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Spend or Save New Wealth? Evidence from the Shale Gas Boom

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Spend or Save New Wealth? Evidence from the Shale Gas Boom*

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PRELIMINARY

Abstract

How do households respond to an unanticipated, substantial, and permanent wealth shock? There is mixed evidence on the degree to which households' decisions follow the predictions of canonical models. Therefore, I exploit a natural experiment, the shale gas boom, to examine households' consumption, debt, and savings decisions. First, using the world's largest peer-to-peer credit market, I find that individuals reduce the use of credit to finance consumption. Households also reduce their use of the market to refinance their existing higher rate debt obligations. These decisions impact the dynamics of the market. That is, the wealth innovation causes the demand for new loans to fall by about 59% of its mean. Second, the wealth shock caused a 7.5 percentage point increase in the rate of stock market participation among households. Collectively, the evidence points towards households both consuming and saving new wealth and these decisions have significant implications for financial markets.

Keywords: Consumption, financial technology, household credit, household finance, peer-to-peer lending, shale gas, stock market participation, wealth

JEL classification: D12, D14, G10, G23, O16

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1 Introduction

Wealth is a principal determinant of the typical household's financial decisions. However, how individuals react to changes in their wealth is not clear (Jappelli and Pistaferri 2010). Yet, households' responses have important implications for financial markets and their long-term welfare (Case, Quigley, and Shiller 2005; Campbell 2006). At the same time, the literature has primarily studied consumption and savings decisions in isolation, ignoring their fundamental linkages (Campbell 1987). Therefore, this paper exploits a natural experiment, the shale gas boom, to study how a substantial, unanticipated, and non-transitory increase in households' wealth levels influences their consumption, savings, and use of financial markets.

Permanent innovations in wealth should impact households' spending and savings decisions. That is, an increase in wealth should lead households to consume (Friedman 1957; Hall 1978). At the same time, rises in wealth can also spur savings behaviors (Deaton 1991; Carroll 1992; Carroll 2009). Importantly, these responses have implications for financial markets through households' use of financial instruments. For instance, access to credit and the use of debt instruments are central to individuals' consumption smoothing decisions in the presence of wealth shocks.[1]

Therefore, I first test households' consumption and savings responses to the wealth shock using data from a large and growing credit market. Specifically, I use data covering the entire history, from 2007 through 2015, of the world's largest peer-to-peer credit market - Lending Club. I use this market because the richness of the data offers a unique opportunity to study households' decisions. First, the market provides a channel through which individuals can make their marginal credit decisions. Second, the depth of the data

[1] At the same time, innovations in financial technology have expanded the availability of credit. For instance, technology related to credit scoring enabled lenders to better identify high-risk borrowers which subsequently expanded access to credit (Einav, Jenkins, and Levin 2013).

provides insights into households' reasons for borrowing, including consumption, saving through debt refinancing, and housing-investment motives. Further, households using the market appear to be similar to the typical U.S. household.[2] Finally, the structure of the data allows me examine both extensive (number of new loans) and intensive (amount of funds borrowed) credit demands.

I also examine households' stock market participation decisions in response to the wealth innovation. I do so because equity investing is an important channel through which households accumulate wealth. Moreover, canonical models predict that all individuals should invest in equities (Samuelson 1969; Merton 1969; Merton 1971). At the same time, increases in wealth can offset participation costs (Vissing-Jorgensen 2002). Therefore, I hypothesize that the positive shock due to the shale gas boom will spur households to participate in the stock market. To test this hypothesis, I rely on annual county-level tax data from the Internal Revenue Service between 2010 and 2014.[3]

Empirically identifying the causal impact of changes in wealth on households' consumption, savings, and use of financial markets is challenging due to endogeneity concerns. Therefore, I use the shale gas boom as an exogenous event affecting the wealth of households living in Ohio, Pennsylvania, and West Virginia. Recent evidence shows that individuals living in areas with shale well activities experienced large changes in their wealth driven by land lease payments, recurring royalties, and other economic spillovers (Feyrer, Mansur, and Sacerdote 2017). Moreover, projections indicate that the boom will last for several decades (U.S. Energy Information Agency 2013). This suggests that the effects of shale well activities are likely to persist and cumulate over time. In light of this, I use fracking

[2]For instance, the average Lending Club borrower's FICO score is approximately 697. Using data as of April 2015, from Fair Isaac Corp, NerdWallet estimates the average FICO score in the U.S. is 695 while about 45% of individuals have a score below 700.

[3]While aggregate data does not provide the ideal setting, the shale gas boom represents a systemic shock to individuals in the region and the effects should manifest in aggregate data.

well activity in the Marcellus Shale region to capture variation in local households' wealth levels. Specifically, I identify areas with shale well activity based on the issuance of fracking well permits. However, the degree of shale well activity within an area may be influenced by households' preferences. Therefore, I instrument for well activity using the thickness of the subterranean geological formations (Maniloff and Mastromonaco 2014; Feyrer, Mansur, and Sacerdote 2017).

My empirical evidence shows that households have strong responses to the large wealth shock. First, increasing wealth reduces individuals' use of the peer-to-peer credit market at the aggregate level. Univariate estimates indicate that households living in areas with shale well activities received about 8,390 loans with a total volume of about $121 million during the sample period. On the other hand, households living in areas without shale activities received 39,088 loans with a total volume of approximately $580 million. To control for potential factors which may influence the univariate estimates, I perform multivariate ordinary least squares and instrumental variable regressions. The effect persists when including controls. For instance, estimates from instrumental variable regressions show that experiencing the wealth innovation causes individuals to reduce demand for new loans by about 59% of the monthly mean. Moreover, conditional on taking a loan, households in areas with shale wells request about $323 less on average. This corresponds to a 2.19% reduction relative to the mean loan amount.

Next, I examine households' credit demands across the three borrowing motives. I find that the wealth shock has differential impacts according to the individual's underlying reason for borrowing. While, the demand for new loans declines across all borrowing motives, loans to be used for refinancing other higher-rate debt experience the largest decline. For instance, new consumption loans decline by 34% and housing-investment loans fall by 32%, of their respective means. Yet, the demand for loans to refinance existing

debt obligations falls by 63% of its mean. In addition, intensive demand also declines for debt management and housing-investment loans. Collectively, the evidence suggests that households use the gains in wealth to consume, pay down existing debt liabilities, and invest.

Turning to stock market participation, I find that the households respond to the positive wealth innovation by investing in equities. For instance, estimates from instrumental variable regressions show that stock market participation among households that experienced the shock increased by eight percentage points. This represents a 36.57% increase relative to an unconditional average participation rate of 20.52%.

Overall, the evidence indicates that changes in wealth can have substantial impacts on households' consumption and savings decisions. Moreover, these decisions aggregate to influence the dynamics of a large credit market. To further examine the effects of the wealth shock, I conduct additional tests. First, I test if households' payments on loans taken in the peer-to-peer market are impacted. However, I do not find significant evidence that households which experienced the wealth shock are less likely to be late on loan installments or default.

Second, I extend the analysis to examine the impact of a new shale well. I do so because each new fracking well can impact households' wealth through land lease agreements and royalty payments. I find that a new shale well causes households to reduce their demand for credit on both the extensive and intensive margins. Moreover, the effects hold across all households' borrowing motives. Moving to stock market participation, I find that a new shale well causes a 0.05 percentage point increase in participation. This corresponds to a 0.24% increase relative to the average participation rate.

I also conduct additional robustness checks. To address potential sample selection concerns related to households' which decide to use the Lending Club platform, I re-perform

the analysis using data from the second largest peer-to-peer credit market, Prosper. The data have been used in several studies examining households' credit outcomes (Duarte, Siegel, and Young 2012; Ravina 2012). I find that the wealth effects identified in the Prosper data are similar to those found in the Lending Club data. That is, the positive innovation in wealth leads households to reduce their demand for credit along both the extensive and intensive margins. Moreover, the economic magnitudes are similar between the two datasets. For instance, relative to the mean number of new loan applications, the presence of local shale well activities cause a 61.76% decline in extensive demand.

Finally, I directly examine the relationships between shale well activities, households' incomes from royalties, and stock market participation. I rely on royalty income because it is one of the primary channels through which shale well activities directly impact households' wealth levels. To implement the analysis, I measure royalty income using households' tax filings reported to the state of Pennsylvania. First, I find that royalty receipts are positively affected by the presence of local shale wells. Second, receipts of royalties cause individuals to participate in the stock market. Overall, these findings suggest that the presence of shale well activities is a reasonable means of identifying areas which experienced the positive wealth shock when detailed tax information is not available.

This study contributes to several literatures. First, the findings add to the growing literature examining the effects of income and wealth innovations on households' decisions and financial markets (Hall 1978; Campbell 1987; Agarwal, Chunlin, and Souleles 2007; Baker 2015; Fella, Frache, and Koeniger 2016). For instance, models of consumption often rely on the assumption of perfect credit markets. However, in the presence imperfect markets, insufficient access to credit markets can ultimately heighten consumption responses. Therefore, savings and capital markets play important roles in households' consumption smoothing processes (Deaton 1991; Carroll 1992; Carroll 1997). Ultimately, this paper

provides evidence that shocks to households' wealth levels impact their consumption and savings decisions and their use of credit markets.

The evidence in this paper also speaks to the growing household finance literature. For instance, how households use financial products and markets to attain their objectives are fundamental questions in this literature (Campbell 2006). I shed light on households' use of a new peer-to-peer credit market in response to an exogenous wealth shock. At the same time, my empirical findings expand the literature examining individuals' stock market participation decisions. While recent studies have examined the effects of transitory wealth shocks on portfolio choices (e.g., Andersen and Nielsen (2011) and Briggs, Cesarini, Lindqvist, and Östling (2015)), I focus on a substantial and non-transitory innovation.

The findings also contribute to an emerging literature examining the roles of peer-to-peer markets and technological innovation within the U.S. financial system (Michels 2012; Lin, Prabhala, and Viswanathan 2013; Morse 2015; Balyuk 2016). To my knowledge, this is the first study to identify the causal impacts of changes in wealth on individuals' use of a peer-to-peer credit market. I also contribute to the literature by showing that the dynamics of the market can be influenced by a geographically-focused economic event. This finding sheds light on the stability of these new platforms which is an important component of the ongoing regulatory debate. At the same time, it supports evidence from other studies which indicate that geographically-concentrated economic shocks can aggregate to impact financial markets (Bernile, Delikouras, Korniotis, and Kumar 2015). Finally, this paper supplements the developing household credit literature (Tufano 2009; Zinman 2014).

The remainder of the paper is organized as follows. Section 2 provides a brief review of the related literature and develops hypotheses. Section 3 discusses institutional details of the peer-to-peer market and describes the primary credit market dataset. In Section 4, I detail the identification strategy and empirical methodology. Section 5 reports the

main empirical findings related to the peer-to-peer credit market. In Section 6, I examine households' stock market participation decisions. Section 7 reports robustness checks and I conclude with a brief discussion in Section 8.

2 Literature Review and Empirical Predictions

In this section, I review the established literature examining households' responses to changes in their wealth. I also characterize the emerging research examining new financial markets with a focus on peer-to-peer markets. Finally, I develop testable hypotheses based on the literatures.

2.1 Wealth Innovations and Household Responses

How individuals respond to wealth shocks continues to be an important and ongoing line of research. Classical models of consumer theory relate individuals' consumption decisions to permanent innovations in wealth (Friedman 1957; Hall 1978). However, there is mixed evidence on the extent to which households' decisions align with normative theories. An increasing volume of literature suggests that households respond to both transitory and permanent shocks; as well as anticipated and unanticipated innovations (Campbell and Mankiw 1990). For instance, several studies use tax rebates to show that households respond to transitory changes in their wealth (Parker 1999; Souleles 1999; Johnson, Parker, and Souleles 2006). Paxson (1992) uses variation in weather and finds that Thai households not only consume, but also save portions of transitory and permanent gains. On the other hand, Hsieh (2003) and Browning and Collado (2001) suggest that households' consumption behaviors incorporate large and easy to predict shocks.

In light of this evidence, the literature has expanded to incorporate households' savings behaviors (Campbell 1987; Deaton 1991; Carroll 1992). For instance, Carroll (1997) shows

that individuals' engage in buffer-stock savings behaviors following income innovations. Therefore, changes in wealth can influence individuals' use of financial products and have important implications for financial markets. For instance, recent studies find that small, transitory gains in wealth can affect households' use of debt instruments. Using the 2001 tax rebate, Agarwal, Chunlin, and Souleles (2007) find that individuals initially pay down their credit card balances but, subsequently, increase consumption. Di Maggio, Kermani, and Ramcharan (2014) exploit automatic interest rate adjustments on hybrid ARM's to identify changes in households' disposable income. They find that individuals use about 10% of the increase to pay down mortgage debt.

Households' portfolio choices are also influenced by innovations in their wealth. Andersen and Nielsen (2011) find that individuals allocate a portion of funds inherited from unexpected deaths to equities. Briggs, Cesarini, Lindqvist, and Östling (2015) capitalize on exogenous lottery windfalls and find a twelve percentage point increase in stock market participation among Swedish households that did not participate prior to the lottery.

In addition to influencing consumption, savings, and financial market decisions, the effects of wealth shocks also vary across households due to heterogeneity in households' underlying characteristics. For instance, Baker (2015) links households' balance sheet characteristics to heterogeneity in consumption responses following exogenous income shocks. The evidence indicates that households with debt are more sensitive to variations. This is important given that financial shocks can propagate through households' balance sheets (Bernanke and Gertler 1995; Bernanke, Gertler, and Gilchrist 1999).

Collectively, the existing literature shows that households' responses to changes in their wealth levels are nuanced. That is, the effects of innovations can manifest in individuals' consumption and savings decisions and influence their use of financial markets. Moreover, heterogeneity in households' balance sheet characteristics also influence their subsequent

financial choices. Yet, understanding how individuals respond to changes in their wealth is important given the implications for financial markets and households' long-term welfare (Campbell 2006).

2.2 Peer-to-Peer Markets

Over the past several years, financial technology has boomed. The revolution has led to the creation of new financial products and markets which are readily accessible to both households and institutions. Among the new financial markets, peer-to-peer lending has emerged as the household credit form of crowd-sourcing. Its principal function is to match households seeking unsecured credit with individuals willing to supply funds (Morse 2015). Peer-to-peer lending has become an increasingly important platform for households to obtain credit. In 2012, the top five peer-to-peer platforms in the U.S. originated approximately $1.2 billion in loans (Fitch Ratings 2014). As of year-end 2015, Lending Club, the largest peer-to-peer platform in the U.S., had independently originated nearly $16 billion in loans. Further, the growth of these new markets is expected to continue. A recent report projects the outstanding float to grow to $114 billion (Fitch Ratings 2014).

Research into the dynamics of peer-to-peer platforms is growing. Recent evidence indicates that social cues and borrowers' personal characteristics play important roles in these markets (Galak, Small, and Stephen 2011; Duarte, Siegel, and Young 2012; Ravina 2012; Freedman and Jin 2014). Iyer, Khwaja, Luttmer, and Shue (2015) show that peer-to-peer lenders are sophisticated in assessing borrowers' creditworthiness from both financial and soft data. Initial studies also point toward borrowers' local economic conditions impacting the dynamics of peer-to-peer markets. Ramcharan and Crowe (2013) find that credit supplies to households' are influenced by borrowers' local housing markets.

Overall, insights from these new lending markets have the potential to significantly

expand the broader credit literature. For instance, there is scant evidence on the interplay between households' demands for credit, driven by heterogenous borrowing motives, and changes in their financial stations (Zinman 2014). The literature has also primarily focused on people's use of secured borrowing channels and use of small, unsecured loans, such as credit card or payday loans (Agarwal, Chunlin, and Souleles 2007; Tufano 2009; Melzer 2011). Peer-to-peer credit markets provide an alternative channel through which households can obtain unsecured credit at rates that are typically lower than these sources.

2.3 Empirical Predictions

The existing literature has not reached a consensus on how wealth innovations influence households' decisions and use of financial markets. Motivated by this, I use the shale gas boom as an exogenous source of wealth variation among individuals residing in the Ohio, Pennsylvania, or West Virginia. Using this natural experiment, I examine the impact of a large, permanent increase in wealth on individuals' consumption and financial decisions.

First, I focus on households' use of a new peer-to-peer credit market. I do so because credit markets are important channels through which households manage their consumption responses to innovations in wealth. At the same time, the peer-to-peer platform provides a new market in which households can make their marginal credit decisions. In light of this, and building upon insights from canonical models of consumption and savings (e.g., Jappelli and Pistaferri (2010)), I expect that changes in wealth will influence households' use of the credit market. Specifically, I conjecture that households which experience the positive wealth innovation from the shale gas boom will reduce their demands for credit. Further, the decline in demand should occur across consumption, debt management, and housing-investment loans.

Second, I examine households' stock market participation decisions. I do so because

equity investing is an important channel through which individuals save and accumulate wealth. At the same time, increasing wealth can offset participation costs and lead to greater participation among households (Vissing-Jorgensen 2002). In light of this, I conjecture that the positive wealth shock from the shale gas boom will spur households to invest in the stock market.

3 Institutional Setting and Credit Market Data

In this section, I describe the peer-to-peer platform and the primary credit market dataset that I use in the analysis. I restrict discussion related to households' stock market participation decisions to Section 6.

3.1 Peer-to-peer Credit Market

Lending Club is the largest online lending platform in the world, originating approximately $16 billion in loans as of year-end 2015.[4] To apply for a loan, individuals specify the amount to be borrowed, their yearly income, and other personal details. Lending Club subsequently verifies the borrower's details using credit reports, W2 statements, and pay stubs. Next, the applicant is assigned a risk rating by Lending Club. The rating determines the interest rate for the loan. Aside from the rate, amount, and duration (36 or 60 months), loan terms are identical for all borrowers. Finally, applicants with a FICO score below 660 are not provided loans.

After Lending Club approves the application, it is listed on the online platform. The online listing includes detailed information about the loan and borrower, including: the amount requested, loan purpose, interest rate, length of the loan, length of employment,

[4]In 2014, Lending Club originated about $4.4 billion in loans. The next largest platform, Prosper Marketplace, originated $1.6 billion.

income, debt-to-income percentage, FICO credit score range, location of residence (at the three digit zip code-level), and other credit history statistics.[5] Investors may review all available loan applications and allocate their funds as desired. If an investor decides to contribute toward funding the loan, the minimum contribution is $25 but there is no maximum. Following funding, Lending Club assesses the borrower an origination fee ranging between 1.1% and 5% of the loan amount. Lending Club also charges a servicing fee of 1% of all loan payments made to investors.

3.1.1 Data

Lending Club's data are publicly available and contain detailed information on 761,119 consumer loans issued between 2007 and year-end 2015. For the analysis, I restrict the data to loans which met Lending Club's credit policies and were listed on the platform. Next, in order to estimate the impact of the exogenous wealth shock associated with the shale gas boom, I retain all loans made to households residing in Ohio, Pennsylvania, or West Virginia. The final sample consists of 47,478 loans which include detailed information about the borrowers.

Panel A of Table 1 reports summary characteristics for the Lending Club borrowers in this region and, for comparison, characteristics of individuals whom participated in the 2007 through 2013 waves of the Panel Survey of Income Dynamics (PSID). The average borrower on the Lending Club platform has an annual income of approximately $69,626, has been employed with his/her current employer for about 6.25 years, and has a debt-to-income ratio of 19.32%. The average individual in the PSID data earns approximately $63,426 per year, has been with his (her) current employer 11.38 years, and has a debt-to-income ratio of 27.15%. Given the substantial variation within the PSID sample, borrowers

[5]The data provide a four point range for the applicant's FICO score, I use the midpoint of the range in all analysis.

on the Lending Club platform appear similar to individuals in the PSID. Moreover, the average Lending Club borrower in the sample has a 697 FICO score which is close to the U.S. average of 695.

The nature of the dataset provides a unique setting for examining households' credit demands. That is, it provides the opportunity to examine households' demands for credit along both the extensive and intensive margins. To do so, I construct two measures. First, to measure extensive demand, I create a variable, *Number of Loans*, which is the aggregate number of loans, per month, within a three-digit zip code area. Second, conditional on submitting a loan application, I measure a household's intensive credit demand using *Amount of Loan*, which is the dollar amount of the funds requested by the household.

Panel B of Table 1 reports summary characteristics of the loans on the Lending Club platform. About 12 loans are issued per month within a three-digit zip code area while average monthly loan growth is 0.32%. The average borrower received a loan of approximately $14,767 at an interest rate of 13%. About 66% of the loans are for thirty-six months with the remaining 34% being for sixty months. The high funding percent, the amount of funds received by the borrower scaled by the amount of funds requested on the loan application, suggests that the potential for limited credit supply to dissuade households from using the peer-to-peer platform should be small.

The richness of the data also provides insights into borrowers' motives. Applicants indicate their reason for borrowing across fourteen loan purpose categories, such as car, debt consolidation, home improvement, vacation, or wedding. I consolidate the fourteen categories into three main motivations - Consumption, Debt Management, and House.[6] Overall,

[6]Applicants assign their loan to one of fourteen purposes: car, credit card, debt consolidation, education, home improvement, house, major purchase, medical expense, moving expense, other, renewable energy, small business, vacation, and wedding. I aggregate home improvement and house loans into the House category, credit card and debt consolidation loans into Debt Management, and car, major purchase, vacation, and wedding loans into the Consumption category. The three motivations contain over 93% of all loans issued on the platform.

applicants' reasons for borrowing are primarily related to debt management motives while house-related and consumption motives compose a smaller portion of the sample.

I supplement the credit data to account for other factors which may impact households' credit decisions and provide summary characteristics of the data in Panel C of Table 1. For instance, changes in other forms of wealth could also influence individuals' credit demands (Ortalo-Magne and Rady 2006). Given that housing wealth comprises approximately two-thirds of the median U.S. households' wealth (e.g., Tracy and Schneider (2001)), I include a control for changes in home values. Specifically, I measure changes in home values in borrowers' local zip code areas using the Single-Family Homes Zillow Home Values Index. I also account for the states' aggregate economic conditions using the Coincident Economic Activity Indices developed by the Federal Reserve Bank of Philadelphia, the amount of loans issued by commercial banks using data from the Federal Financial Institutions Examination Council, and the size of the civilian population using data from the U.S. Bureau of Labor Statistics. I provide detailed definitions of the variables in Appendix I.

4 Identification Strategy and Empirical Methodology

Empirically identifying causal impacts of changes in wealth on households' financial decisions is challenging due to endogeneity concerns. For instance, consumption, savings, and labor income choices are endogenously determined by the household. To overcome this challenge, I use an exogenous shock, the shale gas boom, as an external driver of households' wealth levels.

A recent technology shock to the natural gas industry creates an ideal setting to isolate the effects of a large, positive, and non-transitory wealth shock on households' financial decisions. The combination of hydraulic fracturing and horizontal drilling was unexpected to even industry experts and dramatically altered the state of U.S. energy reserves by

enabling shale gas regions to be profitably developed.[7] For instance, the Marcellus Shale region, which spans areas of upstate New York, Pennsylvania, West Virginia, and Ohio, is estimated to contain unproved recoverable reserves of nearly 141 Trillion Cubic Feet (Tcf) of natural gas (U.S. Energy Information Agency 2012). For context, the United States consumed approximately 27.47 Tcf of natural gas in 2015.

Significant gas production in the Marcellus region did not occur until late 2010 (Swindell 2016).[8] With the onset of drilling and production activities, residents in the region experienced a positive shock to their wealth. This manifested through several channels, including signing bonuses upon entering land lease agreements, royalty payments based on well production, and spillover effects, such as increased employment and higher wages, on both intra- and inter-industry bases (Fitzgerald and Rucker 2014).

The impact on households was significant. For instance, Brown, Fitzgerald, and Weber (2015) estimate that residents in the region received a total of $2.15 billion in royalty income in 2014. Tax return data show that Pennsylvania residents in areas with drilling activity reported an increase of 119% in rents and royalties income from 2006 to 2010 while counties without drilling activity report a 34% increase (Brown, Fitzgerald, and Weber 2015). Moreover, Gilje (2011) finds that deposits at banks in the region increased significantly. Feyrer, Mansur, and Sacerdote (2017) examine the economic benefits from shale activities and find that, at the county-level, each million dollars of new oil and gas production generates 0.78 new jobs, $61,000 in royalty payments, and wage increases of

[7] For instance, John Watson, the CEO of Chevron, characterized the industry as "taken by surprise" by the fracking innovation (Strassel 2011).

[8] Gas production in the Marcellus region remained below 50 Mcf per month until late 2010 (Swindell 2016).

$66,000 ($27,000 of which are wage spillovers to workers in other industries).[9] Overall, the shale boom represents a significant economic event for households residing in the region.[10]

4.1 Identification Strategy

I use fracking well activity in the Marcellus Shale regions of Ohio, Pennsylvania, and West Virginia to capture variation in local households' wealth levels. This is a useful setting for identifying wealth effects as the boom experienced by households in the shale region is exogenous to other underlying household characteristics, such as demographics, health, or education (Gilje 2011). To measure shale activities, I obtain data on all fracking well permits issued in Ohio from the Ohio Department of Natural Resources Division of Oil and Gas, in Pennsylvania from the Pennsylvania Department of Environmental Protection, and in West Virginia from the West Virginia Department of Environmental Protection.

The data contain information on the type of well, the date of the permit application, the date the permit was granted, and the latitude and longitude of the well location. I reverse geocode each well's latitude and longitude information to identify its corresponding zip code using Texas A&M Geoservices and Google Reverse Geocoding. To reduce noise related to test wells, I construct an indictor variable, *Shale Well Area*, which takes a value of one when the cumulative number of shale well permits issued within a three-digit zip

[9] Additional studies have found positive economic effects related to shale activities. For instance, Weber (2012) reports income increased by approximately $69 million over the gas boom years in shale counties in Colorado, Texas, and Wyoming. This translates to an annual employment increase of approximately 1.5% in natural gas boom counties. Jaenicke, Kelsey, and Wrenn (2015) find increases in employment to range between 1.53% and 3.86% in shale counties.

[10] The shale boom may have also spurred gains in illiquid wealth through increasing real estate values. However, Weber and Hitaj (2014) show that real estate values primarily increased in the Pennsylvanian Marcellus region prior to 2007. That is, the greatest appreciation did not occur during the drilling and production boom periods when royalty payments materialize (Weber and Hitaj 2015). Nevertheless, I include a measure of local home values in the regression analyses.

code area reaches twenty-five, and zero otherwise.[11]

4.2 Instrumental Variable Methodology

I instrument for well activity using the subterranean geological formation (Maniloff and Mastromonaco 2014; Shen, Cunningham, and Gerardi 2015; Feyrer, Mansur, and Sacerdote 2017). Specifically, I use the thickness of the underlying shale rock formation as an instrument for shale well activity in the borrower's local area. The thickness of the formation has the potential to serve as an instrument given that well activity is a function of the availability of the resource. Moreover, the rock formations developed during the Devonian era, approximately 380 million years ago, and should be not be correlated with current residents' financial preferences.

I construct the instrument, *Shale Rock Thickness*, using estimates of the thickness of the shale rock from Harper and Piotrowski (1979), Erenpreiss et al. (2011), and the West Virginia Geological and Economic Survey. Specifically, I estimate the thickness for each county based on isopach lines. Then, I aggregate the county-level estimates to the three-digit zip code level using population weights based on the U.S. Census Bureau's 2010 estimates of the number of residents who live in a specific county-zip code pair.

I present correlation statistics for the constructed thickness variable with measures of shale well activity and households' financial decisions in Table 2. Specifically, in Panel A, I find that *Shale Rock Thickness* is positively correlated with well activity. Further, the shale measures are negatively correlated with individuals' demands for credit in the peer-to-peer market. Overall, the correlation estimates suggest that the *Shale Rock Thickness* measure captures an important factor associated with degree of shale well activities in an area.

[11] A cutoff of twenty-five permits represents 1.44% of the mean number of permits issued within a three-digit zip code area. Similar effects are found when using other minimum permit cutoffs, such as 2, 5, and 10.

I use *Shale Rock Thickness* to generate predictions for the local area to have shale well activity by estimating:

$$\begin{aligned} Shale\ Well\ Area_{i,t} = \alpha_0 + \beta_1 Shale\ Rock\ Thickness_i \\ + \theta X_{i,t} + \psi_i + \rho_t + \epsilon_{i,t} \end{aligned} \tag{1}$$

where α_0 is a constant, β_1 is the prediction of the area having shale well activity, $X_{i,t}$ is a vector of controls, ψ_i are state fixed effects, and ρ_t are year fixed effects. The predicted values are then used to instrument *Shale Well Area* when empirically examining households' financial decisions:

$$y_{i,t} = \alpha_0 + \beta_1 Shale\ \widehat{Well}\ Area_{i,t} + \theta X_{i,t} + \psi_i + \rho_t + \epsilon_{i,t}. \tag{2}$$

5 Effects of Wealth on Households' Credit Decisions

In this section, I present the empirical findings related to households' use of the peer-to-peer credit market. For ease of presentation, I first report the effects of the wealth shock on households' aggregate credit demands. I then present findings related to households' underlying borrowing motives.

5.1 Aggregate Effects on the Peer-to-Peer Market

To set the stage, I present univariate estimates of how changes in wealth impact households' credit decisions in Figure 1. The figure characterizes the role of the positive wealth shock on households' demands for credit in the peer-to-peer market. First, Panel A focuses on extensive demand as measured by *Number of Loans*. The estimates indicate increasing wealth due to local shale activities reduces households' extensive credit demands. That is, in areas with shale well activity, approximately 8.81 new loans are created in an average

month. On the other hand, about 12.95 new loans are issued in an average month to households that reside in Ohio, Pennsylvania, or West Virginia but do not have shale wells in their local areas. The difference is both statistically significant (p-value = 0.008) and economically meaningful, representing a 34.63% reduction relative to the mean number of new loans issued on the platform in a month.

Second, Panel B of Figure 1 characterizes the effects of changes in wealth on intensive credit demand, as measured by *Amount of Loan*. The estimates indicate that increases in wealth also reduce the amount of funds that households borrow. That is, in areas with shale well activities, the average loan is approximately \$14,415 while, in areas without shale activities, the average loan is about \$14,843. The difference is both statistically significant (p-value = 0.025) and economically meaningful, representing a 2.90% reduction relative to the unconditional mean loan amount of \$14,767.

Overall, the univariate evidence suggests that the wealth shock has a first-order effect on households' credit decisions. The shock also has economically meaningful impact on the aggregate dynamics of the peer-to-peer market.[12] Next, I examine the effects in a multivariate regression framework to control for potential confounding factors.

Extensive Credit Demand: Number of Loans

Table 3 reports estimates of the effects of the wealth shock, as measured by *Shale Well Area*, on the number of loans. The estimates from univariate panel regressions (column 1) confirm that increases in households' wealth levels have first-order effects on their extensive borrowing decisions. The estimates in column (2) from multivariate regressions, which include controls that may influence households' credit decisions, indicate that the univariate estimates may be conservative. That is, the estimate for *Shale Well Area* increases in

[12]For instance, households in shale well areas received 8,390 loans with a total volume of about \$121 million while households living in areas of Ohio, Pennsylvania, and West Virginia without shale activity received 39,088 with a total loan volume of approximately \$580 million.

magnitude from -4.15 to -6.73 (p-value < 0.001) when including the controls. Further, including state and year fixed effects (column 3) does not significantly impact the estimate.

Turning to the instrumental variable regression estimates, the first-stage estimate for *Shale Rock Thickness* in column (4) indicates that the underlying thickness of the shale rock formation is a significant predictor of shale well activities in the local area. More over, a Kleibergen-Paap Wald F-statistic of 303 suggests that concerns related to weak instruments bias should be limited. Column (5) reports second-stage estimates of how changes in wealth impact households' demands for loans. The estimate of -7.11 (p-value < 0.001) for *Shale Well Area* indicates that increasing wealth causes households to reduce their demand for loans. This estimate corresponds to a reduction of 59.44% of the unconditional monthly average of new loans in the market.

Overall, the findings indicate that changes in households' wealth can significantly influence their use of credit in the peer-to-peer market. That is, the positive wealth shock causes households to reduce their demand for new consumer loans. Moreover, the effects are economically meaningful.

Intensive Credit Demand: Amount of Loan

Table 4 reports estimates of the effects of the wealth shock on the amount of funds requested by borrowers. The estimates from a univariate regression (column 1) confirm that increases in households' wealth levels have first-order effects on their intensive credit decisions. That is, the presence of local shale well activities causes a reduction in the amount of funds borrowed by about $429 on average. The estimates in column (2) from a multivariate regression indicate that the effects persist when controlling for other potential factors which can influence households' credit decisions. Further, including state and year fixed effects (column 3) does not impact the statistical significance of the estimate though the economic magnitude declines to approximately $256.

As in the extensive demand analysis, the estimate for *Shale Rock Thickness* from the first stage of an instrumental variable regression (column 4) indicates that the underlying thickness of the shale rock formation is a significant predictor of shale well activities. Moreover, a Kleibergen-Paap Wald F-statistic of 98.35 suggests that concerns related to weak instruments bias should be limited. Column (5) reports second-stage estimates of the effects of wealth on the amount of funds borrowed. The estimate of -323 (p-value = 0.007) for *Shale Well Area* indicates that the positive wealth innovation causes households to reduce their demand for funds by an average of $323. This corresponds to a 2.19% reduction relative to the mean loan amount.

I further examine the influence of the wealth shock by conducting a propensity score matching analysis. Specifically, I match individuals based on their income, FICO score, debt-to-income, revolving credit utilization, employment length, months of experience using credit, as well as the loan interest rate, term, purpose, verification status, and the date of the loan application. I find that individuals who experience the wealth shock, who are otherwise similar to matched individuals who do not experience the innovation, request about $219 ($p$-value = 0.018) less on average.

To sum up, the findings indicate that changes in households' wealth influence their demands for credit on the intensive margin. That is, conditional on applying for a loan in the peer-to-peer market, an increase in wealth reduces the amount of funds requested by the borrower. Overall, the evidence from both the extensive and intensive analyses suggests that large wealth shocks can significantly influence indivdiuals' credit decisions and aggregate to impact credit markets.

5.2 Effects According to Households' Borrowing Motives

I capitalize on the unique depth of the data and delve below the aggregate analysis to examine if the wealth shock has asymmetric effects driven by heterogeneity in households' underlying borrowing motives. I presents results according to three borrowing motives: (i) consumption, (ii) debt management, and (iii) house-related, in Table 5. Specifically, Panel A of Table 5 reports results from regressions over extensive credit demand while Panel B reports estimates from intensive demand regressions.

Extensive Demand: Number of Loans

First, the estimates in columns (1 - 3) of Table 5 suggest that positive wealth innovation causes households to reduce their use of the credit market if they are borrowing for consumption purposes. For instance, the estimate of -0.49 (p-value < 0.001) for *Shale Well Area* in column (3) indicates that monthly demand for loans to finance constrained consumption decline by 34.38% of the mean number of consumption loans.

Turning to debt management loans, the estimates in columns (4 - 6) show that increasing wealth substantially reduces households' use of the credit market to refinance other outstanding debt obligations. Specifically, the estimate of -6.09 (p-value < 0.001) in column (6) indicates that, relative to the monthly average number of new loans, households reduce demand for new loans to refinance debt by 63.39%.

The wealth shock also impacts individuals' use of credit to invest in housing (columns 7 - 9). Specifically, the estimate of -0.64 (p-value $= 0.008$) in column (9) shows that the innovation causes a decline in the number of new housing-related loans. Moreover, the estimate corresponds to a 31.98% reduction relative to the average monthly demand.

Overall, the findings indicate that increasing wealth causes households to reduce their use of the peer-to-peer market credit market. While loan demand declines across all borrow-

ing motives, debt management loans experience the largest decline in terms of economic magnitude. This suggests that households use a portion of the new funds to engage in savings behaviors, such as paying down outstanding debt liabilities.

Intensive Demand: Amount of Loan

Columns (1 - 3) in Table 6 report regression estimates of the effects of the wealth shock on the amount of funds requested by borrowers using the credit market to finance consumption. Interestingly, the estimates indicate that increasing wealth does not significantly influence households' intensive credit demands. That is, upon using the peer-to-peer market to obtain a loan to fund constrained consumption activities, the shock does not reduce the amount of funds that borrowers request.

On the other hand, wealth increases significantly affect households' intensive demands if they are using the market to manage their existing debt obligations. For instance, the estimate of -222 (p-value = 0.066) in column (6) indicates that the positive wealth innovation from local shale well activities causes, on average, a $222 reduction in the amount of funds borrowed to refinance existing debts. This is a 1.47% decline relative to the mean debt management loan amount. This evidence points towards individuals using a portion of the new wealth to manage their outstanding debt liabilities.

The wealth shock from shale well activities also leads individuals to reduce their intensive credit demands when using the peer-to-peer market to fund housing-related investments. That is, the estimate of -1,207 (p-value = 0.001) shows that households reduce the per-loan amount of funds borrowed by approximately $1,207 on average. This corresponds to a 9.15% decline relative to the average housing-related loan amount.

Collectively, the evidence in Table 5 shows that shocks to wealth influence households' use of credit across a range of borrowing motives, including borrowing to fund constrained consumption, to manage other outstanding debt obligations, and to invest in housing assets.

Moreover, the observed credit behaviors in the peer-to-peer market suggest that households allocate the new wealth to both consumption and savings, such as paying down existing debt obligations.

5.3 Loan Performance

Conditional upon taking out a loan on the peer-to-peer platform, households' abilities to repay the loan could be influenced by the wealth shock. For instance, the new funds could ease the burden of meeting the recurring loan installments. Therefore, I expect households who obtain credit on the platform and reside in areas with shale well activities to have higher loan repayment success.

To examine loan repayments, I construct two performance measures. First, *Loan Default*, takes a value of one if the loan has been charged off or defaulted upon, and zero otherwise. Second, *Paid Late Fee*, takes a value of one if the borrower paid a late fee during the life of the loan, and zero otherwise. Thus, the measures capture related but varying aspects of loan performance. Finally, I empirically test if the wealth shock influences individuals' loan repayments by estimating multivariate probit, instrumental variable probit, and two-stage least squares regressions.

I present the results in Table A1. Overall, the estimates indicate that individuals living in areas with shale well activities do not have higher repayment rates. That is, the wealth gains do not significantly affect the likelihood of default (Panel A) or the likelihood of a late payment (Panel B).

6 Effects of Wealth on Stock Market Participation

The micro-level evidence from the peer-to-peer credit market indicates that households actively manage their credit decisions in response to the non-transitory gain in wealth.

Moreover, the findings suggest that individuals save a portion of the new funds by paying down existing debt liabilities and investing in housing. In light of this, a natural follow-up question arises: do individuals utilize other savings channels in response to a large, positive, and non-transitory wealth shock? To provide insights, I extend the analysis and investigate households' stock market participation decisions.

I examine stock market participation because equity investing is an important channel through which households can accumulate wealth. At the same time, canonical models predict that all individuals should invest in equities (Samuelson 1969; Merton 1969; Merton 1971). Moreover, increases in wealth can offset participation costs and lead to greater participation among households (Vissing-Jorgensen 2002). Therefore, consistent with both the behavior observed in the peer-to-peer data and predictions from canonical models, I hypothesize that stock market participation will increase among households living in areas with shale well activities.

Data and Empirical Methodology

To empirically test the effects of the innovation in wealth on individuals' stock market participation decisions, I rely on aggregate data. While this is not the optimal setting, the shale gas boom represents a systemic shock to individuals in the region and the effects should manifest in aggregate data. To measure the rate of stock market participation, I obtain annual tax filings data from the Internal Revenue Service between 2010 and 2014 for all counties in Ohio, Pennsylvania, and West Virginia. I construct a measure, *Stock Market Participation*, which is the number of returns reporting dividend income scaled by the total number of returns filed within the county during the year.[13] In a given year, I

[13]This measure may understate participation if households in the region prefer to hold stocks that do not pay dividends. For insights into this, I examine the preference for dividends among households living in Ohio, Pennsylvania, and West Virginia using a large dataset of individual investor holdings (Odean 1998; Barber and Odean 2000; Barber and Odean 2001). I find that approximately 87% of households' common stock holdings paid at least one dividend.

find that about 20.51% of households invest in equities (Panel D of Table 1).

I supplement the tax data to control for other factors that influence households' participation decisions. Specifically, I use U.S. Census data to estimate key household demographics within the counties, including the percent of the population that is female and the proportion of the population that is thirty years of age and older. I also control for households' annual income, using tax filings data, and for county-level home values using data from Zillow. Social interactions between households also influence individuals' portfolio choices (Hong, Kubik, and Stein 2004; Brown, Ivković, Smith, and Weisbenner 2008). Therefore, I include a county-level measure of households' sociability developed by Rupasingha, Goetz, and Freshwater (2006) in the regressions. I provide detailed definitions of the variables in Appendix I.

As in the micro-level credit analysis, I use *Shale Well Area* to identify households which experience the wealth shock. I then instrument for *Shale Well Area* with *Shale Rock Thickness*. I present correlation statistics for the primary variables in Panel B of Table 2. Overall, the correlational evidence suggests that shale well activities have a positive effect on local households' stock market participation.

Empirical Findings

To set the stage, I present univariate estimates of the impact of shale well activities on stock market participation in Figure 2. The figure shows that the wealth shock spurs participation in the stock market. That is, the proportion of households investing in equities increases by approximately 1.48 percentage points (p-value = 0.001) in areas with shale well activities. This represents a 7.16% increase relative to the average unconditional participation rate of 20.51% during the sample period.

To further test the hypothesis, I conduct panel regressions and report estimates of the effects in Table 6. The coefficients for *Shale Well Area* remain significant when includ-

ing controls (column 2) and fixed effects (columns 3). Moving to instrumental variable regressions, the first-stage estimate for *Shale Rock Thickness* in column (4) indicates that the underlying thickness of the shale rock formation is a significant predictor of shale well activities in the local area. The second-stage estimate of 0.08 (p-value = 0.002) for *Shale Well Area* (column 5) indicates that the exogenous increase in wealth triggers households to invest in equities. That is, relative to the mean unconditional participation rate of 20.52%, the estimate represents a 36.57% increase in the proportion of households participating in the market.

Overall, the evidence indicates that the positive wealth shock from the shale gas boom sparks households to invest in the stock market. This savings behavior is consistent with the findings from the credit market analysis that showed the shock motivates debt management behavior. At the same time, the evidence is consistent with the stock market participation literature that finds increasing wealth impacts households' portfolio choices (Andersen and Nielsen 2011; Briggs, Cesarini, Lindqvist, and Östling 2015).

7 Robustness Checks

In this section, I present results from additional tests to examine the robustness of the main findings.

7.1 Effects of a Shale Well

The main analysis characterizes the effects of wealth shock based on aggregate shale well activities. However, given that each well may provide incremental benefits to local households, it is natural to ask: what is the effect of a new shale well? To provide insights, I construct a variable, *Number of Permits*, to capture the impact of each shale well. For the credit decision analysis, *Number of Permits* is the number of shale well permits issued

within the three-digit zip code area in the month. For the stock market participation analysis, *Number of Permits* is the number of shale well permits issued within the county during the year. I then re-perform the instrumental variable analyses using *Shale Rock Thickness* to instrument for *Number of Permits*.[14]

The estimates in columns (1) and (2) of Panel A of Table 7 show that a new shale well causes households to reduce their demand for credit on both the extensive and intensive margins. For instance, the estimate in column (2) for *Number of Permits* indicates that, relative to the average number of loans in a month, a new well causes a 5% reduction in the demand for new loans. A new shale well also reduces the average amount of funds borrowed by 0.23% of the mean. Moreover, the effects hold across all sub-samples of loans according to households' borrowing motives.

Turning to stock market participation, the estimate in column (9) indicates that a new shale well causes a 0.05 percentage point increase in the proportion of households reporting dividend income. This corresponds to a 0.24% increase relative to the average participation rate of 20.52%.

7.2 Prosper

Despite the households on Lending Club sharing similar characteristics with the typical U.S. household, concerns related to potential sample selection issues may persist. To examine if such issues influence the findings, I re-perform the analysis using a second dataset. Prosper is the second largest peer-to-peer consumer lending market in the U.S. and has been the focus of several studies examining households' financial decisions (e.g., Duarte, Siegel, and Young (2012) and Ravina (2012)). While the underlying structure of the Prosper platform differs from that of Lending Club, it provides a useful external dataset

[14]The instrumental variable regressions include the full vectors of controls used in the main analyses.

in which to re-examine the effects of the wealth shock on households' credit demands.[15]

I obtain all loans applied for on the Prosper platform between 2007 and year-end 2015. As in the main analysis, I focus on loan applications from individuals residing in Ohio, Pennsylvania, and West Virginia. This results in a sample of 7,217 loan applications during the period. I re-perform the analysis and report the results related to extensive and intensive credit demand in Panels A and B of Table 8, respectively.[16]

Overall, the wealth effects identified in the Prosper data are consistent with those found in the Lending Club data. That is, increasing wealth leads households to reduce their demands for credit along both the extensive and intensive margins. Moreover, the economic magnitudes are similar between the two datasets. For instance, the estimate for *Shale Well Area* in column (2) corresponds to a 61.76% reduction in loan applications, relative to a monthly mean of 4.45.

7.3 Shale Wells, Royalty Income, and Stock Market Participation

A potential concern could be that using the issuance of well permits to identify the wealth shock may not correspond with physical well activities. This is important as physical extraction activities impact households' income through recurring royalty payments.[17] To address this concern, I directly examine the relationships between shale well activity, households' royalty receipts, and stock market participation by focusing on Pennsylvania.

The Pennsylvania Department of Revenue provides tax information which includes data on households' royalty and dividend incomes. I rely on royalties to capture the wealth

[15]The design of the Prosper platform can potentially influence households' use of the market by introducing funding biases (e.g., Duarte, Siegel, and Young (2012) and Ravina (2012)).

[16]The Prosper data do not include the borrowers' FICO scores. Rather, an alternative risk score is provided for each household. I therefore include the risk score measure in place of the borrower's FICO score as a control in the regressions. Other controls are consistent with the main analysis.

[17]However, the issuance of well permits can also signal that local households received income from entering into land lease agreements.

shock as it is one of the primary channels through which shale well activities can affect local households. Given this, I first examine if royalty receipts reported on households' tax filings are influenced by the local shale well activity. I then test if royalty income influences the rate of stock market participation among households.

To implement the analysis, I obtain annual county-level household tax return data for the years 2007 through 2014. To capture changes in households' income, I use the natural log of the dollar amount reported in the Rents, Royalties, Patents and Copyrights section of the tax filings. To measure the degree of household stock market participation, I construct a variable, *Stock Market Participation*, as the number of tax filers that report dividend income as a proportion of the total number of tax filings in the county during the year. As in the main analysis, I use *Shale Well Area* to identify counties with shale well activity.

In my first empirical test, I examine if shale well activity influences households' royalty income. The estimate for *Shale Well Area* in Panel A of Table 9 indicates that shale well activities are positively correlated with households' income from royalties. Moreover, the effect is significant while controlling for home values, population, economic conditions, and county and year fixed effects.

Next, I test if royalty income influences households' stock market participation decisions. The estimates from multivariate panel regressions in Panel B (column 2) show that royalty income is positively correlated with stock market participation. Importantly, in the presence of royalty income, *Shale Well Area* does not significantly influence households' stock market participation decisions. To examine causal effects, I instrument for royalty income using *Shale Rock Thickness*. The second-stage estimates in column (3) show that increasing royalty income causes households to invest in the stock market.

Overall, the evidence in Table 10 suggests that shale well activity is a reasonable means of identifying areas which experienced the positive wealth shock when detailed tax infor-

mation is not available. Further, the effects of increasing royalty income on stock market participation are similar to those found in the main analysis.

8 Conclusion

Wealth is a primary determinant of households' consumption and savings choices. Therefore, clear evidence of how individuals react to changes in their wealth is essential for understanding their financial decisions and, ultimately, for the effective design of financial products and policies.

This paper uses a natural experiment, the shale gas boom, to study how a large, positive, and non-transitory shock to households' wealth affects their financial decisions. First, using the largest peer-to-peer credit market, I find households respond to the shock by reducing their demands for credit. The reduction manifests along both the extensive and intensive margins. That is, individuals demand fewer loans and, conditional on applying for a loan, request less funds. Specifically, the positive wealth shock causes the demand for new loans to decline by about 59% while the amount of funds requested falls by about 2%, relative to their respective means. The evidence also suggests that households use funds from the shock to deleverage by paying down other debt. Second, I examine if households' stock market participation decisions are impacted. I find that the wealth shock boom sparked an eight percentage point increase in the proportion of households which invest.

This study contributes to several literatures. How households use financial products and markets to attain their objectives are fundamental questions in the household finance literature (Campbell 2006). I shed light on households' use of a new peer-to-peer credit market in response to changes in their wealth levels. The findings also speak to the literature examining individuals' consumption and savings decisions in response to changes in their wealth (Jappelli and Pistaferri 2010; Carroll 1997; Carroll 2009).

More broadly, the paper contributes to the growing literatures examining credit markets (e.g., Tufano (2009) and Zinman (2014)) and the role of technology (e.g., Einav, Jenkins, and Levin (2013), Morse (2015), and Duarte, Siegel, and Young (2012)) in the U.S. financial system. At the same time, the evidence in this paper supports the findings from other studies which indicate that geographically-concentrated economic shocks can aggregate to impact financial markets (Bernile, Delikouras, Korniotis, and Kumar 2015). Finally, the findings have important implications for financial technology innovators and policy makers. For instance, the magnitude with which households reduce their use of the peer-to-peer market in response to an exogenous wealth shock suggests that further studies into the stability of emerging online financial markets are warranted.

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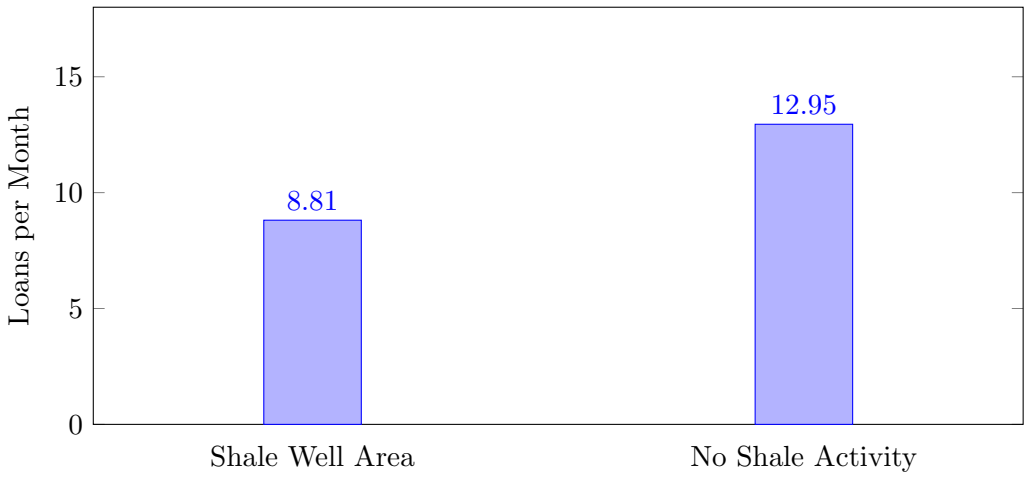
Figure 1: Effects of the Wealth Shock on Households' Credit Demands

The figure presents univariate estimates of the effects of the wealth shock on households' financial decisions. Panel A reports the effects on households' extensive credit demands. Specifically, the bars report the effects on *Number of Loans*, the monthly average number of new loans, at the three-digit zip code level, on the peer-to-peer platform, for areas with shale well activity and areas without shale activities. Panel B presents the effects on households' intensive credit demands. Specifically, the bars report the effects on *Amount of Loan*, the average dollar amount of funds requested by borrowers on the peer-to-peer platform, for areas with shale well activity and areas without shale activities.

(a) Extensive Credit Demand



(b) Intensive Credit Demand

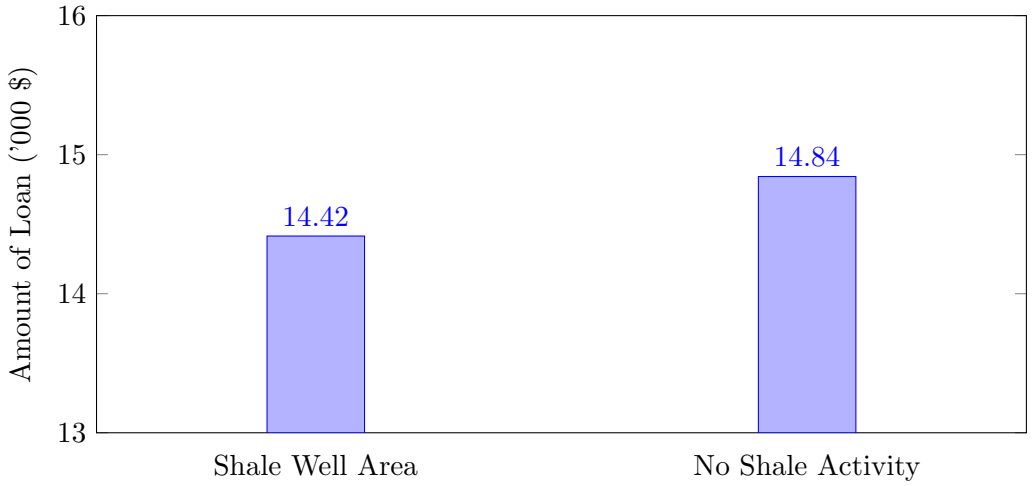


Figure 2: Effects of the Wealth Shock on Stock Market Participation

The figure presents univariate estimates of the effects of the wealth shock on households' stock market participation decisions. Specifically, the bars report the effects on *Stock Market Participation*, the number of tax filers reporting income from dividends as a proportion of the total number of tax filers within a county, for areas with shale well activity and areas without shale activities.

(a) Stock Market Participation

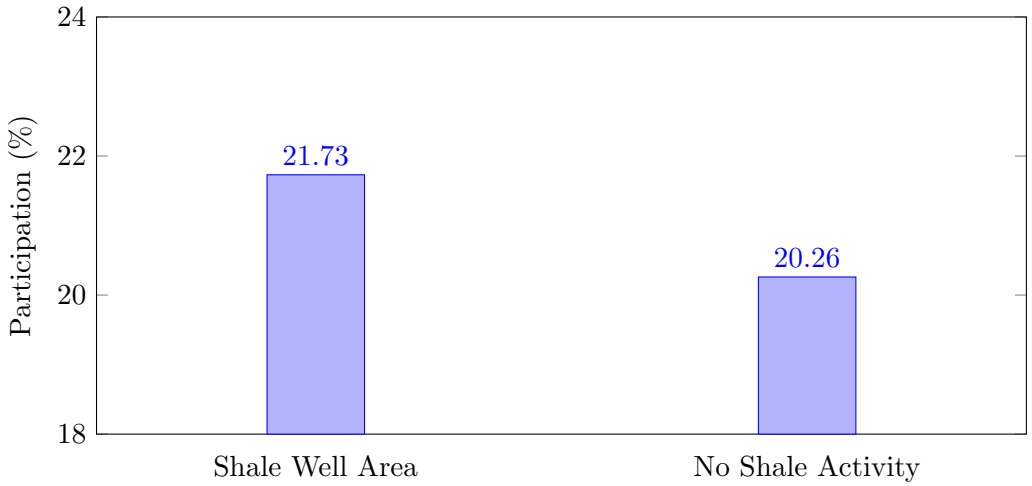


Table 1: Descriptive Statistics

The table presents mean statistics and standard deviations, in parentheses, for the primary data used in the study. Panel A reports summary statistics of Lending Club borrower's attributes and individuals in the 2007, 2009, 2011, and 2013 waves of the PSID. Panel B reports statistics related to the Lending Club loans. Panel C presents descriptive statistics of the economic conditions in the shale region. Panel D reports statistics for the stock market participation sample. Definitions for all variables used in the analysis are included in Appendix I.

Panel A: Borrower Statistics				
	LC Borrowers		PSID	
Annual Income ($)	69,626	(43,384)	63,426	(115,801)
Employment Length (yrs.)	6.25	(3.64)	11.38	(9.34)
Debt-to-income (%)	19.32	(8.12)	27.15	(277.80)
FICO	697	(30.70)		
Revolving Credit Utilization (%)	55.17	(23.39)		
Months of Credit	200	(88.48)		
Panel B: Loan Statistics				
Loans per Month	11.97	(18.94)		
Monthly Loan Growth (%)	0.32	(1.16)		
Interest Rate (%)	13.16	(4.32)		
Loan Amount ($)	14,767	(8,244)		
Funding Percent (%)	99.94	(1.42)		
Loan Term (60 months) (%)	34.02			
Verification Status (%)	68.75			
Loan Purpose (%)				
Consumption	4.04			
Debt Mgt.	88.28			
House	7.68			
Panel C: Economic Statistics				
Number of Well Permits	1,729	(1,624)		
House Prices ($)	126,233	(74,300)		
Economic Conditions	149.92	(8.75)		
Bank Loans ($Mil.)	500	(501)		
Population (Mil.)	5.91	(1.12)		
No. of Loans	47,478			

Table 1: Descriptive Statistics – *Cont'd*

Panel D: Stock Market Participation Sample		
Stock Market Participation (%)	20.51	(4.82)
Annual Income	51,579	(11,362)
Over 30	67.94	(2.99)
Female	50.77	(1.13)
House Prices	122,492	(47,556)
Number of Tax Filings	117,953	(145,028)

Table 2: Correlation Estimates

The table presents Pearson correlation statistics for the primary variables used in the analyses. Panel A reports estimates for the household credit analysis using the sample of peer-to-peer loans. Panel B reports estimates for the stock market participation sample. Significance at the 10%, 5%, and 1% levels are denoted with *, **, and ***, respectively.

Panel A: Credit Data Sample					
	Shale Rock Thickness	Shale Well Area	Total Well Permits	Number of Loans	Amount of Loan
Shale Rock Thickness	1.000				
Shale Well Area	0.719***	1.000			
Total Well Permits	0.525***	0.509***	1.000		
Number of Loans	-0.152***	-0.101***	-0.084***	1.000	
Amount of Loan	-0.026***	-0.031***	-0.014***	0.063***	1.000
Panel B: Stock Market Participation Sample					
	Shale Rock Thickness	Shale Well Area	Total Well Permits	Stock Market Participation	
Shale Rock Thickness	1.000				
Shale Well Area	0.507***	1.000			
Total Well Permits	0.313***	0.569***	1.000		
Stock Market Participation	0.100**	0.120**	0.109**	1.000	

Table 3: Effects of the Wealth Shock on the Number of Loans

The table presents estimates of the effects of the wealth shock on households' extensive credit demands. The main dependent variable in the regressions is *Number of Loans*, the number of loan applications within a three-digit zip code area in a month. Column (1) reports results from a univariate OLS regression while column (2) reports results from the baseline OLS regression. Column (3) shows estimates of the baseline regression including state and year fixed effects. Column (4) reports results from the first stage of the instrumental variable regression and column (5) reports estimates from the second stage regression. Standard errors have been clustered at the three-digit zip code-year-level. Standard errors are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: Number of Loans					
	(1)	(2)	(3)	(4) First Stage	(5) Second Stage
Shale Well Area	-4.1452***	-6.7343***	-6.6414***		-7.1147***
	(1.5537)	(1.4123)	(1.4099)		(1.7021)
Shale Rock Thickness				0.0043***	
				(0.0002)	
Δ House Prices		0.0032***	0.0029***	0.0000	0.0029***
		(0.0009)	(0.0010)	(0.0000)	(0.0010)
Economic Conditions		1.3712***	1.2051***	0.0042	1.2064***
		(0.1412)	(0.2337)	(0.0039)	(0.2327)
Ln(Bank Loans)		7.8392***	-2.7803*	-0.1650**	-2.8762*
		(0.9903)	(1.6389)	(0.0719)	(1.6105)
Ln(Population)		22.3325***	1.9488	-0.7056	2.4515
		(2.4754)	(49.4995)	(1.2621)	(49.8198)
Average Income		0.0001***	0.00005***	-5.59e-07**	0.00005***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Average FICO		-0.0330***	-0.0149*	-0.0001	-0.0147*
		(0.0106)	(0.0080)	(0.0003)	(0.0080)
Average Debt-to-Income		-0.1571***	-0.1886***	0.0018	-0.1865***
		(0.0451)	(0.0422)	(0.0011)	(0.0417)
Average Funding Percent		0.5262	1.8356	0.0186	1.7301
		(6.1408)	(2.0619)	(0.1146)	(2.1130)
Average Interest Rate		-0.7042***	-0.1753**	0.0005	-0.1735**
		(0.1752)	(0.0851)	(0.0031)	(0.0858)
Average Months of Credit		-0.0021	-0.0012	0.0002**	-0.0009
		(0.0036)	(0.0029)	(0.0001)	(0.0028)
State FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
First Stage F-stat.				303.09	
N	4,274	4,274	4,274	4,274	4,274
R-sq.	0.009	0.384	0.434	0.564	0.080

Table 4: Effects of the Wealth Shock on the Amount of Funds Borrowed

The table presents estimates of the effects of the wealth shock on households' intensive credit demands. The main dependent variable in the regressions is *Amount of Loan ($)*, the amount of money requested by the borrower. Column (1) reports results from a univariate OLS regression while column (2) reports results from the baseline OLS regression. Column (3) shows estimates of the baseline regression including state and year fixed effects. Column (4) reports results from the first stage of the instrumental variable regression and column (5) reports estimates from the second stage regression. Standard errors have been clustered at the three-digit zip code-year level and are presented in parentheses. Significance at the 10%, 5%, and 1% level are denoted by *, **, and ***, respectively.

Dependent Variable: Amount of Loan ($)					
	(1)	(2)	(3)	(4) First Stage	(5) Second Stage
Shale Well Area	-428.704**	-315.820***	-256.111***		-323.440***
	(167.810)	(106.910)	(86.370)		(120.406)
Shale Rock Thickness				0.0047***	
				(0.0005)	
Δ House Prices		0.1180*	-0.0571	-0.00001	-0.0618
		(0.0637)	(0.0479)	(0.00002)	(0.0485)
Economic Conditions		40.4263***	-16.1517	0.0015	-16.1074
		(4.8146)	(19.3389)	(0.0027)	(19.3044)
Annual Income		0.0751***	0.0745***	-1.97e-7***	0.0745***
		(0.0027)	(0.0026)	(0.0000)	(0.0026)
FICO Score		46.6066***	49.7346***	-0.0001	49.7278***
		(1.3457)	(1.3941)	(0.0001)	(1.3930)
Debt-to-Income		49.5702***	41.0102***	0.0011***	41.1713***
		(4.8650)	(4.9347)	(0.0003)	(4.9253)
Revolving Credit Util.		36.3622***	37.5595***	-0.00004	37.5372***
		(1.5807)	(1.5928)	(0.0001)	(1.5926)
Employment Length		-64.3012***	-64.1772***	-0.00001	-64.1364***
		(8.7618)	(8.7769)	(0.0004)	(8.7639)
Months of Credit		5.4038***	5.0330***	0.00004*	5.0414***
		(0.4306)	(0.4299)	(0.0000)	(0.4300)
Interest Rate		144.877***	152.812***	0.0002	152.809***
		(12.426)	(12.753)	(0.0004)	(12.739)
Loan Term		5502.567***	5469.290***	0.0027	5470.109***
		(86.374)	(84.265)	(0.0033)	(84.211)
Verification Status		1635.787***	1651.530***	-0.0028*	1651.185***
		(48.796)	(48.510)	(0.0017)	(48.431)
Loan Purpose		-1471.715***	-1424.190***	0.0025	-1423.606***
		(58.380)	(57.490)	(0.0022)	(57.447)
State FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
First Stage F-stat.				98.35	
N	47,478	47,478	47,478	47,478	47,478
R-sq.	0.000	0.433	0.437	0.510	0.429

Table 5: Effects of the Wealth Shock by Borrowing Motive

The table presents estimates of the effects of the wealth shock on households' credit demands according to borrowing motives: consumption, debt management, and house-related. Panel A reports estimates for the effects on extensive demand. The main dependent variable in the regressions is Δ *Number of Loans*, the change in the number of loans from the prior month within a three-digit zip code area. Panel B presents estimates of the effects on intensive demand. The main dependent variable in the regressions is *Amount of Loan ($)*, the amount of money requested by the borrower. Columns (1), (4), and (7) report results from the baseline multivariate regressions. Columns (2), (5), and (8) report estimates from the first stage of the instrumental variables regressions while columns (3), (6), and (9) report estimates from the second stage. Standard errors are presented in parentheses and have been clustered at the three-digit zip code-year level. Significance at the 10%, 5%, and 1% level are denoted by *, **, and ***, respectively.

Panel A: Extensive Demand									
Dependent Variable: Δ Number of Loans									
	Consumption			Debt Mgt.			House		
	(1)	(2) First Stage	(3) Second Stage	(4)	(5) First Stage	(6) Second Stage	(7)	(8) First Stage	(9) Second Stage
Shale Well Area	-0.3786***		-0.4873***	-5.7045***		-6.0881***	-0.7612***		-0.6422***
	(0.0729)		(0.0977)	(1.2498)		(1.5128)	(0.1975)		(0.2431)
Shale Rock Thickness		0.0046***			0.0043***			0.0046***	
		(0.0004)			(0.0003)			(0.0004)	
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
First Stage F-stat.		146.40			261.48			141.16	
N	1,326	1,326	1,326	3,830	3,830	3,830	1,733	1,733	1,733
R-sq.	0.130	0.522	0.041	0.424	0.568	0.084	0.240	0.548	0.065
Panel B: Intensive Demand									
Dependent Variable: Amount of Loan ($)									
	Consumption			Debt Mgt.			House		
	(1)	(2) First Stage	(3) Second Stage	(4)	(5) First Stage	(6) Second Stage	(7)	(8) First Stage	(9) Second Stage
Shale Well Area	-304.258		-616.420	-188.964**		-222.077*	-491.488*		-1206.973***
	(409.3015)		(549.3648)	(86.2855)		(120.9452)	(257.3777)		(371.4958)
Shale Rock Thickness		0.0049***			0.0047***			0.0046***	
		(0.0004)			(0.0005)			(0.0005)	
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
First Stage F-stat.		131.51			96.71			91.25	
N	1,918	1,918	1,918	41,913	41,913	41,913	3,647	3,647	3,647
R-sq.	0.377	0.510	0.354	0.441	0.510	0.437	0.417	0.507	0.409

Table 6: Effects of the Wealth Shock on Stock Market Participation

The table presents estimates of the effects of the wealth shock on stock market participation. The main dependent variable in the regressions is *Stock Market Participation*, the number of tax filers reporting dividend income as a proportion of the total number of tax filers within the county. Column (1) reports results from a univariate OLS regression while column (2) reports results from the baseline OLS regression. Column (3) shows estimates from the baseline regression including state and year fixed effects. Column (4) reports results from the first stage of the instrumental variable regression and column (5) reports estimates from the second stage regression. Standard errors have been clustered at the county-year level. Standard errors are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: Stock Market Participation					
	(1)	(2)	(3)	(4) First Stage	(5) Second Stage
Shale Well Area	0.0148***	0.0221***	0.0056*		0.0768***
	(0.0044)	(0.0035)	(0.0033)		(0.0254)
Shale Rock Thickness				0.0012***	
				(0.0003)	
Income		0.0034***	0.0034***	0.0012	0.0035***
		(0.0002)	(0.0002)	(0.0013)	(0.0002)
Over 30		0.0010	0.0004	0.0075	0.0001
		(0.0006)	(0.0005)	(0.0070)	(0.0007)
Female		-0.0007	-0.0001	0.0230	-0.0023
		(0.0018)	(0.0014)	(0.0162)	(0.0021)
Social Index		0.0178***	0.0246***	0.1308***	0.0210***
		(0.0037)	(0.0034)	(0.0432)	(0.0051)
Ln(Population)		0.0030	-0.0002	-0.0455**	0.0049
		(0.0023)	(0.0021)	(0.0209)	(0.0031)
Δ House Prices		-9.51e-07***	-2.23E-07	0.00001***	-1.24e-06**
		(2.51e-07)	(2.29e-0)	(3.00e-06)	(5.22e-07)
Economic Conditions		-0.0004**	0.0043***	-0.0094	0.0007
		(0.0002)	(0.0012)	(0.0120)	(0.0013)
State FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
First Stage F-stat.				15.93	
N	410	410	410	410	410
R-sq.	0.013	0.693	0.772	0.365	0.467

Table 7: Effects of a New Shale Well on Households' Financial Decisions

The table presents estimates from the second-stages of instrumental variable regressions of the effects of a new shale well on households' credit demands and stock market participation. Panel A reports estimates related to the peer-to-peer credit data. The dependent variable in specifications (1), (3), (5), and (7) is the *Number of Loans* measure. The dependent variable in specifications (2), (4), (6), and (8) is the *Amount of Loans* measure. The main explanatory variable is *Number of Permits*, the number of shale well permits issued within the three-digit zip code area in the month. Panel B (column 9) reports estimates related to stock market participation. The dependent variable is the *Stock Market Participation* measure. The main explanatory measure is *Number of Permits*, the number of shale well permits issued within the county during the year. All regressions contain the full vector of controls used in the main analyses. Standard errors have been clustered at the three-digit zip code-year-level for the peer-to-peer credit data analysis and at the county-year for the stock market participation analysis. Standard errors are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A: Credit Data								Panel B: Stock Market Part.
	Full Sample of Loans		Consumption Loans		Debt Mgt. Loans		House Loans		
	(1) N. of Loans	(2) Amt. of Loan	(3) N. of Loans	(4) Amt. of Loan	(5) N. of Loans	(6) Amt. of Loan	(7) N. of Loans	(8) Amt. of Loan	(9)
No. of Permits	-0.6541***	-34.4968***	-0.0508***	-64.8021	-0.5711***	-23.6443*	-0.0615**	-132.0115***	0.0005***
	(0.1827)	(12.9365)	(0.0148)	(57.4846)	(0.1648)	(12.5650)	(0.0252)	(51.1924)	(0.0002)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
First Stage F-stat.	47.38	16.97	21.42	21.81	44.33	16.51	26.06	16.37	9.91
N	4,274	47,478	1,326	1,918	3,830	41,913	1,733	3,647	410
R-sq.	-0.003	0.429	-0.100	0.354	-0.001	0.436	0.024	0.407	0.179

Table 8: Effects of the Wealth Shock on Households' Credit Demands: Prosper Data

The table presents estimates of the effects of the wealth shock on households' credit demands on the Prosper platform. Panel A reports estimates of the effects for households' extensive credit demand. Specifically, the main dependent variable in the regressions is *Number of Loans*, the number of loan applications within a three-digit zip code area in a month. Column (1) reports estimates from OLS regressions while column (2) reports estimates from the second-stage of instrumental variable regressions. Panel B presents estimates along the intensive margin. That is, the main dependent variable in the regressions is *Amount of Loan ($)*, the amount of money requested by the borrower. Column (3) reports estimates from OLS regressions while column (4) reports estimates from the second stage of instrumental variable regressions. Standard errors have been clustered at the three-digit zip code-year level and are presented in parentheses. Significance at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	Panel A:		Panel B:	
	Dependent Variable: Number of Loans		Dependent Variable: Amount of Loan ($)	
	(1) OLS	(2) Second-stage IV	(3) OLS	(4) Second-stage IV
Shale Well Area	-2.1512***	-2.7488***	-665.98**	-677.24**
	(0.4813)	(-0.7099)	(257.47)	(302.93)
Controls	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
First Stage F-stat.		169.27		88.54
N	1,616	1,616	7,217	7,217
R-sq.	0.238	0.076	0.322	0.238

Table 9: Shale Wells, Royalty Income, and Stock Market Participation

This table reports the effects of shale well activity on the amount of royalties received by households and stock market participation in Pennsylvania from 2007 through 2014. Panel A (column 1) presents the effects of shale well activities on households' royalty income. The dependent variable is the natural log of *Royalty Income*, the county-level dollar amount reported in the Rents, Royalties, Patents and Copyrights section on households' tax filings. The multivariate panel regressions include controls for Δ*House Prices*, population, and economic conditions as well as county and year fixed effects. Panel B reports the effects of royalty income on households' stock market participation. The dependent variable is *Stock Market Participation*, the number of tax filers that report dividend income as a proportion of the total number of tax filings in the county during the year. The regressions include controls for Δ*House Prices*, population, and economic conditions, the percent of individuals over thirty years old, the percent of individuals who are female, as well as county and year fixed effects. Column (2) reports estimates from panel regressions. Column (3) reports estimates from the second stage of an instrumental variable regression where Ln(*Royalty Income*) is instrumented for with *Shale Rock Thickness*. Standard errors have been clustered at the county-year level and are presented in parentheses. Significance at the 10%, 5%, and 1% level are denoted by *, **, and ***, respectively.

	Panel A	Panel B	
	Dependent Variable: Ln(Royalty Income)	Dependent Variable: Stock Market Part.	
	(1)	(2)	(3) Second-stage
Shale Well Area	0.3812***	-0.0016	
	(0.0933)	(0.0013)	
Ln(Royalty Income)		0.0022**	0.0696***
		(0.0011)	(0.0145)
Controls	Y	Y	Y
County FE	Y	Y	N
Year FE	Y	Y	Y
First-stage F-stat.			18.71
N	309		309
R-sq.	0.962		0.461

Appendix I

This table describes the variables used in the analysis. Specifically, column (1) reports the variable name while column (2) provides its definition and information on the construction of the variable.

Variable	Definition
Annual Income	The self-reported annual income provided by the borrower during registration on the Lending Club platform. For the extensive margin analysis, annual income is the monthly average across all borrowers in the three-digit zip code area.
Bank Loans	The total amount of loans and leases provided by commercial banks. The data are the Quarterly Weighted Average Total of Loans and Leases, Net of Unearned Income for Commercial Banks from the Federal Financial Institutions Examination Council.
Debt-to-Income	The ratio of the borrower's total monthly debt payments, excluding mortgage debt and the requested LC loan, divided by the borrower's monthly income. For the extensive credit demand analysis, debt-to-income is the monthly average debt-to-income across all borrowers in the three-digit zip code area. For the PSID summary statistic, debt is the reported total debt amount of the family in the year of the survey.
Economic Conditions	This variable captures the overall economic conditions based on the Coincident Economic Activity Index developed by the Federal Reserve Bank of Philadelphia.
Employment Length	A variable which reports the number of years the borrower has been at his (her) current employer.
FICO	The midpoint of the four point range of the borrower's FICO score at loan origination. For the extensive margin analysis, FICO is the monthly average FICO across all borrowers in the three-digit zip code area.
Female	The percent of the county-level population that is female based on U.S. Census data.
Funding Percent	The amount of funds received by the borrower scaled by the amount of funds requested on the loan application. For the extensive margin analysis, funding percent is the monthly average funding percent across all loans in the three-digit zip code area.
House Prices	This variable captures home values using the Single-Family Homes Zillow Home Values Index. For the credit market analysis, zip code-level values are aggregated to the three-digit zip code-level using population weights from U.S. Census data. For the stock market participation analysis, county-level values are used.

Variable Definitions – *Cont'd*

Variable	Definition
Interest Rate	The interest rate on the borrower's loan. For the extensive margin analysis, interest rate is the monthly average rate across all loans in the three-digit zip code area.
Population	Estimates of the monthly labor force population in the borrower's state of residence from the U.S. Bureau of Labor Statistics. Population estimates for stock market participation analysis are based on the number of tax filings at the county-level.
Loan Purpose	A categorical variable denoting the borrower's reason for requesting a loan. Specifically, consumption loans are composed of car, vacation, wedding, and major purchase loans. Debt management loans consist of credit card and debt consolidation loans. House loans consist of home improvement and house loans.
Loan Term	This variable reports the repayment length of the loan. It takes a value of one if the repayment term is thirty-six months and a value of two if the repayment term is sixty months.
Months of Credit	The total number of months since the borrower opened his (her) first credit line. For the extensive margin analysis, months of credit is the monthly average number of months of credit across all borrowers in the three-digit zip code area.
Number of Permits	For the peer-to-peer credit market analysis, the measure is the number of shale well permits issued in the three-digit zip code area in a month. For the stock market participation analysis, the measure is the number of shale well permits issued within the county during the year.
Over 30	The percent of the population aged thirty or over, at the county-level, based on U.S. Census data.
Paid Late Fee	Indicator variable which takes a value of one if the borrower paid a late fee during the life of the loan. Lending Club assess late fees if the borrower is late on a scheduled loan repayment.
Revolving Credit Utilization	The amount of credit the borrower is using relative to all available revolving credit.
Royalty Income	The county-level dollar amount, in thousands, reported in the Rents, Royalties, Patents and Copyrights section on households' tax filings.

Variable Definitions – *Cont'd*

Variable	Definition
Shale Thickness	County-level estimates of the underlying thickness of the shale rock formation based on estimates from Harper and Piotrowski (1979), Erenpreiss, Wickstrom, Perry, Martin, et al. (2011), and the West Virginia Geological and Economic Survey. For the credit market analysis the estimates are aggregated to the three-digit zip code level based on the 2010 U.S. Census Bureau population estimates.
Shale Well Area	Indicator variable which takes a value of one when the three-digit zip code area has at least twenty-five cumulative shale well permits. Well permit data were obtained from the Ohio Department of Natural Resources Oil and Gas Resources, the Pennsylvania Department of Environmental Protection, and the West Virginia Department of Environmental Protection Office of Oil and Gas.
Sociability Index	A county-level measure of households' sociability developed by Rupasingha et al. (2006).
Stock Market Participation	The number of tax filers that report dividend income as a proportion of the total number of tax filings. The data are based on IRS tax filings data from 2010 through 2014 at the county level for Ohio, Pennsylvania, and West Virginia.
Verification Status	Indicator variable which takes a value of one if the borrower's income or income source was verified by Lending Club, and zero otherwise.

Appendix II

Table A1: Effects of the Wealth Shock on Loan Performance

The table presents estimates of the effects of the wealth shock on loan repayment. In Panel A, the main dependent variable in the regressions is *Loan Default* which takes a value of one if the loan has been charged off or defaulted upon, and zero otherwise. In Panel B, the main dependent variable is *Paid Late Fee* which takes a value of one if the borrower paid a fee due to having a late payment, and zero otherwise. Column (1) reports results from the baseline probit regression. Column (2) reports results from the first stage of the instrumental variable probit regression and column (3) reports estimates from the second stage of the IV probit regression. Columns (4) and (5) report estimates from 2SLS IV regressions which include state and year fixed effects. The regressions include all controls used in the intensive credit demand analysis (Table 4) plus an additional control for the amount of the loan. Standard errors have been clustered at the three-digit zip code-year level and are presented in parentheses. Significance at the 10%, 5%, and 1% level are denoted by *, **, and ***, respectively.

Panel A: Dependent Variable: Loan Default					
	(1)	(2) First Stage	(3) Second Stage	(4) First Stage	(5) Second Stage
Shale Well Area	0.0933		0.0871		-0.0005
	(0.0677)		(0.0617)		(0.0035)
Shale Rock Thickness		0.0048***		0.0047***	
		(0.0005)		(0.0005)	
Method	Probit	IV Probit	IV Probit	2SLS	2SLS
Controls	Y	Y	Y	Y	Y
State FE	N	N	N	Y	Y
Year FE	N	N	N	Y	Y
First Stage F-stat.				98.32	
N	47,478	47,478	47,478	47,478	47,478
R-sq.	0.136			0.510	0.022
Panel B: Dependent Variable: Paid Late Fee					
	(1)	(2) First Stage	(3) Second Stage	(4) First Stage	(5) Second Stage
Shale Well Area	-0.0911		-0.0868		-0.0038
	(0.0627)		(0.0721)		(0.0020)
Shale Rock Thickness		0.0048***		0.0047***	
		(0.0005)		(0.0005)	
Method	Probit	IV Probit	IV Probit	2SLS	2SLS
Controls	Y	Y	Y	Y	Y
State FE	N	N	N	Y	Y
Year FE	N	N	N	Y	Y
First Stage F-stat.				98.32	
N	47,478	47,478	47,478	47,478	47,478
R-sq.	0.057			0.510	0.003