Antidepressant Sales and the Health of the Economy

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Introduction

For as long as the field of psychology has been in existence its topics have been seen by many as a sort of "taboo." People suffering from mental illness only a century ago would have been thrown into some sort of institution in order to rid society of the problem of actually dealing with or attempting to heal them. It has only been recently that the public has come to embrace psychological health as a legitimate field of medicine. With the advent of psychological medications that actually work and contain fewer side effects than their predecessors, people have generally been more willing to acknowledge the presence of a problem, and to attempt to remedy it through the prescription of psychological medication.

Specifically, depression has perhaps been viewed as a legitimate health concern for longer than any other psychological illnesses. Because it is so common, and because it crops up in response to certain life events (such as post-partum depression in a mother following the birth of her child), depression has long been accepted as an issue. Only in recent years, however, have valid treatments been developed to deal with the illness.

Early in the developments in the field of psychopharmacology, such antidepressant medications as tricyclics (TCAs) and monoamine oxidase inhibitors (MAOIs) were conceived. These antidepressants were fairly effective, and are still used when responses to more modern medication are poor. However, these two classes of medication come with many side effects—in some cases extreme. Developers continued to seek a medication that could deal with depression without the adverse effects.

The answer was found in selective serotonin reuptake inhibitors (SSRIs). This class of drugs is commonly used today, and encompasses such common names as Zoloft, Prozac, Paxil, and Celexa. These antidepressants are the most commonly prescribed medications for the

treatment of mental illness, even today, and are used to combat the common symptoms of depression (sadness, anhedonia, etc.) as well as symptoms of anxiety (general nervousness, elevated response to stress, etc.). More importantly, they are able to do so without the many side effects that plagued the earlier antidepressant medications. Antidepressant use took off after the introduction of SSRIs to the general public in 1989 for two reasons: 1. SSRIs contained the benefits of TCAs and MAOIs without the adverse effects, and 2. The public has become more accepting of the use of medication in the treatment of depression over time.

SSRI development has not been the only factor changing the use of antidepressants in the past, however. Many factors have increased antidepressant use. Take the recent recession as an example. During the past few years stocks have fallen and unemployment has skyrocketed; during the same time antidepressant sales have increased greatly. Typically, this is the trend seen throughout the last 40 years—such economic factors as unemployment, gross domestic product (GDP), and inflation tend to have a strong effect on the sales of antidepressant medications.

Normal goods sell less in times of economic hardship; inferior goods sell more. However, antidepressant drugs sell more during times of hardship for different reasons than that which cause an inferior good to sell more. Antidepressants sell more during such times more likely because the times themselves cause an increase in depression (or at the very least, in perceived depression), and people more avidly seek a means of treatment during such a time.

Additionally, a few remaining factors may affect the sale of antidepressant medication, including fertility rate, divorce rate, etc. It has been seen that when fertility rate increases, incidence of post-partum depression (naturally) increases, and thus sales of antidepressant

medication tends to increase. Similarly, stressful life events, such as a divorce, tend to increase depression and antidepressant sales.

Overall, despite the extensive linkages between antidepressant sales and the many factors of economic health which affect them, very little research has been conducted in this area. As seen below, many of the studies that have correlated these ideas have focused on sales as a function of unemployment alone, with merely a nod to GDP's role, and typically little to no acknowledgment of any further variables.

Literature Review

During recessions, depressions, and generally any time the economy is lagging, people may become disheartened. Upset by such factors as job loss, lagging income, and inflation, people deal with the accompanying anxiety in many ways. Many studies have shown that suicide rates increase along with economic woes. In more recent years, as the popularity of antidepressant drugs in the treatment of the symptoms of depression has become more prevalent, the prescriptions of such drugs in periods of economic trouble has increased as well (Hobson, 2011). More research has been done on (as likely more data is available for) the relationship between health of the economy and suicide rates, but the prescription and sale of antidepressant drugs as a response to a sickly economy is potentially a more relevant area for future research as the marketing of the drugs poses a viable alternative to suicide. With this, interestingly, comes the study of antidepressant drugs themselves. The prescriptions are unique in that they are not a normal good, nor an inferior good according to the standard definitions. Expectation of an increase in their sale with a decrease in income has nothing to do with them being an inferior good. Thus, study in this area and on this unique good potentially defies the standard models of

microeconomics and requires a greater understanding of the relationship between economic health indicators and the sale of antidepressants in order to model the distinct connection.

The general trend in antidepressant sales shows that the primary recipients of antidepressant prescriptions fall in the age group of 20 to 54, and that females are prescribed the drugs more often than males (Middleton et al., 2001). The age of the patient especially is an important factor for my study, because this shows that the primary group being prescribed and sold antidepressants is of working age, when factors such as unemployment rate tend to have a greater, more direct effect.

The research in psychiatric health and its relation to economics is a fairly recent development. Perhaps this is because economics has always viewed less rigorous social sciences as "beneath" them, or perhaps it is a result of the growing incidence and awareness of psychiatric disorders such as depression, and their growing impact on the general population. In any event, the primary foundational paper in this area of research was written in 2004 by Andrew Lakoff. "The Anxieties of Globalization: Antidepressant Sales and Economic Crisis in Argentina" relates the 2001 economic crisis in the South American country to a spike in antidepressant sales observed around the same time period. Lakoff was particularly interested in whether the cause of the antidepressant spike was the floundering economy or if it could be the significant increase in awareness of depression including advertising and promotional campaigns for antidepressant medications. The article questions the legitimacy of the population's demand for antidepressants, bringing into question the issues associated with marketing directly to patients, expanding the antidepressant market in times of economic weakness, and defining "depression" as feelings of stress and vulnerability (these are common, but "depression" requires a much more narrow diagnosis).

Lakoff's conclusions opened up the realm of economic psychology further than it ever had before. He found that the most significant factor in the wildly increasing antidepressant sales in Argentina lay not with the patients or the pharmaceutical companies, but with the doctors. Doctors certainly saw more patients complaining of symptoms of depression as awareness grew due to ad campaigns secretly sponsored in part by the pharmaceutical companies themselves; however one could argue that it is a firm's job to market their product, and so the pharmaceutical companies cannot be faulted for participating in that standard of business. However, physicians are responsible with accurately prescribing correct medications for the symptoms and disorders they are intended to alleviate, and, in this case, the doctors did not. Rather than prescribing selective seretonin reuptake inhibitors (SSRIs, the most popular class of antidepressants) for their intended purpose (to increase the levels of seretonin in the brain, thereby treating what is thought to be the biological cause of depression), they prescribed them to people who had no diagnosable biological depression, simply for "the sense of insecurity and vulnerability that the economic and political crisis had wrought." Thus began the research on social, political, and economic, rather than biological, causes of antidepressant prescription. And Lakoff's field has only grown since 2004.

In 2009, Kuhn, Lalive, and Zweimüller looked at the relationship between the economy and antidepressant sales from a slightly different standpoint; specifically, they observed how job loss affected sales of antidepressant medications. Their findings included several significant items. First and foremost, Kuhn et al found that the overall sales of medications and expenditures on other medical costs did not increase significantly with job loss. This is important, because if, for some reason, all medical expenditures increased with involuntary job loss, then the fact that antidepressant medication sales increases in times of economic hardship

would not be surprising, and could, in fact, be explained by a general increase in medical consumption rather than a linked increase in depression or the perception of depression associated with the tougher economy. This fact, thus, made it important to continue to study the positive association found between antidepressant sales and a floundering economy as the increased medical expenditure is seen only on this type of prescription medication and not on prescription medications in general.

Additionally, Kuhn et al discovered an interesting linkage to gender, making it a relevant factor in future antidepressant sale studies. They found that expenditures on antidepressants do increase with involuntary job loss; they also found that depression-related hospitalizations increased dramatically with job loss *for men but not for women*. One could posit the social implications and causes of such a finding, including traditional gender roles, etc. However, the important implication for the field of economic psychology was this: gender does, indeed, have an effect on antidepressant consumption in times of hardship, and should be considered as a potential variable in future models of antidepressant consumption.

In 2011, Nathan Tefft wrote an article entitled "Insights on Unemployment, Unemployment Insurance, and Mental Health." This paper appears to have continued on Kuhn et al's research, broadening the "mental health" to consider anxiety in addition to clinically diagnosed depression. Tefft examined the relationship between these health problems and unemployment, rather than looking at outright job loss as his predecessors had. Significant contributions by Tefft to this area of research are many; however, his most significant contribution was the creation of a linear model which examined the relationship between unemployment and mental health, while choosing to also include a lag variable. A lag variable

makes a great deal of sense in this instance, as one would expect incidence of depression in one time period to be related to incidence of depression in the next.

Although not a formal research article, it is worth noting Caitlin McDevitt's article for the Washington Post in 2011, "The Big Money: Depression and the Recession." The source is worth noting not because of its observation of the linkage between antidepressant sales and a time of recession, as that had obviously been already extensively observed prior to this publication. However, McDevitt makes sure to note something that the previous economic articles had not seemed to thoroughly consider: that the correlation between the two variables does not imply that economic hardship causes depression. On the contrary, McDevitt posits that it could indeed be depression that causes recessions, as worker productivity decreases when workers are depressed, health care costs increase, etc. This particular caveat is important to bear in mind when considering any model that attempts to explain depression with economic factors.

As can be expected, various sources show that antidepressant sales decrease following tighter restrictions and regulations by the Food and Drug Administration, including questions of suicidal effects of the drugs, and warnings of additional side effects (Libby et al., 2009; Kurian et al., 2007; and Olfson et al., 2008). This will present an extraneous variable not accounted for by my model.

Overall, some research has been done in the overlapping fields of psychology and economics, but the area is still wanting of further research. Considering antidepressant medications as a good, they are unique in that they do not fall into the typical "normal" good, as it has been found that a decrease in income leads to an increase in sales; however, they are certainly not a typically defined "inferior" good either. The contributions of Lakoff, Kuhn et al,

and Tefft have perhaps been the greatest toward understanding what affects antidepressant sales, but more research must be done to further the exploration in the future.

Model and Hypotheses:

The model implemented in this paper explores many of the variables mentioned in the introduction for Norway from 1975 to 2005:

$$Sales = \beta_0 + \beta_1(Male\ Unemployment) + \beta_2(Female\ Unemployment) + \beta_3(Inflation) + \beta_4(GDP\ Per\ Capita) + \beta_5\ (SSRI) + \beta_6(Fertility\ Rate) + \beta_7(Divorce\ Rate) + \varepsilon$$

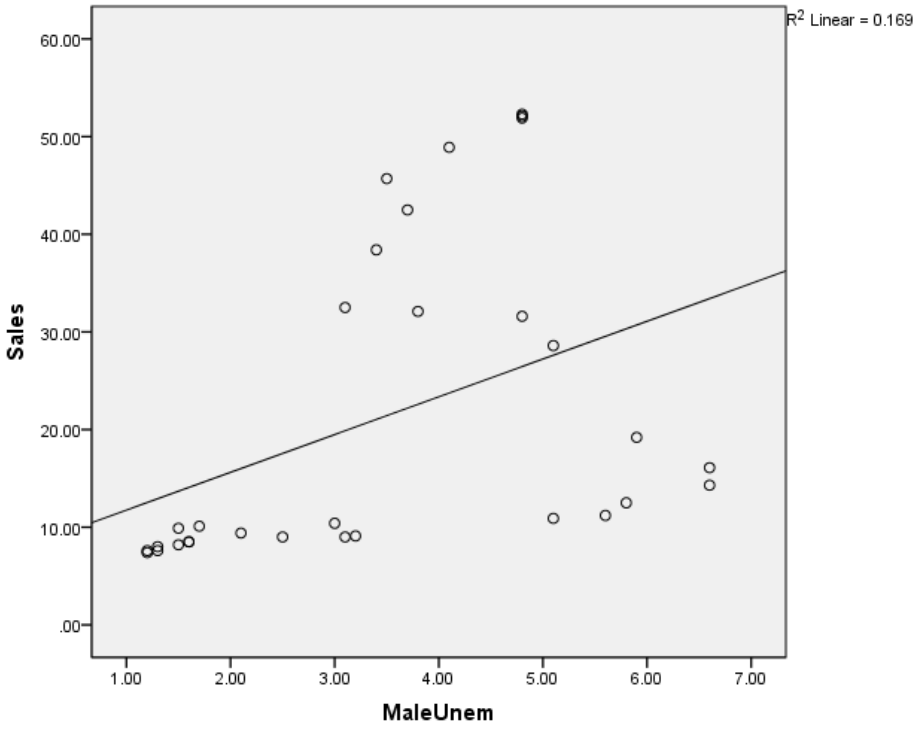
- Sales: This is the sales of all antidepressant drugs to pharmacies and institutions from 1975 through 2005. This does not *necessarily* represent consumption; not all antidepressants sold are consumed. The sales variable is measured in defined daily doses (DDD) per 1,000 inhabitants per day. It is worth noting that it is difficult to find information on antidepressant sales, and so this data was taken from a study done on Nordic countries (specifically, Norway), even though the initial aim of this paper was to explore the effect in the United States. This data was taken from the study, "The Relationship between Sales of SSRI, TCA and Suicide Rates in the Nordic Countries," published in 2010 by Zahl, et al.
- Male Unemployment: This is the percentage of the male labor force without a job. I expect this to be positively correlated with antidepressant sales, as people will rely more on antidepressants when they are out of work and experiencing hardship. This data was retrieved from the World Bank database of economic indicators.

- Female Unemployment: This is the percentage of the female labor force without a job. I expect this to be positively correlated with antidepressant sales for the same reason as above; however, I expect male unemployment to be more strongly correlated with antidepressant sales than female unemployment will be. This data was retrieved from the World Bank database of economic indicators.
- GDP per capita: This is the gross domestic product divided by the population of Norway at midyear. It is given in US dollars. Because the GDP is an indicator of income, and a greater income makes life "easier," I expect this variable to me negatively correlated with antidepressant sales. This data was retrieved from the World Bank database of economic indicators.
- Inflation: This variable is measured using the GDP deflator. It shows the rate of price change in the economy, and is given as a percentage. Inflation increases relative prices, making people comparatively poorer. Because of this effect, I expect inflation to be positively correlated with antidepressant sales. This data was retrieved from the World Bank database of economic indicators.
- SSRI: This is a dummy variable for the presence of SSRI medication on the market. It takes on the value of zero from 1975 to 1988, and one from 1989 to 2005, as 1989 is the year that SSRI antidepressants became available for sale to the general public. I suspect that antidepressant sales increased after the implementation of SSRIs, as this medication made the psychoactive drugs available without the immense side effects present in the TCAs and MAOIs. Thus, I expect this dummy variable to be positively correlated with antidepressant sales. This dummy variable was created based on the information found in the aforementioned study conducted by Zahl et al.

- Fertility rate: This is the average number of births per woman who lives to the end of her childbearing years. As this increases, it would be expected that incidence of post-partum depression would increase, and thus, that antidepressant use would increase. Thus, I expect fertility rate to be positively correlated with antidepressant sales. This data was obtained from the World Bank database of economic indicators.
- Divorce rate: This is the average number of divorces per 1,000 people in Norway. Divorces are life events likely induced by or creating increased stress, which is highly correlated with incidence of depression and antidepressant use. Because of this, I expect divorce rate and sales of antidepressants to be positively correlated. This data was retrieved from the Statistics Norway database.

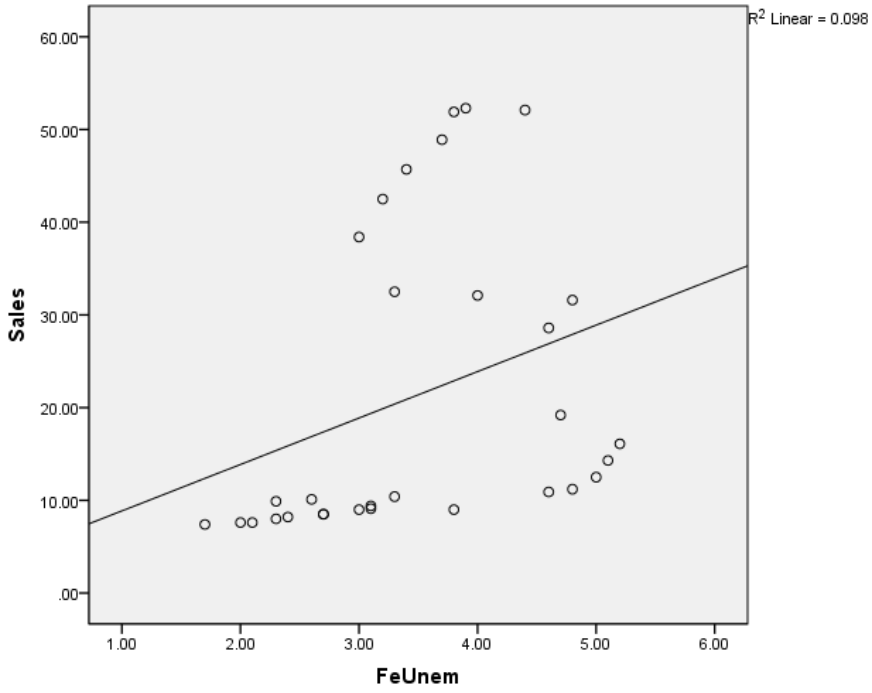
First, a graph plotting each independent variable against sales was created to ensure the validity of running a linearly regressive model.

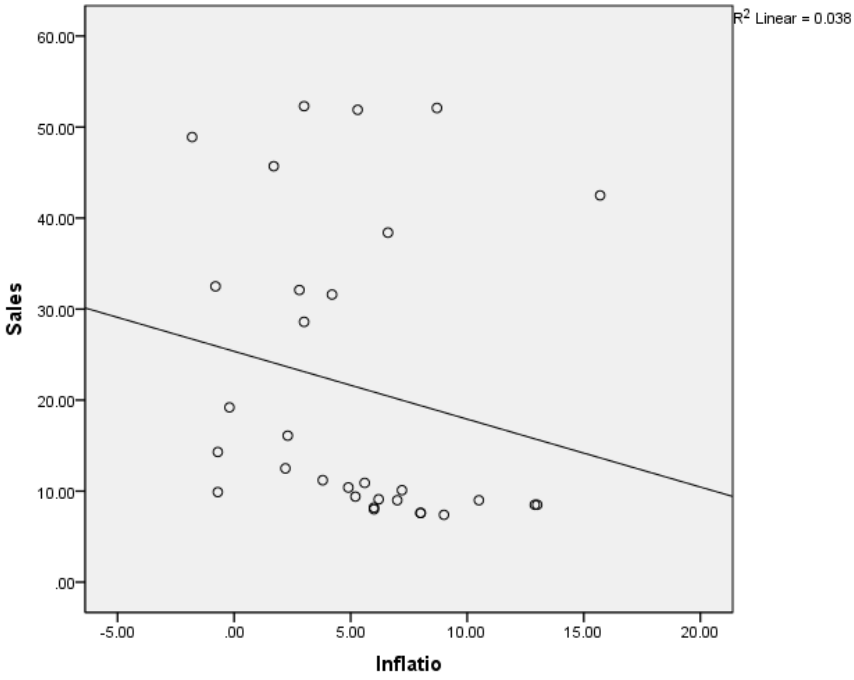
This graph shows that the relationship between male unemployment and sales is linear, although the linear relationship is not as "tight" as one might expect given the relationship found between antidepressant



sales and unemployment in the literature review.

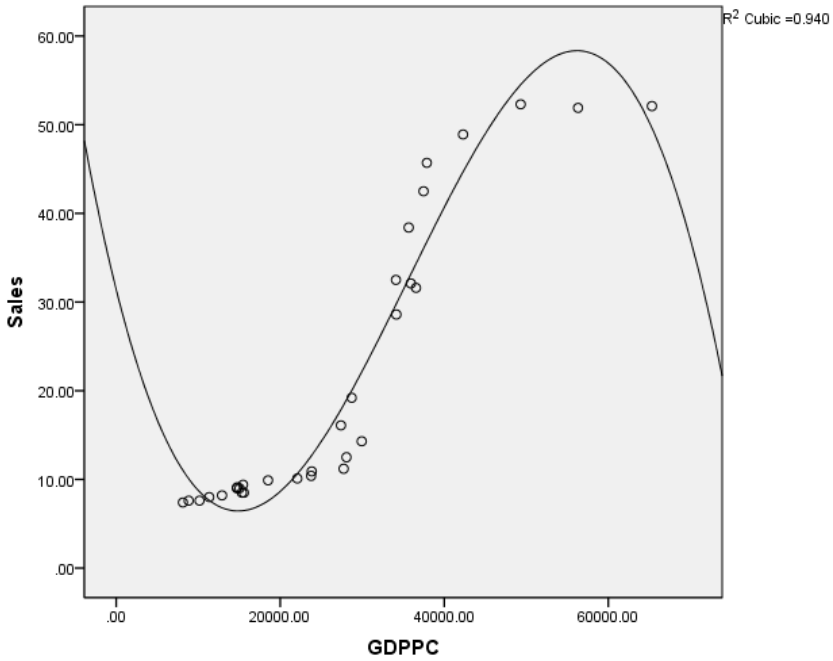
The relationship between female unemployment and sales appears to be similar to the above unemployment relationship. It is linear but not greatly so. It is worth noting that it appears even less linear than male unemployment, which was supported in the literature review (male unemployment is more strongly correlated with antidepressant sales than female unemployment).

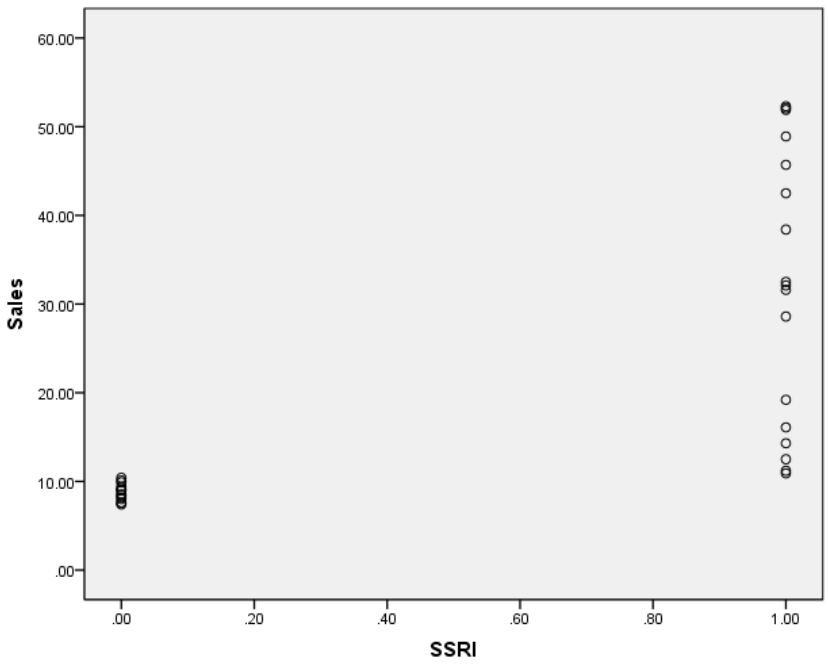




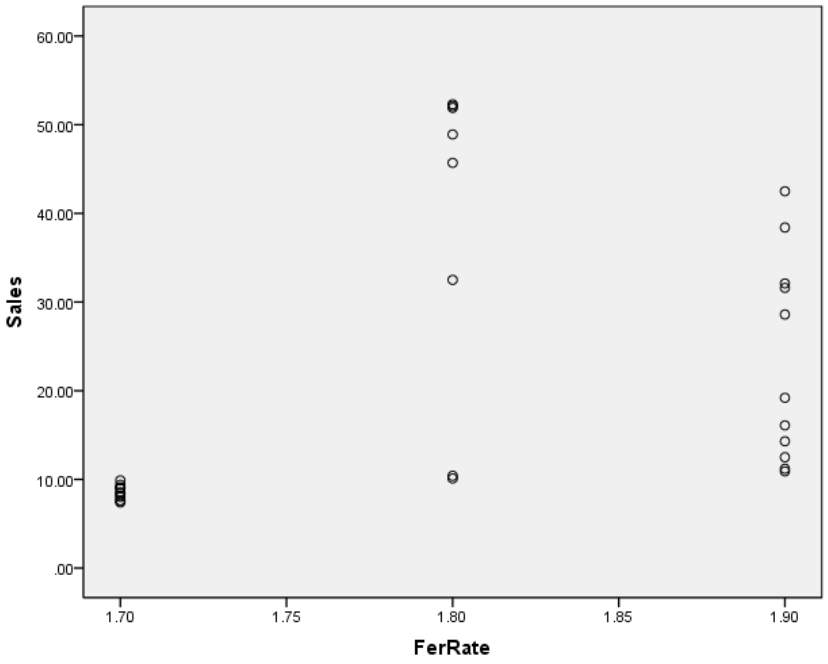
Sales and inflation are negatively related according to this graph, although the linear relationship is not very strong here either.

Sales and GDP per capita are *very* strongly linearly related. However, an even better fit for the relationship between these two variables is cubic. Thus, at this point, I have decided to alter my model to include a square and cubic term of GDP per capita to facilitate a better fit. As with any time a cubic model is used, I expect multicollinearity to be the hazard of this decision; strong multicollinearity *will* obviously be present among GDP per capita and its square and cubic terms.



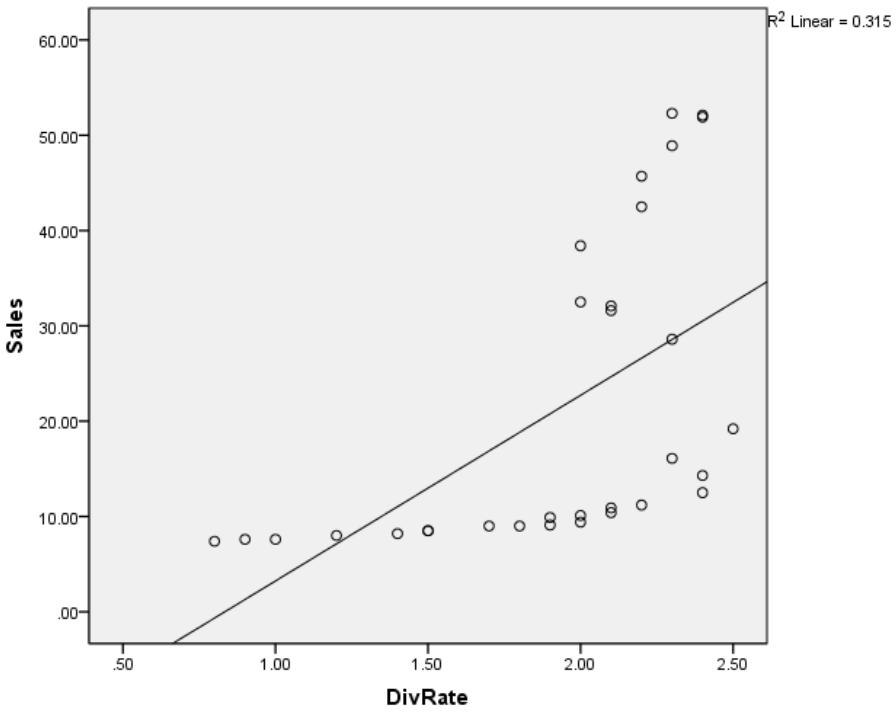


Because it is a dummy variable, the relationship between SSRI and sales does not appear incredibly linear; however, it is worth noting that when the variable takes on the value "0" sales are generally lower than when it takes on the value "1." Thus, a linear model is appropriate.



The relationship between fertility rate and sales does not appear terribly linear. However, there are so few values that fertility rate takes on that the appearance of this graph might be deceiving. Thus, a linear model may still be appropriate to run.

The relationship between sales and divorce rate appears to be fairly positively linear; thus, it is appropriate to run a linear regression on this variable.



Thus, as a result of the scatterplots, a new model was created incorporating two new variables, the square and cubic terms of GDP per capita:

$$Sales = \beta_0 + \beta_1(Male\ Unemployment) + \beta_2(Female\ Unemployment) + \beta_3(Inflation) + \beta_4(GDP\ Per\ Capita) + \beta_5(GDP\ Per\ Capita^2) + \beta_6(GDP\ Per\ Capita^3) + \beta_7\ (SSRI) + \beta_8(Fertility\ Rate) + \beta_9(Divorce\ Rate) + \varepsilon$$

When this was run, however, I had extreme problems, as one might imagine, with multicollinearity between female and male unemployment. The multicollinearity was so terrible that it actually rendered both variables insignificant. So, to better study the relationship between antidepressant sales and unemployment, and to render the multicollinearity issue moot, I removed the less significant of the two variables (female unemployment), leaving male unemployment in the model. As male unemployment was predicted to be more significantly related to antidepressant sales according to previously conducted research, this seemed like the best next step for that reason as well.

The final model created and tested was:

$$Sales = \beta_0 + \beta_1(Male\ Unemployment) + \beta_2(Inflation) + \beta_3(GDP\ Per\ Capita) + \beta_4(GDP\ Per\ Capita^2) + \beta_5(GDP\ Per\ Capita^3) + \beta_6\ (SSRI) + \beta_7(Fertility\ Rate) + \beta_8(Divorce\ Rate) + \varepsilon$$

Results

A regression (as well as several tests of the assumptions) was run for the above model. The results are as follows:

Table 1

Variable	Beta coefficient	T-Ratio	P-value
Male Unemployment	-2.6834	-3.037	.006
Inflation	.41403	3.243	.004
GDP Per Capita	-.00516	-4.503	<.001
GDP Per Capita^2	.21381E-6	6.425	<.001
GDP Per Capita^3	-.21624E-11	-6.860	<.001
SSRI	10.417	2.836	.010
Fertility Rate	-55.20	-3.557	.002
Divorce Rate	11.578	2.594	.017

As can be seen in Table 1, all variables are significant at the alpha = .05 level. However, several are significant in the opposite direction from what was predicted. For every 1 percent increase in male unemployment, antidepressant sales fall by approximately 2.7 DDD. The significant negative relationship is in direct contradiction to the predicted positive relationship. Similarly, for every 1 percent increase in fertility rate, antidepressant sales fall by about 55.2 DDD. This, too, was in contradiction to the predicted positive relationship. It might be difficult to tell by simply looking at the beta coefficients, but in referencing the graph above (or simply examining the beta coefficient of GDP per capita when its polynomial factors are not present) one can tell that the relationship is strongly positive; the predicted relationship was negative.

All other variables were significant in the predicted direction. For every 1 percent increase in inflation, antidepressant sales increased by .414 DDD. The presence of SSRI medications in the market boosted the DDD of antidepressants by about 10.417, as predicted. Lastly, a 1 percent increase in the divorce rate increases antidepressant sale by 11.578 DDD. Thus, many of the predictors did follow the hypothesized relationship with antidepressant sales.

The overall fit of the model suggests that much of the variation in antidepressant sales has been captured by the eight independent variables used. The R^2 value is .9848, and R^2 adjusted is .9790. This suggests that 98.48 percent of the variation in antidepressant sales can be explained by the combined effect of the eight independent variables. In addition, the overall fit of the model as described by the F-statistic is also great; the F-statistic is 169.897 with a p-value < .001, suggesting that the overall model is significant in predicting antidepressant sales at the alpha = .01 level.

It is necessary to conduct several tests in order to confirm the predictive value of the model. A test for heteroscedasticity examines whether variation changes significantly within the variables over time. The test run results in a chi-square value of .000, and a p-value of .99014. Therefore, we reject the notion that heteroscedasticity is present in the model, and conclude that an assumption of constant variance is valid.

A test for autocorrelation is also performed. The number of positive runs present in the data is 15, and the number of negative runs is also 15. The total number of runs is 19, which is not less than 10 nor is it greater than 22. Thus, the runs test concludes that autocorrelation is not a problem in this model. Similarly, the Durbin-Watson test is conducted to test for autocorrelation. The Durbin-Watson statistic is 1.7512, with a n associated p-value of .032164. Thus, a problem with positive autocorrelation does exist according to the Durbin-Watson test. In

a future run of this model, this should be corrected. Because of time constraints and the fact that the runs test found autocorrelation to not be present, however, this was not taken into account at this time.

Last, it is important to test for multicollinearity in a model. Problems with simple multicollinearity were prevalent. Correlations between male unemployment and SSRI, fertility rate, and divorce rate were .8405, .84145, and .82399 respectively. Correlations between SSRI and GDP per capita and SSRI and fertility rate were also .83767 and .88073 respectively. All of these correlations were significant. Because the multicollinearity did not render any of the variables insignificant, it is not a terrible problem in this case. Complex, or higher-order multicollinearity is not a problem in this model according to Klein's Rule of Thumb. The highest R^2 for one independent variable versus all other independent variables is.9601; this is less than the R^2 for the overall model (.9848). In examining for both simple and complex multicollinearity, GDP per capita, GDP per capita^2, and GPD per capita^3 were excluded due to their extreme, predictable multicollinearity with each other.

Conclusions

Overall, this model is excellent at predicting antidepressant sales. However, it does not predict sales in the way that I thought it would, because many of my hypotheses were significantly contradicted when the model was run. There could be a couple reasons for this. The first is that the sample was the problem—either that it was too small, or that something about Norway's healthcare system and social safety created a difference in how economic and social factors such as unemployment and fertility rate affected antidepressant sales from how it would have affected sales in another country, such as the United States. The other potential

problem is that antidepressant sales might just act a lot more like a normal good than I thought. When unemployment fell and GDP per capita rose, people generally bought more antidepressant medication than otherwise. This is exactly how people would treat any normal good.

As for the relationship between fertility rate and antidepressant sales—it does make sense that this would be negative. As much as children might increase post-partum depression among women in a country, the unquantifiable joy they bring to the parents and the satisfaction that people gain from fulfilling their parental duties is enough to alleviate, rather than create, problems with depression that necessitate the sales of medication.

In the future, a larger sample would create a clearer picture of which of the aforementioned explanations is actually the cause for the unexpected directional relationships. In addition, conducting the research on another country besides Norway, perhaps several that have greatly different healthcare systems, might be very beneficial as well.

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Shazam Output

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 Welcome to SHAZAM - Version 10.0 -  JUL 2004 SYSTEM=WIN-XP   PAR=  4000
 CURRENT WORKING DIRECTORY IS: C:\PROGRA~1\SHAZAM
 |_Sample 1 30
 |_STAT Sales MaleUnem Inflatio GDPPC SSRI FerRate DivRate GDPPC2 GDPPC3 /PCOR
 NAME         N    MEAN        ST. DEV      VARIANCE     MINIMUM      MAXIMUM
 SALES        30   20.380       15.484       239.74       7.4000       52.300
 MALEUNEM     30   3.4500       1.7384       3.0219       1.2000       6.6000
 INFLATIO     30   5.1967       4.2838       18.351      -1.8000       15.700
 GDPPC        30   25732.       12465.     0.15538E+09    8127.0       56312.
 SSRI         30  0.53333      0.50742     0.25747        0.0000       1.0000
 FERRATE      30   1.7967     0.88992E-01 0.79195E-02    1.7000       1.9000
 DIVRATE      30   1.9167      0.46763     0.21868       0.80000       2.5000
 GDPPC2       30  0.81235E+09 0.73864E+09 0.54559E+18   0.66048E+08  0.31710E+10
 GDPPC3       30  0.29552E+14 0.39179E+14 0.15350E+28   0.53677E+12  0.17857E+15

  CORRELATION MATRIX OF VARIABLES -       30 OBSERVATIONS


 SALES      1.0000
 MALEUNEM  0.38990       1.0000
 INFLATIO -0.26677     -0.50786       1.0000
 GDPPC     0.91655      0.64553     -0.40105       1.0000
 SSRI      0.71374      0.84050     -0.48300      0.83767       1.0000
 FERRATE   0.43940      0.84145     -0.36727      0.65420      0.88073
           1.0000
 DIVRATE   0.53873      0.82399     -0.52499      0.77093      0.74599
           0.73884       1.0000
 GDPPC2    0.92733      0.53809     -0.32470      0.97165      0.74137
           0.50449      0.64365       1.0000
 GDPPC3    0.87927      0.43234     -0.24554      0.90423      0.61822
           0.35363      0.52735      0.97868       1.0000
              SALES        MALEUNEM     INFLATIO     GDPPC        SSRI
              FERRATE      DIVRATE      GDPPC2       GDPPC3

 |_OLS Sales MaleUnem Inflatio GDPPC SSRI FerRate DivRate GDPPC2 GDPPC3 / ANOVA
AUXRSQ LIST DWPVALUE

 REQUIRED MEMORY IS PAR=      14 CURRENT PAR=    4000
  OLS ESTIMATION
       30 OBSERVATIONS     DEPENDENT VARIABLE= SALES
 ...NOTE..SAMPLE RANGE SET TO:      1,     30

 DURBIN-WATSON STATISTIC  =   1.75124
 DURBIN-WATSON POSITIVE AUTOCORRELATION TEST P-VALUE =    0.032164
               NEGATIVE AUTOCORRELATION TEST P-VALUE =    0.967836
 R-SQUARE OF MALEUNEM ON OTHER INDEPENDENT VARIABLES =   0.9264
 R-SQUARE OF INFLATIO ON OTHER INDEPENDENT VARIABLES =   0.4194
 R-SQUARE OF GDPPC    ON OTHER INDEPENDENT VARIABLES =   0.9991
 R-SQUARE OF SSRI     ON OTHER INDEPENDENT VARIABLES =   0.9500
 R-SQUARE OF FERRATE  ON OTHER INDEPENDENT VARIABLES =   0.9089
 R-SQUARE OF DIVRATE  ON OTHER INDEPENDENT VARIABLES =   0.9601
 R-SQUARE OF GDPPC2   ON OTHER INDEPENDENT VARIABLES =   0.9997
 R-SQUARE OF GDPPC3   ON OTHER INDEPENDENT VARIABLES =   0.9989
 R-SQUARE OF CONSTANT ON OTHER INDEPENDENT VARIABLES =   0.0000
  R-SQUARE =   0.9848     R-SQUARE ADJUSTED =   0.9790
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   5.0374
```

STANDARD ERROR OF THE ESTIMATE-SIGMA = 2.2444
SUM OF SQUARED ERRORS-SSE= 105.78
MEAN OF DEPENDENT VARIABLE = 20.380
LOG OF THE LIKELIHOOD FUNCTION = -61.4713

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
AKAIKE (1969) FINAL PREDICTION ERROR - FPE = 6.5486
(FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
AKAIKE (1973) INFORMATION CRITERION - LOG AIC = 1.8602
SCHWARZ (1978) CRITERION - LOG SC = 2.2806
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
CRAVEN-WAHBA (1979)
GENERALIZED CROSS VALIDATION - GCV = 7.1963
HANNAN AND QUINN (1979) CRITERION = 7.3499
RICE (1984) CRITERION = 8.8154
SHIBATA (1981) CRITERION = 5.6419
SCHWARZ (1978) CRITERION - SC = 9.7822
AKAIKE (1974) INFORMATION CRITERION - AIC = 6.4251

ANALYSIS OF VARIANCE - FROM MEAN

	SS	DF	MS	F
REGRESSION	6846.7	8.	855.84	169.897
ERROR	105.78	21.	5.0374	P-VALUE
TOTAL	6952.5	29.	239.74	0.000

ANALYSIS OF VARIANCE - FROM ZERO

	SS	DF	MS	F
REGRESSION	19307.	9.	2145.2	425.861
ERROR	105.78	21.	5.0374	P-VALUE
TOTAL	19413.	30.	647.09	0.000

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 21 DF	P-VALUE	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
MALEUNEM	-2.6834	0.8837	-3.037	0.006	-0.552	-0.3013	-0.4542
INFLATIO	0.41403	0.1277	3.243	0.004	0.578	0.1145	0.1056
GDPPC	-0.51596E-02	0.1146E-02	-4.503	0.000	-0.701	-4.1537	-6.5146
SSRI	10.417	3.673	2.836	0.010	0.526	0.3414	0.2726
FERRATE	-55.200	15.52	-3.557	0.002	-0.613	-0.3173	-4.8664
DIVRATE	11.578	4.464	2.594	0.017	0.493	0.3497	1.0889
GDPPC2	0.21381E-06	0.3328E-07	6.425	0.000	0.814	10.1995	8.5223
GDPPC3	-0.21624E-11	0.3152E-12	-6.860	0.000	-0.832	-5.4717	-3.1355
CONSTANT	121.90	24.00	5.080	0.000	0.743	0.0000	5.9814

OBS. NO.	OBSERVED VALUE	PREDICTED VALUE	CALCULATED RESIDUAL
1	7.4000	8.8582	-1.4582
2	7.6000	8.1842	-0.58419
3	7.6000	6.8466	0.75340
4	8.0000	6.7850	1.2150
5	8.2000	7.1071	1.0929
6	8.5000	9.8514	-1.3514
7	8.5000	9.8343	-1.3343
8	9.0000	8.7904	0.20962
9	9.0000	6.9657	2.0343
10	9.1000	7.5100	1.5900
11	9.4000	11.078	-1.6779
12	9.9000	9.7847	0.11527
13	10.100	11.151	-1.0509
14	10.400	9.9536	0.44642
15	10.900	9.5966	1.3034

```
     16    11.200       14.681      -3.4812            *       I
     17    12.500       16.391      -3.8915           *        I
     18    14.300       16.353      -2.0530               *    I
     19    16.100       11.979       4.1209                    I        *
     20    19.200       17.403       1.7969                    I   *
     21    28.600       28.659     -0.59279E-01                *
     22    31.600       32.079     -0.47925                   *I
     23    32.100       33.036     -0.93646                 * I
     24    32.500       34.398      -1.8979               *   I
     25    38.400       34.037       4.3625                  I         *
     26    42.500       42.579     -0.78744E-01                *
     27    45.700       43.538       2.1622                    I    *
     28    48.900       48.475      0.42513                    I*
     29    52.300       54.130      -1.8302               *   I
     30    51.900       51.364      0.53626                   I*

DURBIN-WATSON = 1.7512    VON NEUMANN RATIO = 1.8116    RHO =  0.11328
RESIDUAL SUM =  0.22204E-15  RESIDUAL VARIANCE =   5.0374
SUM OF ABSOLUTE ERRORS=   44.329
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.9848
RUNS TEST:   16 RUNS,   15 POS,    0 ZERO,   15 NEG  NORMAL STATISTIC =  0.0000
COEFFICIENT OF SKEWNESS =   0.2637 WITH STANDARD DEVIATION OF 0.4269
COEFFICIENT OF EXCESS KURTOSIS =   0.3372 WITH STANDARD DEVIATION OF 0.8327

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    0.3235 P-VALUE= 0.851

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 12 GROUPS
OBSERVED  0.0  0.0  2.0  0.0  7.0  6.0  7.0  6.0  0.0  2.0  0.0  0.0
EXPECTED  0.2  0.5  1.3  2.8  4.5  5.7  5.7  4.5  2.8  1.3  0.5  0.2
CHI-SQUARE =    9.7702 WITH  1 DEGREES OF FREEDOM, P-VALUE= 0.002
|_DIAGNOS / HET

REQUIRED MEMORY IS PAR=      42 CURRENT PAR=    4000
DEPENDENT VARIABLE = SALES           30 OBSERVATIONS
REGRESSION COEFFICIENTS
  -2.68335536469      0.414032334938     -0.515956724179E-02   10.4168713419
  -55.2002654732       11.5778115326      0.213805249934E-06 -0.216239886473E-11
   121.901260817

HETEROSKEDASTICITY TESTS
                           CHI-SQUARE     D.F.   P-VALUE
                         TEST STATISTIC
E**2 ON YHAT:                    0.000     1    0.99014
E**2 ON YHAT**2:                 0.108     1    0.74269
E**2 ON LOG(YHAT**2):            0.245     1    0.62096
E**2 ON LAG(E**2) ARCH TEST:     0.689     1    0.40667
LOG(E**2) ON X (HARVEY) TEST:    6.267     8    0.61734
ABS(E) ON X (GLEJSER) TEST:      9.976     8    0.26670
E**2 ON X                TEST:
          KOENKER(R2):           9.364     8    0.31253
          B-P-G (SSR) :          9.785     8    0.28043

...MATRIX INVERSION FAILED IN ROW   13
...RESULTS MAY BE UNRELIABLE
E**2 ON X X**2    (WHITE) TEST:
          KOENKER(R2):       **********    16  *********
          B-P-G (SSR) :      **********    16  *********

...MATRIX INVERSION FAILED IN ROW   13
...RESULTS MAY BE UNRELIABLE
```

```
E**2 ON X X**2 XX (WHITE) TEST:
          KOENKER(R2):        **********    44  *********
          B-P-G (SSR) :       **********    44  *********

|_Stop
```