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Financial and Labor Market Determinants of Mortgage Delinquency Rates: McLean County, 1985-2011

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I. INTRODUCTION

It is generally understood that the 2007-2009 recession in the United States had its roots in the real estate market. To quote Schiller (2008): "a speculative bubble in the housing market (...) has now caused ruptures among many other countries in the form of financial failures and a global credit crunch" (p. 1). There is a growing body of literature on the economic impact of the bursting of this "speculative bubble". Efforts have been directed at examining how financial institutions have been impacted and at considering different efforts to re-regulate this industry. As the economic recovery from this particular recession has been slower than after previous contractions, particularly in terms of job creation, research efforts have also focused on labor markets. In this paper, we examine the interplay between financial and labor market factors and the real estate market at the local level. We study McLean County, Illinois, since this county, while being the largest in the state in terms of square mileage, has a median income level and a home ownership rate comparable to those of Cook County –where the City of Chicago is located.

As Marcano and Ruprah (2011) report, recent economic literature tends to cast the phenomenon of mortgage default, the precursor to potential property foreclosure, as either an issue of moral hazard or as an issue of inability to pay. Regarding the issue of moral hazard and mortgage defaults significant attention has been devoted to the study of why and when homeowners choose to stop making their monthly mortgage payments. The premise that homeowners will "walk away" from their properties when the value of the mortgage is greater than the home price, a situation known as having "negative equity" or being "underwater", fits a crude cost-benefit analysis of such a situation. Yet, Foote et al. (2008) find that "contrary to popular belief, […] negative equity is a necessary but not a sufficient condition for foreclosure" (p. 1). In fact, they report that fewer than 10 percent of homeowners experiencing negative equity on their homes eventually experience foreclosure. Moreover, Mian and Sufi (2008) place the onus of foreclosures on the lenders, as "the expansion in the supply of credit driven by disintermediation is responsible for the rapid increase in new loan originations, house price appreciation, and subsequent large increase in default rates" (p. 4). Similar conclusions regarding lending standards and mortgage securitization are reached by Nadauld and Sherlund (2009), Haughwout et al. (2008), and Keys et al. (2008). The prevalence of adjustable-rate mortgage instruments during the build-up of the housing bubble also played a central factor in the buildup of negative equity. As Bucks et al. (2008) point out, borrowers with adjustable-rate mortgages were much more likely to misunderstand the terms of their mortgage contract than their peers. Particularly, they were "likely to underestimate or to not know how much their interest rates could change" (p. 1).

Regarding the issue of inability to pay and mortgage defaults research efforts have been focused on identifying the factors that prevent the homeowners from making their monthly payments. Such factors can be broadly categorized as either financial (e.g. interest rates on the mortgaged principal) or labor-market related (e.g. the employment status of the homeowner). Previous real estate market crises informed the work of Campbell and Dietrich (1983) and Deboer and Conrad (1988), who found that unemployment rates are positively related to mortgage and property tax delinquency levels respectively. More recently, Mayer et al. (2009) find that "In areas with widespread increases in unemployment, house prices generally decline; demand for housing falls as income drops and workers migrate to other areas in search of jobs" (p. 42). Financial factors have also been considered. Gerardi et al. (2007) estimation results indicate that the short-term London Interbank Offered Rate (LIBOR) and unemployment rate are positively associated with

foreclosure levels. Also, Demyanyk and Van Hemert (2009) find that at the outset of the 2006-2007 housing crisis the delinquency rate on fixed-rate mortgages actually fell and that the 'variable' delinquency rate rose enough to cause a cumulative increase in the aggregate delinquency rate.

We focus our study on the arguments related to the inability to pay, rather than on the moral hazard argument, in order to address an ongoing public policy argument: whether mortgage defaults are more strongly influenced by the weakness in the labor market or by the actual costs of financing the mortgages. The policy implications of this argument are enormous. If the costs of mortgages are found to be more relevant than, let's say, the unemployment rate in explaining mortgage defaults, policy efforts should be focused on facilitating debt re-financing; if the inverse is true, policy efforts should prioritize job-creation to stem the mortgage defaults and foreclosures. Cordell et al. (2008) offer their own answer to this question when reporting that the "deadweight losses" derived from foreclosures could be reduced with "loss mitigation" (i.e. re-financing).

We expect that an increase in either fixed or variable interest rates decreases homeowners' ability to make their mortgage payments, thus increasing delinquency rates. Changes in fixed and variable mortgage interest rates should impact homeowners in slightly different ways. A change in the fixed interest rate will only affect newly granted fixed-rate mortgages for either the acquisition of a new house or for the refinancing of the current one. Homeowners already locked-in with a fixed rate and not looking into re-financing would not be affected. A change in the variable interest rate, however, affects the current cost of financing a house purchase financed through a variable interest instrument. We also expect that a deterioration of the general condition of the local labor market decreases homeowners' ability to make their mortgage payments, thus increasing delinquency rates. An increase in the local unemployment rate would signal a decrease in the current average income from labor.

We focus our study on the McLean County housing market because it could be representative of statewide trends. With a population of nearly 170,000 residents, mostly concentrated in the adjacent City of Bloomington and Town of Normal, nearly 275,000 mortgage deeds have been granted over the past 26 years. During most of our period of analysis, 1985-2011, the mortgage delinquency rate has wandered around a mean value of 2.00 percent; yet starting in 2005 it began to grow, peaking at a value above 9.00 percent in 2010. The metropolitan unemployment rate has also been increasing and the regional mortgage financing costs have been at, or above, national averages. As mentioned above, the County has a housing market fairly representative of the rest of the state. To begin with, it contains well defined and distinct urban and a rural "submarkets". Also, the county's average population per household (2.46) and homeownership rate (67.70 percent) are within a five percent margin of the national average values.

The remainder of this paper is organized as follows: Section 2 describes the data and methodology, examining the stationarity of the series; Section 3 identifies the best-fitting linear regressions used to examine the behavior of mortgage delinquency rates, discussing our findings; lastly, Section 4 presents conclusions and outlines policy implications.

II. DATA AND METHODOLOGY

In McLean County, mortgage delinquencies are registered through the issuances of a lis pendens, which are notices informing the grantee of a mortgage that the grantor's payments are 90 days past due. These notices are filed with the County's Recorder's Office and are accessible through an online database. By dividing the number of lis pendens filings by the total number of mortgage deeds issued, the monthly delinquency rate is computed. Our sample period starts in January 1985 and ends in December 2011: a total of 310 observations. Our sample period contains a total of 274,310 mortgage deeds and 5,887 lis pendens, resulting in an average delinquency rate of 2.15 percent. As seen in Figure 1 on the next page, the series displays a period of relative stability between 1985 and 2004, when the monthly delinquency rate oscillates between 1.50 and 2.00 percent. The evolution of the twelve-month moving average of the mortgage delinquency rate suggests a change in the long-term trend by the end of 2005.

National interest rates are obtained from the FRED database maintained by the St. Louis

Federal Reserve Bank. These rates represent an average of the borrowing costs in the United States. Regional interest rates are obtained from the primary Mortgage Market Survey conducted by the federal agency Freddie Mac. These rates represent borrowing costs within the North Central region, comprised of the states of Illinois, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Iowa, North Dakota and South Dakota. We compile both the 30-Year Fixed Rate Mortgage Average and the 1-Year Adjustable Rate Average. Figure 2 compares national and regional fixed interest rates. Figure 3 compares national and regional variable rates. In both cases, secular declining trends are easily observable. Although the fixed rate is generally higher than the variable rate, this difference has ebbed and flowed dramatically in the last decade. In fact, during the most recent recession both rates were effectively identical. In our sample period regional fixed interest rates have been an average of 0.06 percentage points above the national value. Similarly, regional variable interest rates have exceeded national values by an average of 0.15 percent. In December 2011, the end of our sample, the national fixed rate rested at 3.96 percent while the national variable rate was 2.79 percent. In this same month, the regional fixed rate was 3.97 percent while the regional variable rate was 3.06 percent.

Labor market indicators for McLean County are obtained from the Bureau of Labor Statistics' Metropolitan Area Survey. The compiled series, the unemployment rate and the number of unemployed workers, display similar cyclical behavior. Figure 4 and Figure 5 show that both labor market indicators declined between 1990 and 2000, with the unemployment rate reaching a low of 2.2 percent in 1998. Increasing, afterward, the unemployment rate peaked at 5.2 percent in 2005 before declining once again –this time to 3.9 percent in 2007. The latest nation-wide economic contraction has brought the county-level unemployment rate to its highest in 20 years: 9.1 percent.

In order to determine what structural relationship may link financial and labor market variables with the mortgage delinquency rate, we will estimate several linear regression models through Ordinary Least Squares. First, we will study the impact of labor and financial variables on the mortgage delinquency rate separately and then we will combine them into a single regression equation. The first step in our model-building effort is to determine the order of integration of each series: if a series is integrated of order zero, I(0), it follows that it is stationary in levels. We compute the Augmented Dickey-Fuller (ADF) test statistic to determine the presence of a unit root in the series. Following econometric convention, we first compute the natural logarithmic value of the series in order to induce linearity. Table 1 reports the results of the ADF tests of the variables in log-levels (top section) and in first-order differences of the log-levels (bottom section). Except in the case of the mortgage delinquency rate we fail to reject the null hypothesis that any of the series in log-levels has a unit root within a 95 percent confidence interval. We will put forward the argument that the pseudo-stationary behavior of the mortgage delinquency rate between 1985 and 2005 influences the value of the ADF test statistic for the whole sample period. When the first-order differences of the log-level values are considered the reported ADF test statistics strongly reject the null hypothesis of the presence of a unit root in any of the series. Thus, we conclude that all the series are integrated of order one, I(1), and that they should be incorporated into our subsequent regression efforts in terms of growth rates.

In order to check the robustness of our findings we also compute the Kwiatkowski-Phillips-Schmidt-Shim (KPSS) test statistic to directly ascertain the potential stationarity of the series. Table 2 reports the results of the KPSS tests of the variables in log-levels (top section) and in first-order differences of the log-levels (bottom section). In the case of the mortgage delinquency rate and the labor market indicators we strongly reject the null hypothesis that, in log-levels, these series are stationary; in the case of the financial market indicators we fail to reject the null hypothesis of stationarity within a 95 percent confidence interval. When the first-order differences of the log-level values are considered the reported KPSS test statistics allow us not to reject the null hypothesis of stationarity for all the series. As above, we conclude that all the series are integrated of order one, I(1), and that they should be incorporated into our subsequent regression efforts in terms of growth rates.

III. ESTIMATION RESULTS

We now turn to estimating a structural model of county-level mortgage delinquency

rates as a function of labor and financial market factors. We study each of these sets of factors separately and then combine them in order to present the best-fitting linear regression model. We employ an Ordinary Least Squares (OLS) methodology to estimate the parameters of these families of models.

Our first set of estimating equations relates the mortgage delinquency rate with labor market factors. Besides the growth rate in the number of unemployed workers and the growth rate in the unemployment rate we considered the growth rate in the number of employed workers as a potential explanatory variable. Because none of our estimation formulations including this last variable yielded any significant result we chose not to include this equation in our discussion of results. Table 3 presents the estimation results of Model A and Model B. In both models we incorporate a lagged (t-1) value of the dependent variable as an independent variable in order to capture the concept of persistence in the behavior of mortgage delinquency rates. The regression parameter associated with this variable is highly significant and almost identical across model specifications. Its negative sign indicates that an increase (decrease) in the mortgage delinquency rate during any given month is followed the next month by a decrease (increase) in the mortgage delinquency rate. For example, when the mortgage delinquency rate increases by 10 percent during the previous month we should expect a 3.63 (on average) percentage decrease in its value this month. Thus, the mortgage delinquency rate does not increase continually. We also include a dummy variable in order to capture an abnormally large drop in the value of the mortgage delinquency rate during the early months of 1992: during the first quarter of the year the number of recorded lis pendens notices was less than three a month. We attribute these low values to either a clerical issue related to the recording the notices or to a possible change in the legal process regarding the issuing of a lis pendens notice itself. The parameter associated with this dummy variable is highly significant and, as should be expected, negative in sign.

Model A examines the relationship between the county-level mortgage delinquency rate and the metropolitan area unemployment rate. Due to the delay between the time a homeowner becomes unemployed and the time a mortgage is considered to be in default – recall that in the State of Illinois a mortgage is in default after 90 days of non-payment – we lag this variable by four (4) periods. The regression parameter associated with this variable is highly significant and positive in sign. We find that a one percent increase (decrease) in the unemployment rate four months ago translates into a 0.70 percent increase (decrease) in the mortgage delinquency rate during the current month. Lastly, Model B examines the relationship between the county-level mortgage delinquency rate and the metropolitan area number of unemployed individuals. For the same reasons discussed above, we lag this variable by four (4) periods. The regression parameter associated with this variable is highly significant and positive in sign. We find that a one percent increase (decrease) in the number of unemployed individuals four months ago translates into a 0.76 percent increase (decrease) in the mortgage delinquency rate during the current month. We hypothesize that a change in the number of unemployed workers has a larger impact on the mortgage delinquency rate than a change in the unemployment rate due to the structure of the local labor market. Due to the limited range of horizontal mobility in terms of potential employers in the county we expect that when a worker becomes unemployed she or he leaves the area in order to become occupied in a similar activity. Thus, when the actual number of unemployed workers residing in the area increases, its impact on mortgage delinquency rates is larger than that of an identical increase in the area unemployment rate. The explanatory power of our linear regression efforts focused on labor market factors yield very similar R-squares: we explain (on average) 23 percent of the variance in the rate of growth of the delinquency rate. The residual diagnostics yield mixed results. Although we can strongly reject the null hypothesis of heteroskedasticity in the residuals, we cannot conclude definitely that the regression residuals are not autocorrelated or that they are normally distributed. Our second set of estimating equations relates the mortgage delinquency rate with national and regional financial market factors. Table 4 presents the estimation results of Model C and Model D. As before, in both models we incorporate a lagged (t-1) value of the dependent variable as an independent variable in order to capture the concept of persistence in the behavior of mortgage delinquency rates. Our findings are almost identical to those presented above and we will refer

the reader to that section of the paper in order to economize space. The dummy variable discussed above is also incorporated in these models.

Model C examines the relationship between the county-level mortgage delinquency rate and national-level fixed and variable interest rates. Due to the delay between the time fixed interest rates change and the time a homeowner notices changes in her or his potential mortgage financing costs we lag this variable by two (2) periods. The regression parameter associated with this variable is highly significant and positive in sign. We find that a one percent increase (decrease) in the national-level fixed interest rate on mortgages two months ago translates into a 2.71 percent increase (decrease) in the mortgage delinquency rate during the current month. Somehow, surprisingly, we cannot establish any significant statistical relationship between the national-level variable interest rate on mortgages and the county-level mortgage delinquency rate. We put forward the hypothesis that the local real estate market, while moving along with national trends of ballooning activity between 2003 and 2007, did not share the "bubble" qualities associated with large volumes of adjustable-rate mortgages prevalent in other areas. Therefore, only a small fraction of local homeowners was exposed to the variable financing costs brought about by these financial instruments. Lastly, Model D examines the relationship between the county-level mortgage delinquency rate and regional-level fixed and variable interest rates. For the same reasons discussed above, we lag this variable by two (2) periods. The regression parameter associated with this variable is highly significant and positive in sign. We find that a one percent increase (decrease) in the regional-level fixed interest rate on mortgages two months ago translates into a 2.27 percent increase (decrease) in the mortgage delinquency rate during the current month. Again, we cannot establish any significant statistical relationship between the variable interest rate on mortgages and the mortgage delinquency rate, even though in this case we consider regional-level variable interest rates. We will refer the reader to the argument we put forward above. The explanatory power of our linear regression efforts focused on financial market factors yield very similar R-squares: we explain (on average) 21 percent of the variance in the rate of growth of the delinquency rate. The residual diagnostics yield mixed results. Although we can strongly reject the null hypothesis of heteroskedasticity in the residuals, we cannot conclude definitely that the regression residuals are not autocorrelated or that they are normally distributed.

Our final estimation effort combines labor and financial market factors. Besides the one-period lagged value of the growth rate in the mortgage delinquency rate and the event dummy discussed above we include the growth rates in the regional fixed interest rate on mortgages and in the area-level number of unemployed. As before, we lag these variables in order to capture the delay in the reaction of the mortgage delinquency rate that follows a change in both labor market and mortgage financing conditions. The regression parameters associated with these variables are highly significant and positive in sign. We note that when considered simultaneously the magnitude of the parameter linking the number of unemployed with the mortgage delinquency rate increases (by 2.33 percent) while the magnitude of the parameter linking the fixed interest rate on mortgages with the mortgage delinquency rate decreases (by 17.66 percent). Nevertheless, the impact of changes in financial factors is 2.38 times larger than the impact of changes in labor market factors. In fact, a 10 percent increase (decrease) in the fixed interest rate on mortgages translates into an 18.69 percent increase (decrease) in the mortgage delinquency rate, while a 10 percent increase (decrease) in the number of unemployed individuals translates into a 7.85 percent increase (decrease) in the mortgage delinquency rate. This regression yields the highest R-square of all of our models: we are able to explain 24 percent of the variance in the rate of growth of the delinquency rate. Finally, the residual diagnostics yield mixed results. Although we can strongly reject the null hypothesis of heteroskedasticity in the residuals, we cannot conclude definitely that the regression residuals are not autocorrelated or that they are normally distributed.

IV. CONCLUSION

Our study of the behavior of the mortgage delinquency rate in McLean County, IL attempts to explain it as a function of several different factors. We consider, independently and jointly, labor market indicators such as the number of unemployed and the unemployment rate and financial market indicators such as the 30-year fixed and 1-year variable mortgage interest rates. Both na-

tional-level and regional-level mortgage interest rates are, alternatively, examined as potential explanatory variables. We find that the OLS regression yielding the best overall fit is capable of explaining 24 percent of the variance in the growth rate of the mortgage delinquency rate over time. More importantly, we find that when the number of unemployed individuals or the fixed mortgage interest rate change, even by the same percentage amount, the reaction of the mortgage delinquency rate is remarkably different in terms of order of magnitude. In our sample period the impact of changes in financial factors on the county-level mortgage delinquency rate is 2.38 times larger than the impact of changes in labor market factors.

This empirical finding is potentially useful to address an ongoing local debate on whether it is the job losses associated with the latest recession or the onerous financing terms of properties suddenly devalued by the collapse of the real estate market that is resulting in larger numbers of mortgage defaults and, eventually, foreclosures. Our conclusion that financial market indicators play a larger role than labor market indicators could help focus the policy responses to the ongoing problem of property foreclosures. We will argue that policy efforts in this area should emphasize loss-mitigation (i.e. refinancing) instead of job-creation. In that light, we are happy to report that a lender-borrower mediation process has been recently implemented as part of the legal foreclosure proceedings in the local court system. On the other hand, our research leads us to believe that recent reductions in the unemployment rate, both at the national and local levels, would not have as much of a dampening effect on the number of county-level mortgage defaults as many would expect. Finally, we will point out the fact that although local and regional policymakers may be able to influence, to a degree, labor market conditions in the area their degree of influence over financial market conditions is severely constrained. In other words, regulation and control of financial market conditions is mostly conducted at the national level, where local and regional interests and priorities are multiple and often conflicting.

In terms of potential avenues of future research we propose to study the time series characteristics of the fillings of lis pendens notices by themselves. A visual examination of this series seems to indicate a semi-continuous process: a month with a relatively high number of lis pendens notices filed is frequently followed by a month with a relatively low number of lis pendens notices filed. The resulting seesaw plot of the series may provide a clue regarding the prevalent rejection of the null hypothesis of autocorrelation in the regression residuals. A potential manipulation of these series through some sort of moving average or filtering process could merit future research efforts.

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APPENDIX

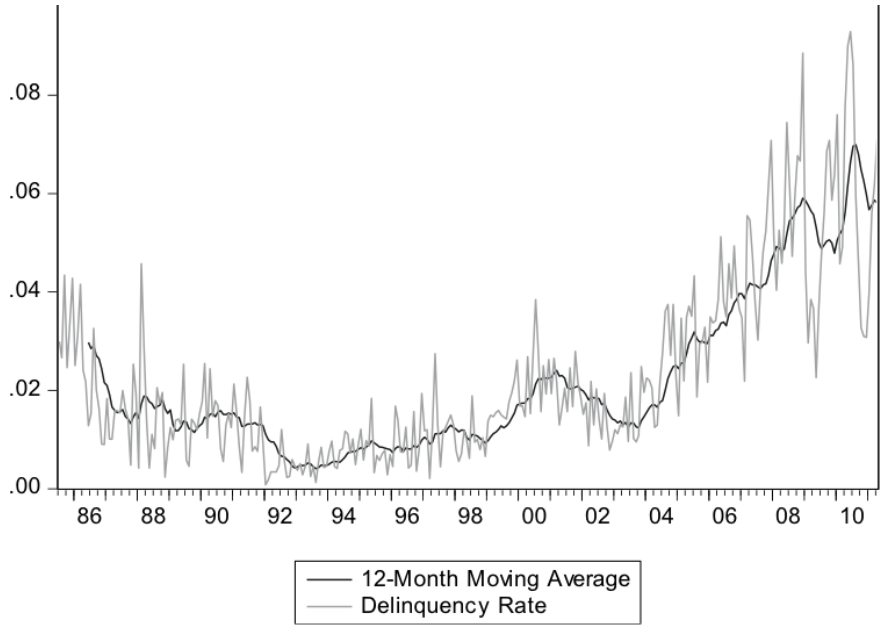

Fig. 1. Histogram of Delinquency Rate and 12-Month Moving Average

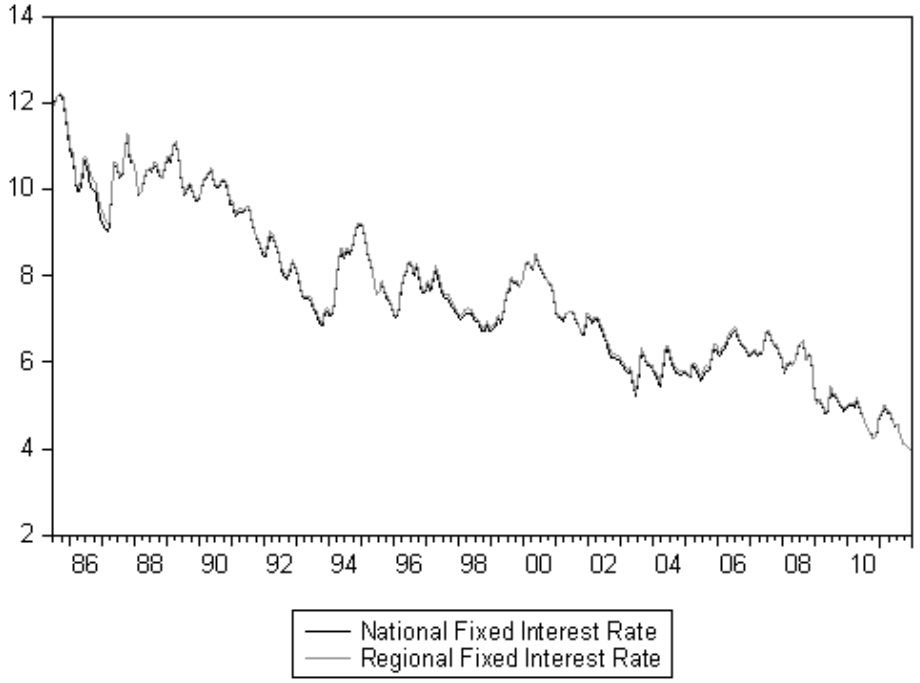

Fig. 2. Histogram of Regional and National 30-Year Fixed Mortgage Interest Rate

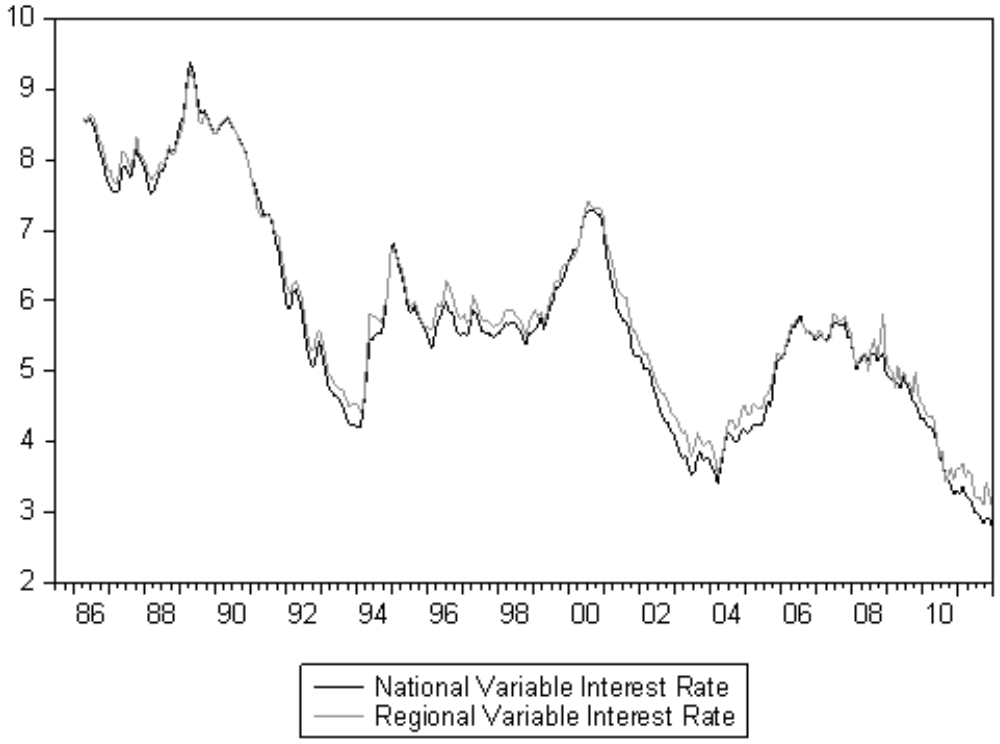

Fig. 3. Histogram of Regional and National 1-Year Variable Mortgage Interest Rates

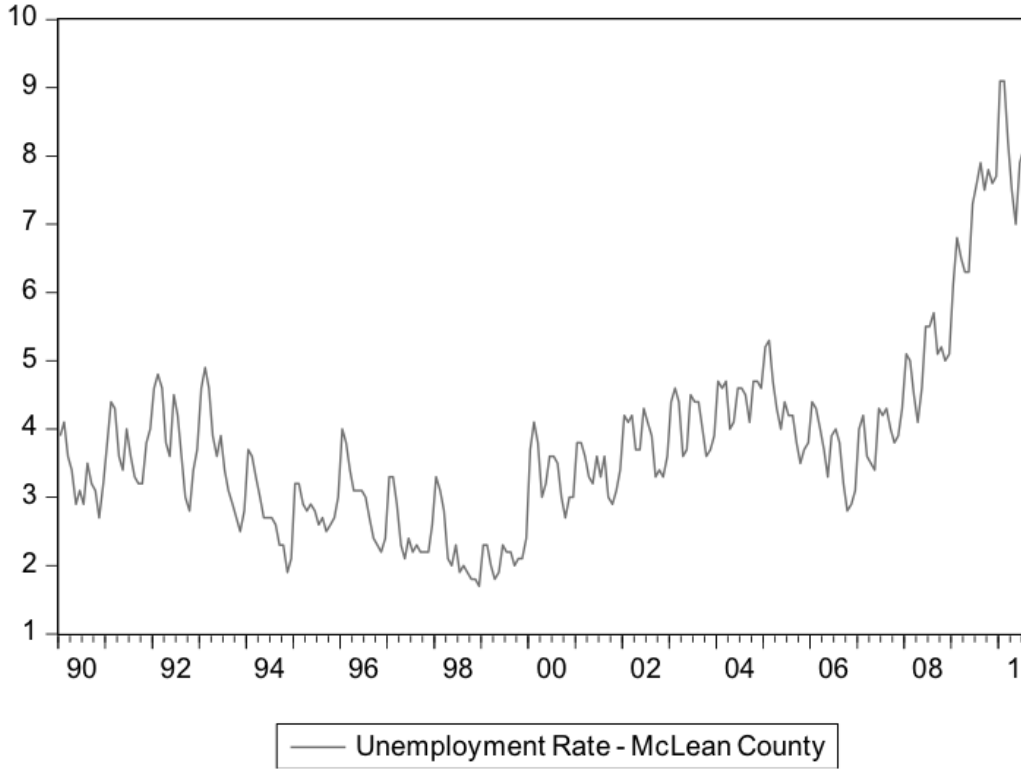

Fig. 4. Histogram of Bloomington-Normal Metropolitan Unemployment Rate

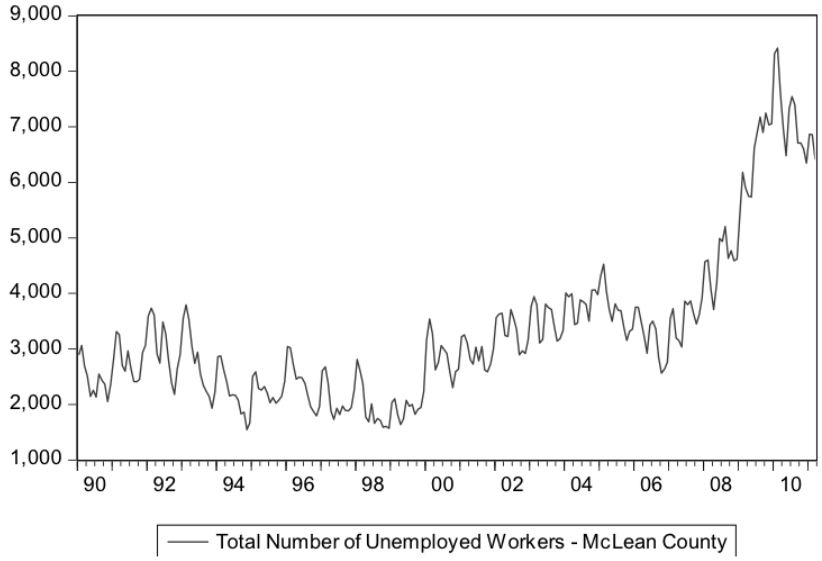

Fig. 5. Histogram of Number of Unemployment Individuals in the Bloomington-Normal Metropolitan

Table 1: Results of the ADF Test for Unit Roots

		Constant+trend	Significance
Variables in logarithms			
The null hypothesis is non-stationarity			
Delinquency rate		-3.8881	**
Unemployment rate		-2.3174	
Unemployed		-2.2151	
Fixed interest rate, regional		-3.2723	*
Fixed interest rate, national		-3.2888	*
Variable interest rate, regional		-1.5903	
Variable interest rate, national		-1.7320	
Critical values (%)			
	1	-3.9875	
	5	-3.4242	
	10	-3.1351	
Variables in logarithms and first order differences			
The null hypothesis is non-stationarity			
Delinquency rate		-11.18235	***
Unemployment rate		-3.6219	**
Unemployed		-3.8281	**
Fixed interest rate, regional		-12.8864	***
Fixed interest rate, national		-12.8054	***
Variable interest rate, regional		-14.8323	***
Variable interest rate, national		-10.3244	***
Critical values (%)			
	1	-3.9875	
	5	-3.4242	
	10	-3.1351	

Table 2: Results of the KPSS Test for Stationarity

	Constant+trend	Significance
Variables in logarithms		
The null hypothesis is stationarity		
Delinquency rate	0.3899	
Unemployment rate	0.3755	
Unemployed	0.3714	
Fixed interest rate, regional	0.0765	***
Fixed interest rate, national	0.0706	***
Variable interest rate, regional	0.0859	***
Variable interest rate, national	0.0836	***
Critical values (%)		
1	0.2160	
5	0.1460	
10	0.1190	
Variables in logarithms and first order differences		
The null hypothesis is stationarity		
Delinquency rate	0.1223	**
Unemployment rate	0.0926	***
Unemployed	0.1076	***
Fixed interest rate, regional	0.0514	***
Fixed interest rate, national	0.0485	***
Variable interest rate, regional	0.0924	***
Variable interest rate, national	0.0845	***
Critical values (%)		
1	0.2160	
5	0.1460	
10	0.1190	

Table 3: Estimation Results Model A And Model B

Dependent variable: % D in the Delinquency Rate (t=0)
n = 259

	Model A	Model B
Constant	0.0139	0.0132
	(0.4606)	(0.4375)
% D in Delinquency Rate	-0.3637***	-0.3628***
(t - 1)	(-6.6027)	(-6.5951)
% D in Unemployed Population		0.7675***
(t - 4)		(2.7845)
% D in Unemployment Rate	0.7022***	
(t - 4)	(2.6791)	
Dummy variable	-2.6546***	-2.6737***
(January 1992)	(-5.4579)	(-5.5040)
R-squared	0.2292	0.2309
P (F-stat)	0.0000	0.0000
Residual Diagnostic Tests, P-values		
White's test (heteroskedasticity)	0.0960	0.0741
Breusch-Godfrey (autocorrelation)	0.0000	0.0000
Jarque-Bera (normality)	0.0158	0.0145

Table 4: Estimation Results Model C and Model D

Dependent variable: % D in the Delinquency Rate (t = 0)
n = 305

	Model C	Model D
Constant	0.0258	0.0223
	(0.8340)	(0.7287)
% D in Delinquency Rate	-0.3888***	-0.3853***
(t - 1)	(-7.5430)	(-7.5220)
% D in National Fixed Interest Rate	2.7128***	
(t - 2)	(2.6631)	
% D in National Variable Interest Rate	1.0225	
(t - 3)	(0.8562)	
% D in Regional Fixed Interest Rate		2.2710***
(t - 2)		(2.1401)
% D in Regional Variable Interest Rate		1.1483
(t -1)		(1.0855)
Dummy variable	-2.6319***	-2.620***
(January 1992)	(-4.9260)	(-4.9016)
R-squared	0.2176	0.2161
P (F-stat)	0.0000	0.0000
Residual Diagnostic Tests, P-values		
White's test (heteroskedasticity)	0.1784	0.1893
Breusch-Godfrey (autocorrelation)	0.0000	0.0000
Jarque-Bera (normality)	0.0000	0.0000

Table 5: Regression Result for Model E

Dependent variable: % D in Delinquency Rate (t = 0)
n = 259

	Model E
Constant	0.1963
	(0.6506)
% D in Delinquency Rate	-0.3709***
(t - 1)	(-6.7568)
% D in Regional Fixed Interest rate	1.8698**
(t - 3)	(1.9049)
% D in Number of Unemployed	0.7854***
(t - 4)	(2.8624)
Dummy variable	-2.6450***
(January 1992)	(-5.4704)
R-squared	0.2417
P (F-stat)	0.000
Residual Diagnostic Tests, P-values	
White's test (heteroskedasticity)	0.0703
Breusch-Godfrey (autocorrelation)	0.0000
Jarque-Bera (normality)	0.0075