An empirical analysis of the effect of labour market characteristics on marital dissolution rates

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Abstract:
The development in the 1960s of the divorce rate is strikingly similar for the USA and Denmark where the rate in both cases increases very fast from 1967-68 until the mid 1970s. Using time series data for the USA and Denmark the relationship between the divorce rate and gender-specific labor market characteristics is analysed by using Granger causality tests and by estimating VAR-models including impulse response functions. Historically, the female labor force participation rate increases before the structural shift in the divorce rate and for both the analyzed countries the analysis suggests that the female labor force participation rate has some influence on the divorce rate.

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1. Introduction

Since the beginning of the 1960s the female labor force participation rate has increased relatively fast in a number of industrialised countries. Thus, the female labor force participation rates in e.g. the USA and Denmark rose from38% and 42%, respectively, in the early 1960s to levels of nearly 60% and 72% in the mid 1990s. In the same period the marital instability increased dramatically in a number of countries. In the USA the divorce rate rose from a level of 2.2 per 1000 inhabitants in the early 1960s to a peak level of 5.3 per 1000 inhabitants in the beginning of the 1980s. However, for the rest of the period the divorce rate has decreased slightly, ending up at a level of 4.3 by the end of the 1990s. There has been an analogous development in Danish divorce rates. Thus in 1960 the number of divorces per 1000 inhabitants was 2.0 and over the next 20 years the divorce rate rose to 3.6 per 1000 inhabitants, despite of a decrease in the number of marriages in the same period. Finally, as is the case for the US, the Danish divorce rate decreased a little in the 1990s reaching a level of 3.1 per 1000 inhabitants in the late 1990s.

The aim of this paper is to analyse the relationship between female labor supply and divorce rates in Denmark and the USA. There have been a number of single country studies, which mainly use cross-sectional data or panel data at the individual level trying to address the causes of divorces in various countries, i.e. labor supply, unemployment, relative wages, number of children etc. Using cross-sectional data, however, several previous studies suffer from problems of endogeneity in the estimations and, furthermore, the long-run trends in divorces are completely ignored as the panel length (where longitudinal data exists) typically includes only 4-6 years. As a consequence, the empirical evidence is somewhat mixed concerning factors influencing the divorce rates, and the partial nature of the past studies makes it difficult to compare the results from different countries.

In line with Bremmer and Kesselring (1999), who analyse US divorces, this study is based on aggregate time series covering the last 50 years. A comparison is made between the USA and Denmark and, as mentioned earlier, there has been an analogous development in the divorce rates in the two countries despite of the differences in the living conditions and cultural characteristics of the two countries etc.

The next section includes evidence on past studies of marital dissolution rates and it is argued that a number of labor market variables like the female labor force participation rate, the female unemployment rate, the relative wage between females and males should be included in the empirical model. Section 3 presents the empirical model and the data and the results of testing the time series for stationarity are shown in the next section. These tests suggest that the empirical analyses should be confined to first difference values of all variables in order to avoid spurious regression problems.

In section 5 a rolling Granger causality test is made between divorce rates and female labor market characteristics for each country. Finally, a four-variable vector auto regressive model is estimated in section 6 and the dynamics of the final model is discussed by using impulse-response function analysis for each country.

2. Some theoretical arguments and earlier empirical evidence

Becker, Landes and Michael (1977) analyse marriage and divorce within an utility maximising framework, where the main idea is that married couples will divorce when the expected gain from divorce is higher than the expected gain from continuing being married. Accordingly, a number of variables like the number of children, the income of spouses, the age of marriage, the educational level of each spouse etc. become important factors in the analysis. Furthermore, the expected earnings of the spouses are introduced as separate factors. Introducing uncertainty Becker et al. (1977) argue that unexpected changes in the earning capacity of especially the males have negative effects on divorces, i.e. unexpected earning reductions for males tend to increase the probability of divorce. Weiss and Willis (1997) confirm this result, showing that unexpected increases in the husbands earning capacity, controlling for base earnings, decreases the probability of a divorce, whereas unexpected increases in the wife's earnings capacity will tend to have a negative effect on the stability of the marriage.

Next, several studies of the past focus on the influence from economic dependence of spouses, see Jensen and Smith (1990), Starkey (1991), Hoffman and Duncan (1993), Amato and Rogers (1997), Zimmer (1999) and Bremmer & Kesselring (1999). Except for Hoffman and Duncan (1993) and Bremmer and Kesselring (1999) it is found in these studies that divorce is more likely to occur in marriages where the females contribute substantially to the family income, i.e. the independence effect is verified in most studies.

Several studies focus explicitly on unemployment of spouses. Jensen and Smith (1990) find that unemployment of the husband significantly increases the risk of a divorce, whereas the unemployment of the wives has no significant effect. Furthermore, it is estimated that 6% of all divorces in Denmark can be attributed to unemployment.

Except for Bremmer and Kesselring (1999), who estimate their model on aggregate time series data for the US, almost all the other empirical evidence comes from cross-sectional micro data or from shorter longitudinal data sets, covering typically 5-6 years. One major weakness in these studies is problems of potential endogeneity, i.e. the decisions on divorce, labor supply, children etc. are determined simultaneously causing potential bias in the results, see Jensen and Smith (1990) for a discussion of the problem. As a consequence, only a few of the micro data based studies formally test for the causality between e.g. unemployment, labor supply and divorce even though the problem is discussed in some papers. Thus, does an increase in labor supply among e.g. wives cause more divorces or does the causation run the opposite way, from divorces to increased labor market participation?

Bremmer and Kesselring (1999) deal with the endogeneity problems by estimating a VAR-model on aggregate data for US divorces, female labor participation rates and the relative wages between women and men. It is shown that previous levels of female labor participation rates and relative wages have no or little effect on current divorce rates, whereas divorces from the past influence the present female labor force participation rates. The VAR-model is estimated in levels with 3 lags, but - as the authors note – no tests for unit roots in the data series were made, and using level values cointegration analysis ought also to be considered.

3. Empirical model

The literature review stresses the importance of a number of labor market variables in explaining the probability of marital divorce. Thus attention should be paid to the labor supply of females i.e. the female labor force participation rate, but also the male and female unemployment rates should be added to the model. Finally, in line with Bremmer and Kesselring (1999), the relative wage between females and men is included in the analysis, expecting an increase in the relative wage ratio to reduce the divorce rate.

Accordingly, the influence of these factors on the divorce rate can be written as

$$D = f\,(\underset{+}{U^M},\ \underset{-}{U^F},\ \underset{+}{P},\ \underset{+}{W})$$

where U^M is the male unemployment rate, U^F the female unemployment rate, P is the female labour force participation rate and W is the female/male wage ratio. The expected sign of the effect is marked under each factor.

The interactions among these variables are in the present analysis modelled in a VAR framework where each variable is a function of past values of itself and the other variables. Contrary to most of the past studies this methodology allows interaction between the divorce rates and the other labor market variables reducing problems with simultaneity as the distinction between endogenous and exogenous variables vanishes when all variables are treated symmetrically, see section 5 where the model is presented in more detail.

4. The development in divorce rates and gender-specific labor market characteristics

Figure 1 shows the development in the US divorces and labor market characteristics since 1948. All variables are shown on a logarithmic scale and the data sources are listed in Appendix 2. Divorces, which has been defined as the number of divorces per (1000) capita, first decrease in 1948 to the absolute minimum in 1958. Then follows a long period with steady increases in the divorce rate reaching its maximum value in 1981. In addition, the figure includes data for the female labor force participation rate, which is measured relatively to the male labor force participation rate - both limited to persons older than 20 years. Except for 1953 the female labor force participation rate has increased each year since 1948. Finally, the development in the female and male unemployment rates is very similar, showing the maximum unemployment level to take place in the early 1980s.

Figure 1 about here

Figure 2 shows the corresponding figures for Denmark. As for the USA the divorce rate is first decreasing and reaches its minimum level in 1965. After that divorces are increasing – reaching a maximum in the 1980s - and in the 1990s the divorce rates are decreasing slightly. Contrary to the US the female unemployment rate has increased with nearly no exceptions since the beginning of the 1970s. Thus in 1971 less than 1% of the female labor force was unemployed and by the end of the 1990s the female unemployment rate has risen to over 13%. The female labor force participation rate has risen steadily in the whole sample period, reaching the highest growth rates in the 1960s.

Figure 2 about here

Before using the data presented in figure 1 and figure 2 for further analysis the time series properties of these variables are analysed. Many economic time series variables, e.g. income variables, are often found to be non-stationary in levels and, consequently, the Dickey-Fuller stationarity tests are performed on the variables used here. The DF-test whether a variable *X* is integrated, I(1), or stationary, I(0), is done by running the following regression, where *t* represents a time trend:

$$\Delta X_t = \alpha + \beta t + \varphi X_{t-1} + lags\ of\ \Delta X_t + \varepsilon_t \tag{1}$$

The test is done with a time trend for all variables although some of the series do not seem to contain a linear trend. Lags of ΔX are included on the right-hand side of (1) in order to whiten the errors. The results of the Dickey-Fuller test for unit roots are reported in table 1.

Table 1 about here

From all test results in table 1 it is concluded that none of the variables seems to be stationary as the null hypothesis of non-stationarity cannot be rejected. Hence, as the variables are non-stationary in levels, they have to be first-differenced in order to become stationary processes (constant unconditional means and variances) unless it can be certified that level values cointegrate, i.e. linear combinations of the variables show up to be stationary indicating stable long-run relationships. In some of the time series variables presented in figure 1 and figure 2 there might be a structural break - e.g. for the divorce rates in the late 1960s - and such variables may in fact be stationary I(0)-variables despite the test results presented in table 1. The Dickey-Fuller test has low power in such cases and therefore, the Perron (1989) unit root test allowing for structural breaks is also applied. The latter analysis reveals that the divorce rates (both countries) and the Danish unemployment rate are stationary when allowing for a shift in the intercept term in the unit root test. When a shift in the deterministic trend slope is introduced for the US wage rate this variable can also be described as stationary. As most of the variables still are I(1)-processes, the following analysis is confined to first-difference values of all variables in order to avoid the so-called spurious regression problem.

5. Granger causality tests

The first step in the analysis is to perform a set of Granger causality tests, e.g. as whether the female labor force participation rate significantly influences divorces or whether causality is more likely to run in the opposite direction. In accordance with Thoma (1994), a set of 'rolling' causality tests is applied where the often used bivariate Granger test is done for a subsample of the data set - in the US case data covering 1948-1960 - and then more observations are added to the subsample one at a time and each time repeating the Granger test. The test is done by the following set of regressions (notation as indicated in figure 1 and figure 2 and Δ denoting the first-difference operator):

$$\Delta \log \mathrm{D_t} = \alpha + \sum_{i=1}^{n} \beta_i \Delta \log \mathrm{D_{t\text{-}1}} + \sum_{i=1}^{n} \gamma_i \Delta \log \mathrm{P_{t\text{-}i}} + \varepsilon_t \qquad (2)$$

An F-test is used to ascertain whether lags of $\Delta \log \mathrm{P_t}$ significantly helps to explain the divorce rate variable on the left hand side of (2). If this is the case - and the opposite regression, reversing the variables in (2), reveals that divorces do not impact on the labor force participation rate - $\Delta \log \mathrm{P_t}$ is said to Granger-cause $\Delta \log \mathrm{D_t}$. In the present case a whole set of rolling causality tests is performed, and the result is a set of p-values which is exhibited in figure 3 for the USA and figure 4 for Denmark. In both cases, the number of lags used in (2) is four as also used in the following VAR models, and only first-differences of the variables enter the regressions.

Figures 3a and b about here

Figures 4a and b about here

Figure 3a exhibits the *p*-values related to the influence of the divorce rate on the labor market variables and in figure 3b the *p*-values concerning the opposite causality is reported. Figures 4a-b exhibit the corresponding *p*-values for Denmark. A *p*-value close to zero indicates a significant influence and in all graphs the 10% level of significance is marked by a horizontal line.

For the USA, divorces seem to Granger cause male unemployment as the *p*-values are below or close to the 10% level of significance for nearly all sample lengths chosen, cf. figure 3a, and in figure 3b male unemployment does not seem to have influence on divorces. Similarly, especially when testing for the whole sample period 1948-1998, divorces also seem to influence the other two labor force variables (i.e. the female labor force participation rate and the female unemployment rate). In the Danish case, divorces also Granger causes the female unemployment rates. Finally, the female labor force participation rate and male unemployment influences the divorce rate - and not vice versa as found for the USA. These results seem to be rather robust to the sample length selection included in the Grange test as long as the data set is at least extended from 1948 to the mid 1970s.

It is somewhat surprising that much of the causation seems to run from divorces to the labor market variables. This may be due to the partial nature of the test where interactions among divorces and labor market variables are excluded when only two variables at a time enter the Granger test in (2). Additionally, when inspecting the parameter estimates from the Granger-tests (not reported), it is revealed that the sign of the parameters varies over the four-lag length. For example, the first two lags concerning the test for the influence from divorces to male unemployment are found to be positive whereas the last two lags show up with a negative relation from divorces to male unemployment. Therefore, in order to better address the questions of multiple interactions and dynamics the next part extends the analysis into the VAR modelling methodology.

6. VAR model estimation

In order to further analyse the interactions among divorce rates and the labor market variables a four-variable vector autoregressive model (VAR) is estimated for the USA and Denmark, respectively. In this framework no distinction is made between endogenous and exogenous variables as all variables are treated symmetrically. This might be an appropriate estimation methodology to choose in the present case as it can be difficult to *a priori* decide on the endogeneity-exogeneity question as mentioned in part 2. In compact form the VAR is written as:

$$X_t = A_0 + A_1 X_{t-1} + ... + A_p X_{t-p} + \varepsilon_t \qquad (3)$$

The 4x1 vector X_t represents first differences of the variables from part 2, i.e. $\Delta \log D_t$, $\Delta \log P_t$, $\Delta \log U^f_t$ and $\Delta \log U^m_t$. A_0 is the matrix of intercept terms and lagged values of the female-male wage ratio (denoted by W_t in Appendix 1) and each equation of the VAR thus allows for influences from the exogenous wage variable. The latter is not included as a separate variable in the VAR model as the primary intention is not to address questions as e.g. the wage-unemployment relationship. A_1 .... A_p are 4x4 matrices of coefficients to the lagged values of X_t. The error terms are represented by the vector ε_t.

As the unit root tests in part 3 in all cases reveal that the variables can best be described as non-stationary I(1)-variables the VAR models are estimated in first differences in order to avoid the so-called spurious regression problem. Furthermore, it is not obvious which of the variables should form potential cointegration relationships - which eventually could represent stationary relationships in a VAR estimation framework - and this fact also favors a first-difference VAR although such an estimation strategy filters out any long-run information in the data.

In order to find the appropriate lag length the VAR model is tested down beginning with lag length of order four and applying two different types of test statistics. Firstly, the multivariate generalizations of the Akaike information criterion (AIC) and the Schwartz criterion (SC) are calculated, see Enders (1995):

$$AIC = NOBS \log |\Sigma| + 2N \quad (4)$$

$$SC = NOBS \log |\Sigma| + N \log (NOBS)$$

NOBS = number of observations

N = number of parameters

$|\Sigma|$ = determinant of the variance / covariance matrix of the residuals.

The minimum values of these test criteria select the appropriate lag length. Additionally, a likelihood ratio test is used in order to decide whether the last lag in the model can be deleted, and this test statistic is calculated as:

$$LR = (NOBS-C) (\log |\Sigma_r| - \log |\Sigma_{ur}|) \quad (5)$$

C = number of parameters in each unrestricted equation.

$|\Sigma_r|$, $|\Sigma_{ur}|$ = determinants of the variance / covariance matrices of the restricted and unrestricted systems, respectively.

The LR-test statistic is χ^2 distributed with degrees of freedom as the number of restrictions in the VAR. Hopefully, the two set of test statistics will not be too contradictory with respect to the optimal number of lags to include in the VAR. The test results concerning the selection of lag-length is reported in table 2.

Table 2 about here

From the AIC/SC-criteria a lag length of either two or one is optimal concerning both the US and the Danish VAR-models. The likelihood ratio test indicates in both cases that the second lag should be maintained in the systems as a large test statistic (corresponding to a small *p*-value) reveals that a null hypothesis of a non-binding second lag in the VAR is rejected at the 5% level of significance. As the results from the two approaches to lag length selection in both cases differ somewhat and some of the parameter estimates of third or fourth lag order show up relatively significant, the following alternate VAR estimation strategy is chosen. The variables in the VAR equations are selected according to an appropriate level of significance (5%), starting from a full fourth-order VAR and then stepwise deleting insignificant parameters. The result is a so-called near-VAR model which is most efficiently estimated by using the seemingly unrelated regression (SUR) technique as the right hand side variables differ between the equations in the VAR model.

The final estimates of the near-VAR models for the US and the Danish cases are reported in Appendix 1. The models do not seem to suffer from autocorrelation or heteroscedasticity in the error terms and also the $\bar{R}^2$ value shows up with relatively high degrees of explanation. The latter varies between 0.3 and 0.6 for the US equations and the $\bar{R}^2$ values range from 0.3 to 0.4 concerning Denmark, which is reasonable taking into consideration that the models are estimated in first differences. Finally, the AIC and SC values obtained for the models are all superior to the results reported in table 2, cf. the notes in Appendix 1, and the remaining number of parameters in the near-VAR models is approximately one third compared to the full VAR model.

7. Impulse response function analyses

The next step in the VAR model framework is to introduce shocks to the error terms in (3) in order to track the consequent changes in each variable taking into consideration all interactions as modelled by the near-VAR. Such an impulse response analysis is exhibited in figures 5 and 6 for the USA and Denmark, respectively, where the shocks have been normalized to a one standard deviation shock in the respective error terms. In order to identify the structural model from a VAR, it is necessary to impose restrictions on the model which is usually done by a so-called Choleski decomposition where all above-diagonal elements of the residual covariance matrix are set to zero. Additionally, the more flexible Sims-Bernanke procedure may be chosen, see Enders (1995) or Doan (1992), where further over-identifying restrictions can be imposed and formally tested. Following the latter procedure reveals that the residual covariance matrix is near diagonal and that a likelihood ratio test setting some of the off-diagonal elements equal to zero is a non-binding restriction and, therefore, these restrictions are imposed for both models when calculating the impulse response functions as presented in figure 5 and figure 6. Consequently, the ordering of the variables does not influence the response function analysis very much and in some cases the immediate impacts are also by definition null, which is also observed in e.g. figure 5b where all responses to a given shock start from period 2 - and not from period 1. The graphs presenting the impulse function analysis are restricted to the cases involving the divorce rate and thereby leaving aside the analysis of e.g. female labor force participation influencing female unemployment.

Figures 5a and b about here

First of all it can be verified that the near-VAR models are stable in the sense that the shocks die out after a relatively short span of years which is also an expected consequence of using first-difference values of the variables restricting the analysis to short-run effects. From figure 5 it is concluded for the USA, that the immediate effect of divorces is to lower the unemployment rates but after a 2-year period these effects are reversed and much more dominant until they eventually vanish after a decade. Also the female labor force participation rate will start to increase three periods after the initial shock.

Shocking the labor market variables, exhibited in figure 5b, reveals that the two unemployment variables have opposite effects on the divorce rate. Increased female unemployment raises the divorce rate for one period and then the effect quickly dies out. Male unemployment seems to have a persistent effect concerning reducing the tendency towards marital dissolution. Increased female labor force participation rates will - like female unemployment - influence the divorce rate upwards. The conclusion concerning the US analysis seems to be that influences between divorces and labor market variables are bi-directional. Divorces increase the labor market variables - and vice versa, except increased male unemployment which tends to lower divorce rates.

Figures 6a and b about here

For Denmark, the results seem to diverge somewhat from the USA. Shocking the divorce rate in figure 6a influences all three labor market variables in a downward direction and dies out already from period 5. Figure 6b reveals that increasing female labor force participation rates will shift the divorce rate upwards - just like found for the USA - and that this effect lasts for several years. Again, the two unemployment rates seem to have opposite effects on divorces, although short-lived - and the directions are reversed compared to the US case. Hence, the overall conclusion from the impulse response function analysis for Denmark is that it is more likely that female labor force participation rates influence on the frequency of divorces than vice versa; and all other effects are more short-lived or less pronounced.

8. Conclusions

During the last 40 years the female labor force participation rate has increased in the industrialised countries and during the same period the divorce rate has increased dramatically. In particular, the divorce rate has developed strikingly similarly in the USA and Denmark where the divorce rate in both cases increases very fast from the mid 1960s and then stabilises at a higher level from the mid/late 1970s.

In this paper empirical evidence is provided on the relationship between the divorce rate, the female labor force participation rate, the female unemployment rate and the male unemployment rate for the USA and Denmark. Using aggregated time series data covering the period 1948-1998 the dynamic properties between these variables have been analysed using both Granger causality tests and VAR impulse response function analysis.

For the USA the bivariate Granger tests seem to indicate a strong influence from divorces to the labor market variables which was also confirmed in the impulse response function analysis. Additionally, the latter analysis also revealed that causation is probably more bi-directional than revealed by the Granger tests. Although the development in divorce rates seems very similar for the USA and Denmark, the conclusion from analysing the Danish case differs somewhat from the US results. The Granger tests indicate an influence from divorces to the unemployment variables, and that the divorce rate is influenced by the female labor force participation rate. The impulse response function analysis reveals that the latter effect is most dominant - indicating that increased female labor force participation ultimately increases the number of divorces. This result is similar for both the analysed countries.

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Appendix 1

Table A1. USA: Near-VAR model; SUR Parameter Estimates.

	D_t	P_t	U^f_t	U^m_t
Constant	-	0.01	-	-
		(4.47)		
W_{t-1}	-	-	-	-
W_{t-2}	-	-	-1.55	-2.58
			(-3.54)	(-4.60)
W_{t-3}	-	-	-	-0.56
				(-2.08)
W_{t-4}	-	0.08	-	-
		(3.14)		
D_{t-1}	0.39	0.42	-	-
	(4.11)	(3.68)		
D_{t-2}	0.43	-	1.52	2.16
	(4.36)		(3.44)	(3.63)
D_{t-3}	-	-	-	-
D_{t-4}	-	-	-	-
P_{t-1}	-	-	-	-
P_{t-2}	-0.99	-	-	-
	(-2.90)			
P_{t-3}	1.25	-	-	-
	(3.71)			
P_{t-4}	-	-	-	-
U^f_{t-1}	0.24	-	-1.56	-1.81
	(4.43)		(-5.15)	(-4.43)
U^f_{t-2}	0.19	-	-1.14	-1.35
	(3.55)		(-3.98)	(-3.48)
U^f_{t-3}	-	-	-	-
U^f_{t-4}	-0.12	-	-	-
	(-2.90)			
U^m_{t-1}	-0.14	-	1.04	1.23
	(-3.73)		(4.69)	(4.06)
U^m_{t-2}	-0.16	-	0.80	0.94
	(-4.13)		(3.96)	-3.38
U^m_{t-3}	-	-	-	-
U^m_{t-4}	0.06	-0.01	-	-
	(2.00)	(-2.18)		
$\bar{R}^2$	0.68	0.33	0.43	0.44
LM (1)	0.26	0.02	0.34	0.68
	(0.61)	(0.88)	(0.56)	(0.41)
LM_{ARCH} (1)	2.73	0.01	0.13	0.25
	(0.10)	(0.94)	(0.72)	(0.62)

Notes: From a fourth order VAR model the most insignificant parameter estimates are stepwise deleted until at least the 5% level of significance is obtained for the remaining parameters. All variables in *first difference log values* and next to the parameter estimates t-values are reported in the parenthesis. LM(1) and LM_{ARCH} are Lagrange Multiplier tests for first order autocorrelation and first order heteroscedasticity, respectively, with marginal level of significance in parenthesis. For the overall model, the value for the Akaike information criterion (AIC) is -1232.2, and for the Schwartz criterion (SC) the value is -1182.8; both below the values reported for the VAR models in table 2.

Table A2. Denmark: Near-VAR model; SUR Parameter Estimates.

	D_t	P_t	U^f_t	U^m_t
Constant	-0.02	-	-0.06	-
	(-2.05)		(-2.26)	
W_{t-1}	-	-	6.17	-
			(2.91)	
W_{t-2}	-	-	-	-
W_{t-3}	-	-	-4.67	-
			(-2.40)	
W_{t-4}	-	0.51	7.64	-
		(3.01)	(4.06)	
D_{t-1}	-	-	-1.31	-
			(-3.84)	
D_{t-2}	-	-	-1.74	-1.89
			(-3.49)	(-3.40)
D_{t-3}	-	-	1.90	1.16
			(3.59)	(2.10)
D_{t-4}	-	-	-	-
P_{t-1}	-	0.42	-	-
		(3.24)		
P_{t-2}	1.07	0.32	-	-
	(2.86)	(2.48)		
P_{t-3}	-	-	-	-
P_{t-4}	0.97	-	6.63	4.66
	(2.57)		(4.45)	(3.11)
U^f_{t-1}	-0.15	-	0.15	-
	(-3.41)		(2.03)	
U^f_{t-2}	0.09	-	-	-
	(2.08)			
U^f_{t-3}	0.06	-	-0.29	-
	(2.37)		(-3.35)	
U^f_{t-4}	-	-	0.24	-
			(3.11)	
U^m_{t-1}	0.10	-0.02	-	-
	(2.01)	(-1.98)		
U^m_{t-2}	-0.10	-0.02	-	-0.20
	(-2.27)	(-2.23)		(-2.12)
U^m_{t-3}	-	-	-	-
U^m_{t-4}	-	-	-	-
$\bar{R}^2$	0.44	0.43	0.42	0.32
LM (1)	0.61	1.00	0.49	2.87
	(0.44)	(0.30)	(0.49)	(0.09)
LM_{ARCH} (1)	0.03	0.04	0.30	0.11
	(0.86)	(0.83)	(0.59)	(0.74)

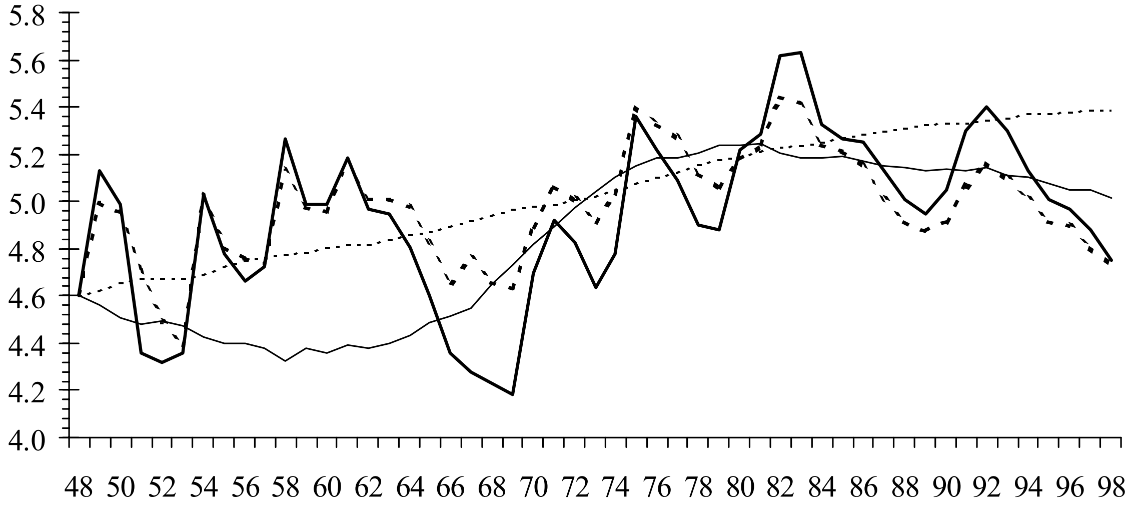
Notes: From a fourth order VAR model the most insignificant parameter estimates are stepwise deleted until at least the 5% level of significance is obtained for the remaining parameters. All variables in *first difference log values* and next to the parameter estimates t-values are reported in the parenthesis. LM(1) and LM_{ARCH} are Lagrange Multiplier tests for first order autocorrelation and first order heteroscedasticity, respectively, with marginal level of significance in parenthesis. For the overall model, the value for the Akaike information criterion (AIC) is -816.6, and for the Schwartz criterion (SC) the value is -770.0; both below the values reported for the VAR models in table 2.

Appendix 2. Data sources.

The US data set covers the period 1948-1998 and the sources are official statistical data from:
Divorces:
Statistical Abstract of the USA 1998, U.S. Department of Commerce.
Monthly Vital Statistics Report, Vol. 43, No. 9(s), Table 1, March 22, 1995. National Center for Health Statistics, U.S. Department of Health and Human Services.
Labor force participation rates and unemployment rates:
www.bls.gov/webapps/legacy/cpsatab1.htm
Wages:
www.census.gov/hhes/income/histinc/p53.html

The Danish data set covers the period 1948-1998 for all variables, except the female/male wage rates where a consistent data series ends in 1992 and data for gender-specific labor force participation rates begin in 1950. The sources are The Fifty-Year Review and the Statistical Ten-Year Review, var. issues, from Statistics Denmark.

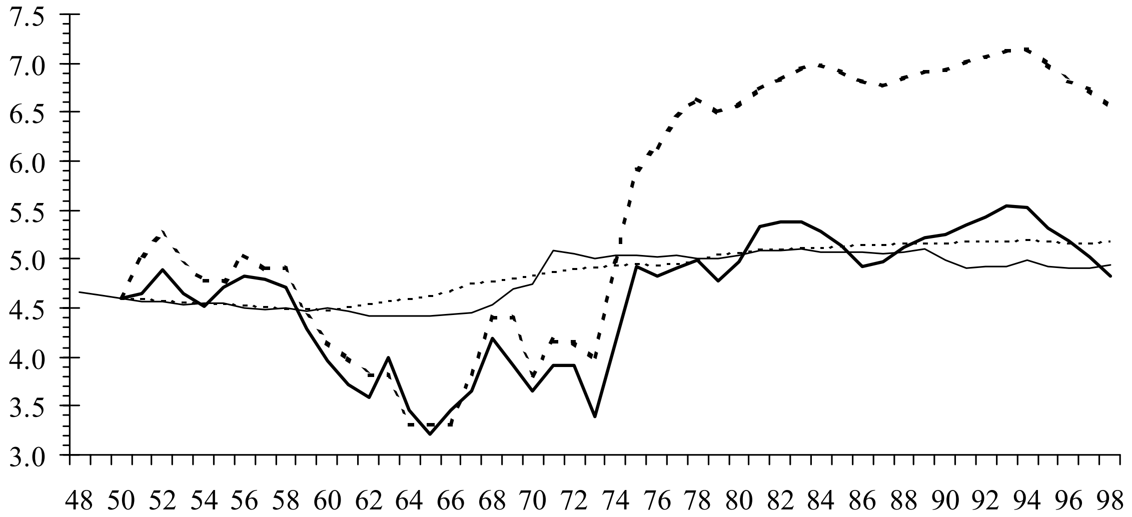
Figure 1. Divorce rates and female labor market characteristics 1948-1998, USA.



Divorce rate, per capita ($\log D_t$)
Female labor force participation rate, measured relatively to the male participation rate ($\log P_t$)
Female unemployment rate ($\text{Log } U^f_t$)
Male unemployment rate ($\log U^m_t$)

Note: All variables presented as indices of log values.

Figure 2. Divorce rates and female labor market characteristics 1948-1998, Denmark.

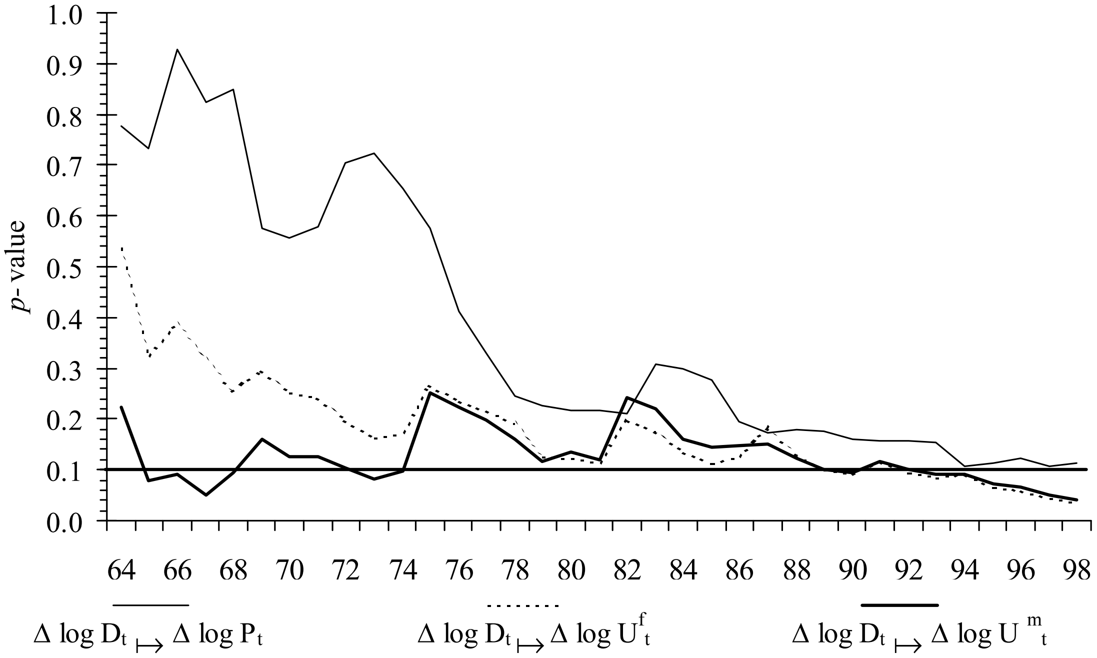


Divorce rate, per capita, 15 years or older ($\log D_t$)
Female labor force participation rate, measured relatively to the male participation rate ($\log P_t$)
Female unemployment rate ($\log U^f_t$)
Male unemployment rate ($\log U^m_t$)

Note: All variables presented as indices of log values.

Figure 3. Granger causality tests - USA.

a. Test values related to the influence of the divorce rate on the labor market variables.



Notes: *p*-values reported concerning the significance level of the lags of the respective variables entering (2) - successively expanding the sample period until 1998. The *p*-values in figure 3b are obtained by reversing the order of the variables in (2).

b. Test values related to the influence of the labor market variables on the divorce rate.

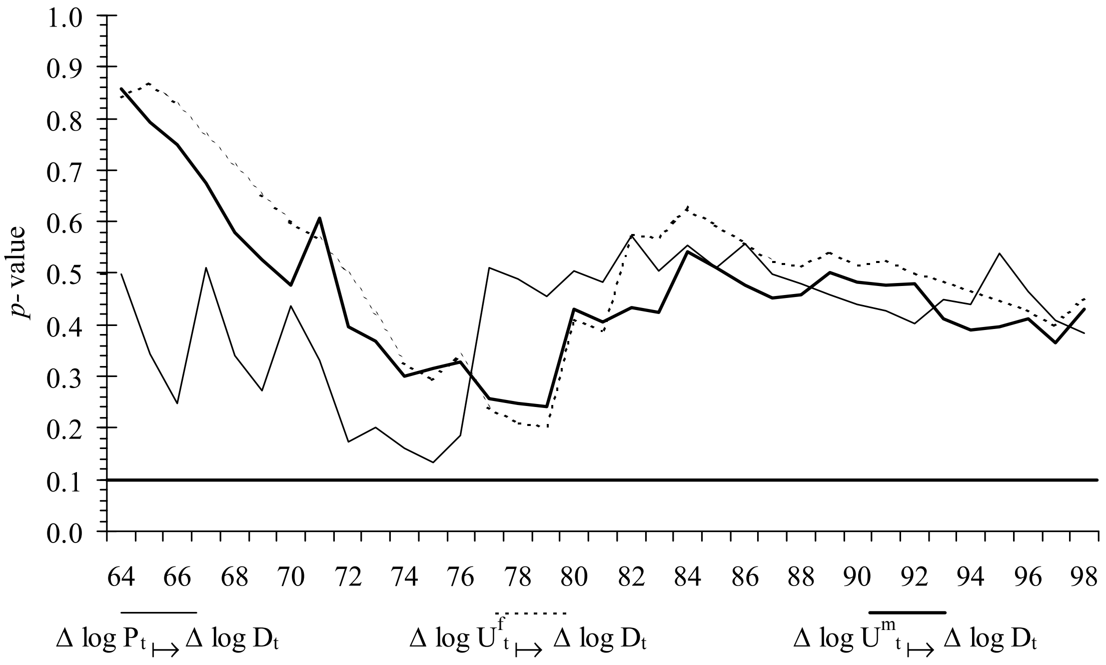
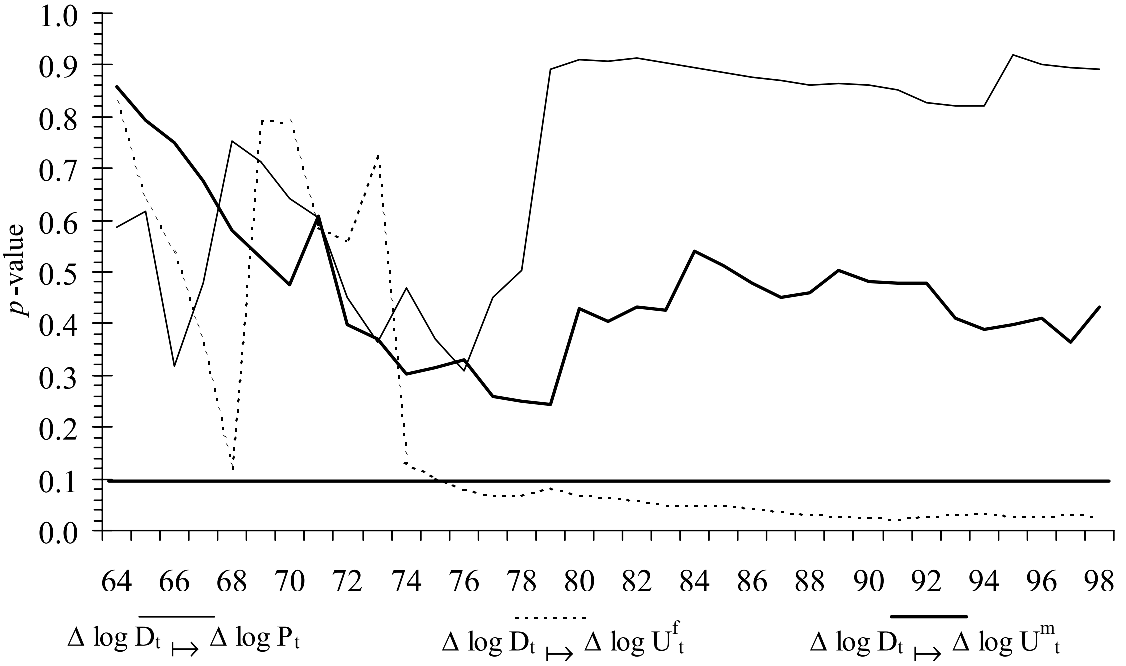


Figure 4. Granger causality tests - Denmark.

a. Test values related to the influence of the divorce rate on the labor market variable.



b. Test values related to the influence of the labor market variables on the divorce rate.

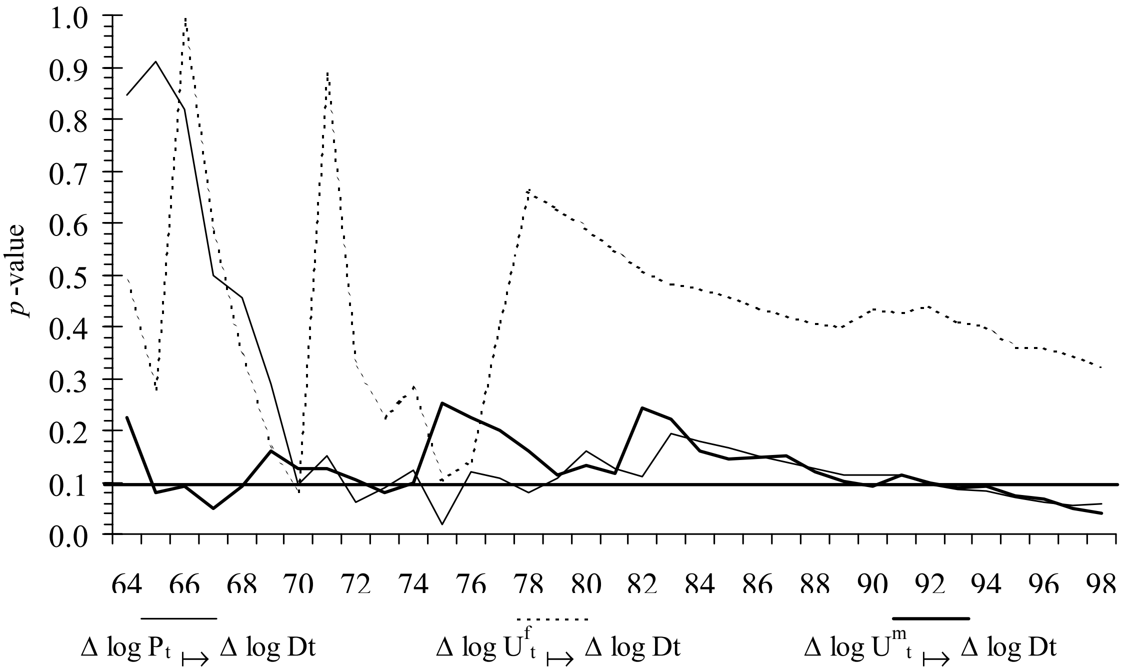
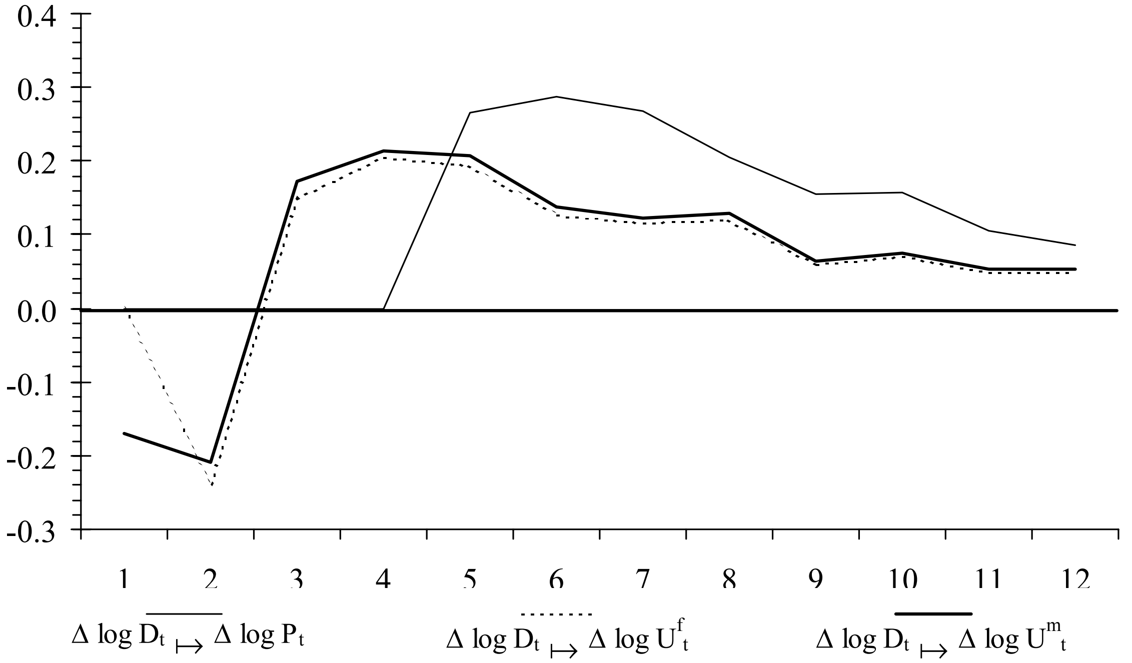


Figure 5. Impulse response function analysis - USA.

a. Effects to the labor market variables from a shock to the divorce rate.



b. Effects to the divorce rate from shocks to the labor market variables.

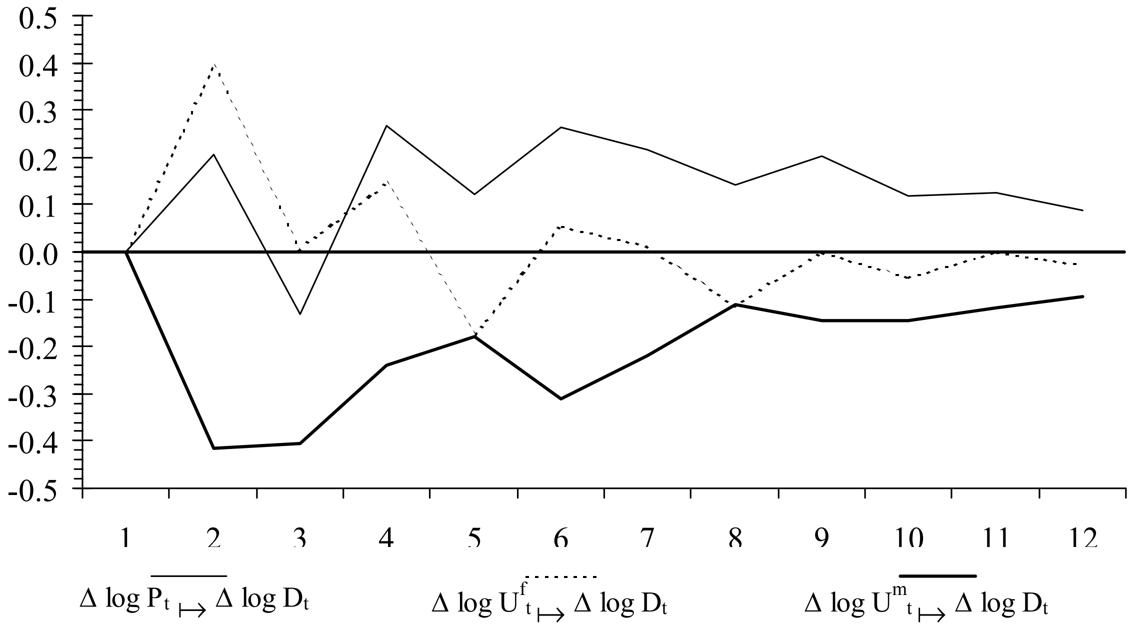
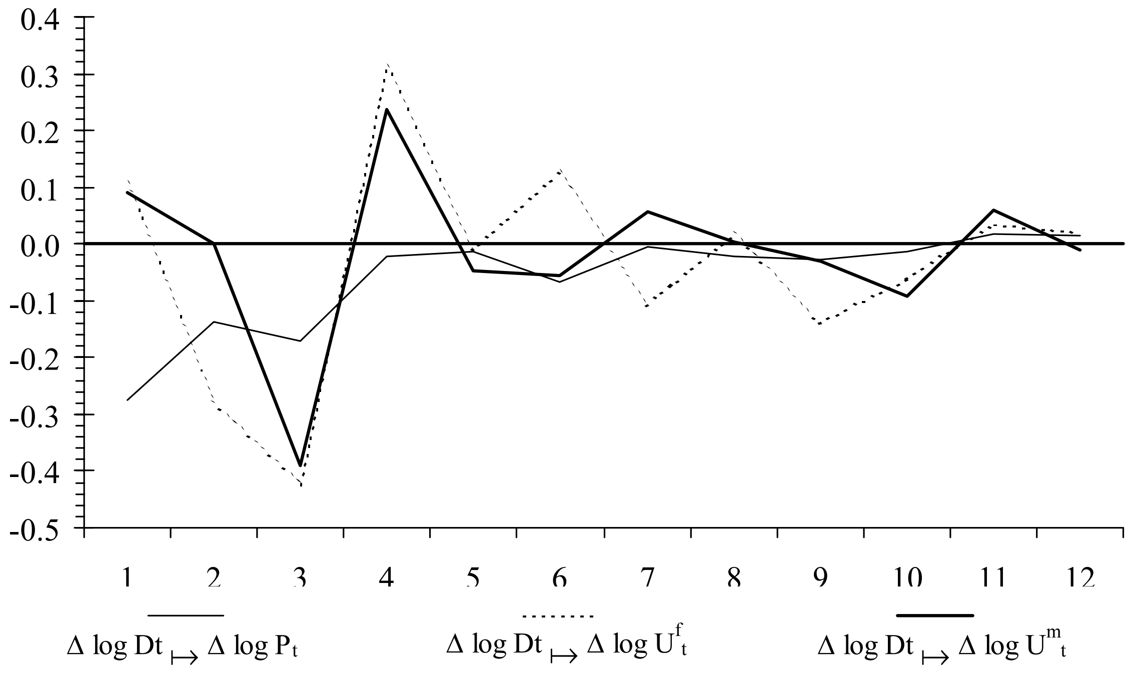


Figure 6. Impulse response function analysis - Denmark.

a. Effects to the labor market variables from a shock to the divorce rate.



b. Effects to the divorce rate from shocks to the labor market variables.

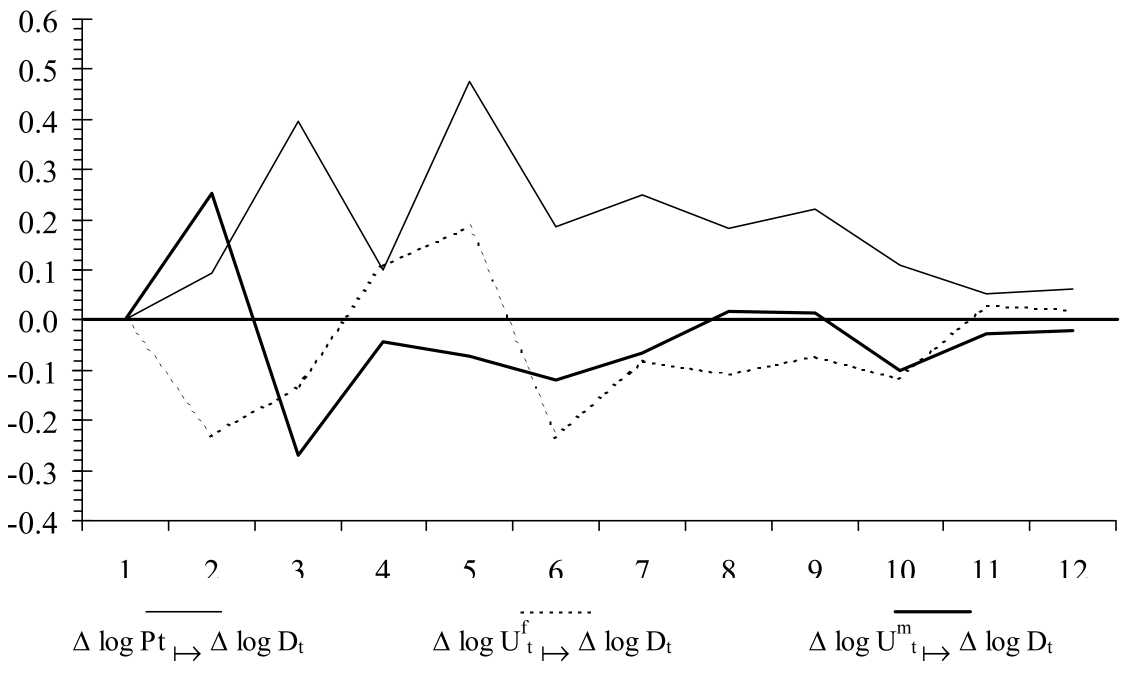


Table 1. Unit root tests.

	USA	Denmark
Variable:		
Divorce rate	-1.57{2}	-1.51{1}
Female labor force participation rate	-0.35{1}	-1.79{1}
Female unemployment	-2.79{1}	-2.15{1}
Male unemployment	-3.49{1}	-2.18{1}

Notes: Log values of the variables used in the tests and the critical value is -3.51 at the 5 percent level of significance calculated from MacKinnon (1991). { } denotes the included lags in the ADF test.

Table 2. Lag length selection.

	USA			Denmark		
Number of lags	AIC	SC	LR-test (p-values)	AIC	SC	LR-test (p-values)
4	-1182.2	-1028.6	0.33	-727.5	-589.8	0.18
3	-1209.4	-1091	0.26	-735.9	-629.5	0.87
2	-1213.7	-1132.3	0.00	-753.6	-680.4	0.03
1	-1182	-1137.6	-	-747.4	-707.5	-

Notes: The test as described by (4) and (5), and for the LR-test only *p*-values reported. All regressions and test statistics are calculated using the time series software package RATS, see Doan (1992) or Enders (1995, 1996) for further details.