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Labor Market Disturbances and Employment Dynamics

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ABSTRACT

Some indicators of the labor market, such as the rate of employment and unemployment rate, exhibit high persistence through time in many economies. Some possible reasons for this dynamic may be a low opportunity cost of time, wages above the labor productivity level, and technological or other shocks affecting the optimum levels of production inputs. These factors may be classified into two groups: those impacting the supply and labor demand shocks. This article uses a real business cycle model (RBC) and a structural vector autoregressive (SVAR) model to examine this issue. It was found that labor demand seems to be more relevant than labor supply disturbance in explaining the dynamics of the labor market. However, shocks to work and leisure decisions explain around one-fourth of the employment fluctuation in the G-7 countries.

Keywords: RBC model, labor market disturbances, SVAR model, G-7 countries.

JEL: C32, C33, E37, E24

1. Introduction

The dynamics of employment and unemployment in the business cycle have captured the attention of economists in recent decades. On the one hand, it has been observed that when economic activity slows, companies do not rapidly adjust the level of employment. Several explanations have been given for this fact. Costs associated with the firing and hiring of employees is one of the principal reasons that have been exposed to explain the trend in employment series. Other causes for this phenomenon may be a limited supply of some specialized labor input and expectations of fast economic recovery. If companies underestimate the duration of the recession, they could conclude that it will be less expensive to maintain extra employees than fire them.

On the other hand, it has also been observed that the unemployment rate does not decrease rapidly when the economy moves from a recession regime to expansion. If companies maintained a higher than optimal number of employees in periods of economic downturn, then increasing their productivity allows for more production without an increase in labor. That is, companies reduce workers' leisure time enjoyed by them in their working hours. However, government transfers that workers receive through various social programs, for extended periods, also explain the dynamics of employment and unemployment. Also, if worker unions manage to maintain real wages above the marginal productivity of labor, the unemployment rate may exhibit persistence.

This inertia in unemployment and employment dynamics delays the recovery of the economies when they are in a recession. The literature on this topic has used mainly microeconomic data. Some authors have modeled the labor's supply-side factors, and others have taken into account the variables that impact the labor demand. In this paper, aggregate data is used to identify factors that explain the persistence of some indicators of the labor market: factors coming from the demand and supply of labor will be examined simultaneously.

There is not ample literature about the specific topics of this paper. Thus, related articles are discussed. Clark and Summers (1982) assert that in the United States, a positive long-term trend in the unemployment rate has been observed. Along the same line of thought, Blanchard and Summers (1986) affirm that Western Europe has suffered from high and rising unemployment from the 1970s. There are different possible explanations for this phenomenon, such as unemployment insurance payments, the intensity of the search process, and the level of the reservation wages, among others. Of these factors, the authors argue that unemployment benefits have a substantial effect on the decisions of workers to search for jobs and leave them. The possibility to qualify for insurance payments for unemployment attracts people who join the labor force

In a very influential paper, Shapiro and Watson (1988) report that labor supply perturbances are the most relevant impulses in explaining the dynamics of output and employment. While Jorgenson et al. (2008) point out that demographic and technological factors determine the labor supply, these authors argue that increases in productivity may offset reductions in the number of people of working-age. This increase in productivity could be the result of recruiting people with higher levels of education or reducing the leisure time that individuals enjoy in working hours or using a new technology that uses less labor input. Autor (2007), reinforces that point by mentioning that there is a type of technology which requires specific skills of workers, which could lead to unemployment in the long term in certain demographic groups. Other relevant papers are Erceg and Levin (2014), and Barnichon and Figura (2015).

On the other hand, Summers (1986) analyzes the unemployment rate trend in the United States and asserts that the unemployment response to structural or cyclical stocks may vary among distinct demographic groups. However, according to Summers, this was not the situation that happened in the United States in the 1980s. Nor does the composition of the workforce work seem to be the explanation for this phenomenon. The author states that individuals that lose high-quality jobs expect to get that same type of job and do not accept low wages. Moreover, a factor that does not mention the author, but which can explain the persistence of unemployment in this type of worker, is the consumption habits and the economic commitments that the job loser has contracted. Individuals who lose high salaries can have high fixed expenses such as mortgages, car loans, and others that they cannot meet at low wages. Moreover, as Summers says, accepting low wages can be a sign of unfit and unproductive employees. Based on this analysis, it can be thought that sectoral disturbances that impact high-wage positions may be responsible for changes in the vacancy-unemployment relationship if those who lose jobs do not accept low salaries in companies that are expanding their production.

2. Theoretical Model

This section presents a description of an economy where the effect of labor supply and demand shocks on employment and other indicators of the state of the economy can be examined. For these purposes is used a modification of a model widely used in the literature of real business cycles, as presented in Collard (2009).

The representative consumer maximizes the following function of preferences:

$$E\left[\beta^{t}\left(lnC_{t}-\varphi\eta_{t}\left(\frac{(L_{t})^{1+\frac{1}{v}})}{1+\frac{1}{v}}\right)\right)\right]$$

Where $0<\beta<1$ s is the discount factor or the intertemporal rate of substitution, η_t is a stochastic process that impacts φ, (>0) is a parameter that measures the reduction in utility that generates work, C_t is consumption, L_t is hours worked , and v is Frisch elasticity of labor supply that reveals the strength of the response of hours worked to the wage rate.

The introduction of a disturbance that affects the decision of the time allocated to work is a novel point of this paper. The way that this labor supply shock (η_t) is modeled implies that it relates inversely to the hours of work. Thus, it can be interpreted as any type of policy or event that discourages employment or reduces the cost of leisure. However, it could also reflect demographic changes that affect the labor supply or impulses that alter the substitution rate between leisure and consumption. The evolution of this shock can be represented this way:

$\eta_t = e^{\psi_t}$

$\psi_t = \rho\psi_{t-1} + \epsilon_{LS,t}$

where $\epsilon_{LS,t}$ is a stochastic element with mean zero and constant variance, and $|\rho| < 1$.

The economic agent budget constraint is given by:

$C_t + i_t = Y_t$

This restriction implies that in each period, the resources (production, y) are allocated to consumption and to increase capital in the next period (i is investment). If δ it is the depreciation rate, the evolution of capital is given by:

$K_{t=1} = e^{\tau_t} i_t + (1 - \delta)K_t$

where $\tau_t$is a stochastic process that affects the technology embedded in the physical capital.

In this economy, the firms hire the workers, rent the capital, and produce the final goods according to:

$Y_t = e^{\lambda_t} K^{\alpha} L^{1-\alpha}$

where λ_t is a stochastic process of technology that follows an AR(1).

The stochastic processes that affect the capital and indirectly the production are supposed to be correlated and are described by:

$\tau_t = \gamma\lambda_{t-1} + \phi\tau_{t-1} + \epsilon_{K,t}$

$$\lambda_t = \phi\lambda_{t-1} + +\gamma\tau_{t-1} + \epsilon_{TEC,t}$$

The first order conditions of the agent problem, together with the equilibrium conditions, define the following system of eight equations:

$$C_t\eta_t\varphi_t(L_t)^{1+\frac{1}{v}} = (1-\alpha)Y_t \quad (1)$$

$$1 = \beta E\left[\left(\frac{e^{\tau_t}C_t}{e^{\tau_{t+1}}C_{t+1}}\right)\left(e^{\tau_{t+1}}\alpha\frac{Y_{t+1}}{K_{t+1}}\right) + 1 - \delta\right] \quad (2)$$

$$Y_t = e^{\lambda_t}K^{\alpha}L^{1-\alpha} \quad (3)$$

$$K_{t=1} = e^{\tau_{t+1}}i_t + (1-\delta)K_t \quad (4)$$

$$\eta_t = e^{\psi_t} \quad (5)$$

$$\psi_t = \rho\psi_{t-1} + \epsilon_{LS,t} \quad (6)$$

$$\tau_t = \gamma\lambda_{t-1} + \phi\tau_{t-1} + \epsilon_{K,t} \quad (7)$$

$$\lambda_t = \phi\lambda_{t-1} + +\gamma\tau_{t-1} + \epsilon_{TEC,t} \quad (8)$$

These equations define the state of the economy. The first equation contains the dynamics of working hours that are directly affected by the supply shock and by technology advances through production. Euler's equation is defined in (2) and contains information on consumption and capital decisions. The other equations have already been defined.

In this model, the state of the economy is described by labor, capital, production, and consumption. This is the standard real business cycle model, where the money market is not included. However, the question posed in this paper can be answered in this setting.

3. Methodology

The issue raised in this article is examined using two different methodologies. The model described in the previous section was calibrated with different values for the parameters. These values come from the literature. Several simulations of the model were realized to determine the importance of labor supply and demand shocks in the dynamics of the economic indicators included in the model. Dynare and MATLAB were used for this purpose (see Adjemian et.al. (2011))

Also, a structural vector autoregression (SVAR), where labor supply and demand shocks are identified, was estimated. The system can be expressed in the following way:

$$\begin{bmatrix} EPR_t \\ LFPR_t \end{bmatrix} = \begin{bmatrix} \alpha_{11}(L) & \alpha_{12}(L) \\ \alpha_{21}(L) & \alpha_{22}(L) \end{bmatrix} \begin{bmatrix} EPR_t \\ LFPR_t \end{bmatrix} + \begin{bmatrix} \varepsilon_{LD} \\ \varepsilon_{LS} \end{bmatrix} \tag{9}$$

Where EPR_t is the employment-to-population ratio series, $LFPR_t$ is the participation rate, ε_{LD} is a permanent shock, and ε_{LS} is a transitory impulse. The first variable of the system is related to labor demand, while the labor force participation rate is an indicator of labor supply. A possible source of the EPR disturbances is technological advance innovations, while ε_{LS} may be a work preference shock. The$\alpha_{\text{ij}}(L)$ are polynomials in the lag operator.

System (9) can be inverted to obtain the VMA representation that is expressed as follows:

$$\begin{bmatrix} EPR_t \\ LFPR_t \end{bmatrix} = \theta(L) \begin{bmatrix} \varepsilon_{LD} \\ \varepsilon_{LS} \end{bmatrix} \tag{10}$$

Here the matrix $\theta(L)$now contains the polynomials in the lag operator. By evaluating that function in L=1, the long-term multiplier matrix (the sum of all coefficients for each element of the matrix) is obtained, which can be represented as such:

$$\theta(1) = \begin{bmatrix} \theta_{11} & 0 \\ \theta_{21} & \theta_{22} \end{bmatrix} \tag{11}$$

In this system, the restriction that ε_{LS} does not have a permanent effect on employment was imposed to identify the structural shocks.

The model was estimated by using panel data for seven countries (Group of Seven (G-7), France, Germany, Italy, Japan, the United States, the United Kingdom, and Canada) through the period of 1980 to 2017. The data was obtained from the World Bank database.

4. Simulations of the Model

Table 2 presents the values of the parameters used to calibrate the model and the initial values of the variables. These are the values usually used in the real business cycle literature. The system examined here is driven by three shocks: two that affect the labor demand (technology and capital specific shocks) and a disturbance that affects the agent preference for leisure/work. The effect of the first two shocks is widely reported in the RBC literature. Thus, in this paper, the impact of several values of the Frisch elasticity and labor supply shocks on the model's results is analyzed. The first parameter is let to vary from 0.10 to 0.75, and the second assumes several values in the interval [0.45 0.99].

Table 1

Values of variables and parameters used in the simulation

Calibration			**Initial values**	
Parameter	Description	Value	Variable	Value
φ	Effect on the usefulness of reduction in work (> 0)	2.95	Y	1.00
α	The exponent of the capital in the production function (k share)	0.36	C	0.80
β	Preferences inter-temporal discount factor	0.99	L	0.33
δ	Depreciation rate	0.025	K	5
ϕ	Persistence in process AR (1) of technology and in the process affecting the accumulation of capital	0.95		
γ	Cross-persistence of technology and capital	0**.025**		

	shocks			
ρ	Persistence of process affecting labor supply	[0.45 0.99]		
υ	Elasticity of Frisch	[0.10 0.75]		

To examine the impacts of these disturbances on the model, first, the autocorrelation function of each series in the different t scenarios are examined (see Table A.1 in the Appendix). As is evident from this Table, aggregate production (Y), consumption (C), and capital (K) exhibit high autocorrelation until the fifth order, in all constructed scenarios. However, for the labor input (l), the increase in the Frisch elasticity and in the AR(1) parameter that defines the labor supply shock rises notably in its persistence. Thus, leisure preference shocks may explain some of the inertia observed in the labor market.

The impulse response function and the variance decomposition are used to examine the dynamics of the variables in the system. Figure 1 displays the response of the variables to impulses on the labor supply. The fall in the working hours diminishes all the variables of the model. This result adds evidence on the adequacy of the model calibration.

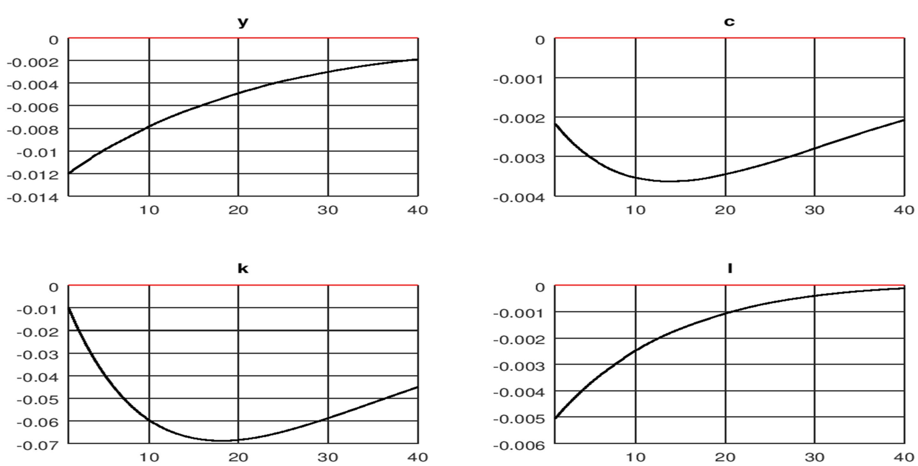

Figure 1: Response to labor supply shock $(\upsilon = 0.10 \; and \; \rho = 0.95)$

The other impulse response functions are presented in Figures A.1 and A.2 in the Appendix. As shown in these graphs, both labor demand shocks (technology and capital productivity) have a positive impact in Y, C, and K. The labor inputs increase as a consequence of the technology shocks in all the time horizons. However, capital productivity shocks increase labor in the short run, but it experiences a slight reduction in a 40-period horizon. This could be the result of more intensive use of capital input because of its increased productivity.

To determine the relative importance of the three types of shocks studied, the variance decomposition of the prediction error is utilized (see Table 2). The technological and capital productive shocks dominate the dynamics of aggregate production and capital in almost all scenarios. However, the labor supply shocks explain only one-fourth of the deviation of consumption from its long-run trend.

Table 2
VARIANCE DECOMPOSITION SIMULATING ONE SHOCK AT A TIME (in percent)

	Percentage of variance attributable to impulses on:		
	Technology (e)	Capital productivity (U)	Labor Supply (z)
Y: Production			
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.45	71.10	26.34	2.68
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.95	50.12	18.57	14.08
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.45	72.83	26.46	0.96
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.95	56.73	20.61	7.76
Frisch (υ):0.54- labor shocks AR(1) parameter (ρ): 0.99	40.83	14.84	23.77
Frisch (υ):0.75- labor shocks AR(1) parameter (ρ): 0.95	58.60	21.24	6.25
C: Consumption			
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.45	65.82	30.59	0.34
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.95	45.58	21.18	11.69
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.45	64.77	31.40	0.14
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.95	50.25	6.39	24.36
Frisch (υ):0.54- labor shocks AR(1) parameter (ρ): 0.99	32.42	10.26	25.60

Frisch (υ):0.75- labor shocks AR(1) parameter (ρ): 0.95	51.58	25.31	5.13
K: Capital			
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.45	59.30	42.48	0.36
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.95	44.32	31.75	8.47
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.45	59.66	42.72	0.14
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.95	48.71	34.88	4.44
Frisch (υ):0.54- labor shocks AR(1) parameter (ρ): 0.99	39.15	28.04	15.20
Frisch (υ):0.75- labor shocks AR(1) parameter (ρ): 0.95	49.96	35.79	3.53
L: Labor			
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.45	40.70	31.65	24.88
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ **): 0.95**	19.82	15.41	**53.85**
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.45	43.58	33.38	20.60
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): **0.95**	19.26	14.75	**55.33**
Frisch (υ):0.54- labor shocks AR(1) parameter (ρ): 0.**99**	8.60	6.59	**85.2**3
Frisch **(υ):0.75**- labor shocks AR(1) parameter (ρ **): 0.95**	19.12	55.70	**14.58**
Note: Numbers do not add up to 100 due to i) non-zero correlation of simulated shocks in small samples and ii) nonlinearity. This is the asymptotic decomposition.			

In the case of the variance decomposition of the labor input, the results are mixed. In the scenarios that the supply shocks process has low persistence, (AR(1) coefficient equal to 0.45), and the Frisch elasticity parameter (**υ**) assumes values between 0.10 or 0.55, the labor demand impulses are responsible for most of the labor deviation from its long-term trend. These results change for the same values for **υ**, but when the labor/leisure preference shocks are more persistent (AR (1) coefficient of 0.95 or 0.99), in this case, up to 85% of the labor input forecast error variance is explained by the labor supply shock**.** However, if v has high values as 0.75, approximately 75% of labor input fluctuations is explained by labor demand impulses, even with high persistence of labor supply shock.

These findings imply that it is possible to build a model in which the persistence in the labor market indicators is explained in part by the labor supply dynamics. This may occur in economies where the cost of leisure is low because there are generous unemployment benefits.

5. Results of the SVAR Estimation

The SVAR model, composed of the employment-to-population ratio (EPR_t) and the participation rate $(LFPR_t)$, was estimated using the variables in levels. The optimal lag length of the system, 2, was determined using the Akaike criteria. The roots for the characteristic polynomial of the system satisfied the stability conditions, and all the parameters estimated are highly significant.

The impulse response functions of the system are displayed in Figures 2 and 3. The permanent shocks, associated principally with technology, have a positive impact on the dynamics of the employment-to-population ratio series and the participation rate as expected. On the other hand, the leisure preference shock (transitory) reduces EPR and has a small positive impact on LFPR.

The variance decomposition of the forecast error (Table 3) shows that the permanent shock is the most critical factor in explaining the labor force participation rate and the employment-population ratios in the G-7 countries analyzed. These are permanent impulses that are mainly related to technological change. However, the transitory shocks associated with leisure preferences, explain up to a maximum of 17% of the labor force participation rate forecast error variance and up to 42 percent of the EPR.

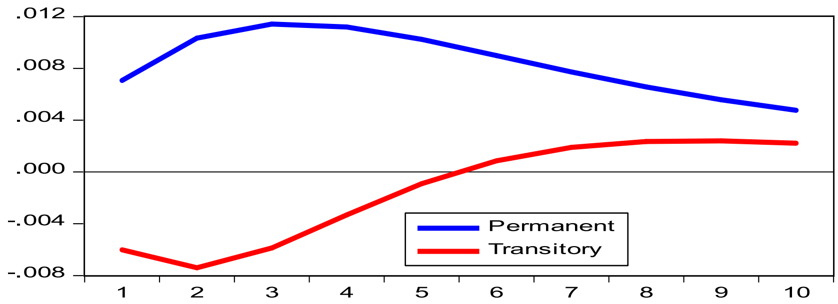

Figure 2: Response of EPR to Structural Shocks

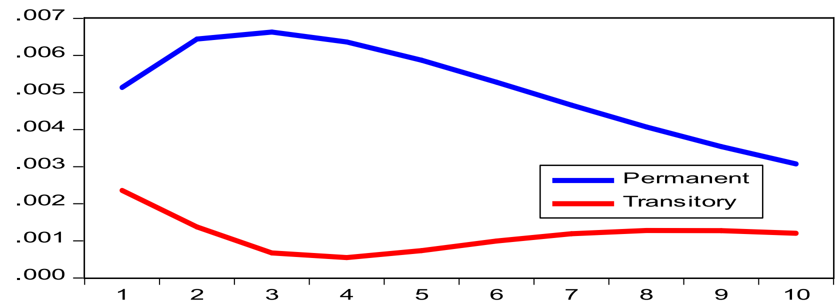

Figure 3: Response of LFPR to Structural Shocks

Table 3
Variance Decomposition
Percentage of Variance Attributable to Labor Supply (Transitory) Shocks

Period	Participation rate	Employment Population ratio
1	17.45	41.95
5	4.48	20.96
7	4.51	17.71
9	5.17	17.28
10	5.46	17.29

6. Conclusions

In this paper, the impact of two types of labor market shocks on the state of the economy was studied using two different approaches. First, a real business cycle model with leisure preference shocks and productivity disturbances was analyzed. The analysis showed that labor demand shocks are the most relevant factor in explaining economic fluctuations in that environment. However, it was also found that labor supply shocks may explain up to one-fourth of the deviation of consumption from its long-run trend, and 85% of the labor input forecast error variance. An SVAR model estimated with data from the G-7 countries also suggests that leisure preference shocks may explain a considerable portion of the labor participation rate and the employment-population ratio. Thus, it is plausible to state that the inertia observed in the labor market in some countries could be not simply the result of labor demand shocks, but also the consequence of economic policies that reduce the cost of leisure. This result implies that it is possible to reduce high unemployment using traditional expansionary policies that stimulate investment and labor demand, but this may not be enough to eliminate all structural unemployment. This objective will require the implementation of policies aimed at bringing individuals back to labor markets. Hence, governments should design measures that increase labor participation.

Finally, it is important to point out that the results of this study should be considered in light of some limitations. First, the model utilized in this paper does not include labor market adjustment costs. Furthermore, the empirical analyses were based on a sample of seven developed economies. Thus, there is room for future research on this topic.

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Appendix: Some results from the analysis

Table A. 1
AUTOCORRELATION OF SIMULATED VARIABLES

	AR order		
	1	3	5
Y: Production			
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.45	0.9653	0.9144	0.8726
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.95	0.9800	0.9399	0.8997
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.45	0.9787	0.9430	0.9104
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.95	0.9847	0.9540	0.9229
Frisch (υ):0.54- labor shocks AR(1) parameter (ρ): 0.99	**0.9892**	**0.9680**	**0.9460**
Frisch (υ):0.75- labor shocks AR(1) parameter (ρ): 0.95	0.9855	0.9567	0.9274
C: Consumption			
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.45	0.9945	0.9824	0.9676
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.95	0.9955	0.9849	0.9712
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.45	0.9941	0.9819	0.9677
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.95	0.9950	0.9843	0.9713
Frisch (υ):0.54- labor shocks AR(1) parameter (ρ): 0.99	**0.9964**	**0.9890**	**0.9799**
Frisch (υ):0.75- labor shocks AR(1) parameter (ρ): 0.95	0.9948	0.9839	0.9709
K: Capital			
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.45	0.9987	0.9934	0.9837
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.95	0.9988	0.9939	0.9847
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.45	0.9989	0.9945	0.9864
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.95	0.9989	0.9948	0.9871
Frisch (υ):0.54- labor shocks AR(1) parameter (ρ): 0.99	**0.9991**	**0.9958**	**0.9897**
Frisch (υ):0.75- labor shocks AR(1) parameter (ρ): 0.95	0.9990	0.9950	0.9876
L: Labor			
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.45	0.8070	0.6051	0.4874
Frisch (υ):0.10 - labor shocks AR(1) parameter (ρ): 0.95	0.9393	0.8215	0.7114
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.45	0.8352	0.6557	0.5442
Frisch (υ):0.55- labor shocks AR(1) parameter (ρ): 0.95	0.9470	0.8436	0.7457
Frisch (υ):0.54- labor shocks AR(1) parameter (ρ): 0.99	**0.9790**	**0.9377**	**0.9897**
Frisch (υ):0.75- labor shocks AR(1) parameter (ρ): 0.95	0.9487	0.8485	0.7533

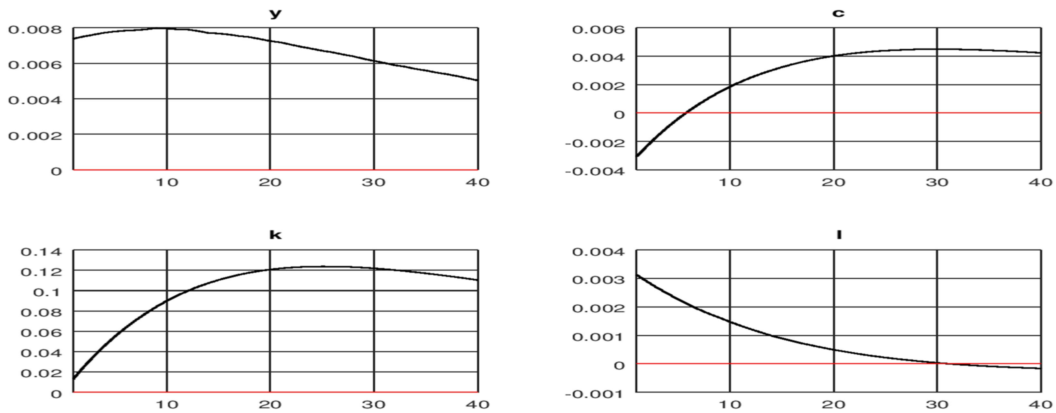

Figure A.1 Impulses Response Functions, Shocks to capital productivity
$(\upsilon = 0.10 \; and \; \rho = 0.95)$

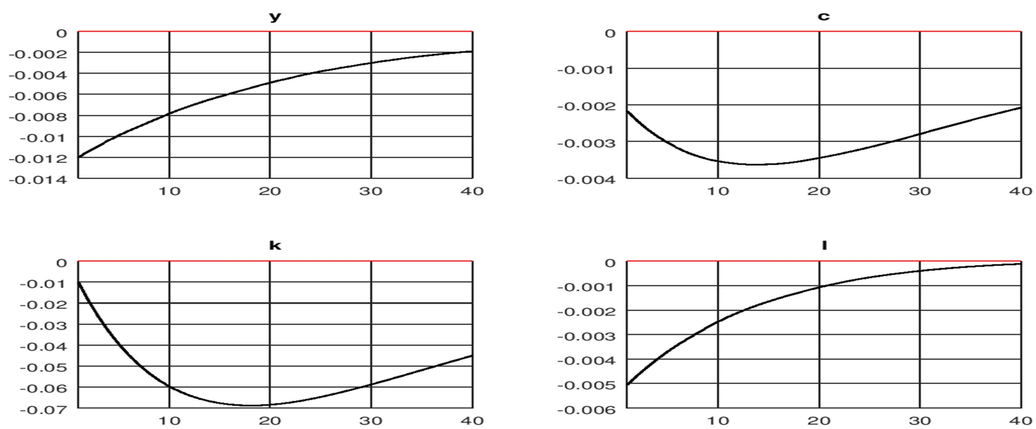

Figure A.2 Impulses Response Functions, Shocks to technology
$(\upsilon = 0.10 \; and \; \rho = 0.95)$