# Divorce and Labor Force Participation: Inferences Using Panel Data

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## I. Introduction

The debate over the causal relationship between female labor force participation and marriage dissolution can generate as many conflicting opinions as an acrimonious divorce proceeding. Some researchers argue that as female labor force participation has increased, women have become more financially independent and have, thus, become more likely to end a less than perfect marriage. From this point of view, the notable increase in female labor force participation that occurred from the 1960's through the 1990's is what caused the dramatic increase in divorce that happened almost simultaneously. Other writers have argued just as convincingly that females, aware of rising divorce rates and wishing to provide themselves with some degree of economic security, entered the labor force in increasing numbers as an act of economic self defense. According to this view, it was the rise in divorce rates that caused the increase in female labor force participation—a diametrically opposite position to that of the previous argument.

Most recent attempts to examine these issues have used nationally aggregated data[1]. This paper diverges somewhat from this approach choosing, instead, to use state level data as the unit of analysis. This has some particular advantages when it comes to analyzing issues that are affected by legal, cultural and demographic differences. State level data provides some degree of control over factors that tend to persist in various geographic regions. For example, the divorce rate in Utah, a predominantly Mormon state, may vary significantly from the divorce rate in New York, a state with greater religious variation. Likewise, divorce rates in Bible belt states may differ considerably from those in California. The use of state level data also controls for differences in the legal attitude toward divorce that has existed between states. For example, some states adopted no-fault divorce laws much sooner than others.

[1] See Bremmer and Kesselring (2004) and No, Andrews, and Yigletu (2007)

The panel data used in the study is also unique. Yearly data on the fifty states and the District of Columbia was extracted from the March Supplement of the Current Population Survey, data collected by a joint effort of the U.S. Bureau of Labor Statistics and the Census Bureau. The extraction process allowed construction of a number of variables that would be difficult, if not impossible, to obtain directly from published sources. In addition, some of the time series were significantly longer than comparable series found in published sources.

Using Granger causality tests, it was found that in most states, the causality was unidirectional going from divorce rates to labor force participation rates. Thus for the majority of the states, higher divorce rates led to more women in the labor force and not vice versa. In only three states, did the causality go the other way, from greater participation in the labor force to higher divorce rates. There was evidence of bilateral causality in seven of the states where past values of both variables affected both the current values of female labor force participation and divorce rates. Finally, the data provided no evidence for causality in either direction in the remaining nine states and the District of Columbia.

A brief review of the literature follows these introductory comments. The next section discusses the data and the methodology. After discussing the results of the statistical tests, the final section of the paper concludes with a summary of the findings and some thoughts on future research.

## II. Review of the Literature

Analyzing the relationship between divorce rates and female labor force participation rates, D'amico (1983) hypothesized that the increased income resulting from more females in the labor market had two opposite effects on the stability of a marriage and the likelihood that it would end in divorce. The first hypothesis, often called the "independence effect," is that as a wife's income rises relative to her husband's, her financial independence increases. This increased independence leads to more marital conflict as the couple competes for status and this increases the probability of divorce. The other, opposing hypothesis, often referred to as "the income effect," holds that the wife's ability to add to family income increases the socioeconomic status of the couple, further solidifies the marriage and

decreases the probability of divorce. D'amico's results tend to reject the independence effect and confirm the presence of the income effect.

However, findings by Becker, Landes and Michael (1977) argue that the probability of divorce rises with increases in the wife's salary and falls with increases in the husband's income. Two separate studies by Spitze and South (1985, 1986) confirm the independence effect. They find increased female labor force participation results in more family conflict and increased divorce rates. They argue in their 1985 paper that it is the number of hours a wife works that has a greater direct effect on the probability of divorce than do other measures that proxy the wife's income. A separate study by South (1985) found that changes in the age structure and female labor force participation had significantly stronger impacts on divorce rates than other macroeconomic variables such as the unemployment rate and whether the economy was experiencing a recession or expansion.

However, two other studies, one by Hoffman and Duncan (1995) and the other by Sayer and Biancji (2000) find no empirical evidence to support the existence of the independence effect. Both of these studies found that if wives' real income increased, divorce rates did not increase.

There are a number of studies providing evidence that more women will enter the labor force if the risk of divorce increases. Both Lombardo (1999) and Greene and Quester (1982) find that if women feel divorce is more likely, they will hedge against the attendant income loss with both increased labor force participation and increased hours spent in the work place. As the probability of divorce increases, women invest less time in nonmarket activities such as child rearing because of the lower relative return and they invest more time in the labor market because the increased human capital from on-the-job training has a relatively higher return. Johnson and Skinner (1986) and Shapiro and Shaw (1983) find that women tend to enter the labor market prior to an expected divorce. Surveying twelve industrialized nations, Mincer (1985) found that rising divorce rates lagged behind rising female labor force participation.

Bremmer and Kesselring (1999) used the Granger causality test on annual U.S. data to analyze the relationship between divorce rates and female labor force participation rates. While lagged values of female labor force participation were found not to affect current values of the divorce rate, past values of the divorce rate were found to be statistically significant in explaining current values of the female labor force participation rate. Their conclusion was that divorce rates Granger-cause female participation in the labor market, but female labor force participation rates do not Granger-cause divorce rates.

Analyzing the divorce decision at the micro level using census data, Kesselring and Bremmer (2006), found that as females experience greater levels of success in the labor market, they also tend to experience higher rates of divorce. This study consisted of a sample of over 100,000 individuals and a key result was that as the female's earnings became a larger portion of the family income, the likelihood of divorce increased even while controlling for general successes in the labor market. Given a limited dependent variable that was either 1 or 0 (either married or divorced), this analysis used probit estimation and sample selection techniques to analyze the divorce decision.

With annual U.S. data, Bremmer and Kesselring (2004) used cointegration techniques to further shed evidence on the relationships between divorce rates, female labor force participation, fertility rates and income. While the analyzed VAR included variables other than female labor force participation and divorce rates, those two variables were the focus of the study. Impulse response functions derived from the estimated vector error-correction model exhibited evidence of bilateral causality or feedback. Increases in either female labor force participation or female income caused the divorce rate to increase. Likewise, both increases in female wages and the divorce rate caused more women to enter the labor force. One of the possible shortcomings of this study is the use of annual nationwide data which prevented the estimations from being able to control for cultural and legal variations between states.

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No, Andrews and Yigletu (2007) applied Bremmer and Kesselring's empirical framework in their analysis dealing exclusively with African-American women. Applying "contemporary time-series methodology" to the same four series analyzed by Kesselring and Bremmer--divorce rates, female labor force participation rates, female income levels and the fertility rates--bilateral causation was found between black divorce rates and the number of black females entering the labor market. Impulse response functions indicated that increases in African-American female labor force participation lead to increases in the African-American divorce rate. But impulse response functions also revealed that increases in African-American divorce rates lead to increases in African-American female labor force participation.

## III. Data and Methodology

Data for this study came from a unique source. The data was extracted from the March Supplement of the Current Population Survey. This survey is conducted by the U.S. Census Bureau on behalf of the Bureau of Labor Statistics and it samples about 50,000 households monthly. The survey has been performed for over 50 years. Data was extracted from the raw observations for each state and then averaged. The data offers a wide variety of information that is not readily available in published sources. For example, the number of females in the labor force could be measured by three different data series. First, there is data on the number of hours that a female worked in the week previous to the survey week. Second, the number of weeks that a woman worked during the previous year is also reported and third, with some minor manipulation, the percentage of females who participated in the labor force during the year previous to the survey can be constructed. This paper focuses on the number of hours that females worked in the week prior to the survey week. Future work will have to examine the other two measures of labor market participation and determine how robust the findings are across the different measures.

When analyzing the relationship between divorce rates and female labor force participation rates with annual U.S. data, divorce rates are obtained from the National Vital Statistics Reports published by

the Centers for Disease Control and Prevention. This data consists of count data. It is the number of divorces that occurred in a given year per 1,000 in population. While it is an accurate measure of the number of divorces in a particular year, it may be a poor proxy for the number of divorced women living in a given area. The stock of divorced women in a given location is also a function of divorces that occurred in previous years. The data from the Current Population Survey provides an estimate of the percentage of the women who are in the labor force and who are also divorced. This variable and its relationship to female labor force participation may be more relevant than the number of divorces that occurred in a given year.

For this exploratory paper, the relationship between the rate of divorce for females in a particular state during year t ($D_t$) and the average number of weekly hours worked by females in the same state during the same year ($H_t$), are analyzed using Granger's (1969) causality test. Two vector autoregressive equations are specified, one equation assumes the current value of $D_t$ is a linear function of past values of D and H and the other equation assumes the current value of $H_t$ is a linear function of the same past values of D and H. The two models are:

$$D_t = \alpha + \sum_{i=1}^{m} \beta_i D_{t-i} + \sum_{i=1}^{m} \delta_i H_{t-i} + \varepsilon_t \qquad (1)$$

and

$$H_t = \theta + \sum_{i=1}^{m} \gamma_i D_{t-i} + \sum_{i=1}^{m} \lambda_i H_{t-i} + \mu_t \qquad (2)$$

where the two white noise, random error terms, $\varepsilon_t$ and $\mu_t$ are assumed to be uncorrelated. It is worth noting that this methodology assumes the number of lags in both equation (1) and (2) are the same, m. Past values of H are said to "Granger cause" the current value of D if the null hypothesis that $\sum_{i=1}^{m} \delta_i = 0$ is rejected. Likewise, past values of D are said to "Granger cause" the current value of H if the null

hypothesis that $\sum_{i=1}^{m} \gamma_i = 0$ is rejected. Depending on whether one rejects or fails to reject either or both null hypotheses, Granger causality tests can reveal unidirectional causality, bilateral causality or independence between $D_t$ and $H_t$. Table 1 summarizes the possible outcomes of the Granger causality tests. For example, if both null hypotheses, $\sum_{i=1}^{m} \delta_i = 0$ and $\sum_{i=1}^{m} \gamma_i = 0$, are rejected, then both $D_t$ and $H_t$ are affected by past values of both variables. This would be the case of bilateral causality or feedback. Finally, if the data is such that neither null hypothesis can be rejected, then $\sum_{i=1}^{m} \delta_i = 0$ and $\sum_{i=1}^{m} \gamma_i = 0$. This situation has been characterized as the case of "independence" where the current value of $D_t$ is not affected by past values of H and the current value of $H_t$ is invariant to past values of D.

One of the critical statistical issues related to the performance of Granger causality tests is the choice of m--the number of lagged values to include for each variable on the right-hand side of equations (1) and (2). Unfortunately, the results of the test can change as the lag length is varied. The econometric literature suggests the use of several different statistical rules to aid in the choice of lag length. The two most commonly recommended rules are: (i) choose the lag length that minimizes the Akaike information criterion, or (ii) choose the lag length that minimizes the Schwarz information criterion.[2] For the purposes of this paper, the Schwarz information criterion is used as it sets a harsher standard than the Akaike information criterion.

## IV. Empirical Results

The results of applying separate Granger causality tests to the fifty states and the District of Columbia are listed in Tables 2 and 3. Table 2 reports the F tests for two different null hypotheses. The first null hypothesis is that the average number of hours that women work per week does not Granger

[2] Other possibilities involve minimizing the Hannan-Quinn information criterion or choosing by sequential likelihood ratio tests the last significant lag (actually the lag before the one that would be statistically insignificant).

cause divorce. The second null hypothesis is the converse, that divorce does not Granger cause the average number of hours per week that women work.

As was discussed earlier and highlighted in Table 1, the two Granger causality tests can result in four possible outcomes and they are summarized in Table 3. For the majority of the states, the statistical tests indicate that the causality is unidirectional going from divorce to the average number of hours that women work per week. This result occurs in 31 of the states. This result strongly argues in favor of the proposition that women hedge against the increased risk represented by higher divorce rates by investing more time in the labor market. The states included in this category are a diverse group. It includes New England states like Maine and Massachusetts, states from the Deep South like Alabama and Georgia, states from the Midwest like Ohio and Iowa and states from the Pacific Northwest including Oregon and Washington.

As indicated in Table 3, the direction of causality goes the other direction, from average number of hours that women work per week to divorce only in only three states: Maryland, Minnesota and Wisconsin. Both null hypotheses can be rejected only in the case of seven states. The states in this category include New York, Idaho and Mississippi, and the evidence indicates that the two variables in these states exhibit bilateral causality as past values of one variable affect current values of another.

Finally, the data is insufficient to reject both null hypotheses in nine states and the District of Columbia. States in this category include Illinois, Indiana, California and Michigan. The statistical tests indicate that the current values of either divorce or the average number of hours worked per week are independent of the past values of the other variable. It should be noted that in seven of these states and the District of Columbia, the F statistic was relatively more statistically significant in the case of the null hypothesis that divorce did not Granger cause the average number of hours that women worked per week. Two of the states, New Hampshire and Virginia, and the District of Columbia had p-values that were between 0.104 and 0.108, almost significant at the 10 percent level. Three other states, Arizona, California and Illinois, had p-values between 0.141 and 0.150.

For the vast majority of the states, the sample consisted of 46 annual observations between 1964 and 2009. There were four exceptions where the state had fewer observations because of missing values. These exceptions are noted in Table 2. Additionally, for the overwhelming majority of the different geographic regions, 47 states and the District of Columbia, the Schwarz information criterion indicated the proper lag length was a single year. Only in the case of three states, New York, Ohio and Washington, did the Schwarz information criterion indicate that the appropriate lag length should be two years.

## V. Conclusions and Future Research

The causal relationship between divorce and female participation in the labor market has been the topic of much debate in the economic and sociological literature. Some argue there is an income effect where the wife's earnings tend to increase household status and thereby contribute to the stability of the marriage, reducing the likelihood of a divorce. Others argue there is an independence effect where the wife's earnings in the labor market will increase her financial independence, leading to increased marital conflict and a higher probability of divorce. While past attempts of analyzing these issues have relied on macro, national data, this study used annual observations from the fifty states and the District of Columbia. This data was extracted from the March Supplement of the Current Population Survey, which yielded several data series that are not available from the usual, published sources. Using regional data to analyze the causality between these two variables provides additional insight because it provides some control over cultural and legal differences across the states.

Using separate Granger causality tests on the rate of female divorce and the average number of hours that women work per week, strong statistical evidence was presented that rising divorce rates lead to increases in female labor force participation, somewhat the opposite of the independence effect. For the vast majority of the states, there is unidirectional causality from rising divorce rates to the average number of hours that women work per week. As women witness the increased probability of divorce, they realize that they can no longer rely on the persistent, joint income of a married household and they

hedge the increased risk of divorce by investing more time in the labor market and, as a result, more time in human capital. Only in three states was there evidence that unidirectional causality went the other direction.

This paper reports preliminary results using a data set that holds a great deal of promise for future research. One possibility includes testing to see how sensitive the results are to changes in chosen lag lengths. In addition, a binary variable indicating the presence of no-fault divorce laws could be added as an additional explanatory variable in each regression. The data set includes other measures of labor force participation, the percent of females in the labor force and the average number of weeks worked during the previous year. Granger causality test could be applied using these variables in place of the ones chosen for this paper, which should provide an avenue for assessing the robustness of these results. There is also the possibility of using more complex panel data techniques (allowing for control of cross correlation between regions) instead of the independent regressions used in this study.

Finally, the data set includes several variables providing different measures of female income and female fertility for all 50 states and the District of Columbia. The additional availability of these measures allow estimation of more complex models of cointegration similar to that estimated by Bremmer and Kesselring (2004) using aggregate U.S. data. This would allow the use of another tool—impulse response functions—to analyze causality between these variables. But these preliminary results provide a surprisingly clear outcome. Overall, it appears that the rising divorce rates that occurred during the 70's, 80's and 90's led to increases in female labor force participation and not the other way around.

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Table 1
Possible Outcomes of the Granger Causality Tests

Models

$$D_t = \alpha + \sum_{i=1}^{m} \beta_i D_{t-i} + \sum_{i=1}^{m} \delta_i H_{t-i} + \varepsilon_t$$

$$H_t = \theta + \sum_{i=1}^{m} \gamma_i D_{t-i} + \sum_{i=1}^{m} \lambda_i H_{t-i} + \mu_t$$

| Null Hypothesis | | |
|---|---|---|
| $H_0 : \sum_{i=1}^{m} \delta_i = 0$ | $H_0 : \sum_{i=1}^{m} \gamma_i = 0$ | Conclusion |
| Decision: fail to reject | Decision: reject | Unidirectional causality from D to H |
| Decision: reject | Decision: fail to reject | Unidirectional causality from H to D |
| Decision: reject | Decision: reject | Feedback or bilateral causality between H and D |
| Decision: fail to reject | Decision: fail to reject | D and H are independent of each other |

Table 2
The Relationship between Percent Divorced and Hours Worked per Week:
Granger Causality Test Using State Data

| State | Null Hypothesis | |
|---|---|---|
| | Average Hours Worked Per Week by Women Does Not Granger Cause Percent Divorced | Percent Divorced Does Not Granger Cause Average Hours Worked per Week by Women |
| Alabama | 0.651<br>(0.423) | 4.231**<br>(0.459) |
| Alaska† | 1.328<br>(0.256) | 9.948*<br>(0.003) |
| Arizona | 0.146<br>(0.705) | 2.249<br>(0.141) |
| Arkansas | 3.591***<br>(0.065) | 6.381**<br>(0.016) |
| California | 0.122<br>(0.728) | 2.157<br>(0.149) |
| Colorado | 2.721<br>(0.106) | 6.490**<br>(0.015) |
| Connecticut | 0.046<br>(0.830) | 0.850<br>(0.362) |
| Delaware | 4.241**<br>(0.046) | 3.440***<br>(0.071) |
| District of Columbia | 1.351<br>(0.252) | 2.698<br>(0.108) |
| Florida | 0.000<br>(0.994) | 2.973***<br>(0.092) |
| Georgia | 0.398<br>(0.532) | 5.645**<br>(0.022) |
| Hawaii | 0.607<br>(0.440) | 4.071**<br>(0.050) |
| Idaho | 6.125**<br>(0.017) | 9.968*<br>(0.003) |
| Illinois | 0.007<br>(0.935) | 2.155<br>(0.150) |
| Indiana | 0.568<br>(0.455) | 0.779<br>(0.382) |
| Iowa | 0.893<br>(0.350) | 7.488*<br>(0.009) |
| Kansas | 2.051<br>(0.160) | 11.196*<br>(0.002) |
| Kentucky | 2.347<br>(0.133) | 4.878**<br>(0.033) |
| Louisiana | 0.487<br>(0.489) | 12.115*<br>(0.001) |
| Maine†† | 0.015<br>(0.903) | 11.471*<br>(0.002) |

See footnotes at end of Table 1.

Table 2 (Continued)
The Relationship between Percent Divorced and Hours Worked per Week:
Granger Causality Test Using State Data

| State | Null Hypothesis | |
|---|---|---|
| | Average Hours Worked Per Week by Women Does Not Granger Cause Percent Divorced | Percent Divorced Does Not Granger Cause Average Hours Worked per Week by Women |
| Maryland | 6.683** (0.013) | 1.746 (0.194) |
| Massachusetts | 0.621 (0.435) | 3.571*** (0.066) |
| Michigan | 1.241 (0.272) | 0.968 (0.331) |
| Minnesota | 5.640** (0.022) | 2.812 (0.101) |
| Mississippi | 4.471** (0.040) | 9.132* (0.004) |
| Missouri | 0.617 (0.437) | 9.473* (0.004) |
| Montana | 17.977* (0.000) | 10.520* (0.002) |
| Nebraska | 0.542 (0.466) | 5.183** (0.028) |
| Nevada†† | 1.655 (0.205) | 4.928** (0.032) |
| New Hampshire | 0.761 (0.388) | 2.759 (0.104) |
| New Jersey | 0.359 (0.552) | 9.065* (0.004) |
| New Mexico | 0.033 (0.586) | 5.704** (0.022) |
| New York‡ | 5.633* (0.007) | 3.409** (0.043) |
| North Carolina | 0.159 (0.692) | 2.833*** (0.100) |
| North Dakota | 1.072 (0.306) | 11.681* (0.001) |
| Ohio‡ | 1.142 (0.330) | 6.508* (0.004) |
| Oklahoma | 0.609 (0.439) | 12.807* (0.001) |
| Oregon | 2.287 (0.138) | 4.581** (0.038) |
| Pennsylvania | 0.030 (0.864) | 3.397*** (0.072) |
| Rhode Island | 0.981 (0.328) | 4.309** (0.044) |

See footnotes at end of Table 1.

Table 2 (Continued)
The Relationship between Percent Divorced and Hours Worked per Week:
Granger Causality Test Using State Data

| State | Null Hypothesis | |
|---|---|---|
| | Average Hours Worked Per Week by Women Does Not Granger Cause Percent Divorced | Percent Divorced Does Not Granger Cause Average Hours Worked per Week by Women |
| South Carolina | 0.885<br>(0.352) | 0.319<br>(0.575) |
| South Dakota | 0.303<br>(0.585) | 4.765**<br>(0.035) |
| Tennessee | 1.125<br>(0.295) | 6.102**<br>(0.018) |
| Texas | 0.115<br>(0.736) | 7.824*<br>(0.008) |
| Utah | 4.045**<br>(0.051) | 8.050*<br>(0.007) |
| Vermont††† | 0.313<br>(0.579) | 3.658***<br>(0.063) |
| Virginia | 2.154<br>(0.150) | 2.783<br>(0.103) |
| Washington‡ | 0.016<br>(0.984) | 5.892*<br>(0.006) |
| West Virginia | 0.132<br>(0.718) | 3.873**<br>(0.056) |
| Wisconsin | 3.000***<br>(0.091) | 2.560<br>(0.117) |
| Wyoming | 2.193<br>(0.146) | 13.106*<br>(0.001) |

*, ** and *** indicate that F tests rejected the null hypothesis at the 1%, 5% and 10% level, respectively.
†Sample: 1968 – 2009. ††Sample: 1965-2009. †††Sample: 1966 – 2009. ‡ Underlying VAR include two lags.

Table 3
Summary of Granger Causality Results

| Unidirectional Granger Causality from Percent Divorced to Average Hours Worked Per Week | | | |
|---|---|---|---|
| Alabama | Kentucky | New Mexico | South Dakota |
| Alaska | Louisiana | North Carolina | Tennessee |
| Colorado | Maine | North Dakota | Texas |
| Florida | Massachusetts | Ohio | Vermont |
| Georgia | Missouri | Oklahoma | Washington |
| Hawaii | Nebraska | Oregon | West Virginia |
| Iowa | Nevada | Pennsylvania | Wyoming |
| Kansas | New Jersey | Rhode Island | |

| Unidirectional Granger Causality from Average Hours Worked Per Week to Percent Divorced | | |
|---|---|---|
| Maryland | Minnesota | Wisconsin |

| Feedback or Bilateral Causality between Average Hours Worked and Percent Divorced | | | |
|---|---|---|---|
| Arkansas | Idaho | Montana | Utah |
| Delaware | Mississippi | New York | |

| Average Hours Worked and Percent Divorced Are Independent of Each Other | | | |
|---|---|---|---|
| Arizona* | District of Columbia* | Michigan | Virginia* |
| California* | Illinois* | New Hampshire* | |
| Connecticut* | Indiana* | South Carolina | |

*Rejecting the null hypothesis that the percent divorced does not Granger cause the average hours worked per week has a lower p-value than rejecting the null hypothesis that the average hours worked per week does not Granger cause the percent divorced.