

ADDENDUM FOR
CREDIT SUPPLY AND THE PRICE OF HOUSING

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Favara and Imbs (2015) – FI from now on – propose an estimation of the effect of deregulation $D_{s,t-1}$ on the growth rate of credit $L_{c,t} - L_{c,t-1}$, which can be written as

$$L_{c,t} - L_{c,t-1} = \alpha_c + \gamma_t + \beta_1 D_{s,t-1} + \rho (L_{c,t-1} - L_{c,t-2}) + \varepsilon_{c,t} \quad (1)$$

where the set of regressors other than deregulation have been omitted for clarity. Since the regression includes both a lagged dependent variable and fixed effects, it can fall victim to the bias discussed in Nickell (1981).¹ This addendum addresses this concern, presenting estimates obtained with three estimators designed to correct for the Nickell bias: the Arellano and Bond (1991) and Blundell and Bond (1998) GMM estimators, and the bias-corrected LSDV estimator proposed by Kiviet (1995).

Table 1, Panel A focuses on loans originated by commercial banks. Panel B focuses on loans originated by placebo lenders, i.e. thrifts, credit unions and independent mortgage companies, which were unaffected by changes in branching regulations. Table 1 reports the results for the number of loans. Results for the other two variables (loan volume and loan to income ratio) that FI show respond significantly to branching deregulations are in Tables 2 and 3.

Columns (1) and (2) in Table 1 report the estimates implied by the AB [Arellano and Bond (1991)] and BB [Blundell and Bond (1998)] GMM estimators, respectively, with all available lags used as instruments.² The AB estimator –commonly known as the "Difference GMM"– corrects for the Nickell bias by first differencing equation (1) to remove county fixed effects, and then using all available lags of the untransformed variables as instruments for the first differenced regressors. The BB estimator –commonly known as "System GMM"– proposes to increase the power of the AB estimator, by appending equation (1) in levels to the first-differenced version of equation (1), thus defining a system of equations. The idea is to augment the instrument set, and the number of orthogonality conditions, including the lagged first-differences of the regressors as instruments for the levels of the regressors in equation (1).³ As shown

¹We thank Diego Restrepo-Tobón and Subal Kumbhakar for bringing this to our attention.

²The two GMM estimators are run using the `xtabond2` command in Stata (see, Roodman, 2009), with variables in forward orthogonal deviations (Arellano and Bover, 1995). The advantage of forward orthogonal deviations is that they do not magnify gaps in unbalanced panels (see e.g., Blundell and Bond, 1998; Bond 2002, Hayakawa, 2009).

³The BB-GMM constitutes an improvement over the AB estimator if the panel is persistent, as in this case the lagged-levels of variables tend become weak instruments for subsequent changes (see Blundell and Bond (1998) or Blundell, Bond and Windmeijer (2000)). In our case persistence in credit growth is low, with an autoregressive coefficient close to 0.10 in absolute value; it is thus not clear the BB-GMM estimator should be preferred to the AB estimator. The drawback of the BB-

in columns (1) and (2) of Table 1, the GMM estimates of the effect of deregulation on credit are positive and significant. The point estimates of β_1 are almost indistinguishable from those reported in FI. Given the possibility of finite-sample GMM bias due to instrument proliferation (see Bond, 2002; Alvarez and Arellano, 2003; Han and Phillips, 2006; Bun and Kiviet, 2006), columns (3) and (4) report AB and BB-GMM estimators with a more parsimonious choice of instruments: both columns use only two lags of available variables to form moment conditions. As shown, the estimates of β_1 are effectively unchanged.

As discussed in Phillips and Sul (2007), both AB and BB GMM estimators can give unstable results under cross-sectional dependence. This is obviously important in our case, as deregulation affects all the counties in the same state. It is therefore useful to verify the significance of β_1 under alternative bias correcting estimators, that do not rely on GMM. For instance, Judson and Owen (1999) conclude that “using a Monte Carlo approach, the bias of LSDV for dynamic panel data models can be sizeable, even for large T . A corrected LSDV estimator is the best choice overall. GMM is a second best solution.” See also Bun and Kiviet (2003) and Bruno (2005a). Column (5) in Table 1 reports estimates of equation (1) using the bias-corrected LSDV estimator proposed by Kiviet (1995). Once again, the estimate of β_1 is positive, significant, and virtually identical to that reported in FI.⁴

Panel B of Table 1 reports estimates of equation (1) for loans originated by placebo lenders. As shown in all columns the two GMM estimators and the bias-corrected LSDV estimator suggest deregulation had no effect on the number of loans originated by the placebo lenders: estimates of β_1 are all insignificant and close to zero. As argued at length in FI, this differential effect of branching regulations across categories of lenders sharpens the causal interpretation of our estimates. The fact that the differential response survives corrections for the Nickell bias suggests the results in FI are consistent, and their interpretation correct.

GMM estimator is that it uses more instruments than the AB estimator, and is thus more prone to run into problems of instrument proliferation and weak instruments. By including the equation in levels, the BB-GMM also imposes extra orthogonality conditions that are unlikely to be satisfied in our context, including the condition that the change in branching deregulation is not correlated with county fixed effects. For this reason, we estimate the BB-GMM estimator with the requirement that the deregulation dummy is used as instrument for the equation in first differences only.

⁴The bias-corrected least-squares dummy variable (LSDV) estimator is implemented using the Stata program `xtlsdvc`, which accomodates unbalanced panels (Bruno, 2005b). A limitation of the Kiviet estimator is that all regressors (other than the lagged dependent variable) are assumed to be exogenous.

Tables 2 and 3 repeat the results of Table 1 for loan volume and loan to income ratio. Once again, the estimates of β_1 for commercial banks are all positive, significant, and almost identical to those reported in FI, while they are all insignificant and close to zero for the placebo lenders.

Based on the results reported in this addendum, we conclude the Nickell bias has no consequences on the estimates presented in FI.⁵ In unreported results, we checked that omitting the lagged dependent variable in equation (1) has only minimal consequences on the estimates of β_1 . This confirms that the positive and significant estimates of β_1 in FI cannot arise from a Nickell bias.

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⁵In one instance the estimates of β_1 become insignificant: when the BB GMM estimator is implemented in first-differences (FD), as opposed to forward orthogonal deviations (FOD). Common practice is to use FOD whenever the panel is unbalanced, and with gaps, as in our case. Moreover, as pointed out in Hayakawa (2009) "simulation results showed that overall the GMM estimator of the FOD model performs better than that of the FD model."

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Table 1 — Number of Mortgages, Dynamic Panel Data estimators

<i>A. Dependent Variable is the growth rate in the number of mortgages originated by banks</i>					
	(1)	(2)	(3)	(4)	(5)
	AB all lags	BB all lags	AB 2lags	BB 2lags	LSDVC
Lagged Dependent Variable	-0.070*** (0.019)	-0.056*** (0.016)	-0.068*** (0.020)	-0.053*** (0.016)	-0.058*** (0.006)
Deregulation	0.026** (0.010)	0.028*** (0.010)	0.026** (0.010)	0.026*** (0.010)	0.027*** (0.005)
Observations	9974	10922	9974	10992	10992
N. of counties	1018	1018	1018	1018	1019
N. of instruments	326	381	110	165	
Arellano-Bond Test AR(1) -- pval	0.000	0.000	0.000	0.000	
Arellano-Bond Test AR(2) -- pval	0.435	0.553	0.421	0.562	

<i>B. Dependent Variable is the growth rate in the number of mortgages originated by placebo lenders</i>					
	(1)	(2)	(3)	(4)	(5)
	AB all lags	BB all lags	AB 2lags	BB 2lags	LSDVC
Lagged Dependent Variable	-0.098*** (0.033)	-0.086*** (0.034)	-0.152*** (0.044)	-0.124*** (0.046)	-0.169*** (0.089)
Deregulation	0.001 (0.008)	0.003 (0.007)	0.003 (0.008)	0.003 (0.008)	0.001 (0.003)
Observations	9563	10580	9563	10580	10580
N. of counties	1014	1017	1014	1017	1017
N. of instruments	316	370	108	162	
Arellano-Bond Test AR(1) -- pval	0.000	0.000	0.000	0.000	
Arellano-Bond Test AR(2) -- pval	0.407	0.248	0.652	0.902	

Notes: This Table presents estimates of equation (1) in this Addendum. The dependent variable is the log change in the volume of mortgages originated by commercial banks - Panel A - and the sample of placebo lenders (independent mortgage companies, thrifts and credit unions), - Panel B. Regressors are the Rice and Strahan (2010) index of interstate branching Deregulation, a lagged dependent variable, current and lagged log change in county's income per capita, population, house price, and the Herfindahl index of loan concentration. All variables are defined in the Online Appendix Table OA1 of Favara and Imbs (2015). Columns (1) and (2) report the Arellano and Bond (1991)'s GMM estimator and the Blundell and Bond (1998)'s system GMM estimator, respectively, using all available lags as instruments; in both columns Deregulation is treated as exogenous variable, and the remaining controls are treated as predetermined variables; in both columns county fixed effects are removed by taking orthogonal forward deviations, as in Arellano and Bover (1995). Columns (3) and (4) reproduce the estimates of columns (1) and (2), using only two lags of available variables as instruments. Column (5) reports the biased-corrected least-square dummy variable estimates of Kiviet (1995). All regressions include year and county fixed effects. Standard errors are clustered by state. In column (5) standard errors are computed by bootstrapping with 500 replications. The Arellano-Bond Test AR(1) and AR(2) report the p-values for a test of first and second order serial correlation in the residual.

*** Significant at the 1 percent level
 ** Significant at the 5 percent level
 * Significant at the 10 percent level

Table 2 — Volume of Mortgages, Dynamic Panel Data estimators

<i>A. Dependent Variable is the growth rate in the volume of mortgages originated by banks</i>					
	(1)	(2)	(3)	(4)	(5)
	AB all lags	BB all lags	AB 2lags	BB 2lags	LSDVC
Lagged Dependent Variable	-0.108*** (0.023)	-0.091*** (0.020)	-0.107*** (0.024)	-0.088*** (0.021)	-0.097*** (0.007)
Deregulation	0.027** (0.011)	0.030*** (0.010)	0.027** (0.011)	0.028*** (0.010)	0.028*** (0.005)
Observations	9974	10922	9974	10992	10992
N. of counties	1018	1018	1018	1018	1019
N. of instruments	326	381	110	165	
Arellano-Bond Test AR(1) -- pval	0.000	0.000	0.000	0.000	
Arellano-Bond Test AR(2) -- pval	0.871	0.904	0.834	0.903	

<i>B. Dependent Variable is the growth rate in the volume of mortgages originated by placebo lenders</i>					
	(1)	(2)	(3)	(4)	(5)
	AB all lags	BB all lags	AB 2lags	BB 2lags	LSDVC
Lagged Dependent Variable	-0.111*** (0.031)	-0.123*** (0.033)	-0.124*** (0.038)	-0.154*** (0.042)	-0.178*** (0.008)
Deregulation	0.001 (0.007)	0.003 (0.007)	0.002 (0.008)	0.003 (0.008)	0.001 (0.004)
Observations	9563	10580	9563	10580	10580
N. of counties	1014	1017	1014	1017	1017
N. of instruments	316	370	108	162	
Arellano-Bond Test AR(1) -- pval	0.000	0.000	0.000	0.000	
Arellano-Bond Test AR(2) -- pval	0.424	0.619	0.656	0.705	

Notes: This Table presents estimates of equation (1) in this Addendum. The dependent variable is the log change in the volume of mortgages originated by commercial banks - Panel A - and the sample of placebo lenders (independent mortgage companies, thrifts and credit unions), - Panel B. Regressors are the Rice and Strahan (2010) index of interstate branching Deregulation, a lagged dependent variable, current and lagged log change in county's income per capita, population, house price, and the Herfindahl index of loan concentration. All variables are defined in the Online Appendix Table OA1 of Favara and Imbs (2015). Columns (1) and (2) report the Arellano and Bond (1991)'s GMM estimator and the Blundell and Bond (1998)'s system GMM estimator, respectively, using all available lags as instruments; in both columns Deregulation is treated as exogenous variable, and the remaining controls are treated as predetermined variables; in both columns county fixed effects are removed by taking orthogonal forward deviations, as in Arellano and Bover (1995). Columns (3) and (4) reproduce the estimates of columns (1) and (2), using only two lags of available variables as instruments. Column (5) reports the biased-corrected least-square dummy variable estimates of Kiviet (1995). All regressions include year and county fixed effects. Standard errors are clustered by state. In column (5) standard errors are computed by bootstrapping with 500 replications. The Arellano-Bond Test AR(1) and AR(2) report the p-values for a test of first and second order serial correlation in the residual.

*** Significant at the 1 percent level
 ** Significant at the 5 percent level
 * Significant at the 10 percent level

Table 3 — Loan to Income Ratio Dynamic Panel Data estimators

<i>A. Dependent Variable is the growth rate in the loan to income ratio originated by banks</i>					
	(1)	(2)	(3)	(4)	(5)
	AB all lags	BB all lags	AB 2lags	BB 2lags	LSDVC
Lagged Dependent Variable	-0.120*** (0.024)	-0.101*** (0.021)	-0.118*** (0.024)	-0.098*** (0.021)	-0.108*** (0.007)
Deregulation	0.027** (0.011)	0.026*** (0.010)	0.027** (0.011)	0.025** (0.010)	0.028*** (0.005)
Observations	9973	10991	9973	10991	10992
N. of counties	1018	1018	1018	1018	1019
N. of instruments	326	381	110	165	
Arellano-Bond Test AR(1) -- pval	0.000	0.000	0.000	0.000	
Arellano-Bond Test AR(2) -- pval	0.975	0.809	0.962	0.804	
<i>B. Dependent Variable is the growth rate in the loan to income ratio originated by placebo lenders</i>					
	(1)	(2)	(3)	(4)	(5)
	AB all lags	BB all lags	AB 2lags	BB 2lags	LSDVC
Lagged Dependent Variable	-0.120*** (0.031)	-0.123*** (0.036)	-0.109*** (0.044)	-0.128*** (0.051)	-0.192*** (0.008)
Deregulation	0.001 (0.007)	0.001 (0.007)	0.001 (0.007)	0.000 (0.007)	0.000 (0.005)
Observations	9562	10579	9562	10579	10579
N. of counties	1014	1017	1014	1017	1017
N. of instruments	316	370	108	162	
Arellano-Bond Test AR(1) -- pval	0.000	0.000	0.000	0.000	
Arellano-Bond Test AR(2) -- pval	0.539	0.645	0.483	0.794	

Notes: This Table presents estimates of equation (1) in this Addendum. The dependent variable is the log change in the loan to income ratio originated by commercial banks - Panel A - and the sample of placebo lenders (independent mortgage companies, thrifts and credit unions), - Panel B. Regressors are the Rice and Strahan (2010) index of interstate branching Deregulation, a lagged dependent variable, current and lagged log change in county's income per capita, population, house price, and the Herfindahl index of loan concentration. All variables are defined in the Online Appendix Table OA1 of Favara and Imbs (2015). Columns (1) and (2) report the Arellano and Bond (1991)'s GMM estimator and the Blundell and Bond (1998)'s system GMM estimator, respectively, using all available lags as instruments; in both columns Deregulation is treated as exogenous variable, and the remaining controls are treated as predetermined variables; in both columns county fixed effects are removed by taking orthogonal forward deviations, as in Arellano and Bower (1995). Columns (3) and (4) reproduce the estimates of columns (1) and (2), using only two lags of available variables as instruments. Column (5) reports the biased-corrected least-square dummy variable estimates of Kiviet (1995). All regressions include year and county fixed effects. Standard errors are clustered by state. In column (5) standard errors are computed by bootstrapping with 500 replications. The Arellano-Bond Test AR(1) and AR(2) report the p-values for a test of first and second order serial correlation in the residual.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

ONLINE APPENDIX FOR
CREDIT SUPPLY AND THE PRICE OF HOUSING

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Federal Reserve Board

Jean Imbs

Paris School of Economics, (CNRS) & CEPR

(Not for Publication)

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Introduction

This Online Appendix accompanies "Credit Supply and the Price of Housing" by Giovanni Favara and Jean Imbs. It reports additional tables mentioned in the paper, but not reported explicitly.

Additional Tables

- Table OA1 provides a description of variables and data sources.
- Table OA2 presents summary statistics.
- Table OA3 reports estimates of β_1 in equation (1) for three-year average values of the growth rate of $L_{c,t}$ and $X_{c,t}$. The three-year intervals are, 94-96, 97-99, 00-02, 03-05.
- Table OA4 investigates when deregulation has most effect on credit. For both the full and the border sample of counties, the Table reports the interaction coefficients of the year when branching deregulation occurs and the Rice and Strahan (2010) deregulation index.
- Table OA5 reports the results of the benchmark regression in equation (1) estimated over a placebo sample period of four years: credit measured between 1990 and 1994 is regressed on branching deregulation measured between 1996 and 2000. The results are shown for banks, Panel A, and placebo lenders, Panel B.
- Table OA6 verifies the impact of deregulation on house prices over three-year intervals. In analogy with Table OA3, the table reports estimates of equation (2) for three-year average values of the growth rates in $P_{c,t}$ and $X_{c,t}$, where the three-year intervals are, 94-96, 97-99, 00-02, 03-05.
- Table OA7 verifies the absence of any effect of the placebo branching deregulation index on house prices when, in analogy with Table OA5, house prices between 1990 and 1994 are regressed on the branching deregulation index between 1996 and 2000.
- Table OA8 presents estimates of equations (1) and (2), performed on the reduced sample of border counties, but splitting further the sample into loans that were

originated to finance properties that are located at different distances from the border.

Table OA1—Description of Variables and Data Sources

Variable name	Variable description	Source
Index of interstate branching deregulation	Index of US interstate branching deregulation for commercial banks based on restrictions to: (1) de novo interstate branching, (2) acquisition of individual branches, (3) statewide deposit cap and, (4) minimum age of the target institution. The index ranges from zero (most restrictive) to four (least restrictive). The index is set to zero in 1994, the year of the passage of Interstate Banking and Branching Efficiency Act (IBBEA).	Rice and Strahan (2010)
Number of Originations	Number of loans originated for purchase of single family owner occupied houses. County level aggregation of loan level data.	HMDA
Volume	Dollar amount of loans originated for purchase of single family owner occupied houses. County level aggregation of loan level data.	HMDA
Number of Denials	Number of loan applications denied for purchase of single family owner occupied houses. County level aggregation of loan level data.	HMDA
Loan to Income Ratio	County level aggregation of principal amount of loan originated for purchase of single family owner occupied houses divided by IRS county wage and salary.	HMDA/IRS
Number Sold	Number of loans originated for purchase of single family owner occupied houses sold within the year of origination to other non affiliated financial institutions or government-sponsored housing enterprises. County level aggregation of loan level data.	HMDA
Herfindahl Index	Sum of squared shares of mortgage loans. The shares are based on the volume of loans originated by a lender relative to the total volume of mortgage loans originated in a county. Loans are for purchase of single family owner occupied houses.	HMDA
Mortgage rate	Ratio of interest and fee income on mortgage loans to mortgage loans	Call Reports
ROA	Net income over assets	Call Reports
Cost of deposits	Interest expenses on deposit to total deposits	Call Reports
NPL	Non-performing mortgage loans to total mortgage loans	Call Reports
Deposit Growth	Log change in total deposits	Call Reports
House Price Index	County median price of existing single-family homes, and CoreLogic repeat sales index of existing single-family homes	Economy Moody's.com
Housing Stock	Housing units single-family occupied, based on US Census data, American Community Survey and Moody's Analytics Estimates.	Economy Moody's.com
Housing supply elasticity	Land-topography based measure of housing supply elasticity.	Saiz (2010)
Income per capita	County personal income per capita.	BEA
Population	County population (in thousands).	BEA

Table OA2—Summary Statistics

	Full sample					Sample of contiguous counties				
	Mean	SD	10th pc	90th pc	Obs	Mean	SD	10th pc	90th pc	Obs
<i>HMDA DATA -- county data</i>										
<i>Commercial Banks</i>										
Number of loans	0.124	0.345	-0.135	0.364	10992	0.101	0.292	-0.130	0.320	2885
Loan volume	0.179	0.378	-0.100	0.436	10992	0.157	0.321	-0.092	0.386	2885
Number of denials	0.090	0.468	-0.460	0.565	10948	0.087	0.412	-0.390	0.527	2877
Loan to income ratio	0.131	0.385	-0.148	0.389	10992	0.110	0.323	-0.146	0.346	2885
Number of loans sold	0.173	0.393	-0.176	0.550	10859	0.156	0.363	-0.174	0.511	2861
<i>Mortgage Companies, Thrifts and Credit Unions</i>										
Number of loans	0.071	0.312	-0.282	0.426	10741	0.064	0.280	-0.251	0.382	2829
Loan volume	0.121	0.319	-0.231	0.469	10741	0.112	0.302	-0.213	0.430	2829
Number of denials	0.064	0.531	-0.527	0.666	10731	0.073	0.517	-0.497	0.607	2829
Loan to income ratio	0.074	0.324	-0.280	0.418	10741	0.064	0.303	-0.256	0.392	2829
Number of loans sold	0.086	0.472	-0.369	0.539	10728	0.089	0.425	-0.336	0.525	2824
<i>Commercial Banks</i>										
<i>Out-of-State banks -- local branches</i>										
Number of loans	0.242	0.917	-0.588	1.232	5407	0.196	0.982	-0.693	1.259	1612
Loan volume	0.324	1.075	-0.610	1.494	5407	0.277	1.130	-0.771	1.510	1612
Number of denials	0.151	0.811	-0.693	1.099	5004	0.133	0.871	-0.847	1.131	1464
Loan to income ratio	0.282	1.075	-0.655	1.450	5407	0.235	1.128	-0.824	1.460	1612
Number of loans sold	0.338	0.982	-0.693	1.609	4183	0.274	1.061	-0.760	1.639	1146
<i>Out-of-State banks --no branches</i>										
Number of loans	0.195	0.414	-0.182	0.598	10917	0.176	0.370	-0.168	0.547	2872
Loan volume	0.243	0.450	-0.141	0.649	10917	0.224	0.391	-0.138	0.597	2872
Number of denials	0.165	0.624	-0.619	0.854	10847	0.164	0.573	-0.528	0.804	2858
Loan to income ratio	0.196	0.454	-0.186	0.598	10917	0.177	0.391	-0.183	0.548	2872
Number of loans sold	0.200	0.469	-0.248	0.693	10744	0.194	0.440	-0.211	0.657	2842
<i>In-State banks</i>										
Number of loans	0.026	0.466	-0.382	0.423	10806	-0.007	0.451	-0.419	0.354	2839
Loan volume	0.083	0.521	-0.375	0.525	10806	0.052	0.517	-0.413	0.461	2839
Number of denials	-0.026	0.551	-0.613	0.550	10381	-0.041	0.541	-0.619	0.523	2747
Loan to income ratio	0.035	0.527	-0.426	0.486	10806	0.004	0.521	-0.459	0.427	2839
Number of loans sold	0.082	0.646	-0.580	0.754	10244	0.043	0.648	-0.629	0.693	2635
<i>All lenders</i>										
Herfindhal index of loan concentration -- all lenders	-0.069	0.268	-0.369	0.203	10992	-0.053	0.270	-0.341	0.216	2885

(continues)

Table OA2—continued

	Full sample					Sample of contiguous counties				
	Mean	SD	10th pc	90th pc	Obs	Mean	SD	10th pc	90th pc	Obs
<i>CALL REPORT -- county data</i>										
Mortgage rate	0.122	0.036	0.081	0.163	10983	0.118	0.034	0.079	0.157	2883
ROA	0.012	0.002	0.010	0.015	10989	0.012	0.002	0.010	0.015	2885
NPL	0.009	0.006	0.003	0.014	10531	0.009	0.005	0.003	0.013	2814
Cost of deposits	0.026	0.009	0.012	0.036	10989	0.026	0.009	0.012	0.036	2885
Deposit growth	0.276	0.585	-0.225	0.801	10944	0.283	0.558	-0.197	0.822	2876
<i>MOODY'S ECONOMY.COM -- county data</i>										
County median house price index	0.052	0.045	0.005	0.103	10992	0.055	0.044	0.006	0.113	2885
Housing stock single family occupied	0.017	0.017	0.001	0.037	10992	0.015	0.015	0.000	0.034	2885
<i>BEA -- county data</i>										
Income per capita	0.013	0.052	-0.017	0.045	10992	0.014	0.025	-0.014	0.044	2885
Population	0.013	0.016	-0.003	0.033	10992	0.011	0.015	-0.004	0.029	2885
<i>STRAHAN and RICE (2010) -- state data</i>										
Index of interstate branching deregulation	1.320	1.475	0.000	4.000	10992	1.315	1.524	0.000	4.000	2885
<i>SAIZ (2010) -- msa data</i>										
Index of housing supply elasticity	2.528	1.316	1.120	3.993	9596	2.436	1.196	1.067	3.815	2751

Notes: Summary statistics of county-year pooled data. Except for the index of interstate branching deregulation and the index of housing supply elasticity, summary statistics refer to the annual log change of each variable during the period 1994-2005.

Table OA3—3-year interval regressions

<i>A. Commercial Banks</i>					
<i>Dependent Variables</i>					
	Number of Originations	Volume	Number of Denials	Loan to Income Ratio	Number Sold
Deregulation	0.037*** (0.013)	0.034** (0.013)	0.024 (0.020)	0.035*** (0.013)	0.027 (0.016)
Observations	4071	4071	4071	4071	4071
N. of counties	1020	1020	1020	1020	1020
N. of states	50	50	50	50	50
R2 within	0.282	0.271	0.437	0.248	0.131

<i>B. Independent Mortgage Companies, Thrifts and Credit Unions</i>					
<i>Dependent Variables</i>					
	Number of Originations	Volume	Number of Denials	Loan to Income Ratio	Number Sold
Deregulation	0.007 (0.007)	0.006 (0.006)	0.019 (0.012)	0.007 (0.006)	0.001 (0.007)
Observations	4071	4071	4071	4071	4071
N. of counties	1020	1020	1020	1020	1020
N. of borders	50	50	50	50	50
R2 within	0.348	0.278	0.593	0.263	0.270

Notes: Dependent variables are the log change in the Number or Volume of Mortgage Originated, the Number of Applications Denied, the Loan to Income Ratio, and the Number of Loans Originated and Securitized. Regressors are: the Rice and Strahan (2010) Index of Interstate Branching Deregulation, current log change in county's income per capita, population, house price, and the Herfindahl index of loan concentration. All variables are defined in Online Appendix Table OA1. The sample includes all US counties in urban areas for which mortgage data are available for the period 1994-2005. Variables are averaged over 3-year periods: 94-96, 97-99, 00-02, 03-05. Panel A reports regression results for mortgage loans originated by commercial banks. Panel B reports regression results for the placebo sample of independent mortgage companies, thrifts, and credit unions. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and 3-year period fixed effects. Standard errors are clustered at the state level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

Table OA4—Deregulation by year

<i>Commercial Banks</i>						
	<i>Full Sample</i>			<i>Border Sample</i>		
	<i>Dependent Variables</i>			<i>Dependent Variables</i>		
	Number of Loans	Volume	Loan to Income Ratio	Number of Loans	Volume	Loan to Income Ratio
Deregulation*1996	--	--	--	--	--	--
Deregulation*1997	0.042* (0.021)	0.043* (0.023)	0.041* (0.021)	0.059*** (0.011)	0.063*** (0.012)	0.058*** (0.012)
Deregulation*1998	0.032 (0.030)	0.039 (0.036)	0.037 (0.035)	0.064*** (0.014)	0.073*** (0.017)	0.072*** (0.016)
Deregulation*1999	0.036*** (0.011)	0.036*** (0.013)	0.036*** (0.012)	0.035*** (0.012)	0.033** (0.014)	0.035** (0.014)
Deregulation*2000	0.007 (0.014)	-0.007 (0.016)	-0.002 (0.015)	0.031*** (0.011)	0.006 (0.012)	0.011 (0.012)
Deregulation*2001	-0.007 (0.010)	-0.013 (0.012)	-0.011 (0.012)	0.039*** (0.009)	0.025** (0.010)	0.016 (0.010)
Deregulation*2002	0.029*** (0.008)	0.023** (0.010)	0.028*** (0.009)	0.009 (0.019)	-0.002 (0.021)	0.002 (0.024)
Deregulation*2003	0.035*** (0.010)	0.029** (0.011)	0.029** (0.011)	0.046*** (0.007)	0.036*** (0.007)	0.042*** (0.007)
Deregulation*2004	0.007 (0.004)	-0.008 (0.005)	-0.006 (0.005)	0.006 (0.005)	-0.012** (0.005)	-0.009 (0.006)
Deregulation*2005	--	--	--	--	--	--
Observations	12338	12338	12337	3225	3225	3225
N. of counties	1046	1046	1046	273	273	273
N. of states	50	50	50	35	35	35
R2 within	0.074	0.063	0.055	0.091	0.075	0.072

Notes: County level linear regressions of the log change in the Number of Mortgage Loans, Volume of Mortgage Loans, Loan to Income Ratio on the Rice and Strahan (2010) Index of Interstate Branching Deregulation interacted with the year a state deregulates. All variables are defined in Online Appendix Table OA1. The sample in the first three columns includes all US urban counties for which mortgage data is available for the period 1994-2005. The last three columns use the sample of counties in MSAs that straddle two or more states. All regressions include county and year fixed effects. Standard errors are clustered at the state level level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

Table OA5 —Commercial banks and other lenders in the placebo sample 1990-1994

<i>A. Commercial Banks</i>					
<i>Dependent Variables</i>					
	Number of Originations	Volume	Number of Denials	Loan to Income Ratio	Number Sold
Deregulation	-0.013 (0.030)	-0.037 (0.025)	-0.027 (0.019)	-0.014* (0.007)	-0.012 (0.024)
Observations	3083	3083	2666	3079	2461
N. of counties	1161	1161	990	1159	897
N. of states	50	50	50	50	50
R2 within	0.304	0.298	0.305	0.297	0.291

<i>B. Independent Mortgage Companies, Thrifts and Credit Unions</i>					
<i>Dependent Variables</i>					
	Number of Originations	Volume	Number of Denials	Loan to Income Ratio	Number Sold
Deregulation	0.001 (0.030)	-0.000 (0.035)	-0.015 (0.042)	0.028* (0.015)	0.021 (0.035)
Observations	2901	2901	2815	2896	2872
N. of counties	1090	1090	1071	1090	1083
N. of states	50	50	50	50	50
R2 within	0.285	0.280	0.439	0.154	0.414

Notes: Dependent variables are the log change in the Number or Volume of Mortgage Originated, the Number of Applications Denied, the Loan to Income Ratio, and the Number of Loans Originated and Securitized. The sample includes all US counties in urban areas for which mortgage data are available for the period 1990-1994. Deregulation refers to the Rice and Strahan (2010) Index of Interstate Branching Deregulation for the years 1996-2000. The index ranges from 0 (most restricted) to 4 (least restricted). Controls include a lagged dependent variable, current and lagged log change in county's income per capita, population, house price, and the Herfindahl index of loan concentration. All variables are defined in Online Appendix Table OA1. Panel A reports regression results for mortgage loans originated by Commercial Banks. Panel B reports regression results for the placebo sample of mortgage loans originated by Independent Mortgage Companies, Thrifts, and Credit Unions. All regressions include county and year fixed effects. Standard errors are clustered by state. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

Table OA6—House prices and deregulation -- 3 year interval regressions

	<i>Dependent Variables</i>		
	House Prices		
	(1)	(2)	(3)
Deregulation	0.010** (0.004)	0.025*** (0.006)	0.024*** (0.006)
Deregulation \times house supply elasticity		-0.009*** (0.002)	-0.009*** (0.002)
Observations	4071	3541	3541
N. of counties	1020	886	886
N. of states	50	48	48
R squared	0.229	0.257	0.330

Notes: County level linear regressions of the log change in House Prices on the Rice and Strahan (2010) Index of Branching Deregulation and its interaction with the Elasticity of Housing Supply. In column (3) control variables include current period log change in county's income per capita, population, and the Herfindahl index of loan concentration. All variables are defined in Online Appendix Table OA1. The sample includes all US counties in urban areas for which mortgage and house price data are available for the period 1994-2005. Variables are averaged over 3-year periods: 94-96, 97-99, 00-02, 03-05. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and 3-year period fixed effects. Standard errors are clustered by state. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

Table OA7—House prices and deregulation in the placebo sample 1990-1994

	<i>Dependent Variables</i>		
	House Prices		
	(1)	(2)	(3)
Deregulation	-0.004* (0.002)	0.001 (0.005)	-0.006** (0.002)
Deregulation \times house supply elasticity		-0.002 (0.001)	0.000 (0.001)
Observations	6347	3436	2557
N. of counties	1663	878	876
N. of states	50	48	48
R squared	0.066	0.036	0.066

Notes: County level linear regressions of the log change in House Prices on the Rice and Strahan (2010) Index of Branching Deregulation and its interaction with the Elasticity of Housing Supply. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). In column 3, control variables include a lagged dependent variable, current and lagged log change in county's income per capita, population, and the Herfindahl index of loan concentration. All variables are defined in Online Appendix Table OA1. The sample includes all US counties in urban areas for which mortgage and house price data are available for the period 1994-2005. All regressions include county and 3-year period fixed effects. Standard errors are clustered by state. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

Table OA8—Distance to the state border in contiguous counties

<i>A. Distances around 20 miles from the border</i>									
	<i>Less than 20 miles</i>			<i>More than 20 miles</i>					
	<i>Dependent Variables</i>			<i>Dependent Variables</i>					
	Number of Originations	Volume	House Prices	Number of Originations	Volume	House Prices			
Deregulation	0.011 (0.007)	0.012 (0.062)	0.003 (0.003)	0.056*** (0.018)	0.062*** (0.020)	0.005*** (0.002)			
Observations	1198	1198	1210	1687	1687	1727			
N. of counties	110	110	110	157	157	157			
N. of states	27	27	27	32	32	32			
R2 within	0.100	0.120	0.541	0.147	0.157	0.392			

<i>B. Distances around 15 and 30 miles from the border</i>									
	<i>Less than 15 miles</i>			<i>Between 15 and 30 miles</i>			<i>More than 30 miles</i>		
	<i>Dependent Variables</i>			<i>Dependent Variables</i>			<i>Dependent Variables</i>		
	Number of Originations	Volume	House Prices	Number of Originations	Volume	House Prices	Number of Originations	Volume	House Prices
Deregulation	0.006 (0.011)	0.008 (0.012)	0.002 (0.003)	0.026** (0.010)	0.029** (0.011)	0.004** (0.002)	0.077** (0.005)	0.084** (0.036)	0.006** (0.002)
Observations	647	647	649	1338	1338	1364	900	900	924
N. of counties	59	59	59	124	124	124	84	84	84
N. of states	21	21	21	33	33	33	25	25	25
R2 within	0.136	0.145	0.543	0.107	0.125	0.469	0.181	0.187	0.420

Notes: Dependent variables are the log change in the Number or Volume of Mortgage Originated by Commercial Banks, and the log change in the House Price index. The main regressor is the Rice and Strahan (2010) Index of Interstate Branching Deregulation. The index ranges from 0 (most restricted) to 4 (least restricted). Additional controls include a lagged dependent variable, current and lagged log change in county's income per capita, population, and the Herfindahl index of loan concentration. All variables are defined in Online Appendix Table OA1. The sample includes all US counties in MSAs straddling two or more US states, and for which mortgage data are available for the period 1994-2005. Panel A reports regression results for the sample of counties that are 20 miles away from the border. Panel B reports regression results for the sample of counties that are 15 or 30 miles away from the border. Distance is the minimum distance between a county and the contiguous state border. All regressions include county and year fixed effects. Standard errors are clustered by state. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.