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WHAT EXPLAINS HIGH UNEMPLOYMENT? THE AGGREGATE DEMAND CHANNEL

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ABSTRACT

A drop in aggregate demand driven by shocks to household balance sheets is responsible for a large fraction of the decline in U.S. employment from 2007 to 2009. The aggregate demand channel for unemployment predicts that employment losses in the non-tradable sector are higher in high leverage U.S. counties that were most severely impacted by the balance sheet shock, while losses in the tradable sector are distributed uniformly across all counties. We find exactly this pattern from 2007 to 2009. Alternative hypotheses for job losses based on uncertainty shocks or structural unemployment related to construction do not explain our results. Using the relation between non-tradable sector job losses and demand shocks and assuming Cobb-Douglas preferences over tradable and non-tradable goods, we quantify the effect of aggregate demand channel on total employment. Our estimates suggest that the decline in aggregate demand driven by household balance sheet shocks accounts for almost 4 million of the lost jobs from 2007 to 2009, or 65% of the lost jobs in our data.

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A sustained high level of unemployment is one of the biggest and most vexing problems in macroeconomics. The issue is especially relevant today: the employment to population ratio dropped from 63% in 2007 to 58% in 2009 where it remains as of the summer of 2011. The problem has been difficult to address in part because there is a lack of consensus on the reasons for unemployment. There are many hypotheses put forth to explain job losses including a decline in aggregate demand, business uncertainty, and structural adjustment of the labor force.

Our analysis is motivated by recent research showing that shocks to household balance sheets are responsible for a sharp and persistent decline in aggregate demand (e.g., Mian and Sufi (2010), Mian, Rao, and Sufi (2011), Eggertsson and Krugman (2011), Guerrieri and Lorenzoni (2011), Hall (2011), Midrigan and Philippon (2011)). In particular, Mian and Sufi (2010) and Mian, Rao, and Sufi (2011) exploit geographical variation across U.S. counties in the degree of household leverage as of 2006, and demonstrate that shocks to household balance sheets are responsible for a large fraction of the decline in consumption from 2006 to 2010.

Can the decline in demand associated with household balance sheet shocks explain the sharp reduction in employment in the U.S. from 2007 to 2009? We show that the answer to this question is a resounding yes. We refer to this channel as the *aggregate demand channel* for unemployment and our analysis demonstrates that it explains a substantial fraction of jobs lost from 2007 to 2009.

Our test of the aggregate demand hypothesis is based on one of its main implications: a negative consumer demand shock in a given location should reduce employment in industries producing non-tradable goods in that specific location, but should reduce employment in industries producing tradable goods throughout the country. For example, when Californians cut back on consumption significantly more than Texans, the non-tradable sector in California loses

more jobs than the non-tradable sector in Texas. However, because Californians buy tradable goods produced throughout the country, job losses in the tradable sector will be distributed evenly across all counties, including those in Texas.

The starting point of our empirical approach is based on Mian, Rao and Sufi (2011), who show that negative consumer demand shocks were strongest in counties with high household leverage. We utilize *industry-by-county* data on employment broken down by *non-tradable* and *tradable* industries. Industries are classified as non-tradable if they are focused in the retail or restaurant business. In order to remove any direct effect of the residential housing boom and bust, we explicitly remove construction or any other real-estate related sector from the non-tradable definition.

Consistent with the aggregate demand channel, job losses in the non-tradable sector from 2007 to 2009 were significantly higher in high leverage counties that experienced sharp demand declines. In particular, a one standard deviation increase in the 2006 debt to income ratio of a county is associated with a 3 percentage point drop in non-tradable employment during this time period, which is 2/5 a standard deviation. Moreover, the large decline in employment in the tradable sector is completely *uncorrelated* with 2006 debt to income – exactly as predicted by the aggregate demand channel.

Can the cross-sectional job loss patterns in non-tradable and tradable sectors be explained by alternative hypotheses? One explanation for sustained low employment levels is based on heightened economic and policy uncertainty. However, in its most basic form, the uncertainty view does not predict such large cross-sectional differences across the country in employment losses. Further, it is unlikely that the uncertainty hypothesis can rationalize the distinct relations between household leverage and non-tradable versus tradable sector job losses that we find here.

A second explanation for unemployment is based on the structural adjustment of the labor force, as displaced labor from overly-inflated housing, construction, and financial sectors relocate to alternative sectors. One may also argue that such structural adjustment issues are more prevalent in more levered counties. However, we show that this argument is unlikely to be an explanation for our results for several reasons. First, our definition of non-tradable job losses explicitly removes job losses associated with construction and other related industries. Second, including control variables for either the construction share of employment as of 2007 or the growth in the construction sector from 2000 to 2007 does not change our results. In fact, these controls are uncorrelated with non-construction non-tradable sector job losses.

Further, we show that both the construction share as of 2007 and the growth in the construction sector during the housing boom are uncorrelated with county-level household leverage when instrumented with housing supply elasticity. The reason for this perhaps surprising result is that low housing supply elasticity areas had higher price appreciation during the boom and hence more leverage, but it was also more costly to expand the housing stock in these areas.[1]

We also examine other margins of adjustment in the labor market. Given the disproportionate job losses in high leverage counties, one would expect to find evidence of a relative wage decline in these counties. We find such evidence: a one standard deviation increase in household leverage is associated with a 1/5 standard deviation reduction in wages. One might also expect that workers would move out of high household leverage counties in response to deterioration in local labor markets. However, we find no evidence of such mobility. In fact, as

[1] As an additional point, it is difficult for the structural adjustment argument to quantitatively explain the increase in aggregate employment since the bulk of the employment losses occurred in non-construction tradable industries.

of 2009, net migration into high leverage counties is positive. Mobility out of high household leverage counties does not explain the employment losses in these areas.

In the final section of our analysis, we use our results to quantify the *total* employment losses due to the aggregate demand channel. Our methodology for doing so is based on the insight that one can use the cross-sectional county level estimate of the effect of demand shocks on unemployment in the *non-tradable* sector to back out the effect of aggregate demand on unemployment in *all* sectors.[2] We estimate that aggregate demand channel can account for 4 million of the 6.2 million jobs lost between March 2007 and March 2009. The methodology behind this calculation is described in Section 2 and the details of this aggregate calculation are in Section 5. Taken together, our results suggest that a decline in aggregate demand related to household balance sheet weakness is the primary explanation for high and persistent unemployment during the economic slump.

Our empirical analysis is most closely related to Mian and Sufi (2010) and Midrigan and Philippon (2011). Mian and Sufi (2010) show a negative correlation between employment growth during the recession and county-level leverage ratios, but note that a disadvantage of their analysis is the inability to separate local employment losses due to local versus national demand shocks. Our empirical methodology is designed to overcome this exact problem.

Midrigan and Philippon (2011) build a general equilibrium model in which the recession is triggered by differential shocks across states in the ability to use housing to finance immediate consumption. In estimating parameters for their model, they utilize state level correlations between ex ante leverage ratios and construction employment, consumption, and deleveraging.

[2] This methodology requires assumptions such as Cobb-Douglas preferences over tradable and non-tradable goods and an elasticity of labor demand with respect to product demand that is constant across sectors. We address these assumptions in detail in Section 2.

Our approach here is complementary. We use micro data on employment in tradable and non-tradable industries to estimate the aggregate effect of demand on unemployment.

The rest of the study proceeds as follows. In the next section we provide motivation for the methodology which we outline in Section 2. Section 3 presents the data and our classification scheme for tradable and non-tradable goods. Section 4 presents the results of our analysis. Section 5 conducts our final aggregate calculation and Section 6 concludes.

Section 1: Motivation and Background

The U.S. economy experienced a tremendous increase in household debt in the years preceding the economic downturn. Household debt doubled from $7 trillion to $14 trillion from 2001 to 2007, and the debt to GDP ratio skyrocketed from 0.7 to 1.0 over the same time period. The increase in debt was closely related to the rise in house prices. For example, Mian and Sufi (2011) show that, holding income constant, homeowners borrowed aggressively against the increase in house prices during this time period.

Theoretical research argues that the elevated level of household debt in combination with the collapse in house prices has been critical in explaining the onset, depth, and length of the current economic slump. Models by Eggertsson and Krugman (2011), Guerrieri and Lorenzoni (2011), Hall (2011), and Midrigan and Philippon (2011) explain the onset and depth of the recession using a combination of tightened credit constraints related to the collapse in house prices in combination with nominal rigidities including the zero lower bound on nominal interest rates. While the models are distinct in the precise nature of the initial shock, all imply that a

decline in aggregate demand driven by household balance sheet weakness is a key driving force explaining the recession.[3]

Empirical evidence in Mian and Sufi (2010) and Mian, Rao, and Sufi (2011) support the argument that household balance sheet weakness was crucial in explaining the collapse in consumption. In particular, these studies exploit geographic variation across U.S. counties in the degree of household leverage as of 2006. The geographic variation proxies well for the borrower heterogeneity that is present in the theoretical models described above. They show that highly levered U.S. counties were the driving force behind sharp drops in consumption during the downturn.

Figure 1 summarizes the findings from Mian, Rao, and Sufi (2011). To construct the figure, they split U.S. counties into deciles based on the debt to income ratio as of 2006.[4] In Figure 1, high (low) household leverage counties are counties in the top (bottom) decile of the 2006 debt to income distribution.

The top left panel shows that high household leverage counties experienced dramatic house price declines during the recession and afterward. House prices declined from 2006 to 2010 by almost 30% in these areas. The combination of high debt levels and the sharp decline in house prices represented a severe balance sheet shock to households. As the other three panels of Figure 1 show, households in high leverage counties responded to this shock by sharply cutting consumption. The drop in durable consumption was very large, but the drop in grocery spending was also pronounced.

[3] Eggertsson and Krugman (2011) and Hall (2011) argue that the zero lower bound on nominal interest rates is the main nominal rigidity that makes the deleveraging-driven decline in aggregate demand crucial for understanding the economic slump. It is not obvious theoretically that unemployment should result. See Hall (2011) in particular for a discussion of this point.

[4] More specifically, the deciles are formed based on the predicted values of the debt to income ratio as of 2006 using housing supply elasticity as an instrument. See Mian, Rao, and Sufi (2011) for more details.

The magnitude of the drops in these variables was much smaller in counties with low household leverage before the recession. House prices never declined in low leverage counties, and consumption levels did not decline nearly as much. The magnitudes of the relative drop in consumption in high debt counties found in Mian, Rao, and Sufi (2011) are large.[5] They estimate that durable consumption levels dropped by 20 percentage points more from 2007 to 2009 in the highest decile of the household leverage distribution versus the lowest decile. Non-durable consumption levels dropped by 10 percentage points more over the same time period.

There is no doubt that the decline in consumption levels from 2007 to 2010 was much more severe in counties with elevated levels of household debt at the beginning of the recession. The key question of our analysis is the following: how much of the decline in employment is directly related to the aggregate demand decline?

Figure 2 presents a first attempt to answer this question. It plots employment growth from 2007 to 2009 against the 2006 debt to income ratio for U.S. counties.[6] There is a strong negative correlation--counties with high household leverage before the recession experienced much sharper declines in employment during the recession. Column 1 of Table 1 presents the weighted least squares version of the scatter-plot in Figure 1. The coefficient in column 1 implies that a one standard deviation increase in the 2006 debt to income ratio is associated with a 1.8 percentage decline in employment from 2007 to 2009, which is 1/3 standard deviation.[7] The

[5] MRS (2011) show evidence on the channels through which weak household balance sheets affected consumption. They show that the effect was much more pronounced among households with low net worth and high loan to value ratios, and they emphasize the importance of deleveraging, delinquencies, and the reduction in collateral-based borrowing availability. For this study, the exact channel for the decline in demand is less important.

[6] Employment at the county level is measured using the Census County Business Patterns data. These data are measured in mid-March of each year. See Section 3 for more details. The figure includes the top 450 counties that have at least 50,000 households.

[7] All standard deviation comparisons use the sample standard deviation where observations are weighted by the total number of households as of 2000.

specification reported in column 2 restricts the sample to counties in Figure 2, i.e. counties with more than 50,000 households as of 2000, and shows a similar estimate.

In evaluating these estimates, an important issue is the source of variation in 2006 county-level leverage ratios. This issue is discussed at length in Mian and Sufi (2009), Mian and Sufi (2011), and Mian, Rao, and Sufi (2011). Mian and Sufi (2009) provide evidence of a sharp increase in the *supply* of mortgage credit in the U.S. from 2002 to 2006. They also show that the house price impact of the increased supply of mortgage credit was not uniform across the country: areas that were more constrained in their capacity to supply housing (e.g., due to difficult-to-build terrain as identified by Saiz (2011)) experienced larger house price gains as credit supply expanded.

Mian and Sufi (2011) use individual level panel data on consumer borrowing to show that U.S. households borrowed 25 to 30 cents for every dollar increase in the value of their housing. This home-equity based borrowing represents a large fraction of the overall increase in U.S. household leverage between 2002 and 2006. In short, the increase in supply of credit to the U.S. led to sharper rise in house prices in counties that had more difficult-to-build terrain. The increase in house prices in turn allowed home owners living in these counties to increase their leverage to unprecedented levels. While this mechanism does not explain all of the cross-sectional variation in leverage by 2006, it does explain a major portion of it.[8]

Taken together, these results suggest that a natural instrument for the 2006 leverage ratio is the elasticity of housing supply in the county (Saiz (2011)).[9] The Saiz elasticity measure is available for 877 counties. Column 3 repeats the column 1 regression for this sub-sample and gets similar results. Column 4 presents the first stage regression of debt to income on housing

[8] In particular, cities in Arizona and Nevada are important outliers. See Mian and Sufi (2009, 2011) for more details.
[9] The Saiz (2011) measure is constructed at the CBSA level. For the 877 counties for which the Saiz (2011) data are available, there are 260 CBSAs. The average number of counties per CBSA is 3 and the median is 2.

supply elasticity which indeed predicts leverage strongly. A one standard deviation increase in elasticity leads to a 1/3 standard deviation lower 2006 debt to income ratio in the county. The instrumental variables estimate of leverage on employment is in column 5 and is similar to its WLS counterpart in column 3.

As we discuss further in Section 3, the instrumental variables estimate is valuable given that the predicted value of the 2006 county level debt to income ratios is uncorrelated with other confounding variables. In particular, once instrumented, 2006 county level leverage ratios are *uncorrelated* with both the share of construction workers in 2007 and the growth in the construction industry during the housing boom. This will allow us to cleanly separate the aggregate demand channel from the construction-related structural adjustment hypothesis.

Section 2: Empirical Framework

The evidence in Figure 2 and Table 1 is useful as motivation, but has some drawbacks. First, even if the entire decline in consumption during the recession was concentrated in high leverage counties, we would not expect employment losses to be entirely concentrated in the same counties. The reason is obvious: goods consumed in high leverage counties are not necessarily produced in the same county. As a result, the correlation between total employment growth and the demand shock at the county level *under-estimates* the true impact of aggregate demand on employment.

Second, the drop in overall employment in high leverage counties may be driven by shocks other than aggregate demand shocks. For example, perhaps high leverage counties were harder hit by a collapse in construction and related sectors. More generally, perhaps high leverage counties were systematically more exposed to certain sectors that received a more

negative productivity shock. In this section, we outline the empirical strategy for overcoming these concerns.

A. Basic framework

Consider an economy made up of *N* equally sized counties or "islands" indexed by *c*. Each county produces two types of goods, tradable (*T*) and non-tradable (*NT*). Counties can freely trade the tradable good among themselves, but must consume the non-tradable good produced in their own county. Consumers have Cobb Douglas preferences with weights α and $(1-\alpha)$ given to the non-tradable and tradable good, respectively. Cobb Douglas preferences imply that in response to a negative demand shock, consumers cut back on the two types of goods proportionately.[10]

Counties differ in the extent of the demand shock, which we denote by δ_c. Without loss of generality we index counties such that $\delta_{c+1} > \delta_c$, so county 1 is hit with the smallest demand shock and county *N* with the most negative demand shock. Moreover δ_c is measured in units of the consumption decline in county *c*.

Households in a county consume goods produced in their own county and other counties. As a result, we need to separate the household demand shock δ_c in a county from the decline in demand faced by *producers* in county *c*. Let γ_c represent the decline in demand faced by all producers in county *c*. Then given Cobb Douglas preferences and the distribution of δ_c:

$$\gamma_c = \alpha\delta_c + (1-\alpha)\bar{\delta} \qquad (1)$$

Where $\bar{\delta} = \frac{1}{N}\sum_{c=1}^{N}\delta_c$. Let β represent the elasticity of employment with respect to output demand. Then the employment decline in county *c* is given by $\beta\gamma_c$. As equation (1) makes clear,

[10] Both Eggertsson and Krugman (2011) and Guerrieri and Lorenzoni (2011) model the demand shock as a tightening of the borrowing constraint on levered households. Levered households respond to the shock by reducing consumption substantially.

the employment decline in a county depends on both the *local demand shock for non-tradable goods* $\alpha\delta_c$ as well as the *county's production share of the aggregate demand shock for tradable goods* $(1-\alpha)\bar{\delta}$.

B. Other sources of employment loss

We have so far assumed that demand shocks are the only source of employment losses in the economy. However, there may be alternative reasons for employment declines that need to be considered when taking the aggregate demand hypothesis to data. We consider two other mechanisms highlighted in the literature. First, declines in output and employment may be due to economy-wide factors such as uncertainty shocks (Bloom (2009); Baker, Bloom, and Davis (2011)). Second, certain counties may be more exposed to employment losses due to "structural unemployment." For example, if the economic decline is driven by a re-allocation of resources away from finance and construction toward other sectors, then counties with larger gains from finance and construction in the housing boom period will have more unemployed workers. Unemployment may remain high as these unemployed workers are retrained for new jobs.

Let η denote employment losses common to all counties due to economy wide factors such as uncertainty shocks and let s_c denote employment losses in county *c* due to structural shocks. Then total employment losses Y_c in a county are given by:

$$Y_c = \beta\alpha\delta_c + \beta(1-\alpha)\bar{\delta} + \eta + s_c \qquad (2)$$

C. Isolating the impact of the aggregate demand shock on aggregate employment

Equation (2) represents total employment losses in a given county inclusive of the three main hypotheses we have considered. The *aggregate* employment losses from demand shocks δ_c are obtained by first summing the county-level employment shocks that come from the decline in *local demand for non-tradable goods* and then adding employment losses from the decline in the

aggregate demand for tradable goods. Doing so gives us an aggregate non-tradable goods demand effect of $N\beta\alpha\bar{\delta}$ and the total aggregate tradable goods demand effect of $N\beta(1-\alpha)\bar{\delta}$.[11] Therefore, the total employment loss due to demand shocks is $JOBSLOSTDEMAND = N\beta\bar{\delta}$ and depends only on the aggregate shock $\bar{\delta}$.

We next illustrate how $JOBSLOSTDEMAND$ can be estimated using county-level data. The estimation of $JOBSLOSTDEMAND$ requires two additional steps: we must remove the effects of structural unemployment s_c and the economy wide shock η from (2), and we need a suitable measure of δ_c.

We define the non-tradable sector as the sector that is non-tradable *and* not exposed to structural unemployment.[12] Then employment losses in the non-tradable sector can be written as:

$$Y_c^{NT} = \beta\alpha\delta_c + \alpha\eta \qquad (3)$$

where Y_c^{NT} represents employment losses in the non-tradable sector, where $Y_c = Y_c^{NT} + Y_c^T$ and $Y_c^T = \beta(1-\alpha)\bar{\delta} + (1-\alpha)\eta + s_c$. Equation (3) takes out the impact of structural employment by limiting itself to the non-tradable sector.

A problem with the estimation of equation (3) is that the actual county-level demand shock δ_c is not directly observed. However, suppose that there is an observable county characteristic X_c such that X_c is monotonically related to δ_c (and hence $\alpha\delta_c$). In our context, X_c represents the debt to income ratio as of 2006 which we have already shown in Figure 1 is strongly correlated with the strength of the consumer demand decline across counties (see also Mian and Sufi (2010) and Mian, Rao, and Sufi (2011)).[13]

[11] That is: $\sum_{c=1}^{N}\beta\alpha\delta_c + \sum_{c=1}^{N}\beta(1-\alpha)\bar{\delta}$

[12] In the empirical section, this translates into removing construction and real-estate related industries from the definition of non-tradable goods.

[13] We could alternatively use the accumulation of household debt from 2002 to 2006 as our measure of X_c, by using the growth in household debt from 2002 to 2006 or the change in the debt to income ratio from 2002 to 2006. These

We can use X_c to back out the marginal effect of the demand shock δ_c on non-tradable employment. To see this, rewrite (3) in differences such that,

$$\Delta Y_c^{NT} = Y_c^{NT} - Y_1^{NT} = \beta(\alpha\delta_c - \alpha\delta_1) \qquad (4)$$

The differencing in equation (4) has stripped out the effect of economy wide shock η from the equation. More importantly, given the monotonic relationship between X_c and δ_c, an unbiased estimate of ΔY_c^{NT} is given by:

$$[E(Y_c^{NT}|X_c) - E(Y_1^{NT}|X_1)] \qquad (5)$$

The term in square brackets can be estimated non-parametrically, or if the relationship between Y_c^{NT} and X_c is linear then via standard OLS. Let $\widehat{\Delta Y_c^{NT}} = [E(Y_c^{NT}|X_c) - E(Y_1^{NT}|X_1)]$, be an unbiased estimate for ΔY_c^{NT} then

$$\sum_{c=2}^{N} \widehat{\Delta Y_c^{NT}} = \sum_{c=2}^{N} \beta(\alpha\delta_c - \alpha\delta_1) = \alpha N\beta\bar{\delta} - \alpha N\beta\delta_1 \qquad (6)$$

Equation (6) and the analysis above gives us the following proposition that summarizes our methodology for estimating $JOBSLOSTDEMAND$.

> *Proposition 1:* As long as the employment effect of the demand shock is non-positive for the county that is least impacted (i.e. $\alpha\beta\delta_1 \geq 0$), the estimate $\frac{1}{\alpha}\left[\sum_{c=2}^{N} \widehat{\Delta Y_c^{NT}}\right]$ represents an underestimate of the total employment loss in the economy due to the aggregate demand shock.

The parameter α can be estimated as the share of non-tradables in the overall economy. In our empirical analysis that follows, we will explicitly test for the condition $\alpha\beta\delta_1 \geq 0$ and implement the methodology summarized in Proposition 1.[14]

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two variables are highly correlated with the debt to income ratio as of 2006. The results of our analysis do not depend on which of the three we use. See Mian, Rao, and Sufi (2011) for more discussion on this issue.

[14] This condition, $\alpha\beta\delta_1 \geq 0$, which is satisfied in the data, helps to mitigate concerns that general equilibrium effects are leading to an over-estimate of the employment losses using the cross-sectional approach. Whatever positive general equilibrium effects on employment are present in counties with low household leverage, they are not positive enough to avoid job losses in those counties. This is precisely why our methodology under-estimates the total job losses due to the aggregate demand channel.

D. Other possible general equilibrium effects

Our primary focus is on estimating the employment consequences of demand shocks δ_c. However as Midrigan and Philippon (2011) show, heterogeneous demand shocks faced by different counties can also potentially impact relative wages across counties and labor mobility. For example, relative wages could decline in areas harder hit by the demand shock. The relative drop in wages could in turn make these counties more competitive in the tradable sector production. The net impact of these labor market adjustments depends on parameters such as wage and labor market rigidity. In the empirical section that follows, we explicitly consider these general equilibrium effects as well.

Section 3: Data, Motivating Example, and Industry Classification

A. Data

County by industry employment and payroll data are from the County Business Patterns (CBP) data set published by the U.S. Census Bureau. CBP data are recorded in March each year. The most recent data available is for 2009. We use CBP data at the 4-digit industry level, so we know the breakdown of number of employees and total payroll bill within a county for every 4-digit industry.[15] We place each of the 4-digit industries into one of four categories: non-tradable, tradable, construction and other. We discuss the classification scheme in the next subsection. We supplement the CBP data with hourly wage data from the annual American Community Survey (ACS). ACS is based on a survey of 3 million U.S. residents conducted annually.

As mentioned above, a key variable in the analysis is the leverage ratio of a county, which is measured as the debt to income ratio as of 2006. Total debt in a county is measured

[15] County data at the 4 digit industry level is at times suppressed for confidentiality reasons. However, in these situations the Census Bureau provides a "flag" that tells us of the range within which the employment number lies. We take the mean of this range as a proxy for the missing employment number in such scenarios.

using consumer credit bureau data from Equifax and income is measured as total wages and salary in a county according to the Statistics of Income by the IRS. For more information on these data sources, see Mian and Sufi (2010) and Mian, Rao, and Sufi (2011).

B. Motivating Example

Section 2 highlights the key prediction of the aggregate demand channel for the drop in employment: the drop in employment in the non-tradable sector will be largest in high leverage counties that experienced a larger decline in aggregate demand. On the other hand, the drop in employment in the tradable sector will be uncorrelated with the county-level debt to income ratio.

We motivate the formal test for this hypothesis using the automobile sector as an example. We know from Figure 1 and Mian, Rao, and Sufi (2011) that areas of the country with high debt to income ratios experienced a sharp relative drop in auto sales during and after the recession. The auto sector allows us to test the aggregate demand channel given that it is divided into two distinct sub-sectors. The tradable sub-sector that is involved in the manufacturing of autos and the non-tradable retail sub-sector involved in the sale of autos.[16]

Figure 3 plots the change in employment in the auto retail (left panel) and auto manufacturing (right panel) against a county's debt to income ratio as of 2006. Since county population distribution is highly skewed we plot only the 450 counties with more than 50,000 households. The results are exactly in line with the aggregate demand channel predictions. Columns 6 and 7 in Table 1 show that the relationship between change in auto retail employment and household leverage is strongly negative and significant, while there is no relationship

[16] Automobile manufacturing consists of the following four digit industry codes: motor vehicle manufacturing (3361), motor vehicle body and trailer manufacturing (3362), and motor vehicle parts manufacturing (3363). Automobile retail consists of: Automobile dealers (4411), other motor vehicle dealers (4412), Automotive parts accessories and tire stores (4413), and motor vehicle parts and supplies merchant stores (4231).

between manufacturing employment and household leverage. Instead, auto manufacturing employment declined significantly across the entire country, as can be seen by the intercept in the left panel of Figure 3.

Figure 3 illustrates the core finding of this paper through a simple transparent example. The negative shock to the demand for autos leads to a reduction in the automobile manufacturing employment everywhere. However, the drop in retail employment is more closely tied with economic geography: the drop in retail automobile sector employment is stronger in areas where the drop in demand for automobiles is higher. Given that low leverage counties experienced only a minor drop in demand for autos and minor job losses in the auto retail sector, we can confidently ascribe the job losses in the auto manufacturing sector *throughout the country* to the reduction in demand coming from high leverage counties. As we show below, this basic pattern extends to employment in all sectors, not just autos.

Another point to take away from this example is that automobile manufacturing employment is only present in 1,528 counties, while automobile retail is present in almost every county (3,009). This is a generic finding that we explore more below: Non-tradable industries are more likely to be present everywhere, while tradable industries tend to be more concentrated geographically.

C. Classifying industries into tradable and non-tradable categories

Splitting employment into jobs producing tradable versus non-tradable goods is a crucial part of our empirical strategy. This is not a trivial exercise. The difficulty is that many industries produce goods that fit into both non-tradable and tradable categories. For example, some banking services cater to local demand--a consumer may need a physical branch to deposit funds. Other banking services cater to national or international demand--for example, investment banking for

large corporations. Given that many industries could be possibly categorized as producing both tradable and non-tradable goods, subjectivity is a real problem in this setting.

Our solution to this problem is two-fold. First, we use two independent classification schemes that follow objective criteria that disallow any subjective judgment. We describe these two methodologies below. Second, we carefully document these classification schemes and provide full disclosure on which industries fall into each category. Given the problem of subjectivity, our goal is to be as transparent as possible. As a side note, an advantage of our methodology outlined in Section 1 is that it is relatively immune to error in classification: As long as industries classified as "non-tradable" are legitimately non-tradable and the α used in the calculations corresponds to this subset of industries, the overall methodology remains valid.

1. Retail and world trade based classification

For our first classification scheme, we define a 4-digit NAICS industry as *tradable* if it has imports plus exports equal to at least $10,000 per worker, or if total exports plus imports for the NAICS 4-digit industry exceeds $500M.[17] *Non-tradable* industries are defined as the retail sector and restaurants. We also use a more restricted version of non-tradable industries that includes only grocery retail stores and restaurants. A third category is *construction*, which we define as industries related to construction, real estate, or land development. A large number of industries do not fit neatly into one of these three categories. We treat these other industries as a separate category we label as *other*. The shares of total employment as of 2007 for these four categories are: tradable (11%), non-tradable (20%), construction (11%), and other (59%).

Table 2 presents the top ten NAICS coded industries in each of our four categories based on the fraction of total employment as of 2007, and Appendix Table 1 lists all 294 4-digit

[17] The industry level trade data for the U.S. is taken from Robert Feenstra's website http://cid.econ.ucdavis.edu. The trade data is based on 2006 numbers.

industries and their classification. Industries producing tradable goods are mostly manufacturing, whereas non-tradable industries are concentrated in retail. The largest industries in the other category are service oriented industries such as health care, education, and finance.[18]

2. Geographical concentration based classification

An alternative is to classify industries as tradable and non-tradable based on an industry's geographical concentration. The idea is that the production of tradable goods requires specialization and scale, so industries producing tradable goods should be more concentrated geographically. Similarly, there are goods and services (such as vacation beaches and amusement parks) that may not be tradable themselves, but rely on national demand rather than local demand. For our empirical approach, these industries that are likely to be concentrated geographically should be classified as tradable. In contrast, industries producing non-tradable goods should be disperse given that all counties need such goods and services.

Our measure of geographical concentration of an industry is based on the employment share of the industry in each county. We use these shares to construct a geographical Herfindahl index for each industry. Consistent with the intuition that geographic concentration captures tradable and non-tradable goods production, we find a Herfindahl index of 0.018 for industries that we classify as tradable in our first classification scheme, and a Herfindahl index of 0.004 for industries we classify as non-tradable. This is a large difference in Herfindahl given that the mean and standard deviation of Herfindahl index across industries is 0.016 and 0.023, respectively.

Table 3 lists the top 30 most concentrated industries and whether they are classified as tradable according to our previous categorization. There are a number of new industries

[18] We exclude health care and education from our primary definition of non-tradables. However, our second method of classification based on geographical concentration allows these sectors to be classified as non-tradables.

classified as tradable according to the geographical concentration measure. The new classification is intuitive. For example, securities exchanges, sightseeing activities, amusement parks, and internet service providers all show up as tradable under the new scheme. This is sensible given that these activities cater to broader national level demand. Similarly, the bottom 30 industries include a number of industries that were not classified as non-tradable in our previous classification scheme. For example, lawn and garden stores, death care services, child care services, religious organizations, nursing care services are all industries that cater mostly to local demand but were missed in our previous classification scheme.

In short, geographical concentration based categorization of industries into tradable and non-tradable is intuitive and avoids subjectivity in selection. Our second classification scheme categorizes the top and bottom quartile of industries by geographical concentration as tradable and non-tradable, respectively.

D. Summary statistics

Table 4 presents summary statistics for our sample. The average debt to income ratio of a county is 2.5 and there is a significant amount of variation. The standard deviation is 1.0 and the spread between the 10th and 90th percentile is large. Employment from 2007 to 2009 drops by an average of 5% across counties, which reflects the severity of the recession. Average wage growth is positive from 2007 to 2009 at the mean, but negative at the 10th percentile. This wage data is from the county business pattern data set and wage is computed by dividing total payroll with the number of employees. As a result, it includes possible changes in the number of hours worked. There are significant differences in the declines in employment across the four categories of employment. The average decline in construction employment across counties is

12% during the recession. It is 12% for tradables, 2.5% for non-tradables, and 1.3% for the food industry.

The next set of variables in Table 4 comes from American Community Survey (ACS). They are based on survey responses and enable us to measure reported hourly wages directly. Since survey data is available at the individual response level, we can also construct various percentiles of the wage distribution for a given county. Average hourly wage as of 2007 is $17 and average reported hourly wage growth is 2.9% from 2007 to 2009.

Section 4: Demand Shocks and Employment Losses

In this section, we implement the methodology outlined in Section 2 to estimate the effect of the aggregate demand shock related to household balance sheet weakness on aggregate employment.

A. Demand shocks and employment losses in non-tradable and tradable Industries

The left panel of Figure 4 presents the scatter-plot of employment losses in non-tradable industries (excluding construction) from 2007 to 2009 against the 2006 debt to income ratio of the county. There is a strong negative correlation. Even at the lowest end of the demand shock, the predicted level of employment change is non-positive. As Proposition 1 explained, this is important for our aggregate calculation.[19] The thin black line in the left panel of Figure 4 plots the non-parametric relationship between job losses in the non-tradable sector and county leverage. The non-parametric relationship closely follows the OLS predicted value; linearity is a reasonable assumption to explore the relationship between job losses and leverage.

[19] In our actual aggregate calculation, we are conservative and use the debt to income ratio at the 10th percentile of the distribution as our control group.

While job losses in the non-tradable sector are strongly negatively correlated with the 2006 debt to income ratio of the county, the right panel of Figure 4 shows no such relation between leverage and job losses in the tradable sector. Instead, the OLS prediction has a negative constant and is flat across the entire distribution. As we discuss in Section 2, this is exactly the expected relation under the aggregate demand hypothesis given that the labor demand shock for tradable goods production should be evenly distributed across the economy.

Table 5 presents the regression coefficients relating employment growth in non-tradable industries from 2007 to 2009 to the 2006 debt to income ratio of the county. The instrumental variables estimate in column 3 implies that a one standard deviation increase in ex ante county leverage is associated with a 3.1% drop in employment in the non-tradable sector. Alternatively, moving from the 10th percentile of the leverage distribution to the 90th percentile is associated with a 6.2% larger drop in employment in industries producing non-tradable goods.

One concern is that counties with high debt to income ratio are somehow spuriously correlated with the type of industries they specialize in. If these industries received a stronger shock, then our results could be spurious. Column 4 includes as controls the share of employment devoted to each sector as of 2007 and the coefficient of interest is the same. We have experimented with introducing other industry controls at the county level – for example, the share of employment at the 2-digit industry level. Our main result remains unaffected.

Column 5 uses the alternative and stricter definition of non-tradables which includes only industries related to retail grocery and restaurants. This alternative definition is a strict subset of our earlier definition. The coefficient on debt to income is negative and statistically significant,

although it is slightly smaller than the column 2 estimate. The difference in magnitude reflects the fact that demand for groceries is less elastic than other goods bought in retail stores.[20]

Columns 6 and 7 report specifications relating job losses in the tradable sector to the 2006 debt to income ratio of a county. The coefficient is close to zero and precisely estimated. The difference between the coefficients for tradable job losses in column 6 and that for non-tradable job losses in column 1 is also statistically significant at the 1% level. The results in columns 6 and 7 also show a statistically significant negative coefficient on the constant. This reflects the fact that employment losses are evenly distributed across the entire country in industries producing tradable goods.

In order to quantify the tradable versus non-tradable results, it is useful to pick points in the 2006 debt to income distribution and calculate the marginal impact of the demand shock going from low to high leverage counties. Consider a county at the 10th percentile of debt to income ratio (with a debt to income ratio of 1.5). Using the estimates from columns 4 and 7 of Table 5, the predicted drops in non-tradable and tradable employment from 2007 to 2009 are 0.3% and 11.6% respectively.[21] In contrast, the predicted employment drops in non-tradable and tradable sectors for the 90th percentile county with debt to income ratio of 3.8 are 5.1% and 11.6% respectively. The fact that high leverage counties experience a sharp employment drop in *both* tradable and non-tradable industries whereas low leverage counties experience an employment drop *only* in tradable industries is what allows us to identify the effect of demand shocks.

[20] Mian, Rao, and Sufi (2011) show that that the relative reduction in consumption in high leverage counties from 2007 to 2009 is smallest for groceries, which is consistent with a lower income elasticity.
[21] Predicted values are estimated at the sample mean of construction, non-tradable and tradable employment shares in a county.

Figure 5 and Table 6 repeat the analysis using the geographical concentration based-definition of tradable and non-tradable industries. Despite being a completely different classification scheme, the results are remarkably similar. The left panel of Figure 5 and columns 1 through 4 of Table 6 show that the relationship between job losses in non-tradable industries – as defined by industries that are least concentrated geographically - and the debt to income ratio as of 2006 is strongly negative. The right panel of Figure 5 and the results in columns 5 and 6 of Table 6 show that the relationship between job losses in tradable industries – as defined by industries that are most concentrated geographically – and debt to income as of 2006 is completely uncorrelated.

B. Testing alternative explanations

The decline in employment in industries producing non-tradable goods from 2007 to 2009 is concentrated in high leverage U.S. counties that simultaneously experience sharp relative declines in credit limits, house prices, debt levels, and consumption. The decline in employment in industries producing tradable goods is spread evenly across U.S. counties. These facts are consistent with the aggregate demand hypothesis of high unemployment levels that we outline in Section 2 above. Could our results be explained by alternative hypotheses? We discuss this question below.

1. The uncertainty hypothesis

A number of commentators and academics have put forth policy, regulatory, or business uncertainty as an explanation for the decline in macroeconomic aggregates (e.g. Baker, Bloom, and Davis (2011), Bloom (2009), Bloom, Foetotto, and Jaimovich (2010), Fernandez-Villaverde, Guerron-Quintana, Kuester, and Rubio-Ramirez (2011), and Gilchrist, Sim, and Zakrajsek (2010)). As we show in Section 2, in its most basic form, an increase in business uncertainty at

the *aggregate* level does not explain the stark *cross-sectional* patterns in employment losses that we observe in non-tradable and tradable industries across U.S. counties. There may be more subtle versions of the uncertainty hypothesis that generate cross-sectional differences, but we have not seen them articulated.

2. The construction-related structural unemployment hypothesis

Another common explanation given for high unemployment is the displacement of workers from real estate related "bubble" industries such as construction and mortgages. Since job losses in these sectors are likely to be permanent once the bubble burst, it will take time for these workers to get re-trained and absorbed in alternative industries. We refer to this as the structural unemployment hypothesis.

There are a number of reasons already shown why the structural unemployment hypothesis is unlikely to explain our results. In the above results, we explicitly remove any employment associated with the construction, real estate, or mortgages from our non-tradable definition. Given this exclusion, the strong correlation between leverage and the decline in non-tradable employment decline is unlikely to be driven by construction related shocks.

However, perhaps our debt to income measure as of 2006 is correlated with the construction sector shock, and a negative shock to construction indirectly affects other non-tradable sector employment. Table 7 tests this concern by first correlating the 2006 debt to income ratio across counties with the county-level share of employment in construction in 2007, and the growth in construction related employment from 2000 to 2007. Columns 1 and 3 of Table 7 show that both these measures of exposure to the construction sector in a county are positively correlated with the 2006 debt to income ratio. How can we be sure that we are capturing a demand effect and not a construction effect?

One answer is in results shown above. In Tables 5 and 6, we include the share of workers in construction as of 2007 as a control variable. The inclusion of this control does not affect the results. In fact, the construction share of employment as of 2007 is barely correlated with job losses in non-construction non-tradable industries when no other variables are included.[22]

A second answer lies in our instrumental variables specification. Columns 2 and 4 of Table 7 show that when we instrument the 2006 debt to income ratio using housing supply elasticity, the predicted values of the debt to income ratio are *not* correlated with either the construction share as of 2007 or the growth in the construction share from 2000 to 2007. In other words, when we isolate the variation in the 2006 debt to income ratio that comes from housing supply elasticity, the variation is uncorrelated with the construction sector.

Recall that column 4 in Table 1 shows that the debt to income ratio as of 2006 is strongly correlated with housing supply elasticity, with an R^2 of 0.18. Why is the instrumented debt to income ratio uncorrelated with the construction share and the growth in construction sector in Table 7? The answer lies in the dual role played by the elasticity instrument. On one hand, less elastic counties saw sharper increases in house prices during the boom. The increase in house prices made credit more easily available due to higher collateral value therefore facilitating more construction activity. On the other hand, less elastic counties have – by definition – a higher marginal cost to expand the housing stock. The combination of these two opposing forces makes housing elasticity uncorrelated with construction activity, but strongly correlated with the accumulation of leverage due to the home equity borrowing effect.

[22] See the middle panel of Appendix Figure 1. When we estimate the corresponding weighted least squares regression in column 1 of Table 5 using the construction share of employment as of 2007 instead of the debt to income ratio as of 2006, the coefficient is -0.047 with a p-value of 0.373. The standard deviation of the construction share weighted by total population is only 0.039. This implies both a very small and statistically weak effect of the construction share on subsequent employment losses in non-construction non-tradable industries. In contrast, the debt to income ratio as of 2006 does an excellent job predicting job losses in the construction sector. See the right panel of Appendix Figure 1.

More generally our results are not driven by a spurious correlation between household leverage and exposure to an industry that happens to be disproportionately affected by the recession. Inclusion of control variables for employment shares of all possible 2-digit industries in county employment do not affect our results. Further, our motivating example using the auto sector provides a "within-industry" test that confirms the broader tradable/non-tradable differences in employment patterns.

3. The credit supply hypothesis

Another possible explanation for high unemployment is based on counties experiencing differential credit supply shocks depending on the severity of the house price collapse. Because leverage as of 2006 is strongly correlated with subsequent house price declines and real estate may be used as collateral for business credit, collateral-induced tightness in business credit might reduce employment in high leverage counties.

One problem with this alternative explanation is that it does not explain why job losses in high leverage counties were concentrated in non-tradable industries. An explanation based on credit supply would imply more job losses within high leverage counties in *all* industries--we find no such effect in industries producing tradable goods.

But a counter-argument is that the non-tradable sector may be more susceptible to credit supply shocks. To address this issue, we take advantage of the CBP data which records employment separately for establishments by various size categories. Table 8 shows that the negative correlation between employment growth in non-tradable industries from 2007 to 2009 and the ex ante county leverage ratio is stronger in *large* establishments. Under the assumption that smaller firms face tighter financial constraints, the results dispute a credit supply based explanation.

C. Other labor market margins of adjustment: Wages and labor mobility

Figures 2 through 5 show a very large decline in employment in high leverage counties relative to low leverage counties. As discussed in Section 2.D, we now consider how the large decline in employment in these areas affects wages and labor mobility.

We begin with wages. In the absence of absolute wage rigidity, we should expect at least some downward response of wages to the large decline in employment in high leverage counties. In Table 9 and the left panel of Figure 6, we find evidence of this effect. In both the left panel of Figure 6 and in columns 1 through 4 of Table 9, we use county level data on wages from the Census County Business Patterns. We find that debt to income ratios as of 2006 have a negative effect on total wage growth from 2007 to 2009. The coefficient in column 2 implies that a one standard deviation increase in the 2006 debt to income ratio leads to 1% lower wage growth, which is about 1/5 a standard deviation. The instrumental variables estimate in column 4 is twice as large.

The advantage of Census data is that it is based on actual IRS payroll data for current employees and is therefore very accurate. The disadvantage is that it only tracks the wages per employee and does not record the hours worked by an employee. As a result, the decline in wages we find in Table 9 may be due to a decline in the number of hours worked by a given employee, not by a lower wage to the employee.

In columns 5 through 7, we use survey data from the American Community Survey on hourly wages. The advantage of the ACS data is that it tracks hourly wages, not total wages per employee. The disadvantage is that the ACS is based on survey data that is likely to be less accurate than payroll data. Regardless, column 5 shows a similar negative effect of county

leverage as of 2006 on hourly wage growth. The similarity of the CBP and ACS results are reassuring that the CBP result is not being driven by workers cutting the number of work-hours.

The ACS also allows us to split the wage effect across the distribution of wages. The right panel of Figure 6 shows a negative relation between wages at the 25th percentile of the distribution and the 2006 debt to income ratio of a county. Columns 6 and 7 examine the correlation between debt to income and wage growth at the 10th and 90th percentile of the wage distribution. We find suggestive evidence that wages decline by more in the lower part of the wage distribution.

Another margin on which workers may adjust is mobility (Blanchard and Katz (1992)). Facing extremely high unemployment rates, workers in high leverage counties may choose to move out of the area. In the left panel of Figure 7, we utilize state level data on population from the Census. From 2007 to 2009, population growth is in fact slightly *positively* correlated with the 2006 debt to income ratio at the state level. In other words, despite the collapsing economy in high debt to income states, the population is growing somewhat faster in these states.[23]

Column 1 of Table 10 confirms this positive correlation and shows that it is statistically significant at the 5% level. The specification in column 2 utilizes net migration in 2008 and 2009 as a fraction of population in 2007. Net migration helps eliminate the effect of population growth driven by fertility differences. The point estimate remains positive but is not significantly different than zero. Columns 1 and 2 of Table 10 help ensure that the employment declines in high leverage areas are not due to people moving out of the area.

An alternative check to ensure that our results are not driven by a decline in available labor force in high leverage counties is to directly look at labor force growth between 2007 and

[23] We do not have county-level measures of population through 2009. It should be kept in mind that the positive correlation of population growth with leverage is a continuation of a higher growth trajectory for population in high leverage counties.

2009 at the county level. This information is provided by the BLS. The right panel of Figure 7 plots labor force growth from 2007 to 2009 in counties against the debt to income ratio as of 2006. There is a slightly positive relation but it is extremely noisy. Columns 3 and 4 of Table 10 show coefficients consistent with the scatter-plot in Figure 7: the correlation is positive but statistically unreliable. The IV version of this regression is positive in column 4. In other words, there is no evidence that high leverage counties experienced disproportionate losses in population or labor force participation. If anything, there is some evidence that high leverage areas continued to growth more strongly in terms of the labor force from 2007 to 2009.

Section 5: The Aggregate Calculation

A. Baseline calculation

We can now apply the methodology outlined in section 1 and summarized by Proposition 1 to compute the aggregate loss in employment due to the aggregate demand shock related to weak household balance sheets. The employment loss due to these demand shocks is given by $\frac{1}{\alpha}\left[\sum_{c=2}^{N} \widehat{\Delta Y_c^{NT}}\right]$, where $\widehat{\Delta Y_c^{NT}} = [E(Y_c^{NT}|X_c) - E(Y_1^{NT}|X_1)]$.

The relationship between non-tradable employment loss and 2006 leverage is almost linear (see Figure 4). We can therefore use results from our main linear regression specification (column 1 of Table 5) to estimate $\widehat{\Delta Y_c^{NT}}$ for each county. This is done by using the predicted value for each county from column 1 of Table 5, and subtracting the predicted value of employment losses for the county with the lowest leverage in 2006.

In order to be conservative and also to avoid basing our estimate on potentially noisy outliers in our sample distribution, we pick the 10th percentile of leverage distribution as our base county. Therefore, $E(Y_1^{NT}|X_1)$ equals the predicted non-tradable employment losses for the

county that corresponds to the 10th percentile of cross-county 2006 leverage distribution. $\widehat{\Delta Y_c^{NT}}$ is set to zero for all counties below the 10th percentile county.

While this is also visually apparent from Figure 4, the predicted log change in non-tradable employment for the 10th percentile county is negative and equals -0.0060. As stated in Proposition 1, it is important for our calculation that our base county non-tradable employment change be negative.

We multiply the predicted percentage change in non-tradable employment for a given county by the level of non-tradable employment in 2007 in that county to compute the predicted change in number of non-tradable jobs. Summing this estimate across counties gives us an estimate of 760 thousand jobs lost in the *non-tradable* sector due to the demand shock.

In order to translate this number into total jobs lost across all sectors, we need to multiply it by the inverse of the share of non-tradable sector, $1/\alpha$. Given a share of 19.6% of non-tradable employment in total employment, we get an estimate of 3.92 million jobs lost across all sectors due to the aggregate demand shock. The total number of jobs lost in our data between 2007 and 2009 equals 6.05 million jobs. As a result, our estimated jobs lost due to the demand shock equals 64.7% of total jobs lost in the economy from 2007 to 2009.

Another interesting parameter that we are able to estimate is the elasticity of employment growth with respect to consumption growth during the recession. Using data on total consumption based on MasterCard purchases from Mian, Rao, and Sufi (2011), we find an elasticity of employment growth with respect to consumption growth of 0.39. We obtain this number from a second stage county-level regression of employment growth from 2007 to 2009 in the non-tradable sector on consumption growth in the county from 2007 to 2009, where consumption growth is instrumented using housing supply elasticity.

An additional question is in regard to the persistence of unemployment into 2010. The CBP county-industry level data on employment are not available through 2010 at the time of this writing. However, we can use county-level employment data from the Bureau of Labor Statistics to get some sense of the answer to this question. The disadvantage is that we are unable to split employment by non-tradable and tradable industries. Nonetheless, Appendix Figure 2 shows that the relative employment drop in high leverage counties persists even into 2010. In fact, there is evidence of a widening of the gap between high and low leverage counties in 2010. These results suggest that the aggregate demand channel may also explain the persistence of unemployment after the recession.

B. Robustness to alternative assumptions

Our estimate for jobs lost due to demand shocks is likely to be an underestimate of the true effect for two reasons. First, as is highlighted in Proposition 1, we do not include in our estimate jobs lost due to demand shocks in the lowest end of county distribution. We have been cautious in using only the 10^{th} percentile as our base county. If we were to use the 5^{th} percentile county instead, which has predicted log change employment of -0.0017, then our estimated job loss due to demand shocks would have been 4.45 million jobs or 73.4% of total jobs lost.

Second, our methodology in Section 1 assumes that consumers cut back on tradable and non-tradable goods proportionately. There is evidence that demand for industries not included in the non-tradable definition such as durable goods and construction are *more* sensitive to a negative demand shock related to weak household balance sheets. For example, Mian, Rao, and Sufi (2011) show that the relative decline in durable goods purchases for leverage counties is much larger than the relative decline for other goods. Incorporating a higher income elasticity of demand for industries not included in the non-tradable sector would increase our estimate of jobs

lost. Based on these factors, we feel that our reported estimate - while already large and significant - is likely to be an underestimate of the true employment losses due to demand shock.

Our macro calculation could have been an overestimate of the true job losses in the economy due to the aggregate demand shock if relative wage declines in high leverage counties had attracted more jobs in the tradable sector. However, we see no evidence of that as the relationship between employment declines in the tradable sector and county leverage is zero and precisely estimated.[24]

On a related note, when we extrapolate the effect on tradables using the non-tradable estimate, we implicitly assume that the aggregate demand effect is similar for exports. This may not be the case if one believes that the aggregate demand shock was limited to the United States.. Since the U.S. exports 8.4% of its GDP, assuming no demand effect on exporting sector would reduce our aggregate employment loss number to (1-0.084)*64.7= 59.3% of total jobs lost.

Section 6: Conclusion

Household debt in the United States reached unprecedented levels before the onset of the recession. The extant literature strongly supports the view that the onset of the recession was driven by a series of shocks to the household balance sheet. In counties with high levels of leverage as of 2006, house prices declined by 30% from 2007 to 2010. Mian, Rao, and Sufi (2011) show that the drop in consumption of all types of goods from 2007 to 2010 was much more severe in high leverage counties.

[24] There remains a possible external adjustment mechanism via trade with the rest of the world. In particular, a serious devaluation of the dollar may induce job creation in the overall export sector all across the U.S. However, job gains in the export sector remain modest, and as the summary statistics in Table 4 show, between 2007 and 2009, job losses in the tradable sector were 4.9% and higher than losses in any other sector. The export-adjustment margin is unlikely to be very meaningful for job creation during the 2007 to 2009 period.

In this study, we estimate how these negative demand shocks affected employment levels during the heart of the recession. Our main insight is that the relation between demand shocks and employment losses in industries catering to local demand can be used to estimate the effect of aggregate demand on aggregate unemployment. We estimate that 4 million of the 6.2 million jobs lost between March 2007 and March 2009 were due to demand shocks. Based on this analysis, we believe that weak household balance sheets and the resulting aggregate demand shock are the main reasons for historically high unemployment in the U.S. economy.

Alternative hypotheses such as business uncertainty and structural adjustment of the labor force related to construction are less consistent with the facts. The argument that businesses are holding back hiring because of regulatory or financial uncertainty is difficult to reconcile with the strong cross-sectional relation between household leverage levels, consumption, and employment in the non-tradable sector. This argument is also difficult to reconcile with survey evidence from small businesses and economists saying that lack of product demand has been the primary worry for businesses throughout the recession (Dennis (2010), Izzo (2011)).

There is certainly validity to the structural adjustment argument given large employment losses associated with the construction sector. However, we show that the leverage ratio of a county is a far more powerful predictor of total employment losses than either the growth in construction employment during the housing boom or the construction share of the labor force as of 2007. Further, using variation across the country in housing supply elasticity, we show that the aggregate demand hypothesis is distinct from the construction collapse view. Finally, structural adjustment theories based on construction do not explain why employment has declined sharply in industries producing tradable goods even in areas that experienced no housing boom.

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Figure 1
Household Balance Sheet Weakness and Aggregate Demand

This figure plots house prices, home equity limits, household borrowing, and auto sales for high and low household leverage counties in the U.S. from 2006 to 2010. High and low household leverage counties are defined to be the top and bottom quartile counties based on the debt to income ratio as of 2006. Quartiles are weighted by the outcome variable in question as of 2006 so that both quartiles contain the same amount of the outcome variable as of 2006 (for house prices we weight by population).

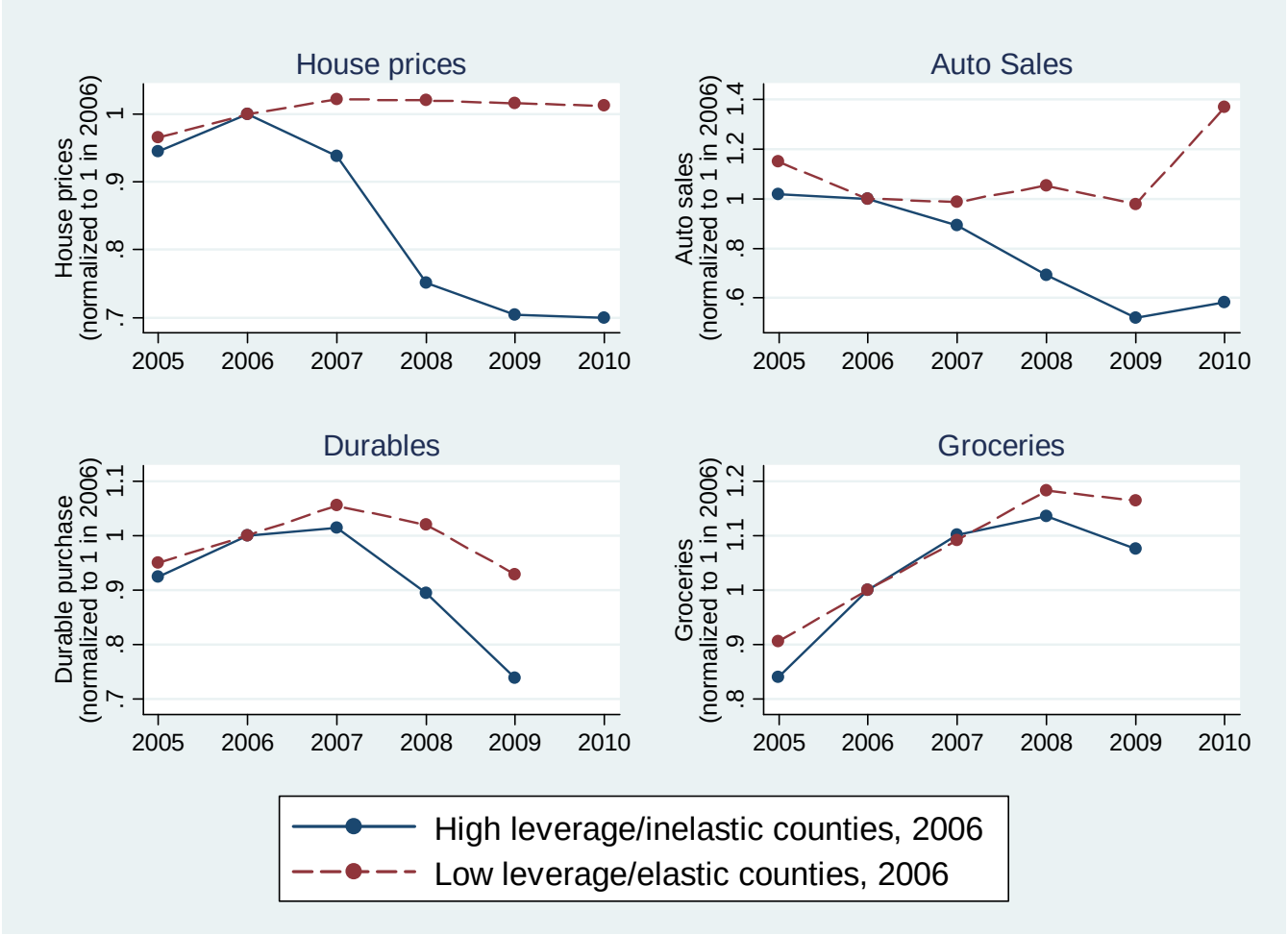

Figure 2

Aggregate Demand and Employment across Counties: All Industries

This figure presents a scatter-plot of county level employment growth from 2007Q1 to 2009Q1 against the debt to income ratio of the county as of 2006. All industries are included. The sample includes only counties with more than 50,000 households.

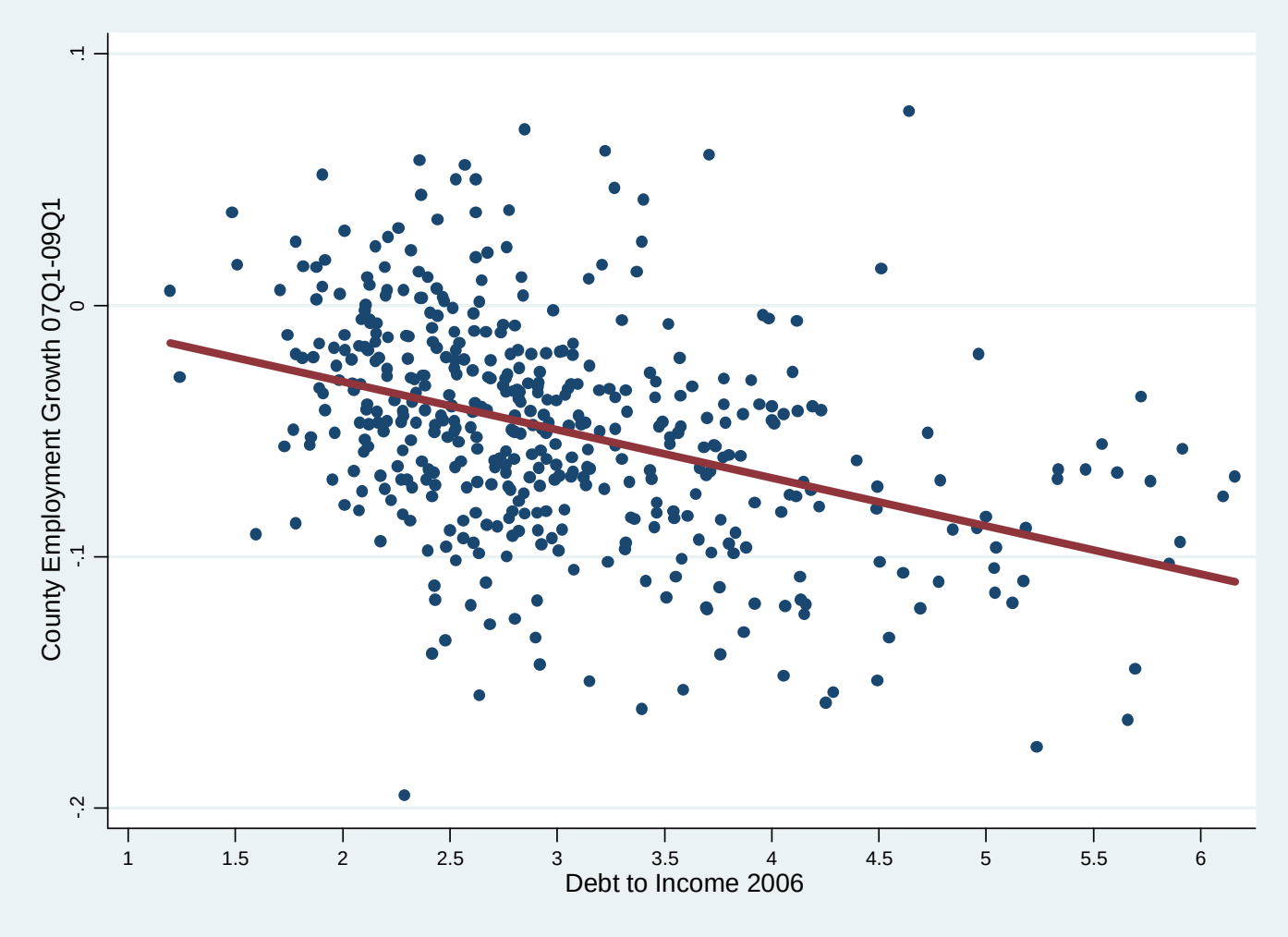

Figure 3
Aggregate Demand and Employment across Counties
Motivating Example: Auto Retail and Auto Manufacturing

This figure presents scatter-plots of county level employment growth from 2007Q1 to 2009Q1 against the debt to income ratio of the county as of 2006. The left panel examines employment in the automobile retail sector and the right panel focuses on automobile manufacturing sector. The sample includes counties with more than 50,000 households.

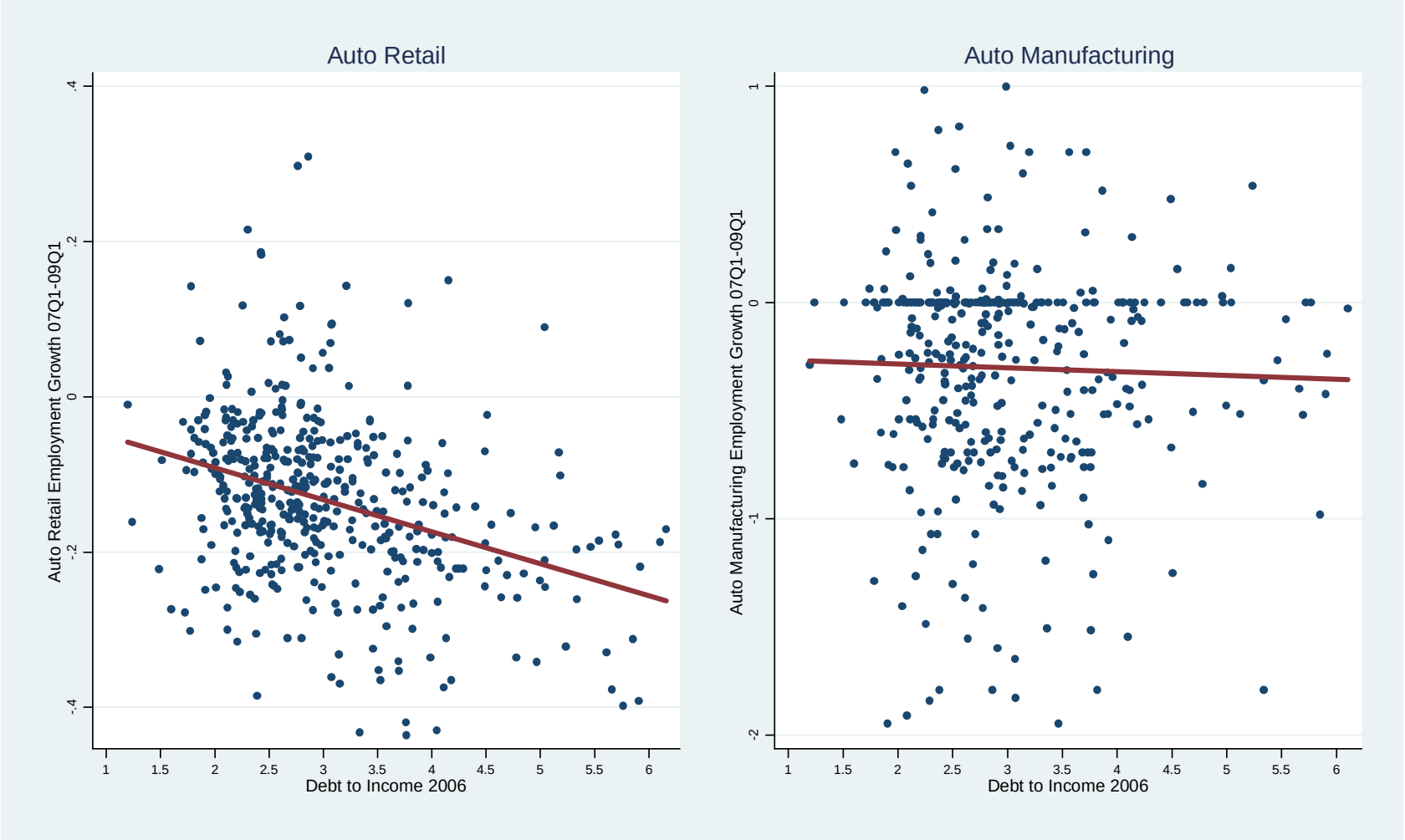

Figure 4

Aggregate Demand and Employment across Counties: Non-Tradable and Tradable Industries

This figure presents scatter-plots of county level employment growth from 2007Q1 to 2009Q1 against the debt to income ratio of the county as of 2006. The left panel examines employment in non-tradable industries excluding construction and the right panel focuses on tradable industries. The sample includes only counties with more than 50,000 households. The thin black line in the left panel is the non-parametric plot of non-tradable employment growth against debt to income.

Figure 5
Aggregate Demand and Employment across Counties:
Geographical Herfindahl-Based Non-Tradable and Tradable Industries

This figure presents scatter-plots of county level employment growth from 2007Q1 to 2009Q1 against the debt to income ratio of the county as of 2006. The left panel examines employment in non-tradable industries based on geographical herfindahl index and the right panel focuses on tradable industries based on the same index. The sample includes only counties with more than 50,000 households.

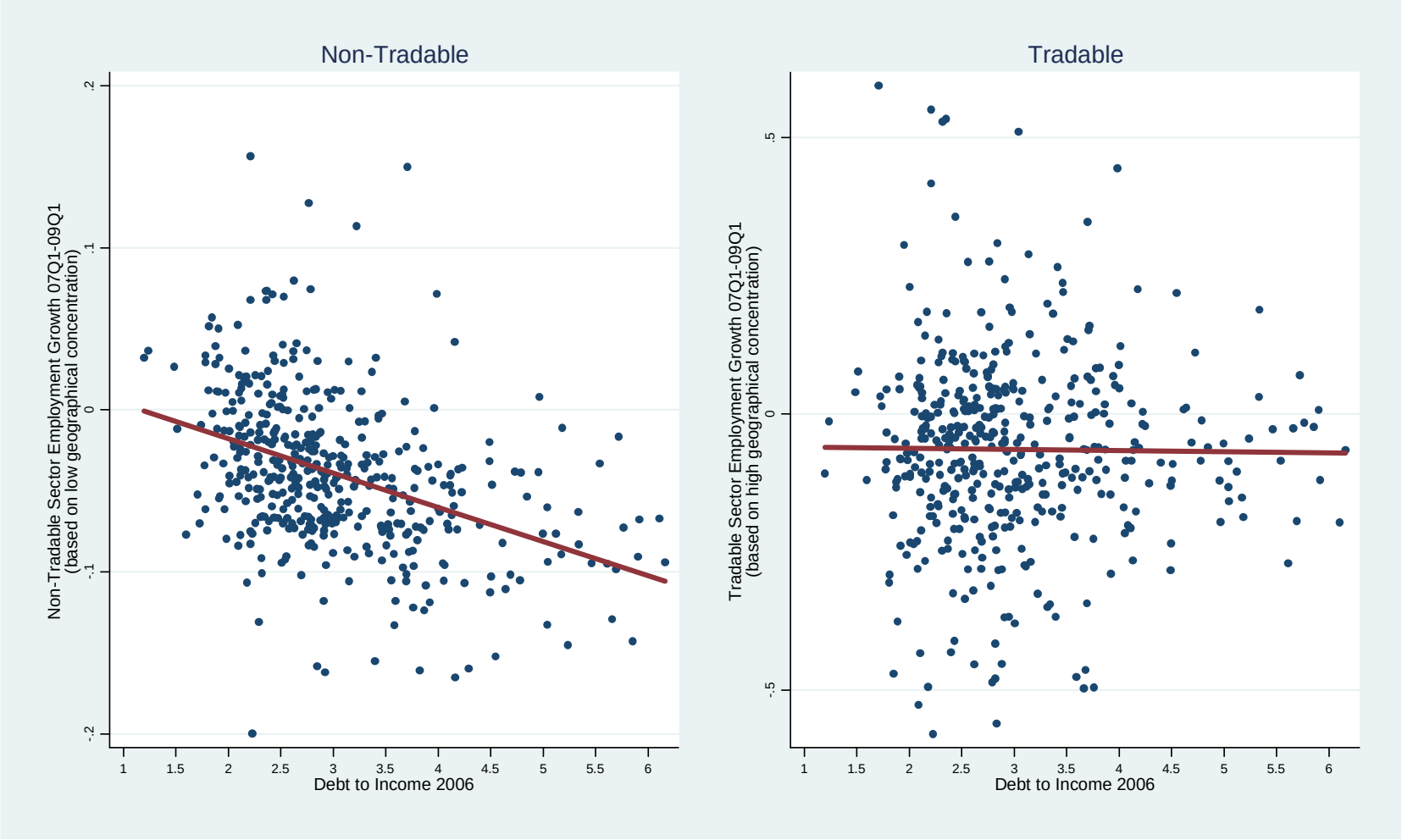

Figure 6
Aggregate Demand and Wage Growth across Counties

This figure presents scatter-plots of hourly wage growth from 2007Q1 to 2009Q1 against the debt to income ratio of the county as of 2006. The left panel examines all wages and the right panel examines wages at the 25th percentile of the distribution. The sample includes only counties with more than 50,000 households.

Figure 7
Household Balance Sheet Weakness and Mobility

This figure presents scatter-plots of mobility from 2007 to 2009 against the debt to income ratio of the county/state as of 2006. The left panel utilizes state level data from the Census on total population growth. The right panel uses labor force data from the county business patterns. The sample for the right panel includes only counties with more than 50,000 households.

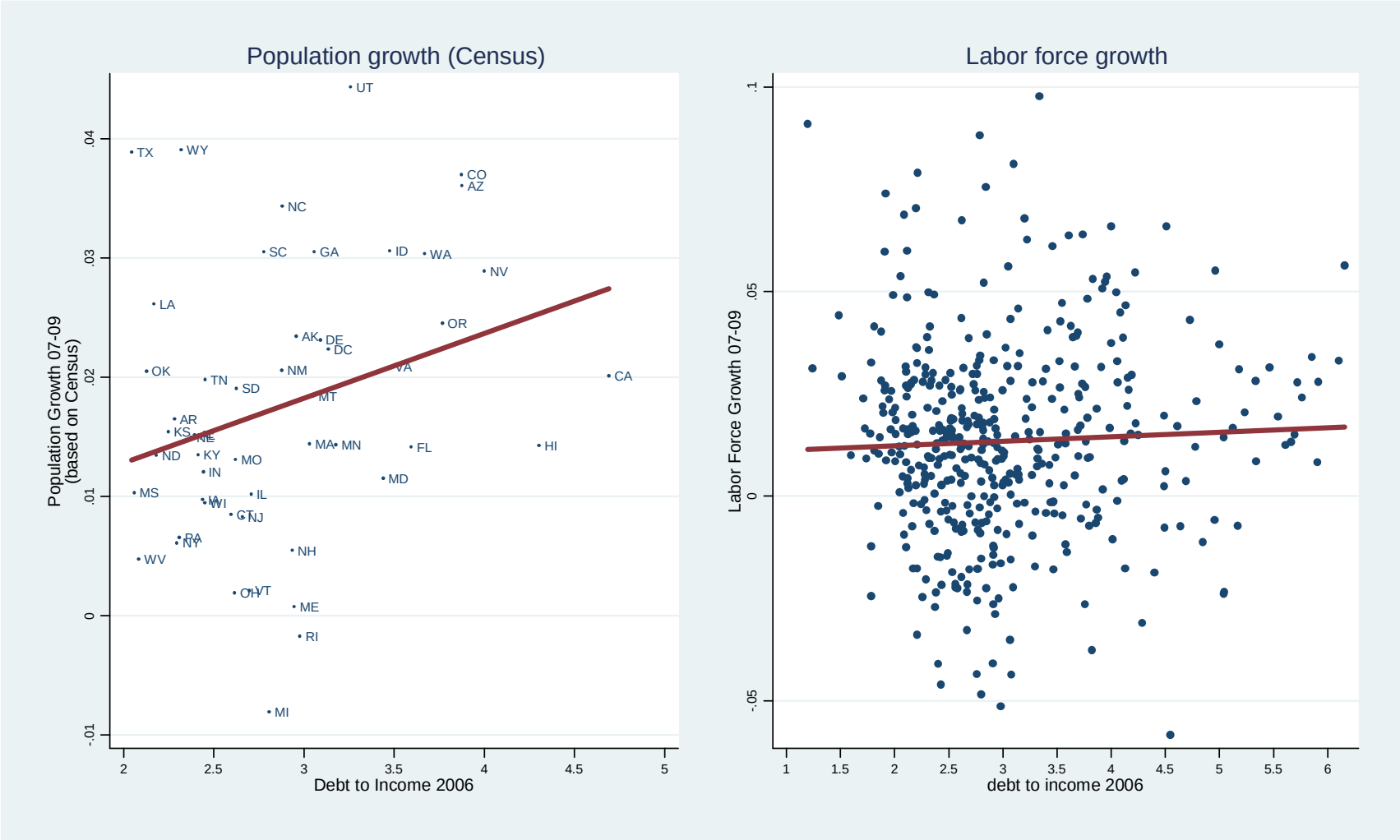

Table 1
Household Balance Sheet Weakness, Aggregate Demand, and Employment

This table presents regression coefficients relating employment growth in a county from 2007 to 2009 to the debt to income ratio of the county in 2006. The specification "WLS" is weighted least squares where the weights are total number of households in the county. The instrumental variables specifications in column 5 uses the housing supply elasticity of the county (Saiz (2011)) as an instrument for the debt to income ratio in the first stage, which is reported in column 4. Standard errors are heterskedasticity robust.

						Motivating Example	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Employment growth, 2007-2009			Debt to income, 2006	Employment growth, 2007-2009	Auto Retail Employment growth, 2007-2009	Auto Manufacturing Employment growth, 2007-2009
Debt to income, 2006	-0.018**	-0.019**	-0.020**		-0.020**	-0.036**	0.006
	(0.002)	(0.002)	(0.003)		(0.006)	(0.004)	(0.025)
Housing supply elasticity (Saiz)				-0.372**			
				(0.059)			
Constant	0.001	0.007	0.010	3.693**	0.010	-0.019	-0.319**
	(0.006)	(0.007)	(0.009)	(0.168)	(0.017)	(0.013)	(0.080)
Specification	WLS	OLS	WLS	WLS	IV	WLS	WLS
Sample	Full	> 50K households	Elasticity available	Elasticity available	Elasticity available	Full	Full
N	3,135	450	877	877	877	3,009	1,528
R^2	0.096	0.130	0.162	0.180	0.162	0.045	0.000

**,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively

Table 2
Industry Categorization

This table presents the largest 10 industries in each category of goods produced. The % column gives the percentage of the entire 2007 labor force represented by the industry in question. Please see the text for the methodology used to categorize each industry. See Appendix Table 1 for a complete list of industries and their category.

Non-tradable Industries (19.6% of total employment)			**Tradable Industries** (10.7% of total employment)		
		%	NAICS	Industry name	%
7221	Full-service restaurants	3.76	3261	Plastics product manufacturing	0.60
7222	Limited-service eating places	3.40	3231	Printing and related support activities	0.53
4451	Grocery stores	2.13	3363	Motor vehicle parts manufacturing	0.52
4521	Department stores	1.36	3116	Animal slaughtering and processing	0.44
4529	Other general merchandise stores	1.12	3364	Aerospace product and parts manufacturing	0.35
4481	Clothing stores	1.06	3327	Machine shops; screw nut and bolt manufacturing	0.33
4461	Health and personal care stores	0.89	3345	Navigational and control instruments manufacturing	0.33
4471	Gasoline stations	0.73	3344	Semiconductor and other electronic manufacturing	0.32
7223	Special food services	0.49	3399	Other miscellaneous manufacturing	0.31
4511	Sporting goods hobby and music stores	0.38	5112	Software publishers	0.29

Construction Industries (11.2% of total employment)			**Other Industries** (58.5% of total employment)		
NAICS	Industry name	%	NAICS	Industry name	%
2382	Building equipment contractors	1.62	6221	General medical and surgical hospitals	4.31
5413	Architectural engineering and related services	1.19	5511	Management of companies and enterprises	2.60
4441	Building material and supplies dealers	1.00	5613	Employment services	2.56
2381	Foundation structure and building contractors	0.91	6211	Offices of physicians	1.79
2383	Building finishing contractors	0.78	5221	Depository credit intermediation	1.77
2361	Residential building construction	0.75	7211	Traveler accommodation	1.54
2362	Nonresidential building construction	0.64	5617	Services to buildings and dwellings	1.42
5313	Activities related to real estate	0.54	8131	Religious organizations	1.39
2389	Other specialty trade contractors	0.48	6231	Nursing care facilities	1.37
5311	Lessors of real estate	0.45	6113	Colleges universities and professional schools	1.35

Table 3
Industry Categorization Based On Geographical Concentration

This table lists the top and bottom 30 industries by geographical concentration. For each industry we compute Herfindahl index based on the shares of employment for that industry across counties. The most concentrated (top 30) are likely to be "tradable" in that they depend on national or international demand. If an industry needs to be physically present in an area to provide its goods or services, then it is likely to be non-tradable and least concentrated (bottom 30). The indicator variable for traded and non-traded reports the classification according to our other methodology reported in Table 2.

Herfindahl Top-30		**Herfindahl Bottom-30**	
Industry name	Traded?	Industry name	Non-Traded?
Securities and commodity exchanges	0	Lawn and garden equipment stores	0
Pipeline transportation of crude oil	0	Farm product raw material wholesalers	0
Cut and sew apparel manufacturing	1	Gasoline stations	1
Motion picture and video industries	0	Nonmetallic mineral mining and quarrying	0
Agents and managers for artists athletes	0	Other general merchandise stores	1
Deep sea coastal and lakes transportation	0	RV parks and recreational camps	0
Cable and other subscription programming	0	Sawmills and wood preservation	0
Sound recording industries	0	Florists	1
Tobacco manufacturing	1	Death care services	0
Independent artists writers and performers	0	General rental centers	0
Railroad rolling stock manufacturing	1	Direct selling establishments	0
Scenic and sightseeing transportation other	0	Building material and supplies dealers	0
Amusement parks and arcades	0	Other motor vehicle dealers	1
Scenic and sightseeing transportation water	0	Nursing care facilities	0
Securities and commodity brokerage	0	Automotive parts accessories and tire stores	1
Internet Service Providers and Web Search	0	Logging	0
Metal ore mining	1	Specialized freight trucking	0
Support activities for water transportation	0	Cement and concrete product manufacturing	0
Apparel goods wholesalers	0	Other wood product manufacturing	0
Other support activities for transportation	0	mental health and substance abuse facilities	0
Monetary authorities- central bank	0	Beer wine and liquor stores	1
Oil and gas extraction	1	Community care facilities for the elderly	0
Fishing	1	Child day care services	0
Apparel knitting mills	1	Vocational rehabilitation services	0
Internet Publishing and Broadcasting	0	Consumer goods rental	0
Pipeline transportation of natural gas	0	Electric power generation transmission	0
Footwear manufacturing	1	Plastics product manufacturing	0
Manufacturing magnetic and optical media	1	Religious organizations	0
Ship and boat building	1	Animal food manufacturing	0
Textile furnishings mills	1	Highway street and bridge construction	0

Table 4
Summary Statistics

This table presents summary statistics for the county-level data used in the analysis. Employment data are from the Census County Business Patterns, wage data are from the American Community Survey, debt data are from Equifax, and income data are from the IRS. The last two columns are weighted by the number of households in the county as of 2000.

	N	Mean	SD	10^{th}	90^{th}	Weighted mean	Weighted SD
Debt to income, 2006	3135	2.456	0.960	1.494	3.596	2.941	0.967
Number of households, 2000, thousands	3135	37	111	2	73	370	620388.500
Labor force growth, 2007 to 2009	3135	0.012	0.041	-0.035	0.055	0.013	0.029
Total employment, 2007, thousands	3135	39	138	1	74	439	754
Employment growth, 2007 to 2009	3135	-0.048	0.103	-0.157	0.057	-0.052	0.056
Average wage, 2007	3091	5.731	2.146	3.719	8.127	8.905	3.822
Average wage growth, 2007 to 2009	3074	0.049	0.187	-0.090	0.196	0.028	0.074
Housing supply elasticity (Saiz)	877	2.507	1.345	1.059	3.993	1.798	1.077
Non-tradable employment growth, 2007 to 2009	3132	-0.025	0.153	-0.158	0.118	-0.037	0.073
Food industry employment growth, 2007 to 2009	3132	-0.013	0.162	-0.154	0.142	-0.020	0.077
Tradable employment growth, 2007 to 2009	3053	-0.121	0.380	-0.481	0.182	-0.116	0.187
Construction employment growth, 2007 to 2009	3126	-0.123	0.237	-0.401	0.139	-0.152	0.151
Other employment growth, 2007 to 2009	3134	-0.017	0.123	-0.146	0.111	-0.025	0.065
Industry geographical herfindahl, 2007	294	0.016	0.023	0.003	0.034	0.020	0.023
Hourly wage, 2007	3142	17.005	2.715	14.511	20.300	20.178	3.848
Hourly wage, 10th percentile, 2007	3142	5.345	0.734	4.525	6.250	6.050	0.835
Hourly wage, 25th percentile, 2007	3142	8.238	1.217	6.923	9.633	9.466	1.534
Hourly wage, median, 2007	3142	20.441	3.631	17.094	24.583	24.512	5.235
Hourly wage, 75th percentile, 2007	3142	30.717	5.660	25.641	36.813	37.517	8.827
Hourly wage, 90th percentile, 2007	3142	12.997	2.137	11.058	15.385	15.326	2.961
Wage growth, 2007 to 2009	3141	0.029	0.104	-0.108	0.154	0.014	0.076
Wage growth, 10th percentile, 2007 to 2009	3141	0.068	0.072	-0.022	0.155	0.051	0.054
Wage growth, 25th percentile, 2007 to 2009	3141	0.066	0.064	-0.009	0.153	0.054	0.047
Wage growth, median, 2007 to 2009	3141	0.056	0.080	-0.044	0.163	0.044	0.056
Wage growth, 75th percentile, 2007 to 2009	3141	0.079	0.061	0.011	0.158	0.060	0.047
Wage growth, 90th percentile, 2007 to 2009	3141	0.048	0.067	-0.033	0.139	0.035	0.046

Table 5
Aggregate Demand and Unemployment across Counties: Non-Tradable And Tradable Industries

This table presents coefficients from regressions relating employment growth in a county from 2007 to 2009 to the debt to income ratio of the county as of 2006. We split employment into non-tradable and tradable industries. The specification "WLS" is weighted least squares where the weights are total number of households in the county. The instrumental variables specification in column 3 uses the housing supply elasticity of the county (Saiz (2011)) as an instrument for the debt to income ratio in the first stage. Standard errors are heterskedasticity robust.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Employment growth, non-tradable industries, 2007-2009				Employment growth, food retail only, 2007-2009	Employment growth, tradable industries, 2007-2009	
Debt to income, 2006	-0.021**	-0.023**	-0.031**	-0.023**	-0.017**	0.007	-0.001
	(0.002)	(0.003)	(0.007)	(0.002)	(0.002)	(0.006)	(0.007)
Construction share, 2007				0.135**			0.029
				(0.047)			(0.119)
Non-tradable share, 2007				-0.070			0.147
				(0.046)			(0.118)
Tradable share, 2007				-0.035			-0.318**
				(0.026)			(0.069)
Constant	0.026**	0.033**	0.054**	0.034*	0.031**	-0.137**	-0.111**
	(0.006)	(0.009)	(0.019)	(0.016)	(0.006)	(0.016)	(0.038)
Specification	WLS	OLS	IV	WLS	WLS	WLS	WLS
Sample	Full	> 50K	elasticity available	Full	Full	Full	Full
N	3,132	450	877	3,132	3,132	3,053	3,053
R^2	0.078	0.081	0.087	0.085	0.047	0.001	0.018

**,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively

Table 6
Aggregate Demand and Unemployment across Counties:
Using Concentration to Measure Tradability

This table presents coefficients from regressions relating employment growth in a county from 2007 to 2009 to the debt to income ratio of the county as of 2006. We use an alternative measure of non-tradable industries based on the concentration of employment across counties--low concentration industries are assumed to be more non-tradable. Columns 1 through 4 examine industries in the bottom quartile based on concentration, columns 5 and 6 use a continuous measure of concentration, and columns 7 and 8 examine industries in the top quartile based on concentration. Standard errors are heterskedasticity robust.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Employment growth, 2007-2009					
Industries?	Lowest concentration quartile industries				Highest concentration quartile industries	
Debt to income, 2006	-0.019**	-0.021**	-0.027**	-0.019**	0.010	0.003
	(0.002)	(0.002)	(0.006)	(0.002)	(0.007)	(0.008)
Lowest Concentration Quartile Share, 2007				-0.000		
				(0.000)		
Highest Concentration Quartile Share, 2007						0.000
						(0.001)
Construction share, 2007				-0.089**		-0.401**
				(0.021)		(0.088)
Non-tradable share, 2007				0.035		0.370*
				(0.037)		(0.147)
Tradable share, 2007				-0.168**		-0.336*
				(0.041)		(0.165)
Constant	0.018**	0.026**	0.043*	0.040**	-0.113**	-0.086
	(0.006)	(0.007)	(0.018)	(0.011)	(0.023)	(0.049)
Specification	WLS	OLS	IV	WLS	WLS	WLS
Sample	Full	>50K	Elasticity available	Full	Full	Full
N	3,134	450	877	3,134	3,067	3,067
R^2	0.090	0.132	0.151	0.110	0.002	0.023

**,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively

Table 7
Household Balance Sheet Weakness and Construction

This table presents coefficients from regressions relating employment growth in a county from 2007 to 2009 to the debt to income ratio of the county as of 2006. We split employment into non-tradable and tradable industries. The specification "WLS" is weighted least squares where the weights are total number of households in the county. The instrumental variables specification in columns 2 and 4 uses the housing supply elasticity of the county (Saiz (2011)) as an instrument for the debt to income ratio in the first stage. Standard errors are heterskedasticity robust.

	(1)	(2)	(3)	(4)
	Construction share, 2007		Construction share growth, 2000-2007	
Debt to income, 2006	0.015**	0.001	0.102**	0.020
	(0.003)	(0.005)	(0.029)	(0.044)
Constant	0.066**	0.110**	0.648**	0.895**
	(0.009)	(0.014)	(0.083)	(0.118)
Specification	WLS	IV	WLS	IV
N	877	877	874	874
R^2	0.151	0.016	0.090	0.032

**,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively

Table 8
Aggregate Demand and Employment Growth in Non-Tradable Industries
By Firm Size

This table presents coefficients from regressions relating employment growth in non-tradable industries in a county from 2007 to 2009 to the debt to income ratio of the county as of 2006. We split firms by the number of employees at the firm. The specification "WLS" is weighted least squares where the weights are total number of households in the county. Standard errors are heterskedasticity robust.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Employment growth, non-tradable industries, 2007-2009					
Number of employees at firm:	1-4	5-9	10-19	20-49	50-99	100+
Share of total employment	0.08	0.07	0.10	0.17	0.12	0.45
Debt to income, 2006	-0.010**	-0.008**	0.005	-0.012**	-0.023**	-0.052**
	(0.002)	(0.002)	(0.003)	(0.002)	(0.005)	(0.005)
Constant	-0.016	0.014	-0.021*	0.006	-0.008	0.109**
	(0.009)	(0.008)	(0.010)	(0.008)	(0.017)	(0.019)
Specification	WLS	WLS	WLS	WLS	WLS	WLS
Sample	Firms with 1-4 employees	Firms with 5-9 employees	Firms with 10-19 employees	Firms with 20-49 employees	Firms with 50-99 employees	Firms with 100+ employees
N	3,125	3,102	3,064	2,898	2,259	1,913
R^2	0.010	0.003	0.001	0.009	0.010	0.057

**,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively

Table 9
Aggregate Demand and Wage Growth across Counties

This table presents coefficients from regressions relating wage growth in a county from 2007 to 2009 to the debt to income ratio of the county as of 2006. The specifications in columns 1 through 4 use total wages from the Census County Business Patterns data. The specifications in columns 5 through 7 use hourly wage growth data from the American Community Survey. "WLS" is weighted least squares where the weights are total number of households in the county. The instrumental variables specification in column 4 uses the housing supply elasticity of the county (Saiz (2011)) as an instrument for the debt to income ratio in the first stage. Standard errors are heterskedasticity robust.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable	Total wage growth, 2007 to 2009, CBP				Hourly wage growth, 2007 to 2009, ACS		
					Mean	10th percentile	90th percentile
Debt to income, 2006	-0.006	-0.009**	-0.008*	-0.020**	-0.006**	-0.008**	-0.002
	(0.004)	(0.003)	(0.004)	(0.007)	(0.001)	(0.002)	(0.002)
Constant	0.047**	0.057**	0.057**	0.093**	0.054**	0.038**	0.050**
	(0.014)	(0.010)	(0.011)	(0.021)	(0.004)	(0.007)	(0.005)
Specification	WLS	OLS	OLS	IV	WLS	WLS	WLS
Sample	Full	> 50K	> 50K, elasticity available	> 50K, elasticity available	Full	Full	Full
N	3,074	450	356	356	3,134	3,134	3,134
R^2	0.007	0.025	0.020		0.017	0.010	0.001

**,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively

Table 10
Household Leverage, Mobility, and Labor Supply across Counties

This table presents coefficients from regressions relating mobility and labor force participation in a county from 2007 to 2009 to the debt to income ratio of the county as of 2006. The specifications in columns 1 through 2 use state level data on population and net migration from the American Community Survey. The specifications in columns 3 through 6 use labor force data from the Census County Business Patterns. "WLS" is weighted least squares where the weights are total number of households in the county. The instrumental variables specification in column 5 uses the housing supply elasticity of the county (Saiz (2011)) as an instrument for the debt to income ratio in the first stage. Standard errors are heterskedasticity robust.

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Population growth, 2007-2009	Net migration, 2007-2009	Labor force growth, 2007-2009		
Debt to income, 2006	0.005*	0.003	0.001	0.001	0.009*
	(0.002)	(0.002)	(0.001)	(0.001)	(0.004)
Constant	0.002	-0.002	0.010**	0.010*	-0.011
	(0.007)	(0.006)	(0.003)	(0.004)	(0.012)
Specification	OLS	OLS	WLS	OLS	IV
Sample	States	States	Full	> 50K	> 50K
N	51	51	3,135	450	356
R^2	0.085	0.041	0.002	0.001	

**,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively

Appendix Table 1
Industry Categorization

This table presents all of the 294 industries by category of goods produced (sorted by 4-digit code within a category). The % column gives the percentage of the entire 2007 labor force represented by the industry in question. Please see the text for the methodology used to categorize each industry.

Non-tradable Industries (Narrow Definition – Restaurants and Grocery)			**Tradable Industries**		
NAICS	*Industry name*	*%*	*NAICS*	*Industry name*	*%*
4451	Grocery stores	2.13	1132	Forest nurseries and gathering of forest products	0.00
4452	Specialty food stores	0.15	1141	Fishing	0.01
4453	Beer wine and liquor stores	0.13	2111	Oil and gas extraction	0.10
4461	Health and personal care stores	0.89	2121	Coal mining	0.07
4471	Gasoline stations	0.73	2122	Metal ore mining	0.03
4481	Clothing stores	1.06	2123	Nonmetallic mineral mining and quarrying	0.10
4482	Shoe stores	0.18	3111	Animal food manufacturing	0.05
4483	Jewelry luggage and leather goods stores	0.14	3112	Grain and oilseed milling	0.05
4511	Sporting goods hobby and musical instrument stores	0.38	3113	Sugar and confectionery product manufacturing	0.07
4512	Book periodical and music stores	0.16	3114	Fruit and vegetable preserving and specialty food manufacturing	0.15
4521	Department stores	1.36	3115	Dairy product manufacturing	0.11
4529	Other general merchandise stores	1.12	3116	Animal slaughtering and processing	0.44
4531	Florists	0.08	3117	Seafood product preparation and packaging	0.03
4532	Office supplies stationery and gift stores	0.27	3118	Bakeries and tortilla manufacturing	0.25
4533	Used merchandise stores	0.12	3119	Other food manufacturing	0.14
4539	Other miscellaneous store retailers	0.23	3121	Beverage manufacturing	0.12
7221	Full-service restaurants	3.76	3122	Tobacco manufacturing	0.02
7222	Limited-service eating places	3.40	3131	Fiber yarn and thread mills	0.04
7223	Special food services	0.49	3132	Fabric mills	0.07
7224	Drinking places (alcoholic beverages)	0.31	3133	Textile and fabric finishing and fabric coating mills	0.04
Non-tradable Industries (remaining non-tradable industries)			3335	Metalworking machinery manufacturing	3141
4411	Automobile dealers	1.05	3149	Other textile product mills	0.07
4412	Other motor vehicle dealers	0.15	3151	Apparel knitting mills	0.02
4413	Automotive parts accessories and tire stores	0.41	3152	Cut and sew apparel manufacturing	0.14
4421	Furniture stores	0.23	3159	Apparel accessories and other apparel manufacturing	0.01
4422	Home furnishings stores	0.27	3161	Leather and hide tanning and finishing	0.00
4431	Electronics and appliance stores	0.42	3162	Footwear manufacturing	0.01

Tradable Industries (continued)			Tradable Industries (continued)		
NAICS	*Industry name*	*%*	*NAICS*	*Industry name*	*%*
3169	Other leather and allied product manuf.	0.02	3332	Industrial machinery manufacturing	0.12
3221	Pulp paper and paperboard mills	0.12	3333	Commercial and service industry machinery manufacturing	0.08
3222	Converted paper product manufacturing	0.25	3334	Ventilation heating air-conditioning and refrigeration equipment manuf.	0.14
3231	Printing and related support activities	0.53	3335	Metalworking machinery manufacturing	0.15
3241	Petroleum and coal products manuf.	0.09	3336	Engine turbine and power transmission equipment manufacturing	0.09
3251	Basic chemical manufacturing	0.15	3339	Other machinery manufacturing	0.25
3252	Resin synthetic rubber and artificial synthetic fibers manufacturing	0.08	3341	Computer and peripheral equipment manufacturing	0.09
3253	Pesticide fertilizer and other agricultural chemical manufacturing	0.03	3342	Communications equipment manufacturing	0.14
3254	Pharmaceutical and medicine manuf.	0.21	3343	Audio and video equipment manuf.	0.02
3255	Paint coating and adhesive manufacturing	0.06	3344	Semiconductor and other electronic component manufacturing	0.32
3256	Soap cleaning compound and toilet preparation manufacturing	0.09	3345	Navigational measuring electromedical and control instruments manufacturing	0.33
3259	Other chemical product manuf.	0.10	3346	Manufacturing and reproducing magnetic and optical media	0.03
3261	Plastics product manufacturing	0.60	3351	Electric lighting equipment manuf.	0.05
3262	Rubber product manufacturing	0.13	3352	Household appliance manufacturing	0.06
3271	Clay product and refractory manuf.	0.05	3353	Electrical equipment manufacturing	0.12
3272	Glass and glass product manufacturing	0.09	3359	Other electrical equipment manuf.	0.13
3279	Other nonmetallic mineral product manufacturing	0.08	3361	Motor vehicle manufacturing	0.17
3311	Iron and steel mills and ferroalloy manufacturing	0.10	3362	Motor vehicle body and trailer manufacturing	0.13
3313	Alumina and aluminum production and processing	0.06	3363	Motor vehicle parts manufacturing	0.52
3314	Nonferrous metal (except aluminum) production and processing	0.06	3364	Aerospace product and parts manufacturing	0.35
3315	Foundries	0.14	3365	Railroad rolling stock manufacturing	0.03
3322	Cutlery and handtool manufacturing	0.05	3366	Ship and boat building	0.13
3324	Boiler tank and shipping container manufacturing	0.08	3369	Other transportation equipment manufacturing	0.04
3325	Hardware manufacturing	0.04	3372	Office furniture manufacturing	0.12
3326	Spring and wire product manufacturing	0.05	3391	Medical equipment manufacturing	0.27
3327	Machine shops; turned product; and screw nut and bolt manufacturing	0.33	3399	Other miscellaneous manufacturing	0.31
3329	Fabricated metal product manufacturing	0.24	5112	Software publishers	0.29
3331	Agriculture construction and mining machinery manufacturing	0.18			

Construction			Other Industries		
NAICS	*Industry name*	*%*	*NAICS*	*Industry name*	*%*
1133	Logging	0.05	1131	Timber tract operations	0.00
2361	Residential building construction	0.75	1142	Hunting and trapping	0.00
2362	Nonresidential building construction	0.64	1151	Support activities for crop production	0.06
2371	Utility system construction	0.44	1152	Support activities for animal production	0.02
2372	Land subdivision	0.07	1153	Support activities for forestry	0.02
2373	Highway street and bridge construction	0.28	2131	Support activities for mining	0.20
2381	Foundation structure and building exterior contractors	0.91	2211	Electric power generation transmission and distribution	0.46
2382	Building equipment contractors	1.62	2212	Natural gas distribution	0.08
2383	Building finishing contractors	0.78	2213	Water sewage and other systems	0.04
2389	Other specialty trade contractors	0.48	2379	Other heavy and civil eng. construction	0.08
3211	Sawmills and wood preservation	0.10	3274	Lime and gypsum product manuf.	0.02
3212	Veneer plywood & eng. wood manuf.	0.10	3312	Steel product manuf	0.04
3219	Other wood product manufacturing	0.27	3321	Forging and stamping	0.11
3273	Cement and concrete product manuf.	0.20	3328	Coating engraving heat treating	0.12
3323	Architectural and structural metals manuf.	0.34	3379	Other furniture related product manuf.	0.04
3371	Furniture and kitchen cabinet manuf.	0.29	4231	Motor vehicle / parts wholesalers	0.30
4233	Lumber / construction wholesalers	0.23	4232	Furniture / home furnishing wholesalers	0.13
4441	Building material and supplies dealers	1.00	4234	Professional / comm. equip. wholesalers	0.58
4442	Lawn and garden stores	0.15	4235	Metal and mineral merchant wholesalers	0.14
5311	Lessors of real estate	0.45	4236	Electrical goods wholesalers	0.37
5312	Offices of real estate agents and brokers	0.31	4237	Hardware plumbing /heating wholesalers	0.20
5313	Activities related to real estate	0.54	4238	Machinery equipment wholesalers	0.60
5413	Architectural engineering services	1.19	4239	Misc. durable goods wholesalers	0.30
			4241	Paper product merchant wholesalers	0.15
			4242	Drugs merchant wholesalers	0.20
			4243	Apparel piece goods wholesalers	0.17
			4244	Grocery and related wholesalers	0.65
			4245	Farm product raw material wholesalers	0.06
			4246	Chemical / allied products wholesalers	0.12
			4247	Petroleum wholesalers	0.09
			4248	Beer wine wholesalers	0.15
			4249	Miscellaneous nondurable goods merchant wholesalers	0.32
			4251	Wholesale electronic markets and agents and brokers	0.29
			4541	Electronic shopping and mail-order houses	0.23
			4542	Vending machine operators	0.05
			4543	Direct selling establishments	0.17
			4811	Scheduled air transportation	0.40
			4812	Nonscheduled air transportation	0.04

Other Industries (continued)			Other Industries (continued)		
NAICS	*Industry name*	*%*	*NAICS*	*Industry name*	*%*
4831	Deep sea and great lakes transportation	0.05	5182	Data processing hosting services	0.32
4832	Inland water transportation	0.02	5191	Other information services	0.05
4841	General freight trucking	0.83	5211	Monetary authorities- central bank	0.02
4842	Specialized freight trucking	0.40	5221	Depository credit intermediation	1.77
4851	Urban transit systems	0.05	5222	Nondepository credit intermediation	0.63
4852	Interurban and rural bus transportation	0.02	5223	Activities - credit intermediation	0.29
4853	Taxi and limousine service	0.06	5231	Securities and commodity contracts intermediation and brokerage	0.45
4854	School and employee bus transportation	0.18	5232	Securities and commodity exchanges	0.01
4855	Charter bus industry	0.03	5239	Other financial investment activities	0.35
4859	Other transit and ground transportation	0.06	5241	Insurance carriers	1.17
4861	Pipeline transportation of crude oil	0.01	5242	Agencies brokerages and other insurance related activities	0.74
4862	Pipeline transportation of natural gas	0.03	5259	Other investment pools and funds	0.03
4869	Other pipeline transportation	0.01	5321	Automotive equipment rental	0.17
4871	Scenic and sightseeing transportation land	0.01	5322	Consumer goods rental	0.20
4872	Scenic and sightseeing trans. water	0.01	5323	General rental centers	0.03
4879	Scenic and sightseeing trans. other	0.00	5324	Commercial and industrial machinery and equipment rental and leasing	0.14
4881	Support activities for air transportation	0.15	5331	Lessors of nonfinancial intangible assets	0.03
4882	Support activities for rail transportation	0.03	5411	Legal services	1.00
4883	Support activities for water transportation	0.08	5412	Accounting tax and payroll services	1.02
4884	Support activities for road transportation	0.07	5414	Specialized design services	0.12
4885	Freight transportation arrangement	0.18	5415	Computer systems design services	1.05
4889	Other support activities for transportation	0.03	5416	Management scientific and technical consulting services	0.84
4921	Couriers and express delivery services	0.45	5417	Scientific research and development services	0.58
4922	Local messengers and local delivery	0.04	5418	Advertising public relations and related services	0.38
4931	Warehousing and storage	0.59	5419	Other professional scientific and technical services	0.50
5111	Newspaper periodical book and directory publishers	0.59	5511	Management of companies and enterprises	2.60
5121	Motion picture and video industries	0.26	5611	Office administrative services	0.40
5122	Sound recording industries	0.02	5612	Facilities support services	0.16
5151	Radio and television broadcasting	0.22	5613	Employment services	2.56
5152	Cable and other subscription	0.04	5614	Business support services	0.63
5161	Internet Publishing and Broadcasting	0.04	5615	Travel arrangement and reservation services	0.21
5171	Wired telecommunications carriers	0.56	5616	Investigation and security services	0.64
5172	Wireless telecommunications carriers	0.25	5617	Services to buildings and dwellings	1.42
5173	Telecommunications Resellers	0.03	5619	Other support services	0.28
5174	Satellite telecommunications	0.01	5621	Waste collection	0.16
5175	Cable and Other Program Distribution	0.22	5622	Waste treatment and disposal	0.05
5179	Other telecommunications	0.02	5629	Remediation and other waste management services	0.10
5181	Internet Service Providers and Web Search Portals	0.07	6111	Elementary and secondary schools	0.69

Other Industries (continued)			Other Industries (continued)		
NAICS	*Industry name*	*%*	*NAICS*	*Industry name*	*%*
6112	Junior colleges	0.07	7139	Other amusement and recreation industries	0.92
6113	Colleges universities and professional schools	1.35	7211	Traveler accommodation	1.54
6114	Business schools and computer and management training	0.06	7212	RV (recreational vehicle) parks and recreational camps	0.04
6115	Technical and trade schools	0.10	7213	Rooming and boarding houses	0.01
6116	Other schools and instruction	0.26	8111	Automotive repair and maintenance	0.74
6117	Educational support services	0.06	8112	Electronic and precision equipment repair and maintenance	0.11
6211	Offices of physicians	1.79	8113	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	0.17
6212	Offices of dentists	0.68	8114	Personal and household goods repair and maintenance	0.09
6213	Offices of other health practitioners	0.51	8121	Personal care services	0.51
6214	Outpatient care centers	0.59	8122	Death care services	0.12
6215	Medical and diagnostic laboratories	0.19	8123	Drycleaning and laundry services	0.32
6216	Home health care services	0.85	8129	Other personal services	0.22
6219	Other ambulatory health care services	0.23	8131	Religious organizations	1.39
6221	General medical and surgical hospitals	4.31	8132	Grantmaking and giving services	0.13
6222	Psychiatric and substance abuse hospitals	0.19	8133	Social advocacy organizations	0.11
6223	Specialty (except psychiatric and substance abuse) hospitals	0.19	8134	Civic and social organizations	0.28
6231	Nursing care facilities	1.37	8139	Business professional labor political and similar organizations	0.44
6232	Residential mental retardation mental health and substance abuse facilities	0.47			
6233	Community care facilities for the elderly	0.58			
6239	Other residential care facilities	0.14			
6241	Individual and family services	0.92			
6242	Community food and housing and emergency and other relief services	0.15			
6243	Vocational rehabilitation services	0.29			
6244	Child day care services	0.71			
7111	Performing arts companies	0.12			
7112	Spectator sports	0.11			
7113	Promoters of performing arts sports and similar events	0.10			
7114	Agents and managers for artists athletes entertainers and other public figures	0.02			
7115	Independent artists writers and performers	0.04			
7121	Museums historical sites and similar institutions	0.11			
7131	Amusement parks and arcades	0.11			
7132	Gambling industries	0.18			

Appendix Figure 1
Household Leverage, Aggregate Demand, and Construction

The left panel replicates the left panel of Figure 3 from the analysis. The middle panel plots the employment losses from 2007 to 2009 in industries producing non-tradable goods against the share of workers in the construction industry as of 2007. The right panel plots employment losses in the construction industry against the debt to income ratio as of 2006.

Appendix Figure 2
Employment Results through 2010

This figure plots total employment in high and low leverage counties from 2006 through 2010. High (low) leverage counties are defined to be those counties in the top (bottom) quartile of the 2006 debt to income distribution, where quartiles are weighted by total population. The sample is restricted to counties with at least 50,000 households. The data for this figure come from the Bureau of Labor Statistics, which is a different source than the data used in the analysis of the paper. These data are not broken down by industry.