table 2: Parametr values

Parameter	Description	Range	A priori			A posteriori		
			Expected value	Standard deviation	Mode	Expected value	Standard deviation	Mode
q_0	Punishment probability (constant)	$[0, 0.25]$	0.11	0.05	0.10	0.12	0.06	0.16
q_1	Punishment probability (marginal change)	$[0, 0.5]$	0.17	0.12	0.00	0.11	0.10	0.00
β	Disutility of effort	$[2, 6]$	3.78	0.85	3.60	4.65	0.62	4.76
α	Elasticity of product to labour input	$[0.63, 0.73]$	0.68	0.02	0.68	0.69	0.02	0.70
ρ_U	Rescaling of replacement rate of unemployed	$[0.5, 1.5]$	1.00	0.22	1.00	1.10	0.20	1.22
ρ_N	Rescaling of replacement rate of non-participants	$[0.5, 1.5]$	1.00	0.22	1.00	1.00	0.20	1.00
ρ_M	Rescaling of replacement rate of emigrants	$[0, 0.55]$	0.33	0.11	0.37	0.29	0.10	0.55
τ	Jump change in the emigration cost (in %)	$[0, 1]$	0.50	0.29	-	0.41	0.27	0.08
r	Discount rate	$[0.025, 0.075]$	0.050	0.011	0.050	0.049	0.010	0.050
g	Trend	$[0.015, 0.035]$	0.023	0.004	0.022	0.018	0.001	0.017
$const$	Constant	$[-\infty, +\infty]$	0	-	0	0.13	0.10	0.12
m	Rescalling LFS parameter (outflow migration)	$[1, 1.7]$	1.31	0.15	1.28	1.40	0.13	1.43
n	Rescalling LFS parameter (return migration)	$[0.4, 0.7]$	0.58	0.06	0.60	0.55	0.06	0.53
σ_1	Error variance	$[0, \infty]$	0.50	0.35	0.25	1.12	0.73	0.82
σ_2	Error variance	$[0, \infty]$	0.50	0.35	0.25	1.45	0.72	0.68

Table 3: Impulse responses

Parameter /variable	Description	Impulse	Wage change				Reservation wage change			
			Expected	**Median**	**5 perc.**	**95 perc.**	**Expected**	**Median**	**5 perc.**	**95 perc.**
q	Decrease in the monitoring efficiency	-1ppt.	−0.46%	−0.31%	−1.36%	−0.15%	−1.66ppt.	−1.57ppt.	−2.57ppt.	−1.04ppt.
β	Increase in the disutility of exerting effort	0.1ppt.	−0.33%	−0.32%	−0.52%	−0.19%	–	–	–	–
rr_U	Increase in the replacement rate of unemployed	10%	−2.50%	−2.51%	−3.52%	−1.48%	6.39ppt.	8.05ppt.	5.09ppt.	6.28ppt.
rr_N	Increase in the replacement rate of non-participants	10%	−3.59%	−3.51%	−5.49%	−1.98%	9.39ppt.	9.24ppt.	11.75ppt.	7.37ppt.
rr_M	Increase in the replacement rate of temporary emigrants	10%	−1.26%	−1.22%	−1.96%	−0.68%	3.09ppt.	2.99ppt.	2.13ppt.	4.39ppt.
r	Increase in the discount rate	1ppt.	-0.07%	0.07%	-0.16%	0.03%	-0.41ppt.	-0.45ppt.	-0.65ppt.	-0.02ppt.
k	Increase in the capital stock or reduction in the population (hours worked)	1%	0.31%	0.31%	0.28%	0.35%	–	–	–	–

Figures 1: A priori and a posteriori parameters distributions

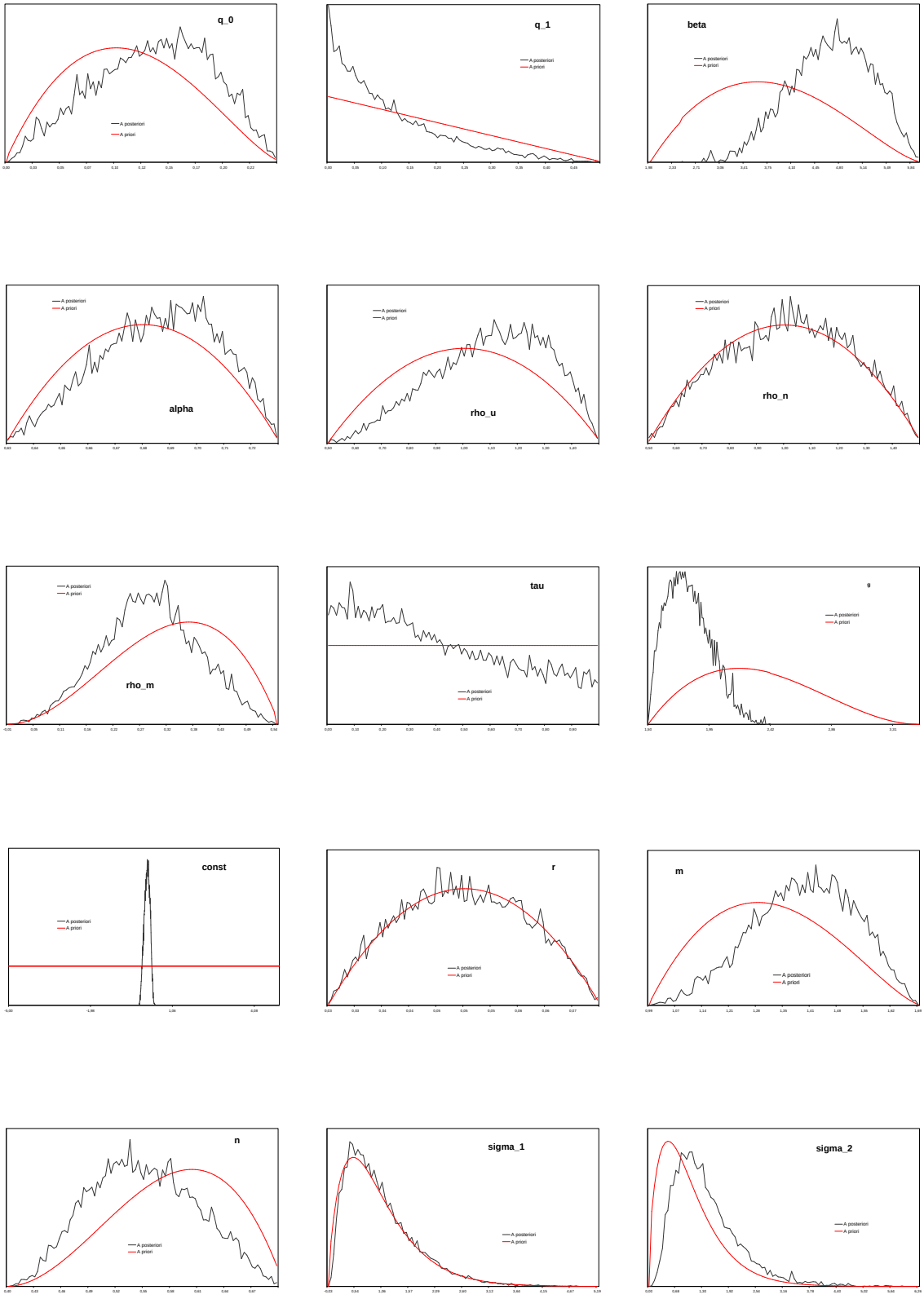

Figure 2: TFP growth rate with the linear trend: LFS data on employment

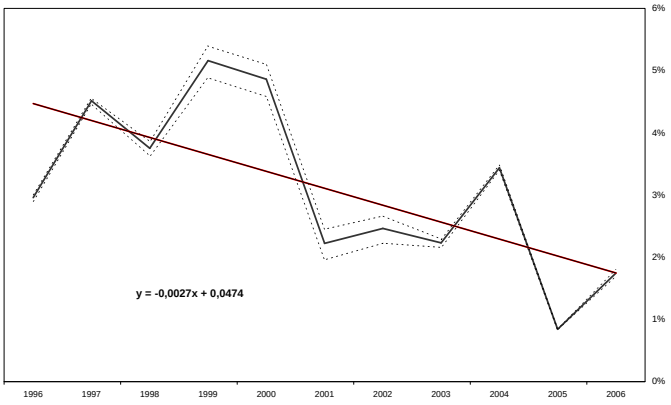

Figure 3: TFP growth rate with the linear trend: steady-state LFS employment

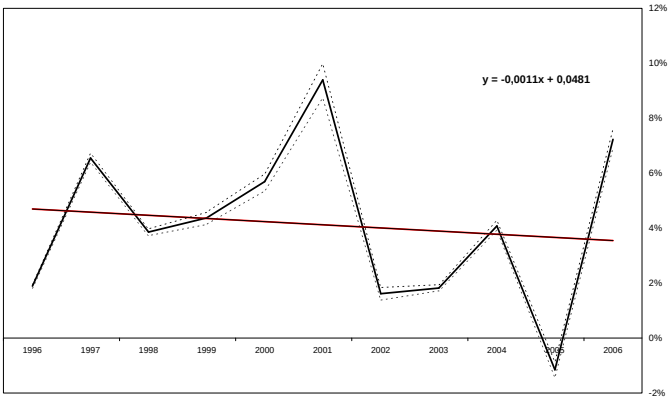

Figure 4: TFP growth rate with the linear trend: employment according to enterprises data

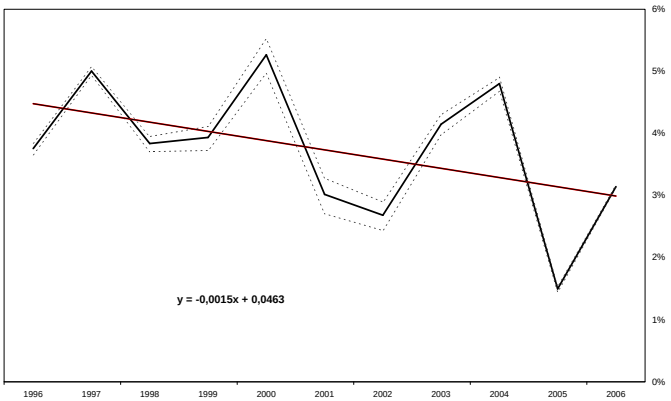

Figure 5: Probability of being caught when shirking

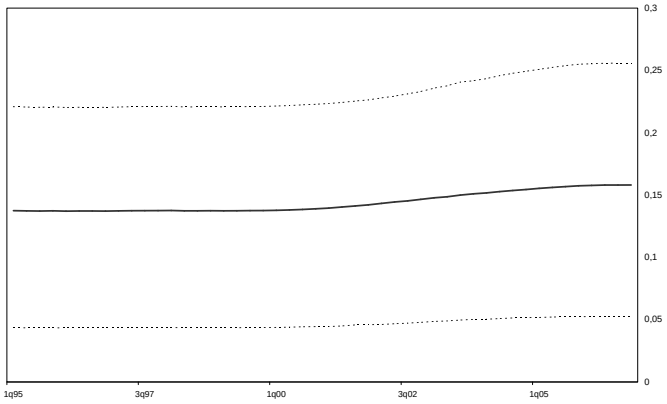

Figure 6: Reservation wage

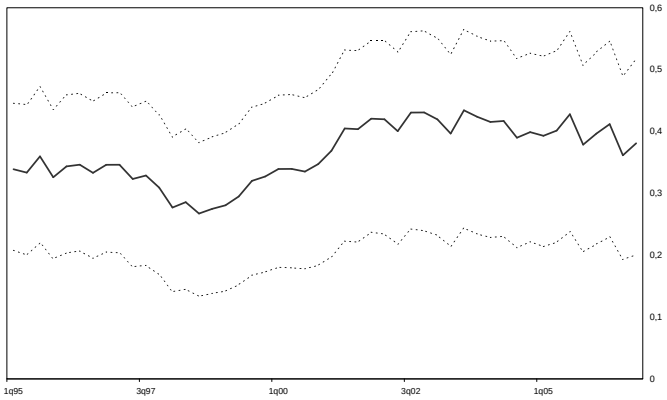

Figure 7: Probability of separation

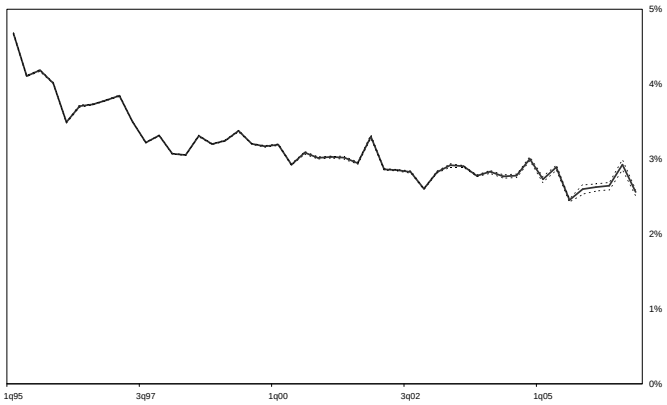

Figure 8: Unemployment rate

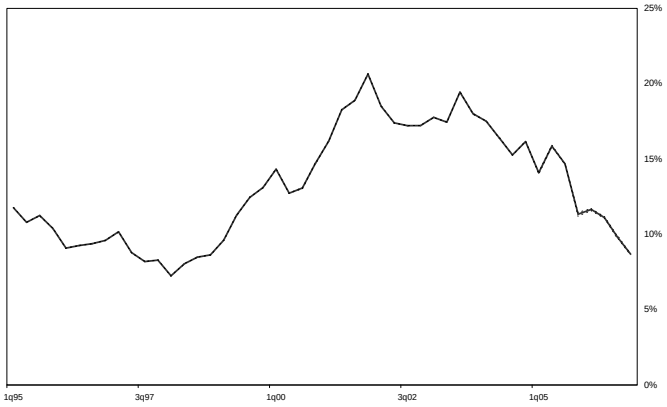

Figure 9: Employment rate

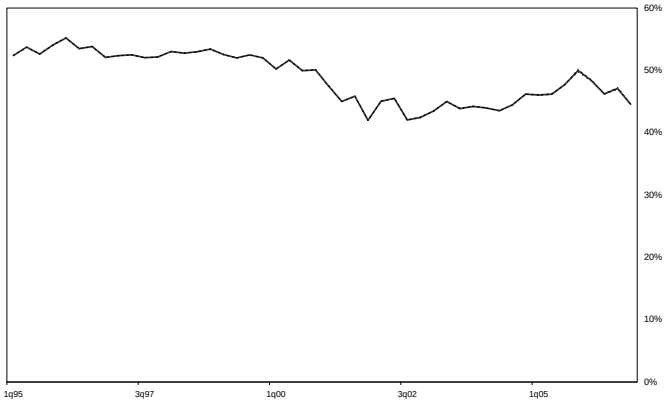

Figure 10: Activity rate

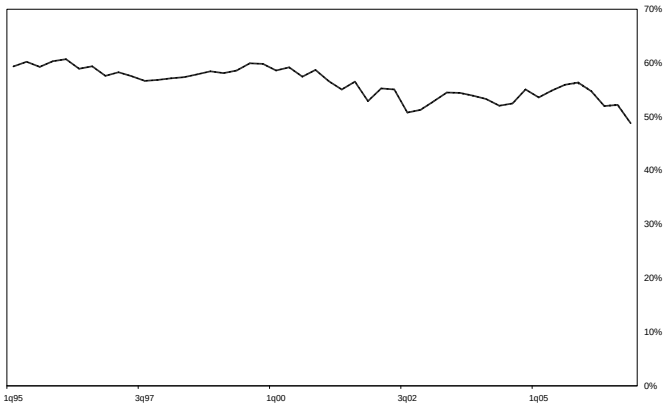

Figure 11: Migration rate

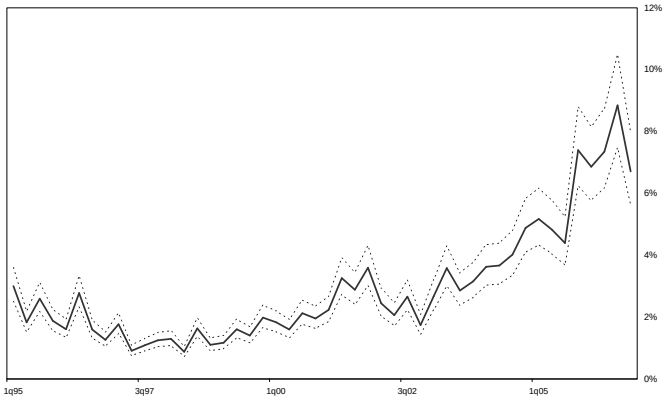

Figure 12: Average effort (in logarithm)

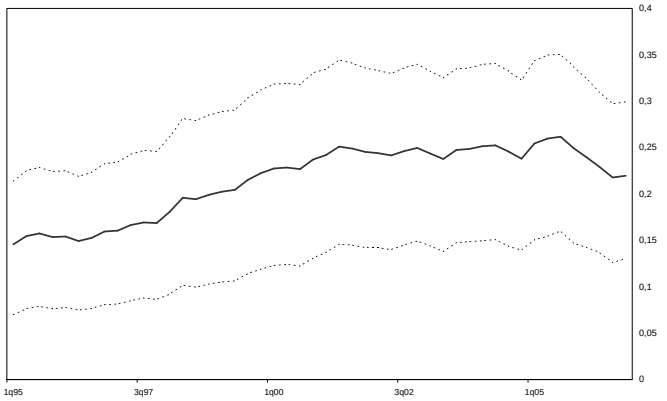

Figure 13: Contribution of the average effort changes to TFP growth

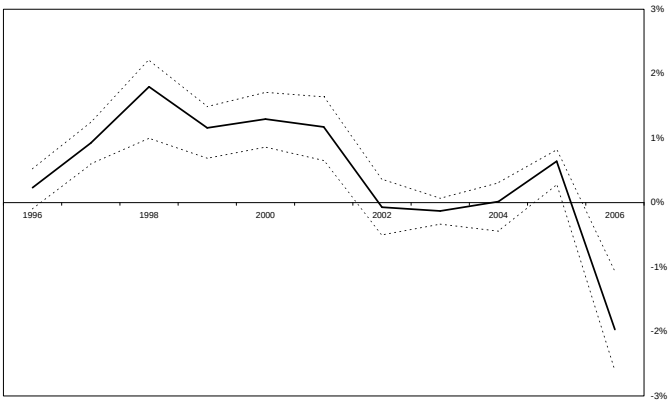

Figure 14: Labour productivity change tied to an increase in monitoring efficiency

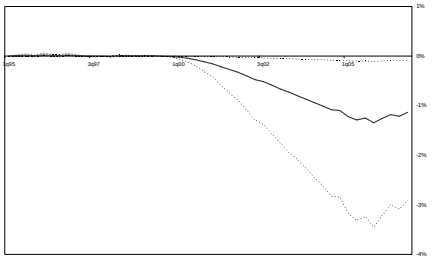

Figure 15: Labour productivity change tied to variation in the replacement rate of unemployed

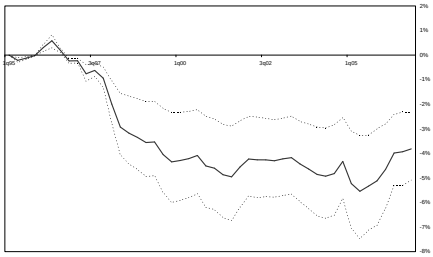

Figure 16: Labour productivity change tied to variation in the replacement rate of non-participants

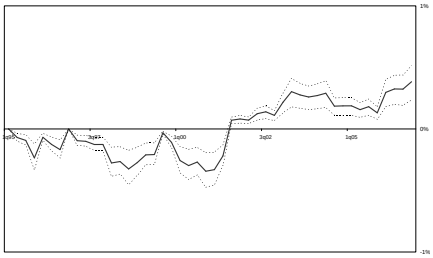

Figure 17: Labour productivity change tied to variation in the replacement rate of emigrants

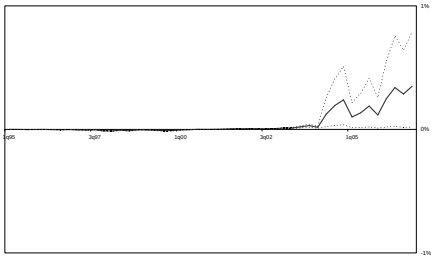

Figure 18: Labour productivity change tied to labour market and migration flows intensity

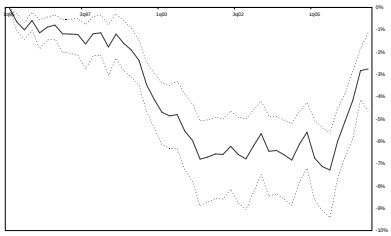

Figure 19: Effects of emigration on the potential GDP (variable capital to labour ratio)

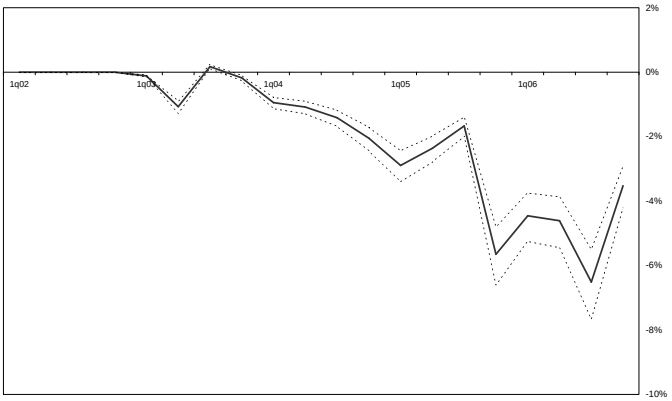

Figure 20: Effects of emigration on the potential GDP (constant capital to labour ratio)

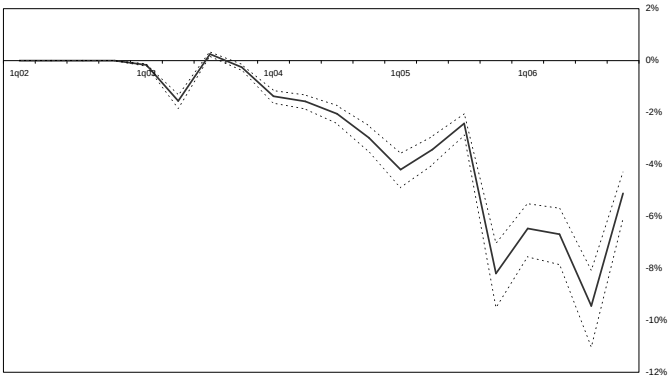

Figure 21: Effects of emigration on the employment level

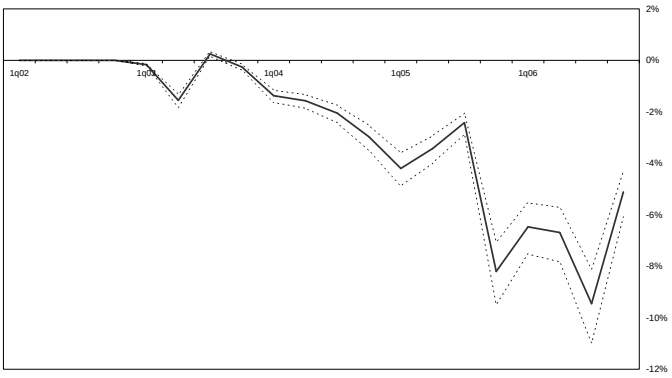

Figure 22: Effects of emigration on the TFP