Macroeconomic Effects of Debt Relief: Consumer Bankruptcy Protections in the Great Recession*

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This paper argues that the debt forgiveness provided by the U.S. consumer bankruptcy system helped stabilize the level of employment during the Great Recession. We begin by documenting that states with more and less generous bankruptcy exemptions had statistically identical employment outcomes during the 2001-2007 period. Starting in 2008, however, states with more generous bankruptcy exemptions had significantly smaller declines in local non-tradable employment and larger increases in unsecured debt write-downs compared to states with less generous exemptions. We interpret these responses as the causal effect of the debt relief provided by the consumer bankruptcy system on employment across states, and develop a general equilibrium model to recover the aggregate effect of this debt relief. The model yields three key results. First, substantial nominal rigidities are required to rationalize our reduced form cross-state estimates. Second, with monetary policy at the zero lower bound, traded good demand spillovers from more generous to less generous states boosted employment everywhere. Finally, the ex-post debt forgiveness provided by the consumer bankruptcy system during the Great Recession increased aggregate employment by almost two percent.

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There is a widespread view that the deterioration of household balance sheets contributed to the sharp decline in U.S. employment between 2007 and 2009. According to this view, the sudden fall in house prices and the simultaneous contraction in credit supply led to a large drop in aggregate consumption as households adjusted towards lower debt levels. Since monetary policy was unable to offset this fall in aggregate demand, employment collapsed nationwide (e.g., Eggertsson and Krugman 2012; Mian and Sufi 2014*b*). An important implication of this view is that ex-post debt forgiveness could have prevented such a collapse by mitigating the decline in aggregate demand.[1] To date, however, there is little empirical evidence on the aggregate impact of ex-post debt relief during economic downturns. Credible estimates of these effects are critical for evaluating the extent to which debt relief could be used as an aggregate demand management tool in future recessions.

In this paper, we use a combination of quasi-experimental estimates and a general equilibrium model to estimate the effects of ex-post debt forgiveness on macroeconomic outcomes during the Great Recession. We focus on the debt forgiveness provided by the protections embedded in the U.S. consumer bankruptcy system, the largest debt relief program in the United States. We overcome the reverse causality and endogeneity issues that bias simple time-series comparisons by first estimating the *relative* effect of ex-post debt forgiveness during the Great Recession, using quasi-random variation in the level of bankruptcy asset exemptions across states. We then develop a general equilibrium model to recover the *aggregate* effect of the ex-post debt forgiveness from these relative treatment effects.

The U.S. consumer bankruptcy system allows eligible households who file for bankruptcy to discharge most unsecured debts, after relinquishing assets above state-specific exemption limits. Eligible households are therefore insured against all financial risk above the level of assets that can be seized in bankruptcy in their state. Bankruptcy exemptions also provide a natural threat point in negotiations with creditors, thereby providing a form of informal debt relief even when these households do not formally file for bankruptcy (e.g., Mahoney 2015). Households benefiting from the consumer bankruptcy system are, naturally, more financially distressed than the general population (e.g., Dobbie, Goldsmith-Pinkham and Yang 2015), and, as a result, are likely to have very high marginal propensities to consume (MPCs) (e.g., Gross, Notowidigdo and Wang 2016). The debt forgiveness provided by the bankruptcy system could therefore boost aggregate demand if the households who

[1]For example, Mian and Sufi (2014*a*) argue that "severe recessions are special circumstances because macroeconomic failures prevent the economy from reacting to a severe drop in demand. [...] When such failures prevent the economy from adjusting to such a large decline in consumption, government policy should do what it can to boost household spending. Debt forgiveness is exactly one such policy, and arguably the most effective."

implicitly finance the bankruptcy system have low MPCs. This idea has not been studied systematically until now.

The formal and informal debt relief provided by the consumer bankruptcy system during economic downturns, and hence the potential boost to aggregate demand, is economically large, both in absolute terms and compared to other social insurance programs. Figure 1 shows the employment-to-population ratio in the United States between 2000 and 2017, together with an estimate of the amount of unsecured credit discharged in Chapter 7 bankruptcy each year. By way of comparison, we also show total payments by the Unemployment Insurance (UI) system, an important automatic stabilizer, and total payouts by the Home Affordable Modification Program (HAMP) and four other debt relief programs under the umbrella of the Troubled Asset Relief Program (TARP).[2] We scale all program payouts by annual personal consumption expenditures (PCE) for comparability throughout. The amount of unsecured debt discharged through Chapter 7 bankruptcy increased sharply in 2008, just as employment fell across the country. The increase in unsecured debt discharges was nearly identical to the increase in UI payments over this time period, and far larger than the payments made through HAMP and the other TARP programs. The informal debt relief provided by the bankruptcy system, as well as the secured debt discharges through Chapter 7 and both the unsecured and secured debt discharges through Chapter 13, only add to this total. In fact, the total net charge-offs on consumer credit, which includes all non-real estate consumer debt written off by creditors, net of recoveries, reached a peak of almost 1.5 percent of personal consumption expenditures in 2010. By contrast, HAMP payouts never reached more than 0.2 percent of PCE in any year.

There is also considerable cross-sectional variation in the generosity of the bankruptcy exemptions by state. The variation is particularly large for the home equity exemptions, the largest and most important exemption category. New York, for example, allows households to protect up to $100,000 of home equity in bankruptcy, while Illinois allows households to protect only $30,000. The variation in homestead exemptions has also been remarkably stable over time, with the initial variation in homestead exemption amounts largely emerging as states formalized their state-level approaches to bankruptcy in the late nineteenth century, in ways that are likely unrelated to current state characteristics (Goodman 1993; Skeel 2001). Consistent with this idea, we show below that most state characteristics are uncorrelated with the state bankruptcy protections in the years just prior to the

[2] In addition to HAMP, we report payouts for the Home Affordable Foreclosure Alternatives (HAFA), the Principal Reduction Alternative (PRA), the Home Affordable Unemployment Program (HAUP), Second Lien Modification Program. See XXX for additional details on these programs, including a detailed breakdown of XXX.

financial crisis. The combination of substantial cross-state variation in bankruptcy exemptions and economically large transfers during the financial crisis makes the consumer bankruptcy system an ideal setting to study the aggregate effects of ex-post debt forgiveness.

We use this variation in a difference-in-differences design that compares outcomes in states with more generous bankruptcy exemptions (the "treated" states) to states with less generous exemptions (the "control" states). This difference-in-differences specification explicitly controls for any pre-existing differences between states with more and less generous exemptions, and, as a result, any time-invariant effects of bankruptcy protections. Our difference-in-differences estimates therefore hold fixed any time-invariant ex-ante impacts of the bankruptcy exemptions, such as over-borrowing, negative effects on credit supply (Gropp, Scholz and White 1997; Severino and Brown 2017), moral hazard in the workplace (White 2011), entrepreneurial risk-taking (Fan and White 2003; Armour and Cumming 2008), or the crowding out of formal insurance (Mahoney 2015). We also explicitly control for any common time effects of the financial crisis, including any common general equilibrium spillovers such as changes in aggregate total factor productivity, monetary policy (Nakamura and Steinsson 2014), or shocks to labor supply (Beraja, Hurst and Ospina 2018). The identifying assumption for our difference-in-differences specification is that, in the absence of any variation in bankruptcy exemptions, outcomes in states with more and less generous exemptions would have evolved in parallel during the Great Recession. This "parallel trends" assumption implies that there are no other reasons why the Great Recession would impact high- and low-exemption states differently, an assumption that we provide extensive support for in our analysis.

Using a rich panel of individual-level credit data and county-level employment data, we find that states with more and less generous bankruptcy exemptions had statistically identical outcomes during the 2001 to 2007 period. Starting in 2008, however, the states with more generous bankruptcy exemptions had significantly smaller declines in local non-tradable employment and larger increases in consumer debt write-downs compared to the states with less generous exemptions. For example, we find that a one standard deviation increase in the generosity of bankruptcy protections (approximately \$65,000 on a base of \$250,000) leads to a 0.399 percentage point increase in non-tradable employment from 2008 to 2010, and a \$150 increase in debt charge-offs over the same time period. The employment results are also extremely persistent, remaining economically and statistically significant through at least 2013. In sharp contrast, we find only a small and statistically insignificant effect on local tradable and other employment in all years.

Our differences-in-differences estimates provide us with credible estimates of the relative effect of an increase in ex-post debt relief across states, holding fixed any common general equilibrium spillovers. In the second part of the paper, we show that the informativeness of these estimates for the aggregate effect of debt relief depends critically on the sign and the magnitude of these general equilibrium spillovers. We develop a simple two-region framework in which debt relief in one region can have an effect on both regions. We define the concept of a relative multiplier obtained by dividing difference-in-difference estimates, and show that this relative multiplier differs from the aggregate multiplier by the magnitude of the effect of the treatment on the control region. Calculating relative multipliers from our empirical differences-in-differences estimates, we obtain a multiplier of 1.81 for non-tradable employment and approximately zero for tradable employment. These multipliers have the interpretation that every additional percent of state consumption charged off as a result of bankruptcy exemptions led to a 1.81 percentage point rise in non-tradable employment in the cross-section of states during the Great Recession. But our framework makes clear that a large difference-in-differences estimate might mask a small aggregate effect of ex-post debt forgiveness if local prices or monetary policy adjust to offset the effect on economic activity in the aggregate. Conversely, a small difference-in-differences estimate might mask a large aggregate effect of debt forgiveness if there are positive demand spillovers across states. Simple "scaling up" exercises rely on an implicit assumption of zero general equilibrium spillovers.

In the final part of the paper, we evaluate the potential importance of these general equilibrium spillovers by developing a New Keynesian model that captures regional linkages through trade, labor markets, and a common monetary policy. Our model combines elements from the closed-economy literature with borrower-saver heterogeneity (e.g., Eggertsson and Krugman 2012) with elements from the open economy currency union literature (e.g., Nakamura and Steinsson 2014). Specifically, we develop a two-agent, two-region, two-good model, where borrowers and savers are spread across a high- and a low-exemption region and consume both tradable and non-tradable goods. In our baseline calibration with standard preferences and relatively sticky prices, we show that our model produces relative multipliers for both non-tradable and tradable employment that are in line with our empirical estimates, with relative debt relief multipliers larger than one for non-tradable employment and close to zero for tradable employment.

Three features of the model generate these contrasting relative debt relief multipliers for non-tradable and tradable employment: heterogeneity in marginal propensities to consume between borrowers and savers, nominal price rigidities, and trade linkages across regions. First, debt relief temporarily increases aggregate spending on all goods in the high-exemption region, because borrowers have higher marginal propensities to consume than savers. Because of nominal price rigidities, this leads to an increase in both non-tradable and tradable employment locally. However, since traded goods can also be imported, tradable employment rises in the low-exemption region as well. Hence, the relative non-tradable employment outcome is positive, while the relative tradable employment outcome is roughly zero. The above mechanism relies crucially on our calibration choice of relatively rigid prices. Under flexible prices, the higher spending in the high-exemption region translates into an appreciation of the terms of trade and a reallocation of tradable demand to the low-exemption region. This reallocation induces a negative relative tradable multiplier. This effect is stronger the more flexible prices are. Hence, the fact that we do not observe a significant relative decline in tradable employment in high-exemption regions suggests a high degree of price rigidity over the period (see Mian and Sufi 2014*b* for a related argument).

We use the model to recover an estimate of the aggregate effect of debt relief during the Great Recession. Recovering aggregate effects requires an assumption on monetary policy. Under the assumption that monetary policy was at the zero lower bound throughout the financial crisis, the model implies that ex-post debt relief had positive effects on employment in both sectors and in both regions. Ex-post debt relief directly increases spending and employment in both sectors in the high-exemption region, which increases tradable employment in the low-exemption region through a demand spillover effect. The increase in tradable employment in the low-exemption region then increases non-tradable spending and employment in the low-exemption region. Calibrating the model to the observed path of debt write-downs during the financial crisis, we find that average employment across regions in the second half of 2009 would have been almost 2 percent lower in both the non-tradable and the tradable sector in the absence of the ex-post debt forgiveness provided by the consumer bankruptcy system.

We conclude by conducting three policy counterfactuals. First, we ask what the effect of ex-post debt relief is in normal times when the zero lower bound does not bind. We find that even with a relatively aggressive monetary policy response, ex-post debt relief continues to have positive effects in all regions and sectors. Second, we ask how the effect of ex-post debt relief changes with the size of the debt relief provided to borrowers. We find that the debt relief multiplier is initially invariant to the size of the debt relief, but as the size of debt relief grows large, the multiplier eventually falls due to the concavity of borrowersâĂŹ consumption functions. Finally, we ask if it matters who pays for debt relief. We find that the answer is no, since savers smooth consumption in response to wealth transfers, no matter where they are located.

Our results are related to an important literature showing how deteriorating household balance sheets can amplify an economic downturn. Hall (2011), Eggertsson and Krugman (2012), Guerrieri and Lorenzoni (2017) and Midrigan and Philippon (2011) illustrate this mechanism theoretically. Mian, Rao and Sufi (2013) show an empirical link between the fall in house prices and household consumption in the United States during the Great Recession, and Mian and Sufi (2014*b*) study the knock-on effect to non-tradable and tradable employment. Most recently, Verner and Gyongyosi (2018) show that an increase in debt burdens led to higher default rates and a collapse in spending in Hungary, translating into a worse local recession and depressed house prices.[3] We contribute to this literature by showing that the ex-post debt forgiveness provided by the consumer bankruptcy system stabilized the level of employment in the United States during the Great Recession. Our findings are consistent with a theoretical literature that shows that interventions in debt market can raise welfare when the economy is depressed (Farhi and Werning 2016*b*, Korinek and Simsek 2016) and that these interventions can be systematized as part of a policy rule when designing the consumer bankruptcy system, augmenting its usual function of balancing ex-ante cost of credit and ex-post idiosyncratic insurance with a macro prudential objective (Dávila 2015, Auclert and Mitman 2018).[4]

Our paper also contributes to recent work estimating the effects of debt relief and mortgage modifications during the Great Recession. Agarwal et al. (2017) show that the Home Affordable Modification Program (HAMP) decreased the number of foreclosures and consumer debt delinquencies, and increased durable spending, but that the program only reached one-third of targeted households due to uneven implementation across lenders. Building on this work, Ganong and Noel (2018) show that the principal write-downs made through HAMP that increased housing wealth without affecting liquidity had no impact on underwater borrowers, while the program's maturity extensions that increased liquidity had a large positive impact. Finally, Piskorski and Seru (2018) find that regional variation in the extent and speed of the post-crisis recovery is strongly related to frictions affecting the pass-through of lower interest rates and debt relief to households including mortgage contract

[3] The relative debt shock multipliers implicit in Verner and Gyongyosi (2018) are quantitatively similar to our relative debt relief multipliers. For example, the headline estimates in Verner and Gyongyosi (2018) translate into a relative debt shock multiplier of around 1.5 on auto spending and -0.08 on aggregate unemployment, while our calibrated model implies a relative debt relief multiplier of 0.8 on total consumption and 0.2 on aggregate employment.

[4] See Kekre (2018) and McKay and Reis (2016) for a similar argument related to the macro prudential objective of unemployment insurance.

rigidity, refinancing constraints, and the organizational capacity of intermediaries to conduct loan renegotiations. Taken at face value, their results suggest that these frictions nearly doubled the time it took for house prices, consumption, and employment to recover after the financial crisis. We complement the work in this literature by showing that the unsecured debt relief provided by the consumer bankruptcy system, and not just the mortgage modifications provided by large government programs, provided an important boost to aggregate demand during the Great Recession, and by explicitly addressing the issue of aggregating cross-regional results.

Finally, our paper builds on the local fiscal multipliers literature that has convincingly shown that, while cross-state comparisons allow one to use plausibly exogenous variation to draw conclusions about the effects of shocks or policies on regional economies, a general equilibrium model is needed to draw conclusions about the aggregate effect of these shocks or these policies (e.g., Nakamura and Steinsson 2014; Farhi and Werning 2016*a*; Suárez Serrato and Wingender 2016; Chodorow-Reich 2017; Martin and Philippon 2017; House, Proebsting and Tesar 2017; Dupor et al. 2018; Corbi, Papaioannou and Surico 2018). In our model, debt relief provides a micro-founded aggregate demand shock that is heterogeneous across regions, just as government spending is in these papers. There are two key differences between our model and those used in prior work. First, the debt relief in our model is a within-household transfer, not the result of direct purchases of goods and services, so that its aggregate effect is driven by differences in marginal propensities to consume across groups. Second, our model explicitly takes into account the difference between traded and non-traded goods, instead of treating all goods as traded, allowing us to exploit the relative employment response in these two sectors as an additional source of model validation.

The remainder of the paper is structured as follows. Section I provides a brief overview of the consumer bankruptcy system and describes our data and empirical strategy. Section II presents our difference-in-differences estimates of the effect of bankruptcy protections on credit and employment outcomes during the financial crisis. Section III establishes a relationship between relative multipliers and aggregate multipliers, and calculates relative debt relief multipliers in our context. Section IV develops our general equilibrium model and performs counterfactuals. Section V concludes.

I. Background, Data, and Empirical Design

A. Background

The debt forgiveness provided by consumer bankruptcy comes from two features of our institutional setting: (1) the ability of households to formally discharge debt through the bankruptcy system, and (2) the incentive for households and creditors to come to a negotiated settlement that avoids a formal bankruptcy filing.

Under the U.S. bankruptcy code, eligible households have the ability to discharge debts by filing for bankruptcy, relinquishing assets above exemption limits, and extinguishing their debts. The U.S. bankruptcy system allows most households to choose between Chapter 7 bankruptcy, which requires households to forfeit all assets above their state's exemption limits in exchange for a discharge of debt and protection from collection efforts, and Chapter 13 bankruptcy, which adds the protection of most assets in exchange for a partial repayment of debt. Chapter 7 is chosen by approximately 75 percent of bankruptcy filers in the United States, as most filers either have little non-exempt debt or are to move all non-exempt wealth into exempt assets before filing. Moreover, the state-specific Chapter 7 exemptions also impact Chapter 13 filers, as they are required to repay at least as much as creditors would have received under Chapter 7. For these reasons, we will focus on Chapter 7 bankruptcy exemptions for the remainder of the paper.[5]

Appendix Table A1 shows Chapter 7 exemptions by state and category in 2007, just prior to the onset of the financial crisis. There is substantial variation in the generosity of the Chapter 7 exemptions by state, particularly for the homestead exemptions, the largest and most important exemption category. These homestead exemptions range from $0 in three states to unlimited in seven states. There is also considerable variation in the other exemption categories, with vehicle exemptions ranging from $0 in 12 states to at least $10,000 in three states, savings exemptions ranging from $0 in 39 states to at least $1,000 in seven states, and wildcard exemptions, which can be applied to any asset, ranging from $0 in 20 states to at least $10,000 in three states. There is additional variation in exemptions from the fact that, as of 2007, residents in 16 states could also choose to file under the federal exemption system

[5] The Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) passed in 2005 changed several features of the bankruptcy. Prior to law, all households were eligible to file under either Chapter 7 or Chapter 13 of the bankruptcy code. BAPCPA reduced the generosity of the bankruptcy code by restricting Chapter 7 to households that passed an income or repayment test. As a result, following BAPCPA, it was more difficult for households with high incomes to shield their home equity in a Chapter 7 filing. However, filing for Chapter 13 still provided a way for homeowners to protect their assets and discharge debts, albeit in a more costly fashion. These changes were applied uniformly across states, and the income test was a function of state income, and so should not influence our results.

instead.

Appendix Figure A1 shows that the variation in Chapter 7 homestead exemptions has also been remarkably stable over time, with most changes being inflation updates. The population-weighted correlation between the 2007 and 1991 homestead exemption ranks, for example, is 0.88, while the correlation between the 2007 and 1920 homestead exemption ranks is still 0.60 among the 38 states with exemptions in both time periods. The initial variation in homestead exemption amounts largely emerged as states formalized their state-level approaches to bankruptcy in the late nineteenth century, in ways that are likely unrelated to current state characteristics (Goodman 1993; Skeel 2001). Consistent with this idea, we show below that most state characteristics are uncorrelated with the state bankruptcy protections in the years just prior to the financial crisis.

In addition to the formal debt relief provided to bankruptcy filers, the bankruptcy system can also provide a type of informal debt relief even when households do not formally file for bankruptcy by establishing a natural threat point in negotiations with creditors. In our context, these negotiated settlements are most likely to occur after borrowers become delinquent on a debt, but before they formally file for bankruptcy protection. These negotiated settlements are frequently the result of borrowers contacting the creditor directly, but can also be arranged by non-profit credit counselors or for-profit debt settlement companies working on behalf of the borrowers, particularly when borrowers are delinquent on several debts simultaneously (Wilshusen 2011). The bankruptcy system provides a natural threat point in these negotiations, as households can always threaten to file for Chapter 7 protection if the negotiations break down. Consistent with this idea, Mahoney (2015) shows a log point increase in the amount of assets left unprotected in bankruptcy raises out-of-pocket medical payments by 34 percent, or more than $5,000. The threat-point of bankruptcy may also impact the share of debt that is charged off in the collection process, where, in general, only about 10 to 20 percent of debt is successfully collected by debt-holders (Fedaseyeu 2015; ACA 2013).

The formal and informal debt relief provided through the consumer bankruptcy system is economically large, with the typical bankruptcy filer discharging about $138,000 in debt in 2017 (U.S. Courts 2017) and about 15 percent of American households – or approximately 18 to 19 million households – having filed for bankruptcy at some point in their lives (Dobbie, Goldsmith-Pinkham and Yang 2015).[6]

[6]We calculate the typical discharge amount using publicly available data from the U.S. Courts. We report the weighted average of the debt discharged under Chapter 7 and the debt discharged under Chapter 13, where the weights are equal to the shares of all bankruptcy cases with complete schedules that were filed under Chapter 7 and Chapter 13.

The amount transferred through the bankruptcy system is also strongly counter-cyclical, consistent with the idea that bankruptcy help households delever following an aggregate shock. For example, more than 4.7 million households filed for bankruptcy between 2007 and 2010 in the recent financial crisis, compared to 3.2 million between 2014 and 2017 (U.S. Courts 2017). In contrast, the Home Affordable Modification Program helped only about 1.7 million households following the onset of the financial crisis (U.S. Treasury 2018), with other debt relief programs such as the Home Affordable Foreclosure Alternatives (HAFA) and Principal Reduction Alternative (PRA) programs helping about another 0.72 million households (U.S. Treasury 2018). The total amount of debt discharged through the bankruptcy system during the financial crisis is also dramatically larger than these other debt relief programs, at approximately $1.1 trillion between 2007 and 2010 (U.S. Courts 2010) compared to only $106 billion over the entire lifespan of the programs (U.S. Treasury 2018).[7]

The consumer bankruptcy system is also larger than a number of other large social insurance programs, most notably the UI system. Between 2007 and 2008, for example, the total Unemployment Compensation outlays averaged $37.9 billion, compared to an average debt discharged of $166.8 billion through the bankruptcy system over the same period (Whittaker and Isaacs 2016; U.S. Courts 2008). During the peak of the financial crisis between 2009 and 2010, the difference across the measures grew even greater with unemployment compensation providing $138.1 billion in benefits on average compared to the $379.6 billion of discharged debt (Whittaker and Isaacs 2016; U.S. Courts 2010).

B. Data Sources and Sample Construction

Our empirical analysis uses information from county-level employment and inflation measures, and individual-level credit data aggregated to the county-level.

County Employment Data. We measure employment outcomes between 2001 and 2013 using county-level data from the Quarterly Census of Employment and Wages (QCEW) published by the Bureau of Labor Statistics (BLS). The data are derived from individual-level Unemployment Insurance (UI) tax files submitted by each state to the BLS. The BLS uses these files to calculate quarterly employment by

[7] We calculate the number of households filing for bankruptcy in each year using publicly available data on the total number of Chapter 7 and Chapter 13 cases from the U.S. Courts. The total amount of debt discharged comes from the total amount of Net Scheduled Debt listed under both Chapter 7 and Chapter 13 case filings. In all bankruptcy calculations, we exclude cases filed in outlying U.S. territories. We estimate the size of non-bankruptcy debt relief programs using information from the relevant publicly available statistics. We estimate that HAFA assisted 476,348 households and provided $30.3 billion in debt relief, PRA helped 245,316 households and provided $21 billion in debt relief, and HAMP helped 1.735 million homeowners and provided $55 billion in debt relief (U.S. Treasury 2018).

county and industry. See the BLS website for additional information on these underlying data.

There are two important challenges in constructing consistent employment measures over our sample period using the QCEW data. The first is that the industry codes in the QCEW data change from NAICS 2002 to NAICS 2007 to NAICS 2012 over this time period. We address this issue using the publicly-available NAICS crosswalks and the Mian and Sufi (2014*b*) industry definitions to create a consistent time series of employment in each county and industry. The second challenge is that the QCEW employment data are suppressed in certain county-industry-year-quarter bins for reasons of confidentiality. Following Mian and Sufi (2014*b*), we address this issue by imputing employment in these suppressed county-industry-year-quarter bins using information from the County Business Patterns (CBP) data. See Appendix B for additional details.

We use the cleaned and harmonized QCEW employment data to construct a panel dataset across countries and year-quarters for non-tradable employment, tradable and other employment, and total employment. We follow the industry groupings defined in Mian and Sufi 2014*b*, where non-tradable employment is defined as the retail and restaurant sectors, tradable employment is defined as industries with sufficiently large imports and exports from the United States, and other employment is defined as all other industries excluding the construction sector. We normalize all employment measures by the number of working-age adults in each county to account for any secular population trends over the years we examine. Information on population totals comes from the U.S. Census.

Credit Bureau Data. We measure credit outcomes between 2001 and 2013 using records from the Equifax / New York Fed Consumer Credit Panel (CCP), a representative five percent random sample of all individuals in the U.S. with credit files.[8] Like other credit report data, the CCP data are derived from public records, collections agencies, and trade lines data from lending institutions. The data include a comprehensive set of consumer credit outcomes, including information on credit scores, unsecured credit lines, auto loans, and mortgages. The data also include year of birth and geographic location at the ZIP-code level. We identify homeowners as any individuals who currently have mortgage or home equity debt outstanding, or those individuals who have had mortgage debt in the previous eight years prior to 2007.[9] No other demographic information is available at the individual level.

[8]The credit bureau data do not include the approximately 22 million adults (nine percent of adults) in the United States without credit files, or information on non-traditional forms of credit such as payday lending, pawn shops, and borrowing from relatives. The data are therefore likely to be less representative on the behaviors and outcomes of very poor populations.

[9]Our measure of homeownership will not include individuals whose homes are fully owned. In our data, 48 percent of individuals are defined as homeowners, compared to around 68 percent in the Survey of Consumer Finances (SCF). Tai

We aggregate these data to the county-by-year-quarter level unless otherwise mentioned. See Avery et al. (2003) and Lee and Van der Klaauw (2010) for additional details on the underlying credit report data.

Inflation Data. Inflation measures come from the Bureau of Labor Statistics (BLS). We use the BLS Consumer Price Index (CPI) measured at the Metropolitan Statistical Area (MSA) level for 26 MSAs at the half-year frequency. We use these price indices to construct annualized inflation measures from 2001 to 2013 in three categories: overall, non-tradable, and tradable inflation. We use the All Items index for overall inflation, the Services index to measure non-tradable inflation, and Commodities to measure tradable inflation. We then use a MSA to county crosswalk to map the measures to our dataset.

House Price Data. County-level house price indices between 2001 and 2013 come from Corelogic. We use quarterly data from 1240 counties over the sample period. For estimation of home equity values in the simulated instrument procedure, we use zipcode-level house price estimates from Zillow.com.

Migration Data. Migration data comes from the American Community Survey (ACS). In-migration is defined as the share of current state residents who lived in a different state or country one year ago. We use data from 2004-2013 due to availability constraints.

Summary Statistics. Table 1 provides descriptive statistics for key outcomes before, during, and after the financial crisis. We report the average percentage change in employment credit outcomes for 2001q1 to 2007q4, 2007q4 to 2010q4, and 2011q4 to 2013q4, as well as the change in consumer price and house price indices over the same time periods. Total employment, scaled by working age population, declined slightly prior to the financial crisis, falling by 2.57 percent from 2001q1 to 2007q4. Employment fell sharply during the crisis, however, dropping by 7.41 percent from 2007q4 to 2010q4, before recovering by 4.06 percent from 2010q4 to 2013q4. Non-tradable and tradable and other employment both followed similar trends as overall employment, although non-tradable employment increased prior to the crisis when compared than either overall employment or tradable employment.

Debt charge-offs were approximately unchanged from 2001q1 to 2007q4, before increasing sharply

(2016) shows that the majority of this discrepancy in homeownership comes from individuals who are 55 and older.

by \$124.78 per person from 2007q4 to 2010q4. Charge-offs then declined by \$241.67 per person from 2010q4 to 2013q4, reflecting both the tighter credit markets and improved economic conditions during this time period. Formal bankruptcy and foreclosure rates increased by 15.8 and 14.5 percentage points, respectively, before the financial crisis, with much larger increases from 2007q4 to 2010q4. Bankruptcy rates then fell by 9.1 percentage points from 2010q4 to 2013q4, with foreclosure rates increasing by 5.7 percentage points. Credit card limits grew from 2001q1 to 2007q4 by almost \$3,000 per person, but substantially declined by nearly the same amount from 2007q4 to 2010q4, followed by a recovery of \$954 per person from 2010q4-2013q4. Credit card debt also increased slightly from 2001q1 to 2007q4, but fell both during and after the financial crisis. Consistent with Foote, Loewenstein and Willen (2016) and Adelino, Schoar and Severino (2018), mortgage credit increased sharply prior to the financial crisis, with a change of more than \$26,000 per person from 2001q1 to 2007q4. Mortgage credit increased by another \$1,839 per person from 2007q4 to 2010q4, before falling by \$3,977 per person from 2010q4 to 2013q4.

In contrast to the economically large changes in employment and credit outcomes over this time period, consumer prices were relatively stable before, during, and after the financial crisis. Prices on all consumer goods, for example, increased by 17.6 percent from 2001q1 to 2007q4, 4.3 percent from 2007q4 to 2010q4, and 6.4 percent from 2010q4 to 2013q4. Non-tradable and tradable prices follow a similar trend, although non-tradable prices increased less from 2001q1 to 2007q4 compared to non-tradable prices. House prices, however, increased by over 40 percent from 2001q1 to 2007q4, before falling by roughly 22 percent from 2007q4 to 2010q4. House prices then partially recovered after the crisis, increasing by 11 percent from 2010q4 to 2013q4.

C. Empirical Design

We estimate the relative impact of ex-post debt forgiveness during the Great Recession using a difference-in-differences design that compares outcomes in states with more generous bankruptcy exemptions (the "treated" states) to states with less generous exemptions (the "control" states). Our difference-in-differences design explicitly controls for any pre-existing differences between states with more and less generous exemptions, and, as a result, any time-invariant effects of bankruptcy protections such as the ex-ante impacts of the bankruptcy exemptions on credit demand, credit supply (Gropp, Scholz and White 1997; Severino and Brown 2017), moral hazard in the workplace (White 2011), entrepreneurial risk-taking (Fan and White 2003; Armour and Cumming 2008), and so on. We also explicitly control for any common time effects of the financial crisis such as the large negative aggregate demand shock for tradable goods. The key identifying assumption for our difference-in-differences specification is that, in the absence of any variation in bankruptcy exemptions, outcomes in states with more and less generous exemptions would have evolved in parallel during the Great Recession. This "parallel trends" assumption allows us to interpret the difference between states with more and less generous bankruptcy exemptions during the financial crisis as the causal effect of the more generous bankruptcy exemptions in the presence of a large aggregate shock. While not directly testable, we provide a battery of robustness checks to support the validity of this assumption.

Bankruptcy Protection Measure Calculation. We measure the generosity of bankruptcy protections in each state prior to the Great Recession using the average cost of filing for Chapter 7 bankruptcy in each state, s, using the pre-crisis bankruptcy asset exemptions in state s and the balance sheets of individuals in all other states, $-s$. Our bankruptcy protection measure isolates the generosity of each state's bankruptcy exemptions, while avoiding two important endogeneity issues. First, by using the pre-crisis bankruptcy exemptions in each state, the protections measure removes any endogenous changes to the exemptions made during the financial crisis. Second, by using balance sheets of individuals in all other states, our protection measure removes any potential effects of the bankruptcy exemptions on household characteristics such as asset holdings or income. Our bankruptcy protection measure is closely related to the "simulated instrument" measures developed by Currie and Gruber (1996) to isolate exogenous variation in Medicaid eligibility across states, and, as in our paper, adapted by Mahoney (2015) to isolate exogenous variation in the generosity of bankruptcy exemptions across states.[10]

We estimate our bankruptcy protection measure in three steps. First, we calculate the financial cost of filing Chapter 7 bankruptcy protection for individual i with asset exemptions from state s in the years prior to the financial crisis. For each asset class covered under the bankruptcy exemptions, let a_{ik} be the corresponding asset value for individual i for asset k (bounded below at 0), d_i be dischargeable debt for individual i, and e_{sk} denote the exemption for asset k in state s. The financial

[10]Our bankruptcy protection measure is also closely related to the measure of financial cost of bankruptcy developed by Fay, Hurst and White (2002). Our measure differs from the bankruptcy protection measures used in Fay, Hurst and White (2002) and Mahoney (2015) in two ways, however. First, we are able to directly measure balance sheet values for some assets, rather than relying on assets and liabilities from surveys as in Fay, Hurst and White (2002) and Mahoney (2015). Second, Mahoney (2015) also exploits within-state variation based on average differences in asset holdings across different age, race, and education cells. We ignore this within-state heterogeneity, both because we are interested in the aggregate effect of the bankruptcy laws, and because are unable to measure across-group heterogeneity in asset holdings using our data.

cost of bankruptcy for a given individual is then defined as the asset values that can be seized under Chapter 7 bankruptcy plus filing costs:

$$b_i^s = \text{Seizable Assets}_{is} - \text{Dischargeable Debt}_i + \text{Filing Cost}$$

where

$$\begin{aligned}
\text{Seizable Assets}_{is} = & \max(\text{Home Equity}_i - \text{Homestead Exemption}_s, 0) \\
& + \max(\text{Auto Equity}_i - \text{Auto Exemption}_s, 0) \\
& + \max(\text{Retirement Assets}_i - \text{Retirement Exemption}_s, 0) \\
& + \max(\text{Financial Assets}_i - \text{Financial Assets Exemption}_s, 0) \\
& + \max(\text{Other Assets}_i - \text{Wildcard Exemption}_s, 0),
\end{aligned}$$

where Home Equity$_i$ is the value of the home for individual i less the outstanding mortgage debt secured by the house, Homestead Exemption$_s$ is the maximum amount of home equity protected in state s, Auto Equity$_i$ is the value of an individual's automobile for individual i less the outstanding auto debt secured by the car, Auto Exemption$_s$ is the maximum amount of auto equity protected in state s, Retirement Assets$_i$ is the funds in individual i retirement accounts, Retirement Exemption$_s$ is the maximum amount of retirement savings protected in state s, Financial Assets$_i$ are other savings and financial assets for individual i, Financial Assets Exemption$_s$ is the maximum amount of financial asset protections for other financial assets in state s, and Wildcard Exemption$_s$ is the catch-all protection for any other assets in state s. Following Fay, Hurst and White (2002) and Mahoney (2015), we use the financial cost of Chapter 7 to characterize the financial cost under both chapters. Since debt payments under Chapter 13 can be no smaller than debt payments under Chapter 7, households face a weakly lower financial cost to filing under Chapter 7.

In the second step, we calculate the average cost of filing for bankruptcy in state s using the household characteristics of individuals in all other states, $-s$, removing any potential effects of the bankruptcy exemptions on household characteristics such as asset holdings or income:

$$\hat{b}_s = |I_{-s}|^{-1} \sum_{j \in I_{-s}} b_j^s \tag{1}$$

where I_{-s} is the entire sample of individuals in all states excluding state s, and b_j^s is the measure of financial cost of bankruptcy for individual j if they were subject to the laws of state s. By using household characteristics of individuals in all other states, $-s$, the variation in $\hat{b}_s$ is only driven by the differences in exemption laws across states, not the differences in individuals' assets and debts across states. See Goldsmith-Pinkham, Sorkin and Swift (2018) for additional details and intuition.

In our final step, we rescale our bankruptcy protection measure for all regression specifications to have a mean of zero and standard deviation of one. We also multiply our rescaled measure by negative one so that we can interpret positive numbers as a higher level of bankruptcy protection. We denote this rescaled and normalized measure for a given state s by $\hat{B}_s$.

Constructing our bankruptcy protection measure requires individual-level information on unsecured debt from credit cards, home equity, vehicle equity, retirement assets, and other financial assets. We measure unsecured debt from credit cards using the CCP credit bureau data described above. Home equity is measured using mortgage balances from the CCP and zipcode-level housing values from Zillow. Vehicle equity, retirement assets, and other financial assets are all estimated using the 2005 and 2007 PSID Wealth Files datasets. We calculate each household's wealth in vehicle equity, retirement assets, financial assets, and other assets in the 2005 and 2007 cross-sections, excluding households with at least one individual who is enrolled in public insurance or is over the age of 65 in the survey year.

In our main specification, we construct our bankruptcy protection measure using state bankruptcy exemption laws in 2007 to remove any endogenous changes to the exemptions made during the financial crisis. In robustness checks, we show that we obtain similar results using state homestead exemptions in 1991, the oldest year where we have information on homestead exemptions in all 50 states.

Bankruptcy Protection Variation. Appendix Figure A2 plots the financial cost of bankruptcy by state, or our bankruptcy protection before we multiply by negative one and rescale to have a mean of zero and a standard deviation of one. There is considerable geographic variation in the average financial cost of bankruptcy across states, with a population-weighted standard deviation of $60,000 on a base of $254,000. The state with the lowest financial cost of bankruptcy is Kansas, at $153,000, and the highest is Virginia, at $337,000. The difference between the 10th and 90th percentile of the state-level distribution is similarly large, at $163,000. There are no systematic patterns in the distribution of the bankruptcy protections, with high- and low-cost states evenly spread across regions.

Appendix Figure A3 plots the financial cost of bankruptcy in each state against the relative generosity of the homestead, vehicle, savings, and wildcard exemptions in each state. We also plot the line of best fit weighted by state population. The variation in the financial cost of bankruptcy across states is almost entirely explained by the state homestead exemptions laws, with a correlation of -0.942 between the overall financial cost of bankruptcy, and homestead exemption ranks. In contrast, the correlation and between the financial cost of bankruptcy and vehicle exemptions is only -0.105, while the correlation with savings and wildcard exemptions is only -0.067 and 0.044, respectively.

We observe a similar pattern in Panel B of Appendix Figure A2, which plots homestead exemptions in each state, and Appendix Table A1, which lists the financial cost of bankruptcy separately for seizable home equity and other seizable financial assets for each state. The variation in the financial cost of bankruptcy for home equity is approximately ten times larger than the variation in the financial costs for any other asset, with a population-weighted standard deviation of \$ 58,999 on a base of \$97,388 for seizable home equity, but only \$6,473 on a base of \$159,841 for other seizable financial assets. The difference between the 10th and 90th percentile of the state-level distribution is similarly large for seizable home equity at \$160,172, compared to only \$11,149 for other seizable financial assets.[11]

Empirical Specification and Identifying Assumptions. For a given outcome, Y, our difference-in-differences regression specification takes the form:

$$Y_{it} = \alpha_i + \lambda_t + \sum_{\substack{u=2001 \\ u\neq 2007}}^{2013} \beta_u 1(\text{Year}_t = u)\hat{B}_{s(i)} + \sum_{\substack{u=2001 \\ u\neq 2007}}^{2013} \gamma_u 1(\text{Year}_t = u) X_i + \epsilon_{it} \tag{2}$$

where α_i are county fixed effects, α_t are year-quarter fixed effects, $\hat{B}_{s(i)}$ is our measure of the generosity of bankruptcy protections for county i in state s, and X_i are potential time-invariant characteristics of county i such as the housing supply elasticity measure from Saiz (2010). The estimated effects of $\hat{B}_{s(i)}$ and X_i are allowed to be time-varying, with β_u denoting the year-by-year impact of the simulated bankruptcy protection each year, and γ_u denoting the potential time-varying impact of other variables that might confound our estimates of bankruptcy protection.[12]

[11]Retirement savings and financial assets (e.g., stock holdings) make up the vast majority of the other financial assets category. The median level of vehicle equity, for example, is less than \$10,000 in most states.

[12]While our policy variation is at the state-level, our regressions use county-level data in most exercises. This allows us to use county-level controls to improve the precision of our estimate. Since we weight by population, our estimates

In this specification, the β_u coefficients can be interpreted as the relative impact of the bankruptcy protections in each year. We omit 2007, β_{2007}, so that the other β_us can be interpreted relative to this pre-crisis baseline period. Our estimates of β_u from 2008 to 2010 will therefore capture the relative short-run impact of the bankruptcy protections during the Great Recession, while the estimates of β_u from 2011 to 2013 will capture the relative long-run impact of the protections during the recovery. As discussed in greater detail below, our estimates do not necessarily measure the aggregate impact of the bankruptcy protections during the crisis and recover periods, as they difference out both positive and negative general equilibrium effects.

The identifying assumption for our difference-in-differences specification is that, in the absence of the Great Recession, the outcomes in states with more and less generous protections would have evolved in parallel. This parallel trends assumption implies that there are no other reasons why the Great Recession would impact more and less generous states differently. While not directly testable, we provide a battery of robustness checks to support the validity of this assumption.

To better understand what our identification assumption entails, Appendix Table A2 examines the correlation between our bankruptcy protection measure and other variables that may have caused differential employment responses during the Great Recession. Panel A reports results for baseline employment outcomes, Panel B for baseline credit outcomes, and Panel C for baseline state characteristics, including Democratic vote shares, maximum unemployment benefits, demographics, market betas, per capita incomes, house prices, homeownership rates, housing supply elasticities, and non-recourse laws. Column 1 reports results using variables measured in 2001, the first year in our sample period. Column 2 reports results using variables measured in 2007, the year just before our estimation period. In each panel and column, we report estimates from OLS regressions of the listed variable on our bankruptcy protection measure, weighted by state-population, with robust standard errors. Statistically or economically significant estimates from these regressions do not necessarily imply a violation of our identifying assumption, as the county fixed effects α_i control for any time-invariant differences across geographic areas. What is critical is that any characteristics that differ across high- and low-protection states do not have a confounding time-varying effect on states' outcomes during the Great Recession. For example, our identifying assumption would be violated if states with more generous bankruptcy protections also had higher levels of non-tradable employment, and non-tradable employment fell more during the financial crisis for reasons unrelated to the consumer bankruptcy

approximate the state-level regression, but with lower residual variance.

system.

Appendix Table A2 reveals no statistically or economically significant differences in the level of employment between areas with high- and low-protections. There are also no significant differences in credit outcomes between areas with high- and low-protections, with the exception of 2007 bankruptcy filings, which are 0.04 percentage points lower in areas with more generous bankruptcy protection. We also find remarkably few differences in the state-level characteristics in high- and low-protection areas. There are, for example, no differences in Democratic vote shares or the generosity of unemployment insurance between high- and low-protection areas, characteristics that partially capture which states are more likely to have responded to the Great Recession through automatic stabilizers or debt forgiveness (e.g., Di Maggio and Kermani 2017; Hsu, Matsa and Melzer 2018). We similarly observe no income or demographic differences between high- and low-protection areas, with, for example, roughly similar populations shares of young people (age < 45) and college-educated people. There is also no correlation between our bankruptcy protection measure and a "market beta," which measures states' correlation with the national employment cycle.[13] We also find no correlation between our measure and the Bartik shock affecting states from 2010-2015, suggesting that our protection measure is not correlated with the industry mix that was exposed to national shocks from 2010-2015 (e.g., Yagan 2017).We do find that areas with more generous protection have higher homeownership rates in both 2001 and 2007, although we find no differences in house prices, the housing supply elasticities discussed in Saiz (2010), or the non-recourse mortgage laws discussed in Ghent and Kudlyak (2011) for either year.

We can also test the validity of our identifying assumption in three ways. The first is to examine whether employment and credit outcomes in states with more and less generous bankruptcy protections evolve in parallel before the financial crisis. Parallel pre-trends are, of course, not proof of our identifying assumption, but similar pre-trends suggest that there are not economically important differences between states with more and less generous bankruptcy protections in the pre-crisis period. We present these results graphically below.

A second test of our identifying assumption is to examine the stability of our coefficient estimates when controlling directly for potential confounding variables (Altonji, Elder and Taber 2005; Oster 2017). Controlling directly for potential confounding variables, such as exposure to the housing boom, interacted with time fixed effects will only impact our coefficient estimates if there is an independent

[13]We measure the "market beta" using the time series correlation for each state's employment growth with the national employment growth sample for each state from 1961 to 2001/2007.

impact of these variables during the crisis. We focus on exposure to the housing boom that contributed to the large boom-bust dynamic in consumer credit and consumption (Mian and Sufi, 2011; Mian, Rao and Sufi, 2013) during this time period. To avoid controlling for intermediate outcome variables such as housing prices that would bias our results, we test for the potential confounding effect of the boom-bust cycle using controls for the supply elasticity of housing, popularized by Saiz (2010) and Mian and Sufi (2011), interacted with time fixed effects. We also control directly for the pre-crisis share of homeowners in a county interacted with time fixed effects, which also controls directly for the correlation we found between our bankruptcy protection measure and homeownership in Appendix Table A2.

A final test of our identifying assumption is to estimate results using state bankruptcy exemption laws from earlier years. We construct our preferred bankruptcy protection measure using the 2007 Chapter 7 bankruptcy exemptions to remove any endogenous changes to the exemptions made during the financial crisis. In robustness checks, we present results using state exemption laws in 1991, the earliest year where information on exemption laws is available for all 50 states and well before either the financial crisis or the pre-crisis increase in house prices and employment.

II. Results

In this section, we examine the short- and long-run effects of consumer bankruptcy protections during the Great Recession using our difference-in-differences research design. We first analyze the effects of bankruptcy protections on employment, before turning to its effects on debt write-downs and the implied cross-state debt relief multiplier.

A. Employment

Table 2 reports estimates of the impact of bankruptcy protections on employment from our parametric difference-in-differences specification that pools the effect of a one standard deviation increase in the generosity of the bankruptcy protections for 2007q4-2010q4 in Panel A, and 2010q4-2013q4 in Panel B. Column 1 reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4-2010q4, the short-run crisis period, or 2010q4-2013q4, the long-run recovery period. Columns 2-5 report coefficients on the reduced form effect of a one standard deviation decrease in the log financial cost of filing for bankruptcy protection from 2007q4-2010q4 or 2010q4-2013q4. Column 2 reports estimates with only county and year-quarter fixed effects. Column 3 adds controls for the Saiz supply elasticity and share of the population who own a home for each county, both interacted with year-quarter fixed effects. Column 4 adds controls for the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure, all interacted with year-quarter fixed effects. Column 5 repeats the same specification excluding the "sand states" of Arizona, California, Nevada, and New Mexico. All regressions are weighted by county population as of 2007 and clustered at the standard errors at the state level to account for within-state correlation between the treatment variable and unobservable shocks (Bertrand, Duflo and Mullainathan 2004; Abadie et al. 2017).

States with more generous bankruptcy protections had significantly smaller declines in local non-tradable employment during the financial crisis compared to states with less generous protections. From 2008q1-2010q4, non-tradable employment collapsed across the country, with an average decline of roughly 5.18 percentage points (column 1). Controlling for only county and year-quarter fixed effects, we find that a one standard deviation increase in our bankruptcy protection measure increases non-tradable employment by 0.499 percentage points, or 9.6 percent of the overall decline in non-tradable employment during this period. In our preferred specification, which adds time-invariant housing controls interacted with year-quarter fixed effects, we find a 0.399 percentage point increase in non-tradable employment, or 7.7 percent of the overall decline in non-tradable employment (column 3). The point estimates remain large and statistically significant when we add controls for state demographics and policies (column 4) or exclude the "sand states" (column 5). All of the results suggest that the more generous bankruptcy protection had an economically and statistically significant impact on non-tradable employment during the Great Recession, consistent with consumers able to default and delever on their debt in states with higher levels of debtor protections.

In sharp contrast, the effects of the more generous bankruptcy protections on tradable and other employment are economically small and statistically insignificant during the financial crisis. In our preferred specification that includes time-invariant housing controls interacted with year-quarter fixed effects, we find that a one standard deviation increase in bankruptcy protections increases tradable and other employment by only 0.162 percentage points from 2008q1-2010q4, or 2.0 percent of the overall decline in tradable and other employment during this period (column 3). We find similar results adding controls for state demographics and policies (column 4) or excluding the "sand states" (column 5), with none of the estimates suggesting economically significant effects of the bankruptcy protections on tradable and other employment. We also find an economically and statistically insignificant effect on total employment during the crisis, as non-tradable employment makes up only about 23 percent of overall employment.

Figure 2 plots the non-parametric version of our preferred specification in column 3 of Table 2 for log non-tradable employment, log tradable and other employment, and log total employment. The omitted year is 2007, meaning all estimates are the effect relative to 2007. We also plot 95 percent confidence intervals calculated using standard errors clustered at the state level. Consistent with our parallel trends assumption, employment outcomes in states with more and less generous bankruptcy protections evolve in parallel before the financial crisis. Consistent with our results in Table 2, however, there is a sharp relative increase in non-tradable employment starting in 2008 in high-protection states compared to low-protection states, with a roughly 0.5 percent difference between the high- and low-protection states by 2010. There is also no discernible increase in tradable and other employment and total employment during the financial crisis, again consistent with the results in Table 2.

Figure 2 also allows us to examine the relative long-run impact of the protections during the recovery. The effects on non-tradable employment are persistent throughout the recovery period, with a roughly 0.85 percent difference between the high- and low-protection states in 2011, 2012, and 2013. Non-tradable employment increased by an average of 5.3 percentage points over this time period, meaning that effects in percentage terms are similar in both the crisis and recovery periods. Panel B of Table 2 reports parametric difference-in-differences estimates for the recovery period, revealing that a one standard deviation increase in bankruptcy generosity increases non-tradable employment by 0.842 percentage points from 2011 to 2013, or 15.9 percent of the overall increase in non-tradable employment during this period (column 3). The long-lasting effects of the bankruptcy protections on non-tradable employment throughout the recovery period are broadly consistent Verner and Gyongyosi (2018), who find persistent effects of foreign currency debt exposure on employment in Hungary. These persistent effects are difficult to justify in standard models of aggregate demand, which imply that the effect of transitory demand shocks should die out over time. We return to this issue in section IVG.

Consistent with the short-run results, both Figure 2 and Table 2 suggest little impact of the bankruptcy protections on tradable and other employment. In our preferred specification that includes time-invariant housing controls interacted with year-quarter fixed effects, we find that a one standard deviation increase in bankruptcy protection measure actually decreases tradable and other employment by 0.075 percentage points during the recovery period, or 2.0 percent of the overall change in tradable and other employment during this period (column 3). We also find an economically and statistically insignificant effect on total employment during this time period, again because of the small share of non-tradable employment in the economy.

B. Debt Write-Downs

Table 3 and Figure 3 reports estimates of the impact of bankruptcy protections on debt write-downs, measured using the charge-offs that occur when seriously derogatory debts are removed from individuals' credit reports. Charge-offs do not include medical debt held by hospitals (e.g., Mahoney 2015), mortgage debt on second homes with negative equity (e.g., Ganong and Noel 2018), and payday loans (e.g., Dobbie and Skiba 2013), meaning that we will understate the impact of bankruptcy protections to the extent that these debts are also written off due to the more generous protections. We return to this issue below when calculating the cross-state debt relief multiplier.

Consistent with the employment results in Table 2, states with more generous bankruptcy protections had significantly larger increases in debt write-downs during the financial crisis compared to states with less generous bankruptcy protections. In our preferred specification that includes time-invariant housing controls interacted with year-quarter fixed effects, we find a $54.50 increase in debt write-downs from 2008q1-2010q4, or 43.7 percent of the overall increase in debt write-downs during this time period (column 3). The point estimates remain large and statistically significant when we add controls for state demographics and policies (column 4) or exclude the "sand states" (column 5), with all of the results suggesting that the more generous bankruptcy protections had an economically and statistically significant impact on debt write-downs during the Great Recession. We also find much larger effects for homeowners, at $80.46, compared to renters, at $22.58, consistent with the idea that the homestead exemptions were a particularly important source of debt forgiveness during the financial crisis and the most important source of variation of our bankruptcy protection measure (see Appendix Figure A3).

Figure 3 reveals that debt write-downs in states with more and less generous bankruptcy protections evolve in parallel before the financial crisis, consistent with our parallel trends assumption. There is also a clear increase in debt write-downs in states with more generous bankruptcy protections starting in 2008, with a peak in 2009. The effect of the bankruptcy protections on write-downs declines during the recovery period, with a larger and more persistent effect on homeowners in both the crisis and recovery periods. In Panel B of Table 3, we find that debt write-downs increased by $33.69 for the full sample and by $48.41 for homeowners during the recovery period, 13.9 and 12.1 percent of the subgroup-specific changes in debt write-downs over this time period, respectively (column 3). These results are consistent with the bankruptcy system providing significant debt forgiveness to borrowers during the financial crisis, with a much more limited impact during the recovery period.

C. Additional Credit Outcomes and Robustness Checks

Additional Credit Outcomes. Appendix Table A3 reports estimates of the impact of bankruptcy protections on other credit market outcomes in both the short- and long-run. There is little impact of the more generous bankruptcy protections on bankruptcy filing rates in either the short- or long-run, likely because of off-setting effects on employment rates and local economic conditions. There is a modest negative impact of the more generous bankruptcy protections on credit card limits, with statistically significant impacts when we add state demographic and policy controls. The effects on credit card debt are approximately zero during the crisis, with modest negative effects during the recovery period. We also find impact of the more generous bankruptcy protections on mortgage debt in any time period. Taken together, these results suggest there may be a small contraction in borrowing limits due to increase in debt write-downs, but that any contraction was small compared to the nationwide fall in borrowing observed during financial crisis.

The only credit outcome significantly impacted by the bankruptcy protections during the financial crisis is foreclosure rates, which increase by 0.257 percentage points from 2008q1-2010q4 and 0.401 percentage points from 2011q1-2013q4 in our preferred specification that includes time-invariant housing controls interacted with year-quarter fixed effects. There are not any incentives in Chapter 7 bankruptcy to enter foreclosure on one's primary residence, but there are strategic incentives to enter foreclosure on one's secondary home because of the benefit of preserving one's primary assets against creditors.

There is also, of course, the possibility that the increase in foreclosure rates is driven by a confounding variable such as a differential change in house prices in high- and low-protection areas. We explore this possibility in Appendix Table A5, where we report results of the impact of bankruptcy protections on log house prices. There is an economically and statistically insignificant impact of the protections on house prices in both the crisis and recovery periods. These results suggest that a differential change in house prices are unlikely to bias our main employment and debt write-down results, and that the foreclosure effects documented above are likely due to the strategic incentive to enter foreclosure on one's second home.

Robustness Checks. We have shown that there are no pre-trends in employment and credit outcomes and that our coefficient estimates are stable when controlling directly for potential confounding variables. A final check of our identifying assumption is to estimate results using state bankruptcy exemption laws from earlier years. Appendix Tables A7 and A8 present results using state homestead exemptions in 1991, the earliest year where information on exemption laws is available for all 50 states and well before either the financial crisis or the pre-crisis increase in house prices and employment. We find consistently positive results for non-tradable employment across all specifications, but the estimates smaller in magnitude and statistically insignificant in some specifications, likely because the additional noise in our bankruptcy protection measure attenuates the estimates downward. We also find positive and statistically significant effects on debt write-downs, although the estimates are again smaller than our main results. We interpret these results as supporting our conclusion that more generous bankruptcy protections increase non-tradable employment and debt write-downs, even when using noisier historical proxies of bankruptcy protection, but the additional noise limits the statistical precision of our estimates.

III. From Micro to Macro

We interpret the empirical responses estimated in the previous section as the causal effect of the debt relief provided by the consumer bankruptcy system on employment across states. In this section, we develop a general equilibrium framework to relate these differences-in-differences estimates to the macroeconomic causal effect of interest in terms of an abstract "effect of the treatment on control regions." In the next section, we will write down a model with that admits the same structure for potential outcomes and allows us to recover this effect under various assumptions.

A. Mapping the Model to our Difference-in-Differences Estimates

In this section, we show that the model's relative employment response across the high- and low-exemption regions corresponds theoretically to our empirical difference-in-differences estimates, and we discuss the relation between these estimates and various macroeconomic causal effects of interest.

We start from the observation that our model is symmetric and (approximately) linear in aggregate variables such as debt relief and total factor productivity (TFP). The aggregate effect of one-time debt relief shocks also features limited aggregate anticipation or persistence, as we will show below.[14] This implies that a given outcome (such as log employment) $Y_{i,t}$ in region i at time t can be represented, to a first-order approximation, as:

$$Y_{i,t} = \alpha_i + \lambda_t + \mathcal{M}_H \Delta_{i,t} + \mathcal{M}_F \Delta_{-i,t} \tag{3}$$

where $\Delta_{i,t} \equiv \varphi^B \Delta^B_{i,t}$ is debt relief in region i per person in region i.

Equation (3) expresses the outcome $Y_{i,t}$ as the sum of a region fixed effect α_i representing the time-invariant steady state level of the outcome, a time fixed effect λ_t representing any common dynamic shocks such as nationwide changes in TFP $A_{T,t}$ and $A_{NT,t}$, and the causal effect of debt relief on region i, which is the response to the debt relief shock in *both* the home and foreign region $\mathcal{M}_H \Delta_{i,t} + \mathcal{M}_F \Delta_{-i,t}$. The *home multiplier* $\mathcal{M}_H$ represents the causal effect of home debt relief $\Delta_{i,t}$ on home outcome $Y_{i,t}$, including any general equilibrium effects. Similarly, the *foreign multiplier* $\mathcal{M}_F$ represents the causal effect of foreign debt relief $\Delta_{-i,t}$ on home outcome $Y_{i,t}$. The model's symmetry between regions implies that $\mathcal{M}_H$ and $\mathcal{M}_F$ do not depend on i. As we now show, the spillover term $\mathcal{M}_F \Delta^B_{-i,t}$ leads to the disconnect between cross-sectional estimates provided by our difference-in-differences design and the causal effect of interest from a macroeconomic perspective.

Since aggregate debt relief per person is $\Delta_t \equiv \frac{1}{2}\sum_i \Delta_{i,t}$, we can rewrite Equation (3) as:

$$Y_{i,t} = \alpha_i + \underbrace{\lambda_t + 2\mathcal{M}_F \Delta_t}_{\tilde{\lambda}_t} + (\mathcal{M}_H - \mathcal{M}_F)\Delta^B_{i,t} \tag{4}$$

Equation (4) implies that, if we had exogenous variation in debt relief across states, a regression of outcome $Y_{i,t}$ on region fixed effect, time fixed effect and debt relief $\Delta^B_{i,t}$ would recover a regression coefficient:

$$\mathcal{M}_{rel} = \mathcal{M}_H - \mathcal{M}_F \tag{5}$$

In an integrated economy, local macroeconomic changes such as debt relief at home $\Delta^B_{H,t}$ simultaneously "treats" all regions. However, Equation (5) shows that a cross-sectional regression differences out the effect $\mathcal{M}_F$ of the treatment in the "control" region. When $\mathcal{M}_F > 0$, the relative multiplier $\mathcal{M}_{rel}$ understates the effect of the treatment on the local region $\mathcal{M}_H$, because the local treatment also

[14] The general first-order equation for potential outcomes, taking into account anticipation and persistence, is $Y_{i,t} = \gamma_i + \lambda_t + \sum_{s=-\infty}^{\infty} \mathcal{M}_{H,s} \Delta_{i,t+s} + \sum_{s=-\infty}^{\infty} \mathcal{M}_{F,s} \Delta_{-i,t+s}$. Limited anticipation and persistence allow us to simplify this equation using $\mathcal{M}_{H,s} = \mathcal{M}_{F,s} = 0$ for $s \neq 0$. This hypothesis is not necessary for our results, but allows us to simplify the discussion by focusing on the impact effect of the debt relief shock and focusing on the two contemporaneous multipliers $\mathcal{M}_H$ and $\mathcal{M}_F$.

increases the other region's outcome. When $\mathcal{M}_F < 0$, the regional multiplier $\mathcal{M}_{rel}$ instead overstates the causal effect of interest because the treatment lowers outcomes in the other region. In our model, $\mathcal{M}_F$ can take on either sign depending on parameter values.

In our empirical section, we used cross-state variation in bankruptcy exemptions to calculate the relative debt relief multiplier $\mathcal{M}_{rel}$. In the simplest case with two regions and no controls, Equation (3) implies that the relative debt relief multiplier is simply the ratio of two difference-in-differences estimates:

$$\frac{(Y_{H,t} - Y_{F,t}) - (Y_{H,2007} - Y_{F,2007})}{(\Delta^B_{H,t} - \Delta^B_{F,t}) - (\Delta^B_{H,2007} - \Delta^B_{F,2007})} = \mathcal{M}_{rel} = \mathcal{M}_H - \mathcal{M}_F \tag{6}$$

While the relative debt relief multipliers $\mathcal{M}_H$ and $\mathcal{M}_F$ may be of interest for regional policy evaluation, the macroeconomic effect of interest is the *aggregate debt relief multiplier*, or the causal effect of aggregate debt relief on aggregate employment. The aggregate multiplier is independent of Δ_t, and equal to:

$$\mathcal{M}_{agg} = \frac{\frac{1}{2}\sum_i (\mathcal{M}_H \Delta_{i,t} + \mathcal{M}_F \Delta_{-i,t})}{\Delta_t} = \mathcal{M}_H + \mathcal{M}_F \tag{7}$$

Aggregate debt relief affects all regions, and its average effect across regions reflects the *sum* of its local and its spillover effect. This point is general and does not depend on our assumption that there are only two regions.[15] Except in the special case of no spillovers $\mathcal{M}_F = 0$, this is different from the cross-sectional multiplier in Equation (6). Nevertheless, since $\mathcal{M}_{rel}$ contain information about $\mathcal{M}_H$ that is relevant for $\mathcal{M}_{agg}$, it is an important gauge of the model's success.

For empirical papers interested in aggregate macroeconomic outcomes, the results above highlight a key tension in interpreting cross-region elasticities. Cases where the $\mathcal{M}_{rel}$ is positive may reflect a situation where the overall aggregate effect is tiny, or negative, and vice versa. Moreover, traditional back-of-the-envelope approaches which fix $\mathcal{M}_F = 0$ are making very strong (typically non-identifiable) assumptions about the treatments across regions. This suggests that not only should carefully identified causal estimates be used as moments in a structural moment matching exercise (as suggested by Nakamura and Steinsson (2018)), but that those causal estimates should not be interpreted without a structural model when studying aggregate macroeconomic outcomes.

In the next sections, we calibrate our model and validate this calibration by comparing the relative debt relief multipliers $\mathcal{M}_{NT,rel}$ and $\mathcal{M}_{T,rel}$ to those calculated in our empirical section. We then use

[15] In the more general case with n symmetric regions, the potential outcomes Equation (3) is replaced with $Y_{it} = \alpha_i + \lambda_t + \mathcal{M}_H \Delta_{it} + \mathcal{M}_F \frac{1}{n-1} \sum_{j \neq i} \Delta_{jt}$. Equation (5) is replaced by $\mathcal{M}_{rel} = \mathcal{M}_H - \frac{1}{n-1}\mathcal{M}_F$, and Equation (7) is still $\mathcal{M}_{agg} = \mathcal{M}_H + \mathcal{M}_F$.

the aggregate multiplier $\mathcal{M}_{agg}$ from our calibrated model to recover the aggregate effect of debt relief during the recession.

Our approach to mapping causal cross-sectional estimates to a macroeconomic effect of interest builds on recent work by Nakamura and Steinsson (2014) in the context of government spending, and Guren et al. (2018) in the context of housing wealth effects. See Nakamura and Steinsson 2018 for a recent summary of other recent work in this area, and Beraja, Hurst and Ospina (2018) and Sarto (2018) for other approaches. We build on this prior work theoretically by showing an explicit relationship between $\mathcal{M}_{rel}$ and $\mathcal{M}_{agg}$, and empirically by using the cross-sectional multipliers for tradable and non-tradable employment as "identified moments." One advantage of our approach compared to past work is its transparency, as we can directly compute $\mathcal{M}_{H}$, $\mathcal{M}_{F}$, $\mathcal{M}_{rel}$, and $\mathcal{M}_{agg}$ in any given calibration.

B. Calculating the Cross-State Debt Relief Multiplier

Armed with these concepts, we now use our difference-in-differences estimates to calculate the cross-state debt relief multiplier for both non-tradable and tradable employment, or the implied impact of debt write-downs on employment in each sector during the financial crisis. These cross-state debt relief multipliers are helpful in understanding the economic magnitude of our difference-in-differences results, and they are important inputs to the general equilibrium model developed below.

The cross-state debt relief multipliers identify the percentage increase in employment from each percentage point increase in debt write-downs, measured as a share of consumption. In theory, these debt relief multipliers can be estimated as the simple ratio of our difference-in-differences estimates for each employment sector and debt write-downs, scaled by consumption.

There are two potential problems with simply taking the ratio of our difference-in-differences estimates, however. The first is that this simple approach assumes that *all* of the debt forgiveness created by the consumer bankruptcy system is captured by our debt write-down measure. Yet, there are many important types of debt forgiveness that are not included in our debt write-down measure, including medical debt charged off by hospitals (e.g., Mahoney 2015), the debt on second homes with negative equity charged off by mortgage lenders (e.g., Ganong and Noel 2018), and the debt charged off by most payday lenders (e.g., Dobbie and Skiba 2013). We therefore inflate our difference-in-differences estimate for debt write-downs to account for the incomplete nature of our write-down measure. We calculate the fraction of forgiven debt included in our debt write-down measure using a sample of

Chapter 7 bankruptcy filings, where we find that our write-down measure captures approximately 77.5 percent of the debt forgiven in the typical Chapter 7 filing.[16]

The second potential problem with simply taking the ratio of our difference-in-differences estimates is that this assumes that the effect of bankruptcy protections acts solely through the channel of debt relief, and not through some alternative channel. Our debt relief multiplier will therefore be biased if, for example, bankruptcy protections have an independent effect on employment by increasing the incentive to work by eliminating or reducing wage garnishment orders (e.g., Dobbie and Song 2015; Donaldson, Piacentino and Thakor 2018). We are unable to estimate the magnitude of these independent effects using our data, and, as a result, unable to account for this issue when calculating our debt relief multiplier. Our estimate of the debt relief multiplier likely represents an upper bound of the true debt relief multiplier, at least to the extent that any independent effects of bankruptcy protections increase employment, as suggested by prior work.

Formally, we define the cross-state, or relative debt relief multiplier as:

$$\mathcal{M}_{s,rel} = \frac{\Delta \log(\text{Employment}_s)}{\text{Write-Downs}/\text{Consumption}}, \qquad s \in \{\text{NT}, \text{T}\}, \tag{8}$$

where $\Delta \log(\text{Employment})_s$ is the change in employment for sector s over a given period of time, and Write-Downs is economy-wide change in debt scaled by aggregate consumption for the same time period. The cross-state debt relief employment multiplier $\mathcal{M}_s$ therefore measures the percentage increase in employment from each percentage point increase in debt write-downs in consumption units.

We calculate the cross-state debt relief multipliers using our preferred specification from column 3 of Tables 2 and 3. Following the adjustment for the fraction of forgiven debt included in our debt write-down measure discussed above, we find:

$$\mathcal{M}_{NT,rel} = 1.81, \qquad \mathcal{M}_{T,rel} = 0.39. \tag{9}$$

These cross-state debt relief multipliers suggest economically significant relative effects of debt forgiveness of debt write-downs on employment in non-tradable sectors, but economically small relative effects on employment in tradable sectors. We now discuss how to use these cross-state debt relief

[16] Our debt relief multiplier will, of course, be biased upwards (downwards) if we are underestimating (overestimating) the fraction of forgiven debt included in our debt write-down measure. We do not account for this estimation error when describing the cross-state debt relief multiplier.

multipliers, along with a general equilibrium model that incorporates plausible linkages across regions, to recover the aggregate effect of debt forgiveness on employment.

IV. Model

In this section, we develop a general equilibrium model to recover the aggregate effect of the unsecured debt relief that resulted from the crisis, as well as to perform counterfactual analyses under various assumptions about macroeconomic policy. Our model combines elements from recent New Keynesian models of currency unions with incomplete markets that have been used to study fiscal and transfer multipliers (see for example Farhi and Werning 2016*a*, Nakamura and Steinsson 2014, and Chodorow-Reich 2017). We expand upon this standard framework in two natural directions given our context. First, our model includes heterogeneity in the marginal propensity to consume out of liquid wealth for savers and borrowers, which allows ex-post debt relief to have real effects. Second, our model includes both traded and non-traded goods, which allows us to examine the causal effect of debt relief on traded and non-traded employment separately, facilitating the mapping between our empirical difference-in-differences estimates and the model.

A. Model Setup

Our model is a two-agent, two-region, two-good ("TANK^3") currency union model. The model features a home H and foreign F region, each producing traded T and non-traded NT goods, and each inhabited by a representative borrower B and a representative saver S. The home region and the foreign region have equal size of $\frac{1}{2}$. In each region, borrowers make up the fraction φ^B of the population, and savers the faction $\varphi^S = 1 - \varphi^B$. Households $h \in \{B, S\}$ share the same utility function over consumption and hours worked (up to a factor that normalizes their total hours), but differ in their discount factor β^h, with $\beta^B < \beta^S$. They also face an exogenous credit constraint, which is binding for borrowers in steady state. Goods are produced under monopolisitic competition. We index goods by type $\{T, NT\}$, production location $i \in \{H, F\}$, producer j, and time t.

Households. All households within a region consume traded and non-traded goods, receive employment and dividend income, and can borrow and save in nominal risk-free bonds. Households maximize utility:

$$\mathbb{E}\left[\sum_{t=0}^{\infty}\left(\beta^h\right)^t u^h\left(C^h_{i,t}, N^h_{i,t}\right)\right]$$

where β^h is the discount factor of household type $h \in \{B, S\}$, $C^h_{i,t}$ is aggregate consumption of household type h living in region i at time t, and $N^h_{i,t}$ is that household's labor supply. For our baseline specification, we assume standard separable preferences of the form $u^h(C, N) = \frac{C^{1-\sigma}}{1-\sigma} - \chi^h \frac{N^{1+\psi}}{1+\psi}$, where ψ is the inverse Frisch elasticity of labor supply and σ the inverse elasticity of intertemporal substitution in consumption. Consumption C is itself an aggregate of the consumption of traded and non-traded goods:

$$C(C_T, C_{NT}) = \left[\alpha^{\frac{1}{\eta}} (C_T)^{\frac{\eta-1}{\eta}} + (1-\alpha)^{\frac{1}{\eta}} (C_{NT})^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$$

where α represents the expenditure share on traded goods at a unit relative price. In turn, traded and non-traded goods are made up of an aggregate of intermediate goods:

$$C^h_{T,i} = \left(\int_0^1 \left(C^h_{T,i,j}\right)^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{\epsilon-1}} \qquad C^h_{NT,i} = \left(\int_0^1 \left(C^h_{NT,i,j}\right)^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{\epsilon-1}}$$

where $C^h_{T,i,j}$ is household h's demand for the traded good produced in location i by firm j (similarly for $C^h_{NT,i,j}$), and ϵ is the elasticity of substitution between goods.

We assume that non-traded goods are all produced locally, but traded goods can be imported from the other region. Tradable goods $j \in \left[0, \frac{1}{2}\right]$ are produced in the home region, and goods $j \in \left(\frac{1}{2}, 1\right]$ are produced in the foreign region. Since the home region also has size $\frac{1}{2}$, there is no home bias in tradable spending.

There is free trade across the two regions, so the price of traded goods is the same in both locations. We write $P_{T,j}$ for the common price of tradable intermediate good j, and $P_{NT,i,j}$ for the price of intermediate good j in region i. The nominal price indices for tradable and non-tradable goods are defined as:

$$P_T = \left(\int_0^1 \left(P_{T,j}\right)^{1-\epsilon} dj\right)^{\frac{1}{1-\epsilon}} \qquad P_{NT,i} = \left(\int_0^1 \left(P_{NT,i,j}\right)^{1-\epsilon} dj\right)^{\frac{1}{1-\epsilon}}$$

and the consumer price index in region i is given by:

$$P_i = \left[\alpha P_T^{1-\eta} + (1-\alpha)\left(P_{NT,i}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}}$$

Workers are immobile, so the nominal hourly wage may differ in the two regions. We write W_i for the nominal wage in region i.

The budget constraint of agent h, in region i at time t is given by:

$$P_{i,t}C_{i,t}^h + B_{i,t-1}^h - \Delta_{i,t}^h = \frac{B_{i,t}^h}{1+I_t} + W_{i,t}N_{i,t}^h + D_{i,t}$$

where $C_{i,t}^h = C\left(C_{T,i,t}^h, C_{NT,i,t}^h\right)$ is aggregate consumption for consumer i in region h at time t, $B_{i,t}^h$ is her nominal debt level, I_t the nation-wide nominal interest rate, and $D_{i,t}$ are total nominal profits of firms in region i. The government does not impose any taxes or transfers, except for those needed to impose the consumer debt write-downs $\Delta_{i,t}^h$, as detailed below. Consumers face a borrowing constraint, such that their real debt (in units of the traded good price index) is constrained to stay below a constant level $\overline{b}$ at all times:

$$B_{i,t}^h \leq \overline{b}P_{T,t} \quad \forall h, i$$

Firms. Firms produce goods under monopolistic competition using local labor as their only input. Firm j produces tradable good j using the production function:

$$Y_{T,j,t} = A_{T,t}\left(N_{T,j,t}\right)^{\gamma}$$

where A_T denotes productivity in the traded good sector–which is common across firms and regions–and γ denotes the extent of diminishing returns to production. Similarly, non-tradable firms in both the home and foreign regions produce non-tradable goods using the production function:

$$Y_{NT,i,j,t} = A_{NT,t}\left(N_{NT,i,j,t}\right)^{\gamma} \qquad i \in \{H, F\}$$

where A_{NT} denotes the common productivity in the non-traded good sector.

Prices for both traded and non-traded goods are set in a Calvo fashion, with each firm getting a chance to reset their price with a probability $1-\theta$ that is iid across firms and over time. When $\theta = 0$, prices are fully flexible. The degree of price rigidity θ is the same for both traded and non-traded goods.

Monetary Policy. For our baseline specification, we assume that monetary policy sets a constant nominal interest rate I_t:

$$I_t = \overline{I} \tag{10}$$

where $\bar{I}$ is the steady state nominal interest rate in our model. Since our focus will be on the effects of debt relief shocks, this baseline specification implies that monetary policy is unresponsive to the effect of these shocks, mimicking a situation where debt relief takes place at the zero lower bound.[17] We refer to this policy as *ZLB policy*.

We will also consider the effect of debt relief in a non-crisis period. In this non-crisis period, we assume that the monetary authority responds to consumer price inflation in both regions with an equal weight ϕ. In this *Taylor rule policy* scenario, the central bank sets the nominal interest rate such that:

$$1 + I_t = \left(1 + \bar{I}\right) \left(\frac{P_{H,t}}{P_{H,t-1}}\right)^{\phi} \left(\frac{P_{F,t}}{P_{F,t-1}}\right)^{\phi} \tag{11}$$

where $\frac{P_{H,t}}{P_{H,t-1}}$ is home consumer price inflation at time t, $\frac{P_{F,t}}{P_{F,t-1}}$ is foreign CPI inflation, and ϕ is the degree of responsiveness of monetary policy to inflation.

To ensure the determinacy of outcomes in response to transitory debt relief shocks, both in the ZLB policy case given by Equation (10), and in the Taylor rule policy case given by Equation (11) when ϕ is sufficiently low, we assume that the central bank ensures that the economy returns to steady state at a time T that is far enough in the future that the effects of these debt relief shocks have died out.

Equilibrium. Equilibrium in our model is defined in a standard way.[18] Market clearing requires that, at any point in time, the labor market clears locally, so that aggregate employment in region i is both equal to aggregate supply by all agents and to aggregate demand by all local firms (the sum of traded goods employment $N_{T,i}$ and non-traded goods employment $N_{NT,i}$),

$$N_{i,t} \equiv \varphi^B N_{i,t}^B + \varphi^S N_{i,t}^S = N_{T,i,t} + N_{NT,i,t} \quad i \in \{H, F\}$$

The non-traded goods market must clear locally, so that: $C_{NT,i,j,t} = Y_{NT,i,j,t}$ in each region i and for each non-traded firm j, and the traded goods and the asset market must clear nationwide. This implies in particular that all borrowers' debts are also savers' assets:

$$\frac{\varphi^B}{2}(B_{H,t}^B + B_{F,t}^B) + \frac{\varphi^S}{2}(B_{H,t}^S + B_{F,t}^S) = 0.$$

[17]While the steady state nominal interest rate $\bar{I}$ is always strictly positive in our model, it is easy to conceive of "great recession" shocks, such as shocks to productivity, that would push the economy to $I_t = 0$. Since the model is approximately linear, these shocks would not interact with the effects of debt relief conditional on ZLB policy. Our assumption helps us isolate the effect of debt relief at the ZLB without explicitly modeling these great recession shocks.

[18]See Appendix C for the full set of equations describing the equilibrium solution, as well as a description of our solution method.

In the zero-inflation steady state of our model, borrowers in both regions are at their credit constraint:

$$B_i^B = \bar{b} P_T \quad \forall i$$

and the nominal and real interest rate are both equal to $\bar{I} = \left(\beta^S\right)^{-1} - 1$.

Debt Relief. We model the debt relief shock as follows. At time 0, it is unexpectedly announced that home borrowers will receive a sequence of transfers $\Delta_{H,t}^B$ and that foreign borrowers will receive a sequence of transfers $\Delta_{F,t}^B$. The home borrowers can use these transfers to pay down their debts, and, since they are constrained, they will do so fully in equilibrium, provided that the transfers are small enough. This sequence of transfers captures the ex-post nature of the debt relief shock that we are modeling, in that it reduces borrowers' debts without affecting borrowing rates or ex-ante credit supply.

Each period, total transfers $\Delta_t \equiv \frac{\varphi^B}{2}\left(\Delta_{H,t}^B + \Delta_{F,t}^B\right)$ are paid for by a lump-sum tax on savers in one or both regions, such that:

$$\frac{\varphi^S}{2}\Delta_{H,t}^S = -f\Delta_t \quad \frac{\varphi^S}{2}\Delta_{H,t}^S = -(1-f)\Delta_t \tag{12}$$

The parameter $f \in [0,1]$ in (12) indexes the regional incidence of payment for the debt relief in our model. Consider, for example, the case where $\Delta_{F,t}^B = 0$, so that debt relief only takes place in the home region H. Then, if $f = 1$, savers at home pay entirely for local debt relief, generating the largest domestic offset. In that case, the aggregate demand effect of debt relief comes entirely from the difference in marginal propensities to consume between borrowers and savers in the home region. If $f < 1$, debt relief also implies regional redistribution, or a net asset transfer from the foreign region to the home region. The case $f = \frac{1}{2}$ implies that the burden of debt relief in the home region is borne equally by savers in both regions.

B. Model Calibration

In line with our objective of maintaining a transparent mapping between model and data, our baseline calibration uses standard parameter values from the literature. In later sections, we discuss the economic role of these parameters by discussing robustness of our results to parameter values.

Table 4 summarizes our baseline calibration, with all parameters at the quarterly frequency. We set the fraction of borrowers in each region to 0.5, reflecting the approximate share of households carrying a positive credit card balance in our data.

We set $\beta^S = 0.983$ so that the steady state annual real interest rate is 7 percent per year, corresponding to the average interest rate paid by households in 2007Q4 according to national account estimates.[19] For borrowers, we consider a baseline of $\beta^B = 0.92$. Provided that $\beta^B < \beta^S$, our model produces identical outcomes for small shocks. (β^B becomes relevant when we study large shocks, as we discuss in Section IVF.) In our baseline of separable preferences, $u^h(C, N) = \frac{C^{1-\sigma}}{1-\sigma} - \chi_h \frac{N^{1+\psi}}{1+\psi}$, we assume that the long-run income and substitution effects on labor supply cancel out, so $\sigma = 1$, and set the Frisch elasticity of labor supply to a standard macroeconomic value of $\psi^{-1} = 1$.

We set $1 - \alpha = 0.236$, since our measure of non-tradable sectors, following Mian and Sufi (2014*b*), represents only 23.6 percent of employment. We follow the standard practice of setting an elasticity of substitution within tradable and non-tradable goods equal to 10 to match a steady-state level of markups of 11 percent, and set the elasticity of substitution between T and NT to a relatively high value of 2. We set $\gamma = 0.66$ to match a steady-state labor share of $\frac{\epsilon}{\epsilon-1}\gamma = 0.6$, as in NIPA data for the period.

We consider two assumptions for price rigidity. In our baseline, prices are sticky and $\theta = 0.8$, implying an average price duration of 5 quarters. This level of price stickiness is on the high end of the empirical estimates, but we show in Section IVC that only a high degree of price rigidity can rationalize our empirical relative multiplier estimates. We also consider an alternative calibration with fully flexible prices ($\theta = 0$). We will argue that our empirical relative multipliers soundly reject this specification.

We set $\bar{b}/C = 1$ so that aggregate credit card debt equals 12.5 percent of annual PCE, its U.S. value in 2008.[20] We normalize the steady-state hours of borrowers and savers to 1, implying that borrowers and savers have the same income before interest payments. In the steady state equilibrium, borrowers are at their borrowing limits and spend 1.7% percent of their income on interest payments. We set average PCE at $C = \$32,000$, its U.S. value in 2007Q4. We solve for a symmetric steady state in which all relative prices are 1. We obtain the values of A_T, A_{NT}, χ^S and χ^B that achieve these steady-state targets, as described in Appendix CB.

[19] According to the BEA, mortgage interest payments were \$682bn and other consumer credit payments were \$265bn at an annualized rate in 2007Q3. According to the Flow of Funds, in that quarter there was \$10.5trn outstanding in mortgage credit and \$2.5trn in consumer credit. The average annual interest rate paid by households was therefore 6.9 percent in that quarter.

[20] In our data, the average credit card balance is \$4000 per person. This implies a balance of $\frac{\$4000}{\varphi^B} = \$8000$ per borrower, which is 100% of quarterly PCE.

C. Impulse Responses and the Degree of Price Rigidity

We first study impulse responses to debt relief shocks. Recall from Section IVA that we are interested in recovering both $\mathcal{M}_H$ and $\mathcal{M}_F$ for both the tradable and non-tradable sectors. To do so, we assume that the only shock that hits the model is a home debt relief shock of $\Delta_H = 1\%$ of home PCE, with $\Delta_F = 0$. This shock corresponds to a one-time reduction of the level of debt of every borrower in the home region by 2%, or $160. By definition, the percentage point impact impulse response to this shock in the home and foreign region correspond to our multipliers of interest, $\mathcal{M}_H$ and $\mathcal{M}_F$, respectively.

Figure 4 presents the impulse response of the model to this one-time debt relief shock in the home region. The effects of the debt relief shock are not very persistent, with very limited impact on aggregate outcomes beyond the first quarter. This lack of persistence validates our focus on "the" debt relief-multiplier, and shows why our model fits the assumptions of section III used to derive Equation (3) in Section IVA. See Auclert, Rognlie and Straub (2018) for additional discussion on why TANK models generate limited endogenous persistence.

In our baseline calibration, non-tradable employment rises by more than one percent in the home region in the short run, but only slightly increases in the foreign region over the same time period:

$$\mathcal{M}_{NT,H} = 1.56, \qquad \mathcal{M}_{NT,F} = 0.33, \qquad \mathcal{M}_{NT,rel} = 1.23 \tag{13}$$

In contrast, tradable employment increases by around one percent in both the home and foreign regions in the short run in our baseline calibration:

$$\mathcal{M}_{T,H} = 0.89, \quad \mathcal{M}_{T,F} = 0.99, \qquad \mathcal{M}_{T,rel} = -0.10 \tag{14}$$

These relative debt relief multipliers are close to, but slightly below, our empirical debt relief multipliers reported in Equation (9).

Our model's success in matching the empirical debt relief multipliers of both tradable and non-tradable employment relies on the interaction between its three main features: heterogeneity in marginal propensities to consume between borrowers and savers, nominal rigidities, and trade linkages across regions. First, debt relief redistributes wealth from savers in both the home and foreign regions, who have low MPCs, to borrowers in the home region, who have high MPCs. This redistribution from savers to borrowers stimulates consumption in the home region, increasing aggregate demand for both non-tradable goods locally and for tradable goods everywhere. Second, given relatively sticky prices, this additional spending stimulates production and therefore incomes at home, leading to additional spending on both traded and non-traded goods in the home region (i.e., positive $\mathcal{M}_{NT,H}$ and $\mathcal{M}_{T,H}$). Finally, given trade linkages, the rise in labor demand from traded goods firms raises tradable employment in the foreign region as well (i.e., a positive $\mathcal{M}_{T,F}$). Interestingly, the positive $\mathcal{M}_{T,F}$ also increases incomes and therefore overall spending in the foreign region, leading to an increase in non-tradable employment in the foreign region as well (i.e., a positive $\mathcal{M}_{NT,F}$).

An important lesson from Equation (14) is that, even though the observed relative tradable employment multiplier $\mathcal{M}_{T,rel}$ is close to zero, this multiplier masks a large and positive response of tradable employment in both regions. In our model, $\mathcal{M}_{T,rel}$ is slightly negative because of terms of trade effects: the increase in home wages makes goods produced in the home region relatively more expensive. This induces some substitution of consumers away from home goods towards foreign goods, so that foreign traded employment increases by more than home traded employment. However, those terms of trade effects are relatively muted given our assumed degree of price stickiness, and the economy mostly adjusts to debt relief via an increase in income everywhere.

Our ability to match both the tradable and non-tradable employment multipliers are in fact very specific to our calibration of high price rigidity. Appendix Figure A4 shows the impulse responses under flexible prices, $\theta = 0$. In this calibration, aggregate home employment goes *down* in the short-run. Upon receiving debt relief, borrowers increase consumption but also immediately reduce hours worked (a wealth effect, large under standard separable preferences).[21] Since non-traded goods can only produced locally while traded goods can be imported, the overall effect is a moderate rise in local non-tradable employment and a large increase in imports, intermediated by an increase in the prices of home tradables. Overall, under flexible prices, $\mathcal{M}_{NT,rel}$ is close to 0 while $\mathcal{M}_{T,rel}$ is very negative (i.e., less than -0.6).

In this sense, the non-tradable and the tradable relative employment multiplier are both useful moments to identify the degree of macroeconomic price stickiness. Figure 5 illustrates this point by plotting the relative employment multipliers for both non-tradables and tradables as a function of the degree of price rigidity θ. Both $\mathcal{M}_{NT,rel}$ and $\mathcal{M}_{T,rel}$ increase with θ, and get closer to their empirical counterpart as θ grows larger. If anything, our empirical estimates would lead us to infer completely fixed prices for this period, $\theta = 1$ (see Mian and Sufi 2014*b* for a related argument.)

[21] The wealth effect from debt relief is also visible in our sticky price calibration when comparing employment rates of borrowers and savers. Hours rise mostly for savers, with hours for borrowers remaining relatively flat.

We conclude this subsection by considering what models could achieve an even better fit to our empirical relative debt relief multipliers. While our baseline model does a reasonable job, there are two versions of our model that are able to hit the empirical relative nontradable multiplier exactly right, though both have drawbacks in other dimensions.[22] The first version increases the aggregate degree of home bias by reducing the tradable share of consumption α. Appendix Figure A8 shows that, as α is reduced, the home multiplier rises and the foreign multiplier falls, increasing $\mathcal{M}_{NT,rel}$. More home bias reduces the amount of foreign demand "leakage," increasing the local multiplier. Holding the other parameters constant, we obtain $\mathcal{M}_{NT,rel} = 1.81$ for $\alpha = 0.09$, an implausible degree of home bias for the United States, leading us to prefer our baseline to this alternative for policy evaluation.

The second version of our model that more closely fits the relative non-tradable multiplier in the data replaces our baseline specification of preferences with GHH preferences (Greenwood, Hercowitz and Huffman 1988), with period utility function $u^h(C, N) = \log\left(C - \chi_h N^2\right)$. In Appendix Figure A8, we repeat Figure 5 with this alternative specification. When $\theta = 0.68$, we are able to exactly match the relative non-tradable employment multiplier of $\mathcal{M}_{NT,rel} = 1.81$. However, in this parametrization, the implied home and foreign multipliers are very large for both non-tradable and tradable goods. That is, at the zero lower bound, $\mathcal{M}_{NT,H} = 16.03$ and $\mathcal{M}_{NT,H} = 14.22$, while $\mathcal{M}_T \simeq 15$ for both. As discussed in Auclert and Rognlie (2017), these large aggregrate multipliers are due to the interaction between nominal price rigidities and the strong complementarity between consumption and labor supply that GHH preferences generate. These effects seem implausibly strong, again leading us to prefer our baseline to this alternative for policy evaluation.

D. Using the Model to Recover the Aggregate Effect

Having established that our model matches our empirical relative employment multipliers well, we proceed to perform our main counterfactual exercise. We ask the model the contribution of unsecured debt relief to employment during the great recession. For this question, it is the aggregate multiplier $\mathcal{M}_{agg}$, rather than the relative multiplier $\mathcal{M}_{rel}$, that is relevant.

Observe from Equations (13) and (14) that, in our model, the aggregate multiplier is the same for tradable and nontradable employment, and it is equal to $\mathcal{M}_{agg} = \mathcal{M}_{T,agg} = \mathcal{M}_{NT,agg} = 1.88$. Therefore, to obtain an estimate of the employment effect of debt relief, we need an estimate of the

[22] We focus on the relative non-tradable employment multiplier. The relative tradable employment multiplier is always slightly negative in our model because we do not have home bias in tradable spending and relative price movements always reduce home competitiveness in producing tradables. To generate a positive relative tradable multiplier our model would need to feature enough tradable home bias, in addition to nontradable home bias.

aggregate unsecured debt relief that took place over the great recession. Multiplying this number by $\mathcal{M}_{agg}$ then delivers our average counterfactual employment effect, for both tradable and nontradable employment.

We proceed as follows. From our data, we have an estimate of total debt relief at a point in time. Chargeoffs on credit card debt were relatively flat at XXX% of PCE between 2001Q1 and 2007Q4. Chargeoffs then increased dramatically to reach XXX% of PCE at their peak in 2009Q3. As in Section II8, we then scale this number by $1/0.77$ to reflect our best estimate of the aggregate excess debt relief that took place over this period.

Clearly, some debt relief takes place even in normal times. For our counterfactual we are interested in the contribution of the *excess* debt relief that took place during the recession. We estimate excess debt relief by subtracting the 2007Q4 number from the levels observed after that date. This procedure delivers the green line in Panel A of Figure 6. We then feed in this path of excess debt relief to the model, assuming that agents are constantly surprised by the excess debt relief that takes place each quarter. We then recover our aggregate employment counterfactual for non-tradable employment (Panel B, green line) and tradable employment (Panel C, green line). At the peak in 2009Q3, this exercise delivers an aggregate employment effect of $1\% \times 1.88 = 1.88\%$, or roughly 2.6 million jobs.

Figure 6 also reports the outcomes in a two representative high-exemption ("home") and low-exemption ("foreign") regions. We assume that the average debt relief across the high and the low exemption regions is equal to the average debt relief in the data (the green line), and that the difference between the high and the low exemption region is equal to our estimated effect from a one-standard deviation movement in our exemption measure from Figure 3. This exercise makes clear that our empirical variation picks up the difference between two large numbers. Comparing the relative outcome in the model (solid black line) vs the data (dashed black line) gives a sense of our model's success.

E. The Role of Monetary Policy

Our counterfactuals so far have been premised on our assumption of zero lower bound policy. As a comparison between our baseline impulse responses (figure 4) and our flexible-price impulse responses (figure A4) shows, the response of monetary policy is crucial to determine the aggregate effect. Absent a change in prices or monetary policy, debt relief induces an aggregate wealth effect. Under the zero lower bound, monetary policy does not respond to the increase in inflation from the pressure of aggregate demand. By contrast, under flexible prices, monetary policy increases nominal interest rates by almost 40 basis points, prompting savers everywhere to dramatically reduce their consumption and offset the rise in borrower consumption at home.

While such a tightening of monetary policy is implausible in crisis times, such as the great recession that is our main focus, it may not be implausible in non-crisis times, during which we would expect the central bank to counter any inflationary shock such as a debt relief shock. Appendix Figure A5 evaluates the effect of alternative degrees of monetary tightening, indexed by the degree of responsiveness of the central bank to inflation (the Taylor rule coefficient ϕ_π), in our baseline calibration. The case $\phi_\pi = 0$ corresponds to our baseline of the zero lower bound. As Nakamura and Steinsson (2014) have pointed out, the relative multiplier differences out the effect of monetary policy across the two regions. Hence, no matter how much monetary policy tightens, the relative multipliers $\mathcal{M}_{T,rel}$ and $\mathcal{M}_{NT,rel}$ remain the same.[23] However, the larger the response of monetary policy, the lower the effect on nontradable and tradable employment in both regions. But our insight that there are positive spillover effects on the foreign region, so that $\mathcal{M}_{NT,F} > 0$ and $\mathcal{M}_{T,F} > 0$, remains valid under many plausible values of ϕ_π. The point of zero spillover for nontradables, $\mathcal{M}_{NT,F} = 0$ is only reached for $\phi_\pi = 6.5$, corresponding to a relatively large monetary tightening of 15 basis points.

F. Additional Counterfactuals

We use the model to conduct two additional counterfactuals.

An important question is the extent to which our results scale. Would the employment effects have been twice as high, if the amount of debt relief during the great recession had been twice as large? Figure 7 plots the multipliers, both absolute and relative, as a fraction of the size of the debt relief shock. The impact multiplier is largest when the shock Δ is small relative to PCE. This is because small transfers are spent immediately by constrained consumers. When the transfer gets sufficiently large, borrowers start saving a fraction of it, lowering the impact multiplier and spreading the aggregate effect of debt relief over multiple periods. The lower their discount factor β^B, the larger the transfer needs to be before this happens. In our baseline calibration with an annual $\beta^B = 0.92$, this nonlinearity takes place once transfers reach 3% of GDP.[24] This exercise provides an important cautionary tale for debt relief programs as aggregate demand management, since they show that those programs are

[23]Since this is a currency union model where relative prices across regions also matter, the limit with the Taylor rule coefficient $\phi_\pi \to \infty$ does not correspond to the flexible price limit, whose relative multipliers are different, as Figure 5 shows.

[24]This result can be understood by considering the shape of the consumption of borrowers, which we derive explicitly for a continuous-time version of the model in Appendix CF. As in Achdou et al. (2017), the consumption function of borrowers behaves likes a square-root function of debt relief when debt relief is sufficiently small. This concave consumption function translates into a concave aggregate employment effect as a function of debt relief size, or a diminishing multiplier.

most effective at boosting current demand when they are relatively small in magnitude.

Another important question in the evaluation of debt relief policies is the question of financing. Who pays for debt relief matters, because if the agents that are financing the debt relief, such a leveraged banks, are themselves highly constrained, the aggregate outcome may not be large or may even be contractionary. We can address this concern in two ways. First, within our model, we can assess what happens as we vary the burden of debt relief financing f between home and foreign savers. If home savers pay for home debt relief, aggregate effectiveness might be more limited than if foreign savers paid for it. Appendix Figure A6 shows that while this is qualitatively right, lowering f towards zero does not qualitatively reduce either the relative or the home multiplier significantly at all. The intuition is that saver MPCs are always low, so the amount of regional offset is low no matter where savers are located. Second, we can speculate on what would happen in an alternative model in which savers had MPCs as high as borrowers but were located in the foreign region. Such a model would generate positive relative multipliers but a zero aggregate multiplier. However, quantitatively, the offset from savers would imply relative multipliers that are much smaller than those that are generated by our model. We conclude that, while the MPCs of agents financing debt relief is important for the aggregate effectiveness of debt relief policy, our results are only consistent with low MPCs for savers over the period.

G. Persistence

Our model is successful at generating the sign and magnitude of the short run empirical multipliers in the data. We close this section by considering the issue of persistence. Figure 2 shocks that, in the data, employment effects are highly persistent, and in fact increase over time following debt relief. While this finding is consistent with the highly persistent responses to local unemployment shocks documented in Yagan (2017), it implies the long-run multipliers are even larger than the short-run multipliers. This outcome cannot be generated in any simple model such as ours, in which debt relief constitutes a transitory demand shock. In principle, mechanisms relying on an innovation response to demand shock (Benigno and Fornaro 2018), or slow human capital decay following aggregate unemployment (Jarosch 2015) might be able to quantitatively explain our findings. XXXX Refer to Hurst et al on persistence also XXXX We leave this question for future research.

V. Conclusion

In this paper, we combine cross-state variation in bankruptcy exemptions with a general equilibrium model to show that ex-post debt forgiveness can stabilize macroeconomic activity during a debt-driven recession. Using a rich panel of individual-level credit data and county-level employment data, we find that states with more and less generous bankruptcy exemptions had statistically identical outcomes during the 2001 to 2007 period. Starting in 2008, however, the states with more generous bankruptcy exemptions had significantly smaller declines in local non-tradable employment and larger increases in consumer debt write-downs compared to the states with less generous exemptions. In sharp contrast, we find only a small and statistically insignificant effect of more generous bankruptcy exemptions on local tradable and other employment.

We then develop a general equilibrium model to recover the aggregate effect of consumer debt forgiveness and conduct policy counterfactuals. The model yields three key results. First, substantial nominal rigidities are required to rationalize the reduced form estimates. Second, with monetary policy at the zero lower bound, traded good demand spillovers from more generous to less generous states boosted employment everywhere. Finally, the debt forgiveness provided during the Great Recession increased total employment by almost 2 percent.

The findings from this paper can also help inform ongoing efforts to evaluate the welfare impact of the consumer bankruptcy system. These evaluations typically use quantitative models to weigh the trade-off between the ex-post consumption smoothing benefits provided by bankruptcy protection at the individual level (e.g., Dobbie and Song 2015), with the ex-ante increased borrowing costs suggested by economic theory (e.g., Athreya 2002, Li and Sarte 2006, Livshits, MacGee and Tertilt 2007, Chatterjee and Gordon 2012) and documented empirically by Severino and Brown 2017. Our results suggest that aggregate demand effects are important to evaluate the macroeconomic benefits of the consumer bankruptcy system, so that the overall benefit may be broader than previously realized. We therefore view the incorporation of our empirical estimates into a general equilibrium model of the credit market incorporating ex-ante effects as an important area for future research.

References

Abadie, Alberto, Susan Athey, Guido W. Imbens, and Jeffrey Wooldridge. 2017. "When Should You Adjust Standard Errors for Clustering?" National Bureau of Economic Research Working Paper 24003.

Achdou, Yves, Jiequn Han, Jean-Michel Lasry, Pierre-Louis Lions, and Benjamin Moll. 2017. "Income and Wealth Distribution in Macroeconomics: A Continuous-Time Approach." *Manuscript*.

Adelino, Manuel, Antoinette Schoar, and Felipe Severino. 2018. "Dynamics of Housing Debt in the Recent Boom and Great Recession." *NBER Macroeconomics Annual*, 32(1): 265–311.

Agarwal, Sumit, Gene Amromin, Itzhak Ben-David, Souphala Chomsisengphet, Tomasz Piskorski, and Amit Seru. 2017. "Policy intervention in debt renegotiation: Evidence from the home affordable modification program." *Journal of Political Economy*, 125(3): 654–712.

Altonji, Joseph G., Todd E. Elder, and Christopher R. Taber. 2005. "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools." *Journal of Political Economy*, 113(1): 151–184.

Armour, John, and Douglas Cumming. 2008. "Bankruptcy Law and Entrepreneurship." *American Law and Economics Review*, 10(2): 303–350.

Athreya, Kartik B. 2002. "Welfare Implications of the Bankruptcy Reform Act of 1999." *Journal of Monetary Economics*, 49(8): 1567–1595.

Auclert, Adrien, and Kurt Mitman. 2018. "Consumer Bankruptcy as Aggregate Demand Management." *Manuscript*.

Auclert, Adrien, and Matthew Rognlie. 2017. "A Note on Multipliers in NK Models with GHH Preferences." *Manuscript*.

Auclert, Adrien, Matthew Rognlie, and Ludwig Straub. 2018. "The Intertemporal Keynesian Cross." National Bureau of Economic Research Working Paper 25020.

Avery, Robert B, Paul S Calem, Glenn B Canner, and Raphael W Bostic. 2003. "An Overview of Consumer Data and Credit Reporting." *Federal Reserve Bulletin*, 89: 47.

Benigno, Gianluca, and Luca Fornaro. 2018. "Stagnation Traps." *The Review of Economic Studies*, 85(3): 1425–1470.

Beraja, Martin, Erik Hurst, and Juan Ospina. 2018. "The Aggregate Implications of Regional Business Cycles." *Manuscript*.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Differences-In-Differences Estimates?" *The Quarterly Journal of Economics*, 119(1): 249–275.

Chatterjee, Satyajit, and Grey Gordon. 2012. "Dealing with Consumer Default: Bankruptcy vs Garnishment." *Journal of Monetary Economics*, 59: S1–S16.

Chodorow-Reich, Gabriel. 2017. "Geographic Cross-Sectional Fiscal Spending Multipliers: What Have We Learned?" National Bureau of Economic Research NBER Working Paper 23577.

Corbi, Raphael B., Elias Papaioannou, and Paolo Surico. 2018. "Regional Transfer Multipliers." Social Science Research Network SSRN Scholarly Paper ID 3283008, Rochester, NY.

Currie, Janet, and Jonathan Gruber. 1996. "Saving Babies: The Efficacy and Cost of Recent Changes in the Medicaid Eligibility of Pregnant Women." *Journal of Political Economy*, 104(6): 1263–1296.

Dávila, Eduardo. 2015. "Using Elasticities to Derive Optimal Bankruptcy Exemptions." NYU Stern Working Paper.

Di Maggio, Marco, and Amir Kermani. 2017. "Unemployment Insurance as an Automatic Stabilizer: The Financial Channel."

Dobbie, Will, and Jae Song. 2015. "Debt relief and debtor outcomes: Measuring the effects of consumer bankruptcy protection." *The American Economic Review*, 105(3): 1272–1311.

Dobbie, Will, and Paige Marta Skiba. 2013. "Information Asymmetries in Consumer Credit Markets: Evidence from Payday Lending." *American Economic Journal: Applied Economics*, 5(4): 256–82.

Dobbie, Will, Paul Goldsmith-Pinkham, and Crystal Yang. 2015. "Consumer Bankruptcy and Financial Health." National Bureau of Economic Research Working Paper 21032.

Donaldson, Jason Roderick, Giorgia Piacentino, and Anjan V Thakor. 2018. "Household Debt and Unemployment."

Dupor, Bill, Marios Karabarbounis, Marianna Kudlyak, and M. Saif Mehkari. 2018. "Regional Consumption Responses and the Aggregate Fiscal Multiplier." SSRN Scholarly Paper 3131248.

Eggertsson, Gauti B., and Paul Krugman. 2012. "Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach." *Quarterly Journal of Economics*, 127(3): 1469–1513.

Fan, Wei, and Michelle J White. 2003. "Personal Bankruptcy and the Level of Entrepreneurial Activity." *Journal of Law and Economics*, 46(2): 543–568.

Farhi, Emmanuel, and Iván Werning. 2016*a*. "Chapter 31 - Fiscal Multipliers: Liquidity Traps and Currency Unions." In *Handbook of Macroeconomics*. Vol. 2, , ed. Harald Uhlig and John B. Taylor, 2417–2492. Elsevier.

Farhi, Emmanuel, and Iván Werning. 2016*b*. "A Theory of Macroprudential Policies in the Presence of Nominal Rigidities." *Econometrica*, 84(5): 1645–1704.

Fay, Scott, Erik Hurst, and Michelle J White. 2002. "The Household Bankruptcy Decision." *The American Economic Review*, 92(3): 706–718.

Fedaseyeu, Viktar. 2015. "Debt Collection Agencies and the Supply of Consumer Credit." Federal Reserve Bank of Philadelphia Working Paper 15-23.

Foote, Christopher L, Lara Loewenstein, and Paul S Willen. 2016. "Cross-Sectional Patterns of Mortgage Debt during the Housing Boom: Evidence and Implications." National Bureau of Economic Research Working Paper 22985.

Ganong, Peter, and Pascal Noel. 2018. "Liquidity vs. Wealth in Household Debt Obligations: Evidence from Housing Policy in the Great Recession." National Bureau of Economic Research Working Paper 24964.

Ghent, Andra C, and Marianna Kudlyak. 2011. "Recourse and residential mortgage default: evidence from US states." *The Review of Financial Studies*, 24(9): 3139–3186.

Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift. 2018. "Bartik Instruments: What, When, Why, and How." National Bureau of Economic Research.

Goodman, Paul. 1993. "The Emergence of Homestead Exemption in the United States: Accommodation and Resistance to the Market Revolution, 1840–1880." *The Journal of American History*, 80(2): 470–498.

Greenwood, Jeremy, Zvi Hercowitz, and Gregory W. Huffman. 1988. "Investment, Capacity Utilization, and the Real Business Cycle." *American Economic Review*, 78(3): 402–417.

Gropp, Reint, John Karl Scholz, and Michelle J White. 1997. "Personal Bankruptcy and Credit Supply and Demand." *The Quarterly Journal of Economics*, 112(1): 217–251.

Gross, Tal, Matthew J. Notowidigdo, and Jialan Wang. 2016. "The Marginal Propensity to Consumer Over the Business Cycle." *Working Paper*.

Guerrieri, Luca, and Matteo Iacoviello. 2015. "Occbin: A Toolkit for Solving Dynamic Models with Occasionally Binding Constraints Easily." *Journal of Monetary Economics*, 70: 22–38.

Guerrieri, Veronica, and Guido Lorenzoni. 2017. "Credit Crises, Precautionary Savings, and the Liquidity Trap." *Quarterly Journal of Economics*, 132(3): 1427–1467.

Guren, Adam M., Alisdair McKay, Emi Nakamura, and Jón Steinsson. 2018. "What Do We Learn From Cross-Sectional Empirical Estimates in Macroeconomics?"

Hall, Robert E. 2011. "The Long Slump." *The American Economic Review*, 101(2): 431–469.

House, Christopher L, Christian Proebsting, and Linda L Tesar. 2017. "Austerity in the Aftermath of the Great Recession." National Bureau of Economic Research Working Paper 23147.

Hsu, Joanne W, David A Matsa, and Brian T Melzer. 2018. "Unemployment insurance as a housing market stabilizer." *American Economic Review*, 108(1): 49–81.

Jarosch, Gregor. 2015. "Searching for Job Security and the Consequences of Job Loss."

Kekre, Rohan. 2018. "Unemployment Insurance in Macroeconomic Stabilization." *Manuscript*.

Korinek, Anton, and Alp Simsek. 2016. "Liquidity Trap and Excessive Leverage." *American Economic Review*, 106(3): 699–738.

Lee, Donghoon, and Wilbert Van der Klaauw. 2010. "An Introduction to the FRBNY Consumer Credit Panel." Federal Reserve Bank of New York Staff Report.

Livshits, Igor, James MacGee, and Michele Tertilt. 2007. "Consumer Bankruptcy: A Fresh Start." *The American Economic Review*, 97(1): 402–418.

Li, Wenli, and Pierre-Daniel Sarte. 2006. "US Consumer Bankruptcy Choice: The Importance of General Equilibrium Effects." *Journal of Monetary Economics*, 53(3): 613–631.

Mahoney, Neale. 2015. "Bankruptcy as Implicit Health Insurance." *The American Economic Review*, 105(2): 710–746.

Martin, Philippe, and Thomas Philippon. 2017. "Inspecting the Mechanism: Leverage and the Great Recession in the Eurozone." *American Economic Review*, 107(7): 1904–37.

McKay, Alisdair, and Ricardo Reis. 2016. "Optimal Automatic Stabilizers." National Bureau of Economic Research Working Paper 22359.

Mian, Atif, Amir Sufi, and Emil Verner. 2017. "How Do Credit Supply Shocks Affect the Real Economy? Evidence from the United States in the 1980s." National Bureau of Economic Research Working Paper 23802.

Mian, Atif, and Amir Sufi. 2011. "House Prices, Home Equity-Based Borrowing, and the U.S. Household Leverage Crisis." *The American Economic Review*, 101(5): 2132–2156.

Mian, Atif, and Amir Sufi. 2014*a*. *House of Debt: How They (and You) Caused the Great Recession, and How We Can Prevent It from Happening Again.* Chicago ; London:University Of Chicago Press.

Mian, Atif, and Amir Sufi. 2014*b*. "What Explains the 2007–2009 Drop in Employment?" *Econometrica*, 82(6): 2197–2223. 00014.

Mian, Atif, Kamalesh Rao, and Amir Sufi. 2013. "Household Balance Sheets, Consumption, and the Economic Slump." *The Quarterly Journal of Economics*, 128(4): 1687–1726.

Midrigan, Virgiliu, and Thomas Philippon. 2011. "Household Leverage and the Recession." National Bureau of Economic Research Working Paper 16965.

Nakamura, Emi, and Jón Steinsson. 2014. "Fiscal Stimulus in a Monetary Union: Evidence from US Regions." *American Economic Review*, 104(3): 753–792.

Nakamura, Emi, and Jón Steinsson. 2018. "Identification in Macroeconomics." *Journal of Economic Perspectives*, 32(3): 59–86.

Oster, Emily. 2017. "Unobservable Selection and Coefficient Stability: Theory and Evidence." *Journal of Business & Economic Statistics*, 1–18.

Piskorski, Tomasz, and Amit Seru. 2018. "Debt Relief and Slow Recovery: A Decade after Lehman." National Bureau of Economic Research.

Saiz, Albert. 2010. "The Geographic Determinants of Housing Supply." *The Quarterly Journal of Economics*, 125(3): 1253–1296.

Sarto, Andres. 2018. "Recovering Macro Elasticities from Regional Data." *Manuscript*.

Severino, Felipe, and Meta Brown. 2017. "Personal Bankruptcy Protection and Household Debt." SSRN Working Paper.

Skeel, David A. 2001. *Debt's Dominion: A History of Bankruptcy Law in America.* Princeton University Press.

Suárez Serrato, Juan Carlos, and Philippe Wingender. 2016. "Estimating Local Fiscal Multipliers." National Bureau of Economic Research Working Paper 22425.

Tai, Mingzhu. 2016. "House Prices and the Allocation of Consumer Credit." *Manuscript*.

The Association of Credit and Collection Professionals (ACA) . 2013. "2013 Top Collection Markets Survey." https://www.acainternational.org/assets/industry-research-statistics/2013-topmarketsurvey-electronic.pdf?viawrapper.

U.S. Courts. 2008. "Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) Report." http://www.uscourts.gov/statistics-reports/bapcpa-report-2008.

U.S. Courts. 2010. "Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) Report." http://www.uscourts.gov/statistics-reports/bapcpa-report-2010.

U.S. Courts. 2017. "Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) Report." http://www.uscourts.gov/statistics-reports/bapcpa-report-2017.

U.S. Treasury. 2018. "Making Home Affordable Program Performance Report - Fourth Quarter 2017." https://www.treasury.gov/initiatives/financial-stability/reports/Documents/4Q17MHAReportFinal.pdf.

Verner, Emil, and Gyozo Gyongyosi. 2018. "Household Debt Revaluation and the Real Economy: Evidence from a Foreign Currency Debt Crisis." SSRN Working Paper.

White, Michelle J. 2011. "Corporate and Personal Bankruptcy Law." *Annual Review of Law and Social Science*, 7(1): 139–164.

Whittaker, Julie M., and Katelin P. Isaacs. 2016. "Unemployment Insurance: Programs and Benefits." Congressional Research Service CRS Report RL33362. https://fas.org/sgp/crs/misc/RL33362.pdf.

Wilshusen, Stephanie. 2011. "Meeting the Demand for Debt Relief." Payment Cards Center, Federal Reserve Bank of Philadelphia Discussion Paper 11-04.

Yagan, Danny. 2017. "Employment Hysteresis from the Great Recession." National Bureau of Economic Research.

Table 1: Descriptive Statistics

	Avg Change from 2001q1-2007q4	Avg Change from 2007q4-2010q4	Avg Change from 2010q4-2013q4
Panel A: Employment Outcomes	(1)	(2)	(3)
Non-Tradable Emp. (Δ p.p.)	1.194	-5.178	5.300
Tradable + Other Emp. (Δ p.p.)	-3.376	-7.988	3.740
Total Emp. (Δ p.p.)	-2.570	-7.406	4.056
Panel B: Credit Outcomes			
Annual Charge-offs (Δ $)	-3.918	124.775	-241.672
Bankrupty Rate (Δ p.p.)	0.158	0.107	-0.091
Foreclosure Rate (Δ p.p.)	0.145	0.906	0.057
Credit Card Limits (Δ $)	2,790.922	-2,539.916	954.736
Credit Card Debt (Δ $)	182.507	-132.620	-276.685
Mortgage Debt (Δ $000)	26.124	1.839	-3.977
Panel C: Inflation Outcomes			
Non-Tradable CPI (Δ p.p.)	21.836	4.985	6.417
Tradable CPI (Δ p.p.)	10.908	3.167	6.503
Total CPI (Δ p.p.)	17.646	4.292	6.462
Panel D: Housing Outcomes			
House Price (Δ p.p.)	40.958	-21.846	10.669

Note: This table reports summary statistics. Each column reports the difference in the outcome over the period, averaged over all counties in the sample using population weights. Panel A reports the difference in log employment per working age person, or the percent change in the share employed of the working age population. Employment data is from the Quarterly Census of Employment and Wages. Non-tradable industries are defined as the retail and restaurant sectors following Mian and Sufi (2014*b*). Tradable and Other industries are also defined following Mian and Sufi (2014*b*). Panel B reports the average change across counties for various credit outcomes using data from Equifax. Annual charge-offs reports the average difference in dollars in the amount of derogatory debt discharged by credit card and auto lenders per person. Bankruptcy and foreclosure rates report the difference in the percent of people who file for foreclosure and bankruptcy per county. Credit card limits and debt report the difference in dollars per person and mortgage debt reports the difference in mortgage debt in thousands of dollars per person. All employment and credit outcomes are smoothed according to a moving average which includes $t-2$ through $t+1$. Panel C reports the difference in log consumer price index over the period, or the percent change in inflation. Non-tradable CPI is based on prices for services, and tradable CPI refers to commodity prices following Mian, Sufi and Verner (2017). Panel D reports the difference in log house prices, or the percent change in house prices. House price data comes from Corelogic.

Table 2: Reduced Form Effects of Bankruptcy Protections on Employment

	Avg Change	Effect of Bankruptcy Protections			
Panel A: 2008q1-2010q4	(1)	(2)	(3)	(4)	(5)
Log Non-Tradable Emp.	-5.178	0.499***	0.399**	0.422***	0.435***
	(6.737)	(0.183)	(0.166)	(0.100)	(0.104)
Log Tradable + Other Emp.	-7.988	0.162	0.086	−0.125	−0.048
	(8.263)	(0.366)	(0.330)	(0.221)	(0.211)
Log Total Emp.	-7.406	0.231	0.156	−0.005	0.061
	(6.919)	(0.311)	(0.272)	(0.176)	(0.170)
Panel B: 2011q1-2013q4					
Log Non-Tradable Emp.	5.300	1.096***	0.842***	0.941***	0.945***
	(5.896)	(0.228)	(0.268)	(0.241)	(0.241)
Log Tradable + Other Emp.	3.740	−0.103	−0.075	−0.249	−0.209
	(8.224)	(0.455)	(0.404)	(0.275)	(0.273)
Log Total Emp.	4.056	0.139	0.130	0.018	0.054
	(6.712)	(0.337)	(0.308)	(0.212)	(0.211)
Number of Observations		161,720	161,720	161,720	155,324
County F.E.		Y	Y	Y	Y
Year-Quarter F.E.		Y	Y	Y	Y
Housing Controls × YQ F.E.		N	Y	Y	Y
Additional Controls × YQ F.E.		N	N	Y	Y
Exclude Sand States		N	N	N	Y

Note: This table reports estimates of the reduced form effect of cross-state bankruptcy protections on log employment outcomes scaled by working age population (age 18-65). The first row of each panel reports results for log non-tradable employment, defined as the retail and restaurant sectors. The second row reports results for log tradable and other employment, defined as industries with sufficiently large imports and exports from the United States, and other as all non-tradable, tradable, and construction industries. The third row reports results for log total employment. Column 1 reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4-2010q4 or 2010q4-2013q4. Columns 2-5 report coefficients on the reduced form effect of a one standard deviation decrease in the log financial cost of filing for bankruptcy protection from 2007q4-2010q4 or 2010q4-2013q4. Column 2 reports estimates with county and year-quarter fixed effects. Column 3 repeats the regression, adding the Saiz supply elasticity and share of the population who own a home for each county, interacted with year-quarter fixed effects. For counties without the Saiz supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. Column 4 repeats the same regression, but with a set of location controls interacted with year-quarter fixed effects: the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure. Finally, Column 5 repeats Column 4, but excludes the "sand states," or Arizona, California, Nevada, and New Mexico. All regressions are weighted by county population as of 2007 and cluster the standard errors at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Table 3: Reduced Form Effects of Bankruptcy Protections on Debt Write-Downs

	Avg Change	Effect of Bankruptcy Protections			
Panel A: 2008q1-2010q4	(1)	(2)	(3)	(4)	(5)
Charge-Offs in Full Sample	124.775	50.385	54.503**	38.177***	33.578***
	(199.676)	(35.896)	(22.779)	(9.016)	(9.530)
Charge-Offs for Homeowners	242.352	77.499	80.459**	55.587***	53.032***
	(360.046)	(61.751)	(39.185)	(13.294)	(16.064)
Charge-Offs for Renters	-11.849	24.626*	22.579**	15.272*	10.799***
	(104.352)	(14.019)	(10.733)	(8.916)	(3.258)
Panel B: 2011q1-2013q4					
Charge-Offs in Full Sample	-241.672	31.714	33.691*	22.861***	22.137***
	(174.642)	(27.598)	(18.338)	(6.916)	(7.408)
Charge-Offs for Homeowners	-400.601	47.585	49.411	29.151***	29.348**
	(290.675)	(51.431)	(32.105)	(10.418)	(11.763)
Charge-Offs for Renters	-91.944	9.889	9.325	8.088*	7.311*
	(139.866)	(7.273)	(6.480)	(4.157)	(3.896)
Number of Observations		161,720	161,720	161,720	155,324
County F.E.		Y	Y	Y	Y
Year-Quarter F.E.		Y	Y	Y	Y
Housing Controls $\times$ YQ F.E.		N	Y	Y	Y
Additional Controls $\times$ YQ F.E.		N	N	Y	Y
Exclude Sand States		N	N	N	Y

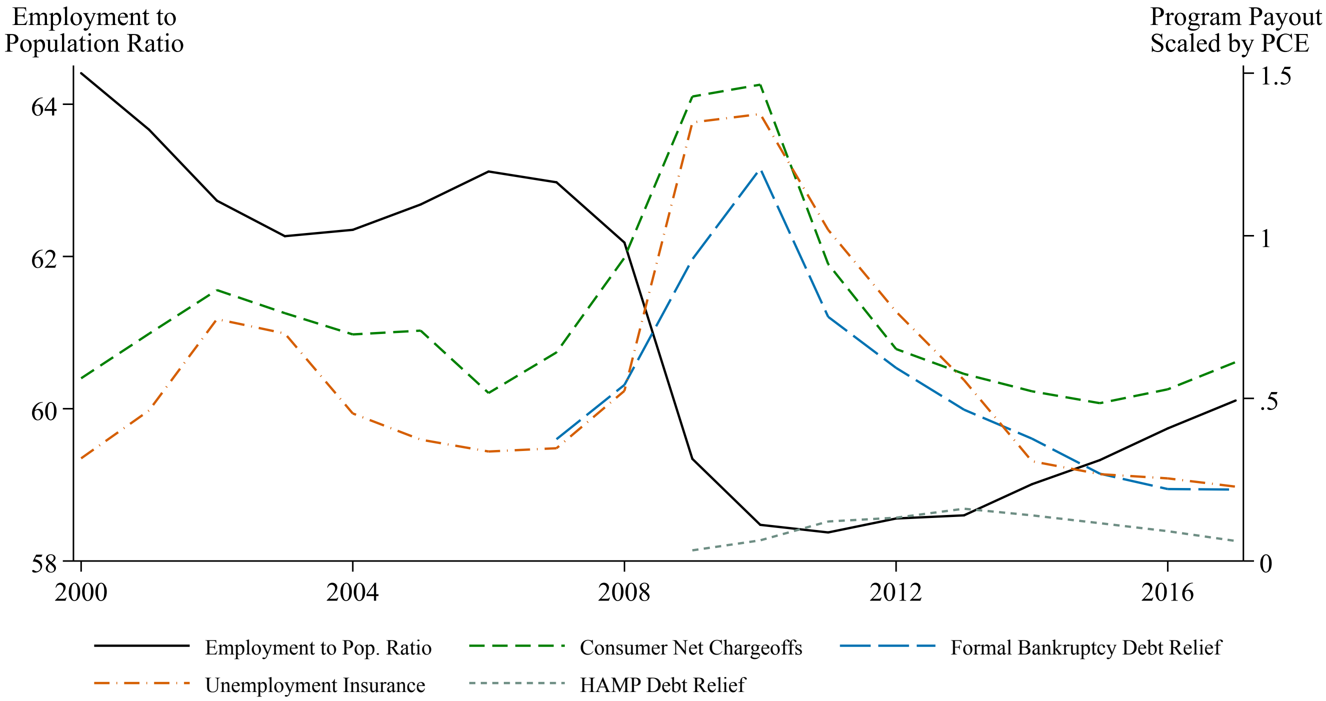
Note: This table reports estimates of the reduced form effect of cross-state bankruptcy protections on consumer debt charge-offs. The first row of each panel reports results for the full sample. The second row reports results for homeowners, defined as mortgage borrowers in 2007. The third row reports results for renters, defined as all non-mortgage borrowers in 2007. Column 1 reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4-2010q4 or 2010q4-2013q4. Columns 2-5 report coefficients on the reduced form effect of a one standard deviation decrease in the log financial cost of filing for bankruptcy protection from 2007q4-2010q4 or 2010q4-2013q4. Column 2 reports estimates with county and year-quarter fixed effects. Column 3 repeats the regression, adding the Saiz supply elasticity and share of the population who own a home for each county, interacted with year-quarter fixed effects. For counties without the Saiz supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. Column 4 repeats the same regression, but with a set of location controls interacted with year-quarter fixed effects: the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure. Finally, Column 5 repeats Column 4, but excludes the "sand states," or Arizona, California, Nevada, and New Mexico. All regressions are weighted by number of individuals in the credit report panel as of 2007 and cluster the standard errors at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Table 4: Model Parameters and Baseline Calibration

	Parameter (Quarterly Frequency)	Value	Target
φ^B	Fraction of borrowers in each region	0.5	Share with credit card balance
β^S	Saver discount factor	0.983	7% annual interest rate
β^B	Borrower discount factor	0.92	Arbitrary level below β^S
$u(C, N)$	Utility function	$\log(C) - \chi_h N^2$	Standard specification
$1 - \alpha$	Non-tradable share	0.236	Data (Mian and Sufi 2014*b*)
η	Subst. between T and NT	2	Standard value
ϵ	Subst. within T and within NT	10	Standard value
γ	Exponent on labor in production	0.66	Data (NIPA)
θ	Fraction of firms with fixed price	0.8	Duration of price rigidity = 5Q
$\overline{b}/C$	Debt limit (% of annual GDP)	16.67%	Avg Debt/GDP=8.33%
f	Incidence of debt relief	0.5	Equal incidence across regions

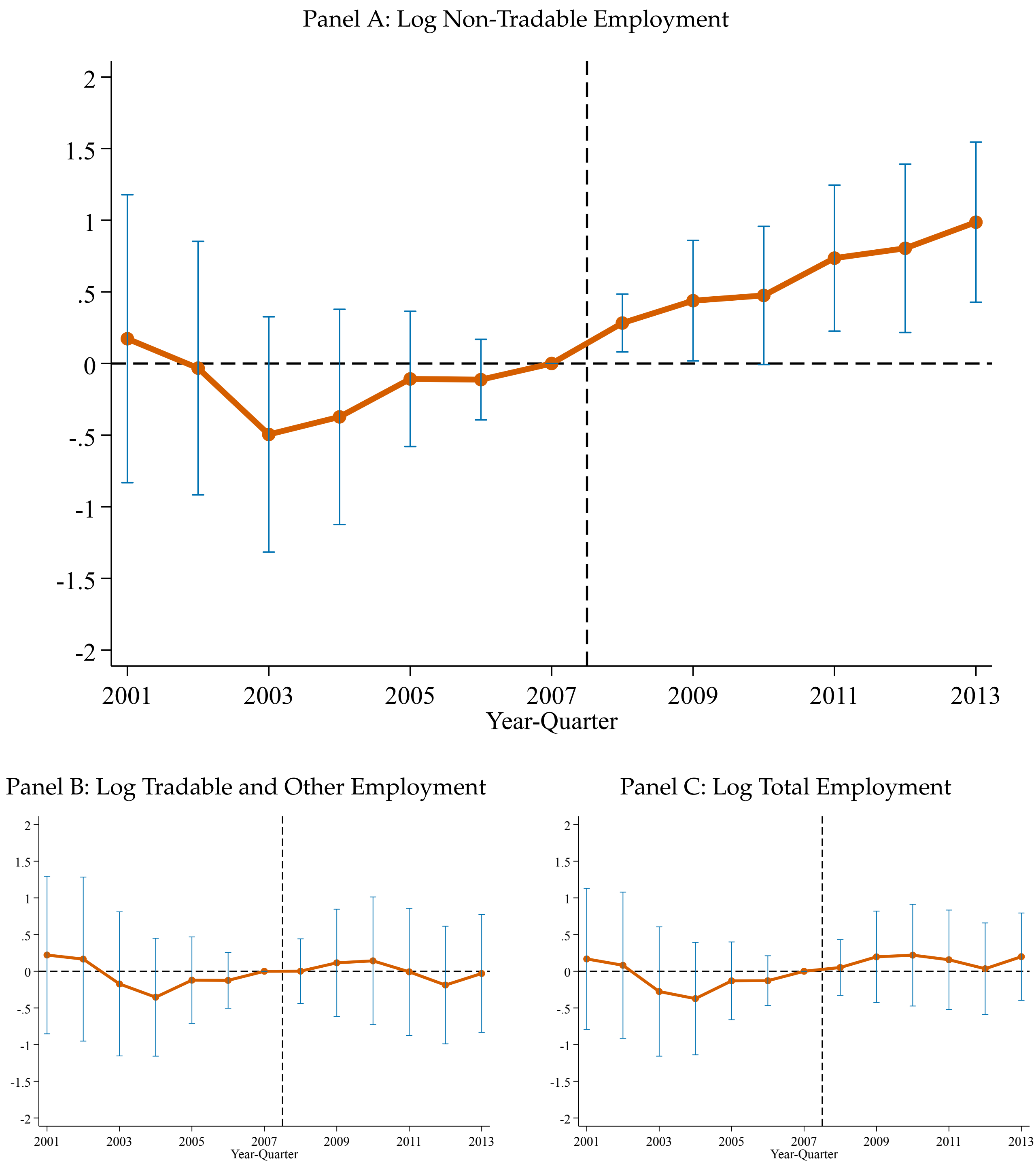
Note: This table displays parameter calibration values for the model in Section IV. See the text for additional details on the definition of each parameter and the target values.

Figure 1: Employment and Debt Relief during the Great Recession



Note: This figure plots the employment-to-population ratio over time on the left y-axis, and payout measures for four different programs as a percentage of PCE on the right y-axis. The black solid line of "Employment to Pop. Ratio" plots the 12-month average employment-to-population ratio, as measured by the CPS in December of each year. The green short-dash line of "Consumer Net Chargeoffs" plots net consumer charge-offs on non-housing debt. We combine two sources to estimate this figure: 1) net charge-off rates from commercial banks on all consumer loans (which exclude real estate), available here: `https://www.federalreserve.gov/releases/chargeoff/chgallsa.htm`, and are measured net of recoveries as a percentage of average loans and annualized; 2) the level of consumer loans liabilities, measured using the flow of funds and available here: `https://fred.stlouisfed.org/series/HNOCCIQ027S`. We multiply these two numbers together to approximate the level of net charge-offs by consumers. The blue long-dash line of "Formal Bankruptcy Debt Relief" plots the annual level of unsecured debt scheduled for discharge for Chapter 7 bankruptcy filers reported in the BAPCPA reports here: `https://www.uscourts.gov/statistics-reports/analysis-reports/bankruptcy-abuse-prevention-and-consumer-protection-act-report`. The orange dash-dot line of "Unemployment Insurance" plots the annual program outlays from unemployment insurance reported by the Department of Labor and available here: `https://oui.doleta.gov/unemploy/chartbook.asp`. The green short-dash line of "HAMP Debt relief" combines the reported debt relief of three programs: the Home Affordable Modification Program (HAMP), the Principal Reduction Alternative (PRA) and the Home Affordable Foreclosure Alternatives (HAFA). These programs all fell under the Making Home Affordable (MHA) umbrella run by the Treasury. To construct annual numbers, we take changes in the reported cumulative debt relief for each program reported in the Program Performance Reports (e.g. U.S. Treasury (2018)). For 2009-2012, where only HAMP numbers are reported, we proportionally allocate the other programs to the same share as HAMP.

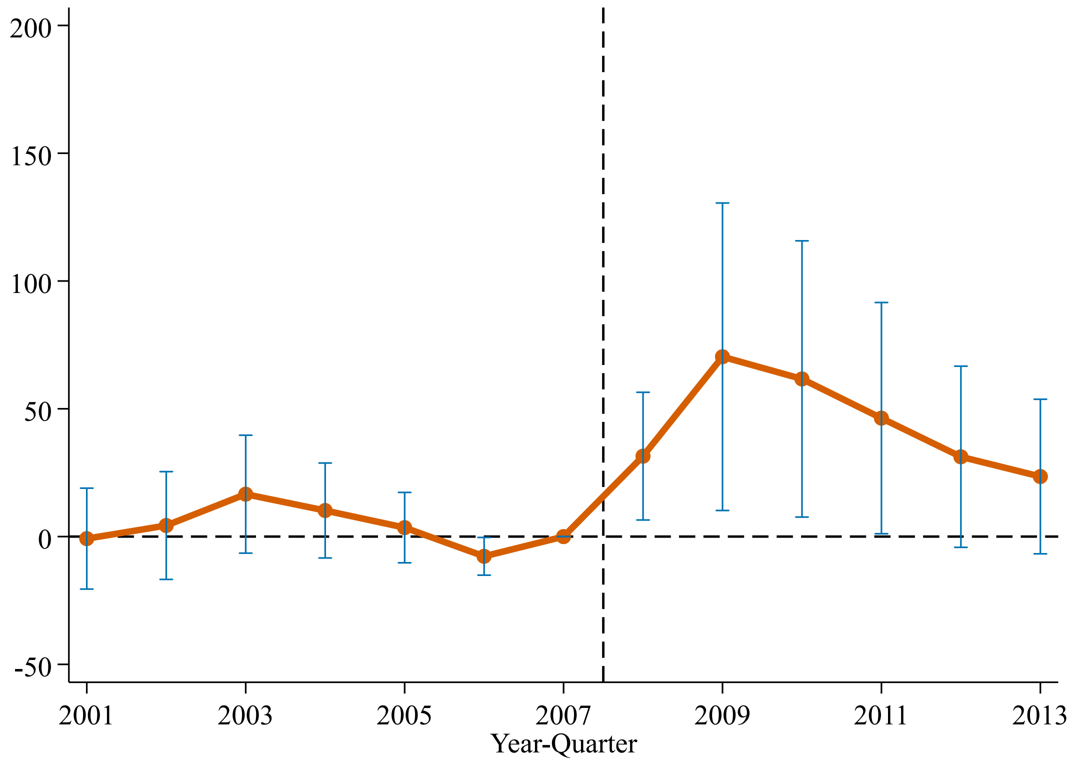
Figure 2: Reduced Form Effects of Bankruptcy Protections on Employment



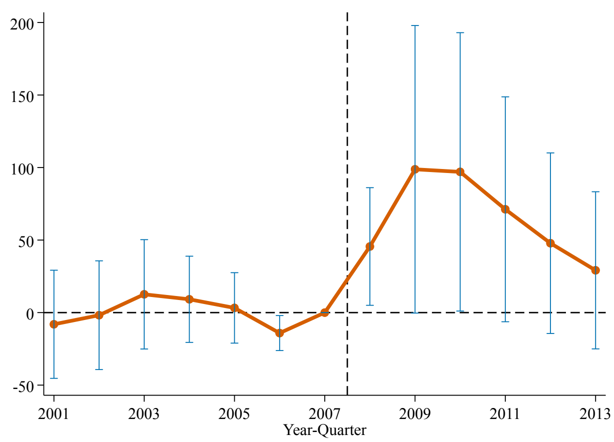
Note: This figure plots reduced form estimates of the effect of cross-state bankruptcy protections on employment outcomes. Panel A reports results for log non-tradable employment, defined as the retail and restaurant sectors. Panel B reports results for log tradable and other employment, defined as industries with sufficiently large imports and exports from the United States, and other as all non-tradable, tradable, and construction industries. Panel C reports results for log total employment. We report the coefficients from a panel regression of each log employment measure scaled by working age population on the log financial cost of filing for bankruptcy protection interacted with year fixed effects. All specifications are weighted by county population as of 2007 and include county and year-quarter fixed effects, as well as the Saiz supply elasticity and share of the population who own a home for each county interacted with year-quarter fixed effects. For counties without the Saiz supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. The estimated effect is normalized to zero in 2007, meaning all estimates are relative to 2007. The dashed lines are 95 percent confidence intervals from standard errors clustered at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Figure 3: Reduced Form Effects of Bankruptcy Protections on Per-Period Debt Write-Downs

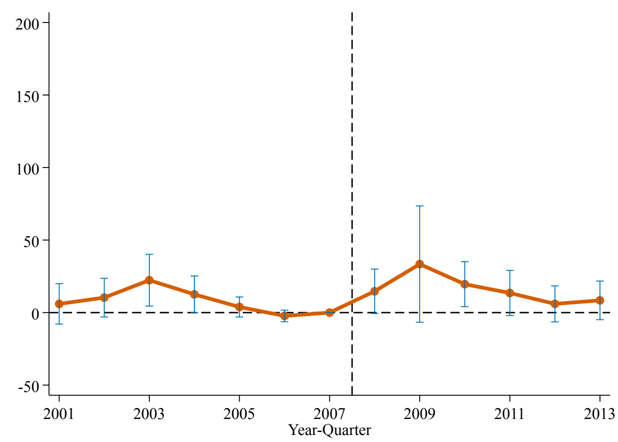
Panel A: Charge-Offs in Full Sample



Panel B: Charge-Offs for Homeowners Only

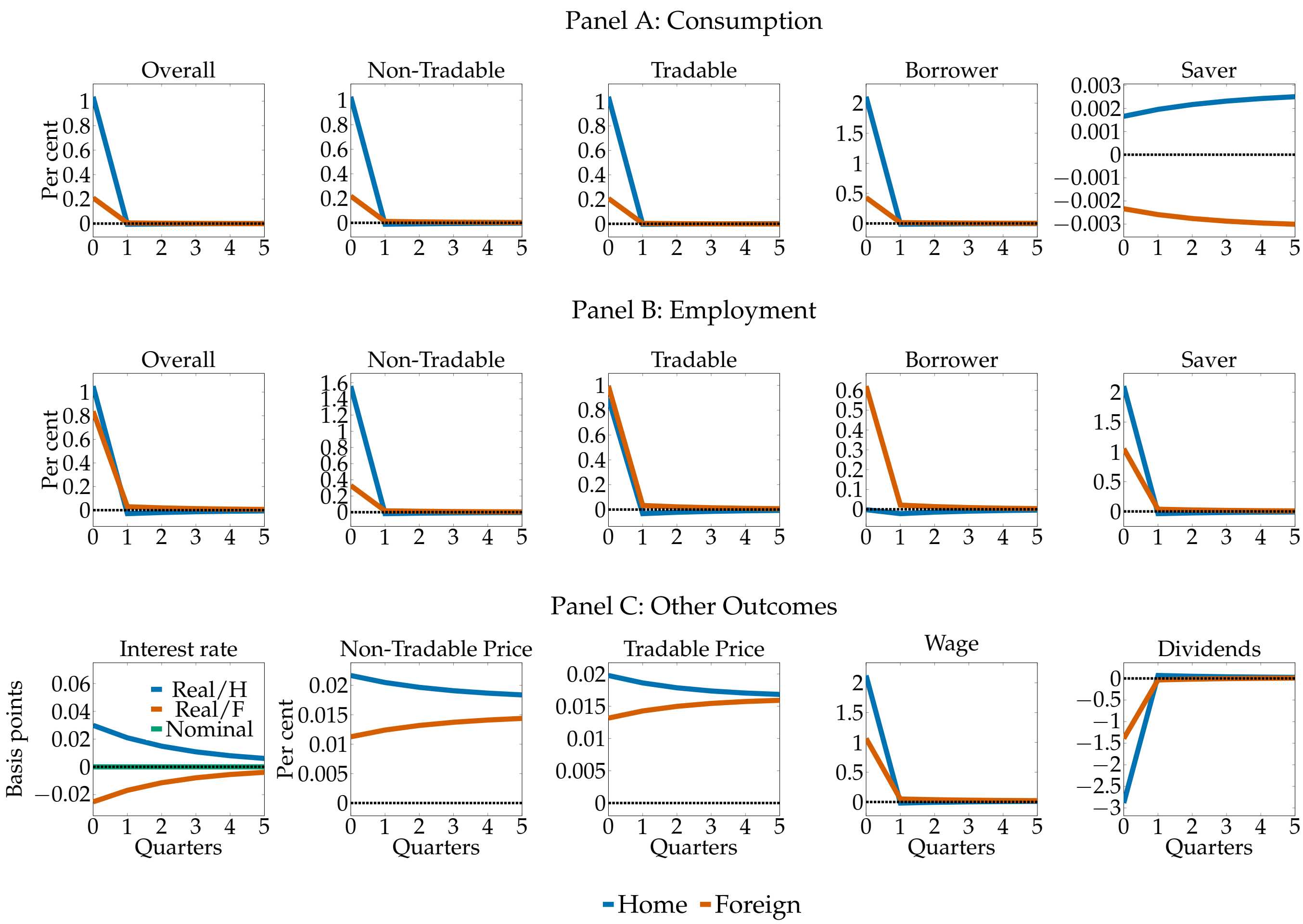


Panel C: Charge-Offs for Renters Only



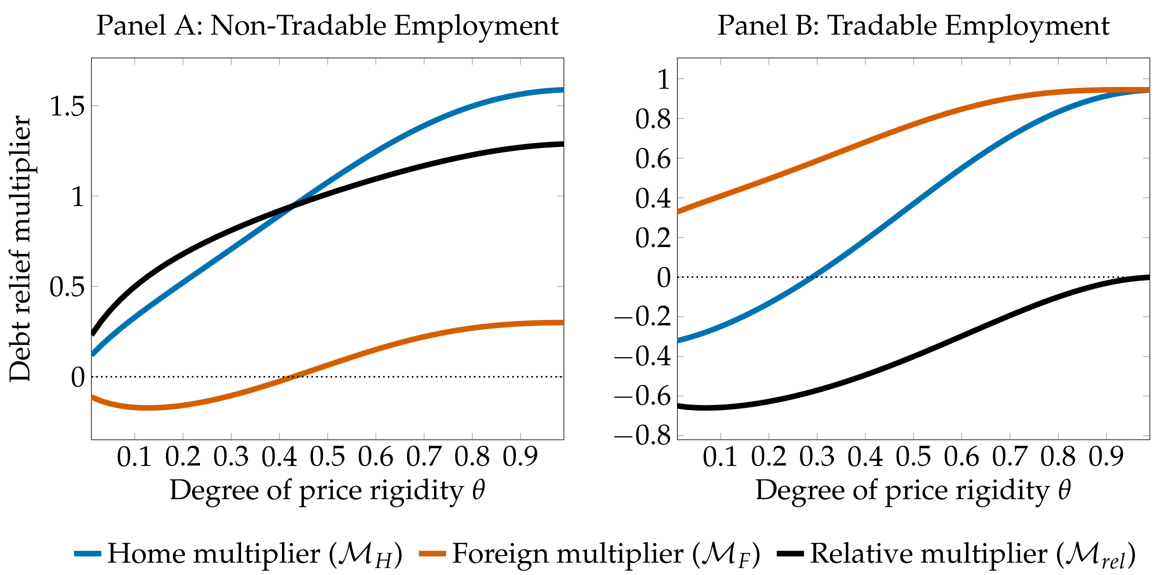
Note: This figure plots reduced form estimates of the effect of cross-state bankruptcy protections on annual charge-offs. Panel A reports results for the full sample. Panel B reports results for homeowners, defined as mortgage borrowers in 2007. Panel C reports results for renters, defined as all non-mortgage borrowers in 2007. We report coefficients from a panel regression of charge-offs on the log financial cost of filing for bankruptcy protection interacted with year fixed effects. All specifications are weighted by county population as of 2007 and include county and year-quarter fixed effects, as well as the Saiz supply elasticity and share of the population who own a home for each county interacted with year-quarter fixed effects. The estimated effect is normalized to zero in 2007, meaning all estimates are relative to 2007. The dashed lines are 95 percent confidence intervals from standard errors clustered at the state level. Coefficients are multiplied by four to scale average quarterly charge-off amounts to annual charge-offs. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Figure 4: Impulse Response to a Debt Relief Shock under Sticky Prices



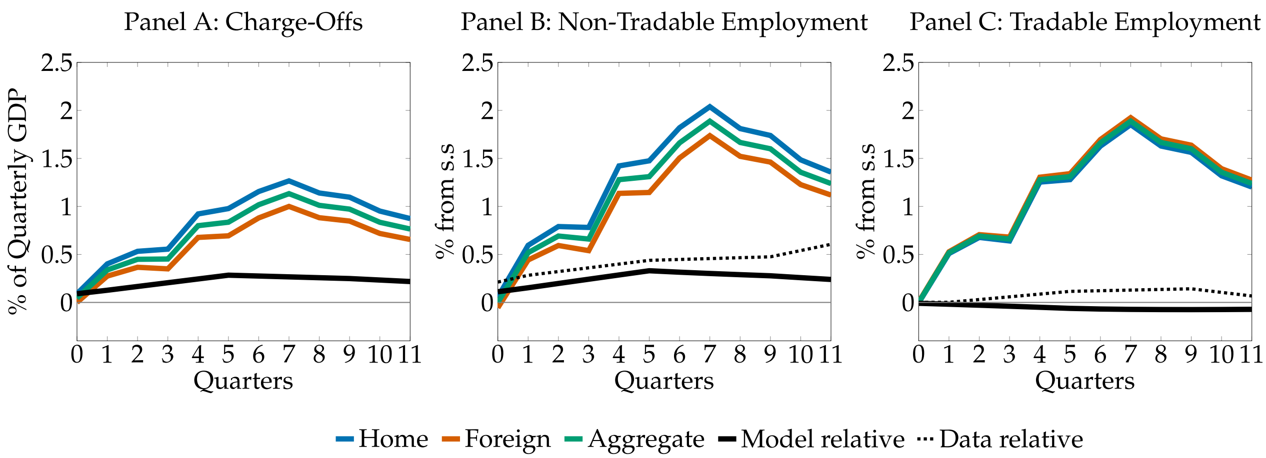
Note: This figure plots the effect, in our model, of a debt relief shock that reduces borrower debts in the high exemptions regions by 1 percent of GDP on aggregate outcomes under the assumption that prices are sticky ($\theta = 0.8$). The blue line represents outcomes in the home region ("high-exemption"), and the red line is outcomes in the foreign region ("low-exemption"). Panel A displays consumption outcomes, where the first column displays aggregate consumption, the second and third columns display non-tradable and tradable consumption, and the fourth and fifth columns display borrower and saver consumption. Panel B displays employment outcomes, where the first column again displays aggregate employment, the second and third columns display non-tradable and tradable employment, and the fourth and fifth columns display borrower and saver employment. Panel C displays price outcomes, where the first column displays nominal and real interest rates, the second and third columns display non-tradable and tradable prices, the fourth column displays nominal wages, and the fifth column displays aggregate dividends from firms.

Figure 5: Debt Relief Multiplier as a Function of the Degree of Price Rigidity θ



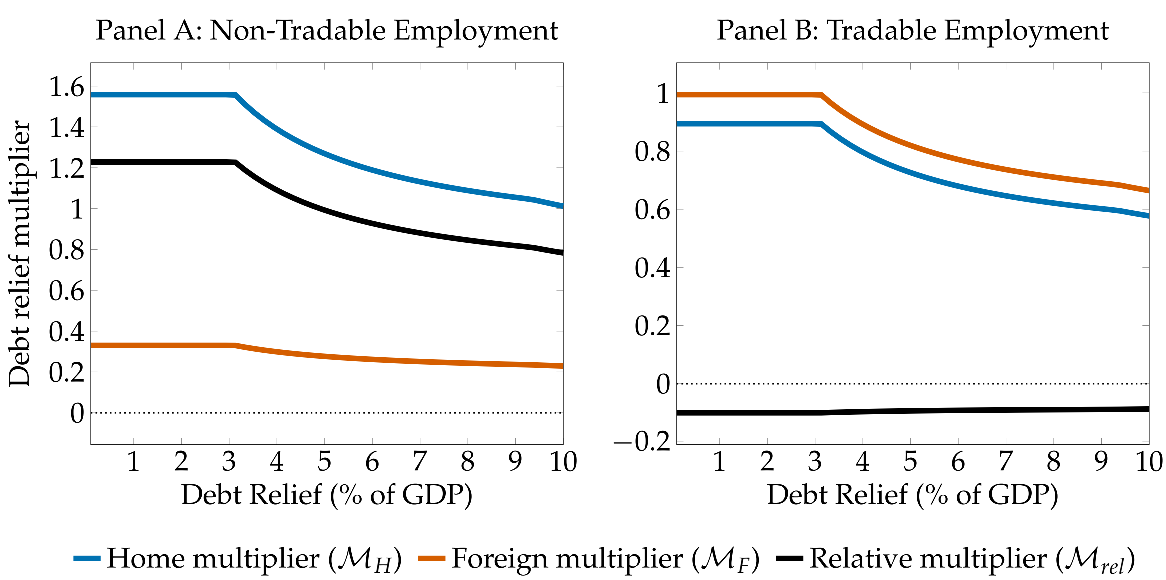
Note: This figure shows the home, foreign and relative debt relief multipliers, in our model, for non-tradable and tradable employment as a function of the degree of price rigidity. The blue line is the response of log employment in the home region ("high-exemption") to a reduction in home borrowers' debts of 1 percent of GDP. The red line is the response of log employment in the foreign region ("low-exemption") to the same shock. The black line is the difference between the responses in the home and the foreign region ("relative multiplier"), which corresponds to the debt relief multiplier identified by our difference-in-differences research design. To draw this figure, we assume that monetary policy follows a Taylor rule with a coefficient $\phi_\pi = 0.8$ that is sufficient to guarantee determinacy. This lowers the home and foreign multipliers slightly for $\theta = 0.8$, and ensures that the outcome converges to flexible prices as $\theta \to 0$. As we show in Section IVE, the relative multipliers are independent of monetary policy, so they are identical to those resulting from assuming the zero lower bound throughout.

Figure 6: Model Predictions for the Path of Employment During the Recession



Note: This figure shows the effect of debt relief, in our model, on the path of non-tradable and tradable employment in high- and low-exemption regions during and after the financial crisis. Panel A plots our assumptions for the path of debt relief in the home ("high-exemption") and foreign ("low-exemption") regions. We assume that average charge-offs across the home and the foreign region equal the observed path of charge-offs in the data starting in 2007q4. We also assume that charge-offs in the home region equal charge-offs in the foreign region plus the empirically estimated effect of a one standard deviation increase in bankruptcy protections in the data. Panels B and C shows the model-implied paths of non-tradable and tradable employment in both regions after 2007q4, i.e. the counterfactual effect of financial crisis chargeoffs on employment implied by our model. The solid black line represents the model-implied difference between the outcomes in the home and foreign regions, which corresponds to the model-predicted difference-in-differences effect of a one standard deviation increase in bankruptcy protections in the data. The dotted black line represents the empirically estimated difference-in-differences effect of a one standard deviation increase in bankruptcy protections in the data.

Figure 7: Debt Relief Multiplier as a Function of the Size of Debt Relief



Note: This figure shows the debt relief multiplier, in our model, for non-tradable and tradable employment in high- and low-exemption regions as a function of the size of the debt relief shock. The blue line is the debt relief multiplier in the home region ("high-exemption"), the red line the debt relief multiplier in the foreign region ("low-exemption"), and the black line represents the difference between the multipliers in the home and the foreign regions. The figures show that the effect of debt relief on employment is linear initially, but later declines with the size of the debt relief due to borrowers becoming less constrained and spreading their spending out over additional periods.

Appendix A. Additional Results

Appendix Table A1: Bankruptcy Exemptions by State

	Chapter 7 Bankruptcy Exemptions in 2007				Financial Cost of Bankruptcy	
State	Homestead	Vehicle	Savings	Wildcard	Home Equity	Other Assets
Alaska	67,500	3,750	1,750	0	113,742	159,444
Alabama	10,000	0	0	3,000	160,173	162,586
Arkansas	Unlimited	1,200	0	500	0	182,904
Arizona	150,000	5,000	150	0	66,855	152,309
California	75,000	2,550	4,050	0	86,855	152,515
Colorado	90,000	3,000	0	0	99,353	160,923
Connecticut	150,000	1,500	0	1,000	66,356	161,572
Delaware	50,000	0	0	500	126,679	163,453
Florida	Unlimited	1,000	0	1,000	0	158,622
Georgia	20,000	3,500	0	600	153,329	160,939
Hawaii	30,000	2,575	0	0	133,183	161,519
Iowa	Unlimited	7,000	0	100	0	157,972
Idaho	50,000	3,000	0	800	126,750	160,401
Illinois	30,000	2,400	0	4,000	143,346	160,583
Indiana	30,000	0	300	8,000	145,012	161,844
Kansas	Unlimited	20,000	0	0	0	153,636
Kentucky	10,000	2,500	0	1,000	160,056	160,170
Louisiana	25,000	0	0	0	147,256	164,026
Massachusetts	500,000	700	1,200	0	4,323	160,463
Maryland	0	0	0	11,000	166,668	159,593
Maine	70,000	5,000	0	400	111,979	159,852
Michigan	31,900	2,950	0	0	137,110	161,934
Minnesota	200,000	3,800	0	0	48,263	159,709
Missouri	15,000	3,000	0	1,250	156,118	160,760
Mississippi	75,000	0	0	10,000	108,814	162,834
Montana	200,000	2,500	0	0	47,869	161,567
North Carolina	37,000	3,500	0	500	139,270	161,600
North Dakota	80,000	1,200	0	5,000	105,199	170,776
Nebraska	12,500	0	0	2,500	157,593	162,728
New Hampshire	200,000	4,000	0	1,000	47,904	160,220
New Jersey	0	0	0	1,000	131,025	162,298
New Mexico	60,000	4,000	0	500	119,369	160,310
Nevada	350,000	15,000	0	0	16,683	155,892
New York	100,000	2,400	2,500	0	88,370	156,339
Ohio	10,000	1,000	400	400	163,915	162,217
Oklahoma	Unlimited	3,000	0	0	0	161,414
Oregon	39,600	2,150	7,500	400	134,560	182,680
Pennsylvania	0	0	0	300	136,446	163,664
Rhode Island	300,000	10,000	0	0	24,032	156,892
South Carolina	10,000	1,200	1,000	0	160,519	162,895
South Dakota	Unlimited	0	0	6,000	0	165,850
Tennessee	7,500	0	0	4,000	164,097	162,346
Texas	Unlimited	0	0	30,000	0	153,806
Utah	40,000	2,500	0	0	134,532	161,927
Virginia	10,000	2,000	0	0	158,357	183,046
Vermont	150,000	2,500	700	400	66,713	160,856
Washington	40,000	2,500	0	2,000	132,896	151,869
Wisconsin	40,000	1,200	1,000	0	135,426	162,018

West Virginia	50,000	2,400	0	800	126,737	161,485
Wyoming	20,000	2,400	0	0	150,847	161,709

Note: This table reports Chapter 7 asset exemptions by state in 2007 and average financial cost of bankruptcy. The homestead and vehicle exemptions refer to the maximum equity in a residential home or vehicle exempt from bankruptcy seizures. Savings refers to the amount of cash and bank account assets exempt, while wildcard exemptions can generally be applied to any other assets, or increase the exemption amount of other categories. The last two columns report the average financial cost of bankruptcy by state based on state-specific exemptions and a national sample of households' wealth. The first of the last two columns reports the average home equity at risk in each state using home equity amounts from a national sample of home equity estimates from Equifax measured in 2007. The second of the last two columns reports the average amount of assets at risk for all other assets except housing using 2005 and 2007 PSID surveys excluding the state at hand. Both columns exclude individuals in the random sample from that state.

Appendix Table A2: Correlates with State Bankruptcy Protection Measure

	Levels in 2001	Levels in 2007
Panel A: Employment Outcomes	(1)	(2)
Log Non-Tradable Employment	0.014	0.013
	(0.012)	(0.009)
Log Tradable + Other Employment	−0.006	−0.010
	(0.019)	(0.020)
Log Total Employment	−0.002	−0.005
	(0.016)	(0.016)
Panel B: Credit Outcomes		
Bankrupty Rate (p.p.)	−0.020	−0.041**
	(0.016)	(0.016)
Foreclosure Rate (p.p.)	0.033	−0.075
	(0.039)	(0.060)
Credit Card Limits ($)	−2.281	−82.992
	(351.177)	(489.225)
Credit Card Debt ($)	52.226	49.320
	(49.649)	(45.253)
Mortgage Debt ($000)	−0.891	0.130
	(1.774)	(4.141)
Debt-to-Income Ratio	0.005	0.058
	(0.049)	(0.138)
Panel C: State Characteristics		
Democratic Vote Share (p.p.)	−0.638	−0.694
	(1.522)	(1.944)
Max. Unemp. Benefit ($)	219.405	133.546
	(501.763)	(727.673)
Population <45 (p.p.)	0.102	0.386
	(0.890)	(0.887)
College Educated (p.p.)	0.271	0.124
	(0.625)	(0.701)
Market Beta	−0.055	−0.033
	(0.046)	(0.042)
Annual Income per Capita ($)	221.372	576.162
	(635.750)	(887.380)
Log Average House Price	1.258	4.943
	(0.948)	(4.973)
Homeownership Share	−1.283**	−1.410**
	(0.556)	(0.584)
Elasticity of Housing Supply	0.042	
	(0.140)	
Recourse Indicator	0.029	
	(0.063)	
Bartik Shock	0.628***	
	(0.211)	

Note: This table reports results of OLS regressions of various outcomes on the log financial cost of bankruptcy. All county-level outcomes are aggregared to the state level using population weights. Each row and column refer to a separate regression. Employment and credit outcomes are described in the notes to Table 1. Percent Democratic vote refers to the presidential vote counts in 2000 and US House of Representatives vote counts by state in 2006, excluding special elections. Percent with a college degree refers to the percent of population over 25 with a bachelors degree or higher. Elasticity of housing supply, from Saiz (2010), is time invariant. The recourse indicator refers to whether or not state law allows for lenders to seek recourse in the case of bankruptcy and is treated as time invariant in the sample. Housing units is taken from the census. The debt-to-income ratio is from Mian and Sufi (2014*b*). The market beta is the coefficient relating national employment growth to state employment growth from 1961-2001/2007. All regressions are weighted by state population as of 2007 and cluster the standard errors at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Appendix Table A3: Effects of Bankruptcy Protections on Other Consumer Debt Outcomes

	Avg Change	Effect of Bankruptcy Protections			
Panel A: 2008q1-2010q4	(1)	(2)	(3)	(4)	(5)
Bankrupty Rate (p.p.)	0.107	-0.005	-0.002	-0.001	-0.003
	(0.118)	(0.009)	(0.007)	(0.005)	(0.004)
Credit Card Limits ($)	-2,539.916	-16.026	-38.402	-26.223	-23.311
	(958.845)	(36.031)	(33.407)	(20.852)	(17.796)
Credit Card Debt ($)	-132.620	30.515	31.516	10.059	8.360
	(270.095)	(39.938)	(22.202)	(11.120)	(12.754)
Mortgage Debt ($000)	1.839	-0.034	-0.051	-0.363^{**}	-0.356^{*}
	(5.044)	(0.285)	(0.265)	(0.179)	(0.200)
Foreclosure Rate (p.p.)	0.906	0.249^{*}	0.257^{***}	0.223^{***}	0.216^{***}
	(1.080)	(0.145)	(0.095)	(0.031)	(0.039)
Panel B: 2011q1-2013q4					
Bankrupty Rate (p.p.)	-0.091	0.001	0.004	0.005	0.003
	(0.094)	(0.015)	(0.008)	(0.006)	(0.006)
Credit Card Limits ($)	954.736	-30.221	-105.276	-68.180	-46.853
	(1,007.336)	(159.535)	(124.984)	(42.363)	(43.125)
Credit Card Debt ($)	-276.685	-21.966	-32.189^{*}	-52.191^{***}	-48.584^{***}
	(303.066)	(23.782)	(17.003)	(12.374)	(12.030)
Mortgage Debt ($000)	-3.977	-0.918	-1.164	-1.193^{***}	-1.103^{**}
	(5.331)	(0.970)	(0.759)	(0.444)	(0.485)
Foreclosure Rate (p.p.)	0.057	0.379	0.401^{**}	0.337^{***}	0.316^{***}
	(0.318)	(0.243)	(0.159)	(0.055)	(0.064)
Number of Observations		161,720	161,720	161,720	155,324
County F.E.		Y	Y	Y	Y
Year-Quarter F.E.		Y	Y	Y	Y
Housing Controls × YQ F.E.		N	Y	Y	Y
Additional Controls × YQ F.E.		N	N	Y	Y
Exclude Sand States		N	N	N	Y

Note: This table reports estimates of the effect of cross-state bankruptcy protections on consumer debt outcomes. Column 1 reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4-2010q4 or 2010q4-2013q4. Columns 2-5 report coefficients on the reduced form effect of a one standard deviation decrease in the log financial cost of filing for bankruptcy protection from 2007q4-2010q4 or 2010q4-2013q4. Column 2 reports estimates with county and year-quarter fixed effects. Column 3 repeats the regression, adding the Saiz supply elasticity and share of the population who own a home for each county, interacted with year-quarter fixed effects. For counties without the Saiz supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. Column 4 repeats the same regression, but with a set of location controls interacted with year-quarter fixed effects: the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure. Finally, Column 5 repeats Column 4, but excludes the "sand states," or Arizona, California, Nevada, and New Mexico. All regressions are weighted by number of individuals in the credit report panel as of 2007 and cluster the standard errors at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Appendix Table A4: Effects of Bankruptcy Protections on Inflation

	Avg Change	Effect of Bankruptcy Protections			
Panel A: 2008q1-2010q4	(1)	(2)	(3)	(4)	(5)
Non-Tradable CPI	4.985	0.257	0.241	−0.046	−0.047
	(1.810)	(0.251)	(0.265)	(0.311)	(0.353)
Tradable CPI	3.167	−0.077	−0.064	−0.159	−0.104
	(1.246)	(0.214)	(0.182)	(0.096)	(0.118)
Total CPI	4.292	0.095	0.093	−0.122	−0.096
	(1.270)	(0.133)	(0.138)	(0.185)	(0.207)
Panel B: 2011q1-2013q4					
Non-Tradable CPI	6.417	0.116	0.099	−0.399	−0.359
	(1.087)	(0.426)	(0.452)	(0.607)	(0.693)
Tradable CPI	6.503	0.052	0.029	−0.037	0.077
	(1.052)	(0.334)	(0.376)	(0.213)	(0.229)
Total CPI	6.462	0.070	0.056	−0.230	−0.159
	(0.806)	(0.236)	(0.251)	(0.357)	(0.398)
Number of Observations		11,804	11,804	11,804	11,388
County F.E.		Y	Y	Y	Y
Year-Quarter F.E.		Y	Y	Y	Y
Housing Controls × YQ F.E.		N	Y	Y	Y
Additional Controls × YQ F.E.		N	N	Y	Y
Exclude Sand States		N	N	N	Y

Note: This table reports estimates of the effect of cross-state bankruptcy protections on log regional consumer price index. Column 1 reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4-2010q4 or 2010q4-2013q4. Columns 2-5 report coefficients on the reduced form effect of a one standard deviation decrease in the log financial cost of filing for bankruptcy protection from 2007q4-2010q4 or 2010q4-2013q4. Column 2 reports estimates with county and year-quarter fixed effects. Column 3 repeats the regression, adding the Saiz supply elasticity and share of the population who own a home for each county, interacted with year-quarter fixed effects. For counties without the Saiz supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. Column 4 repeats the same regression, but with a set of location controls interacted with year-quarter fixed effects: the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure. Finally, Column 5 repeats Column 4, but excludes the "sand states," or Arizona, California, Nevada, and New Mexico. All regressions are weighted by number of individuals in the credit report panel as of 2007 and cluster the standard errors at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Appendix Table A5: Effects of Bankruptcy Protections on Log House Price Index

	Avg Change	Effect of Bankruptcy Protections			
Panel A: 2008q1-2010q4	(1)	(2)	(3)	(4)	(5)
Log House Price	-21.846	-3.147	-3.114	-3.184^{***}	-2.968^{***}
	(14.963)	(3.003)	(2.224)	(0.854)	(0.898)
Panel B: 2011q1-2013q4					
Log House Price	10.669	-1.357	-1.310	-1.962	-1.547
	(12.554)	(3.990)	(3.096)	(1.341)	(1.339)
Number of Observations		122,736	122,736	122,736	114,544
County F.E.		Y	Y	Y	Y
Year-Quarter F.E.		Y	Y	Y	Y
Housing Controls $\times$ YQ F.E.		N	Y	Y	Y
Additional Controls $\times$ YQ F.E.		N	N	Y	Y
Exclude Sand States		N	N	N	Y

Note: This table reports estimates of the effect of cross-state bankruptcy protections on log house prices from Corelogic. Column 1 reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4-2010q4 or 2010q4-2013q4. Columns 2-5 report coefficients on the reduced form effect of a one standard deviation decrease in the log financial cost of filing for bankruptcy protection from 2007q4-2010q4 or 2010q4-2013q4. Column 2 reports estimates with county and year-quarter fixed effects. Column 3 repeats the regression, adding the Saiz supply elasticity and share of the population who own a home for each county, interacted with year-quarter fixed effects. For counties without the Saiz supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. Column 4 repeats the same regression, but with a set of location controls interacted with year-quarter fixed effects: the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure. Finally, Column 5 repeats Column 4, but excludes the "sand states," or Arizona, California, Nevada, and New Mexico. All regressions are weighted by number of individuals in the credit report panel as of 2007 and cluster the standard errors at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Appendix Table A6: Effects of Bankruptcy Protections on Log In-Migration

	Avg Change	Effect of Bankruptcy Protections			
Panel A: 2008q1-2010q4	(1)	(2)	(3)	(4)	(5)
Log In-Migration	-11.134	1.453	1.495	2.273**	2.465***
	(9.390)	(1.053)	(0.991)	(0.866)	(0.886)
Panel B: 2011q1-2013q4					
Log In-Migration	4.941	1.334	1.437	2.489**	2.623**
	(7.230)	(1.649)	(1.355)	(1.219)	(1.212)
Number of Observations		111,960	111,960	111,960	107,532
County F.E.		Y	Y	Y	Y
Year-Quarter F.E.		Y	Y	Y	Y
Housing Controls $\times$ YQ F.E.		N	Y	Y	Y
Additional Controls $\times$ YQ F.E.		N	N	Y	Y
Exclude Sand States		N	N	N	Y

Note: This table reports estimates of the effect of cross-state bankruptcy protections on the log of the share of state population who moved from outside the state in the last year. Data is from the ACS. We use data from 2004-2013 due to availability constraints. The first column reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4 to 2010q4 or 2010q4 to 2013q4. Columns 2-5 report coefficients on the effect of bankruptcy protections on log in-migration. Regressions are run at the year-quarter level, with non-parametric controls for the effect of the policy in the pre-period. All estimates should be interpreted as the effect on relative differences from 2007q4 for a one standard deviation in bankruptcy protections, as 2007q4 is the omitted time period. Column 3 repeats the regression, adding the Saiz supply elasticity and share of population who own a home for each county, interacted with year-quarter fixed effects. For counties without the supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. Column 4 repeats the same regression, but with a set of location controls interacted with year-quarter fixed effects: the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure. Finally, Column 5 repeats Column 4, but excludes the "sand states": Arizona, California, Nevada, and New Mexico. All regressions are weighted by county population as of 2007. Standard errors are clustered at the state level.

Appendix Table A7: Effects of 1991 Homestead Exemption on Employment

	Avg Change	Effect of Bankruptcy Protections			
Panel A: 2008-2010	(1)	(2)	(3)	(4)	(5)
Log Non-Tradable Emp.	-5.178	0.111	0.077	0.230*	0.245*
	(6.737)	(0.164)	(0.151)	(0.118)	(0.123)
Log Tradable + Other Emp.	-7.988	−0.207	−0.251	−0.244*	−0.243*
	(8.263)	(0.168)	(0.157)	(0.144)	(0.144)
Log Total Emp.	-7.406	−0.147	−0.188	−0.156	−0.152
	(6.919)	(0.150)	(0.139)	(0.118)	(0.119)
Panel B: 2011-2013					
Log Non-Tradable Emp.	5.300	0.247	0.167	0.477***	0.506***
	(5.896)	(0.227)	(0.232)	(0.134)	(0.138)
Log Tradable + Other Emp.	3.740	−0.223	−0.237	−0.180	−0.161
	(8.224)	(0.196)	(0.186)	(0.148)	(0.141)
Log Total Emp.	4.056	−0.131	−0.152	−0.052	−0.031
	(6.712)	(0.166)	(0.167)	(0.120)	(0.115)
Number of Observations		161,720	161,720	161,720	155,324
County F.E.		Y	Y	Y	Y
Year-Quarter F.E.		Y	Y	Y	Y
Housing Controls × YQ F.E.		N	Y	Y	Y
Additional Controls × YQ F.E.		N	N	Y	Y
Exclude Sand States		N	N	N	Y

Note: This table reports estimates of the effect of historical cross-state bankruptcy protections on log employment outcomes scaled by working age population (age 18-65). See A1 for details on the historical exemptions. The sample excludes states without 1920 homestead exemptions, leaving 38 states. Column 1 reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4-2010q4 or 2010q4-2013q4. Columns 2-5 report coefficients on the reduced form effect of a one standard deviation decrease in the log financial cost of filing for bankruptcy protection from 2007q4-2010q4 or 2010q4-2013q4. Column 2 reports estimates with county and year-quarter fixed effects. Column 3 repeats the regression, adding the Saiz supply elasticity and share of the population who own a home for each county, interacted with year-quarter fixed effects. For counties without the Saiz supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. Column 4 repeats the same regression, but with a set of location controls interacted with year-quarter fixed effects: the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure. Finally, Column 5 repeats Column 4, but excludes the "sand states," or Arizona, California, Nevada, and New Mexico. All regressions are weighted by number of individuals in the credit report panel as of 2007 and cluster the standard errors at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

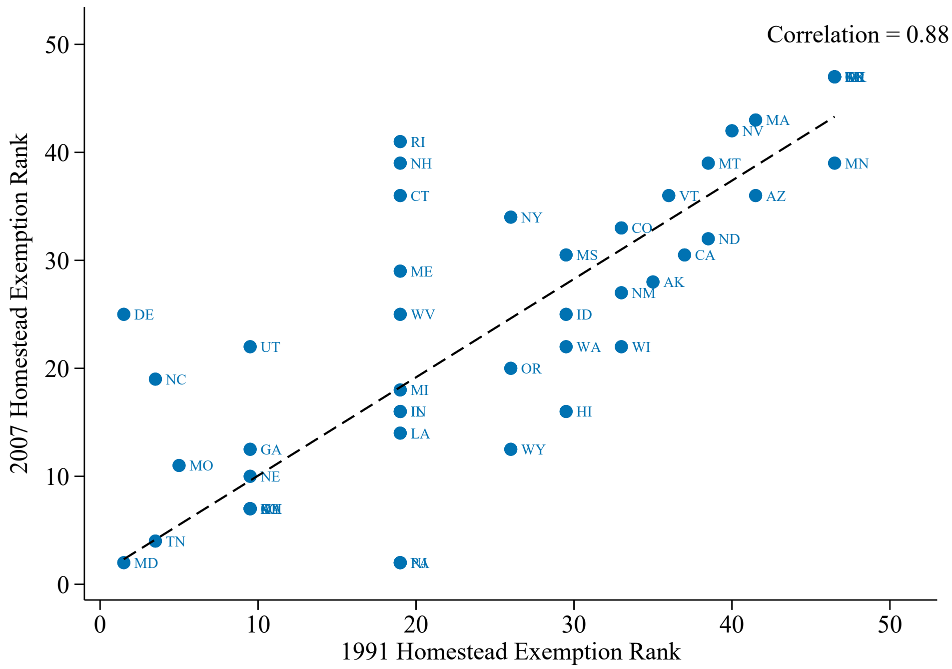
Appendix Table A8: Effects of 1991 Homestead Exemption on Debt Write-Downs

	Avg Change	Effect of Bankruptcy Protections			
Panel A: 2008-2010	(1)	(2)	(3)	(4)	(5)
Charge-Offs in Full Sample	124.775	10.422	12.940	12.459***	9.892**
	(199.676)	(12.015)	(8.363)	(3.528)	(3.794)
Charge-Offs for Homeowners	242.352	15.561	18.856	18.932***	16.427**
	(360.046)	(20.788)	(14.499)	(5.138)	(6.287)
Charge-Offs for Renters	-11.849	5.371	5.105*	3.889	2.118
	(104.352)	(3.959)	(2.871)	(3.129)	(1.833)
Panel B: 2011-2013					
Charge-Offs in Full Sample	-241.672	4.248	5.559	6.562**	6.025*
	(174.642)	(9.428)	(7.130)	(3.175)	(3.000)
Charge-Offs for Homeowners	-400.601	4.421	6.928	10.465**	9.386**
	(290.675)	(16.756)	(11.474)	(4.432)	(4.350)
Charge-Offs for Renters	-91.944	1.426	1.207	0.268	0.428
	(139.866)	(2.728)	(2.547)	(2.049)	(1.729)
Number of Observations		161,720	161,720	161,720	155,324
County F.E.		Y	Y	Y	Y
Year-Quarter F.E.		Y	Y	Y	Y
Housing Controls × YQ F.E.		N	Y	Y	Y
Additional Controls × YQ F.E.		N	N	Y	Y
Exclude Sand States		N	N	N	Y

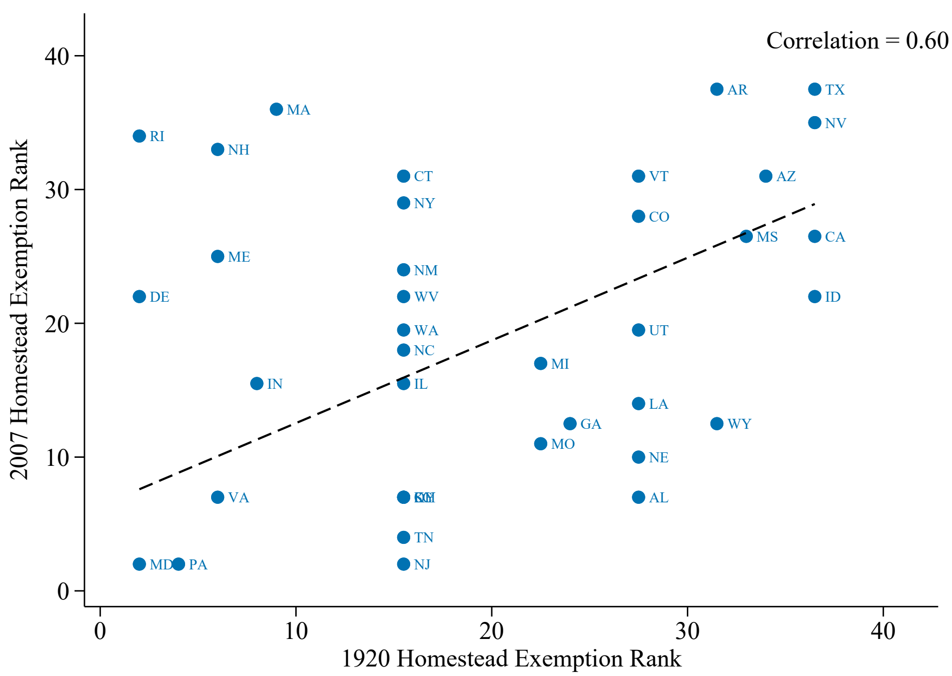
Note: This table reports estimates of the effect of historical cross-state bankruptcy protections on annual charge-offs. See A1 for details on the historical exemptions. The sample excludes states without 1920 homestead exemptions, leaving 38 states. Column 1 reports the cross-county average and standard deviation of the change in the dependent variable from 2007q4-2010q4 or 2010q4-2013q4. Columns 2-5 report coefficients on the reduced form effect of a one standard deviation decrease in the log financial cost of filing for bankruptcy protection from 2007q4-2010q4 or 2010q4-2013q4. Column 2 reports estimates with county and year-quarter fixed effects. Column 3 repeats the regression, adding the Saiz supply elasticity and share of the population who own a home for each county, interacted with year-quarter fixed effects. For counties without the Saiz supply elasticity measure, the measure is set to zero, and an additional dummy for missing supply elasticity is interacted with year-quarter fixed effects. Column 4 repeats the same regression, but with a set of location controls interacted with year-quarter fixed effects: the share of Democratic voters in 2004, the maximum unemployment insurance benefit, the share of college-educated voters in a county, the share of the population that is under the age of 45, the average debt-to-income ratio for the state in 2007, and the Bartik shock measure. Finally, Column 5 repeats Column 4, but excludes the "sand states," or Arizona, California, Nevada, and New Mexico. All regressions are weighted by number of individuals in the credit report panel as of 2007 and cluster the standard errors at the state level. See the text for additional details on the specification and the Table 1 notes for additional details on the outcome measures and sample.

Appendix Figure A1: Stability of Exemptions Over Time

Panel A: 2007 Homestead Exemption vs. 1991 Homestead Exemption

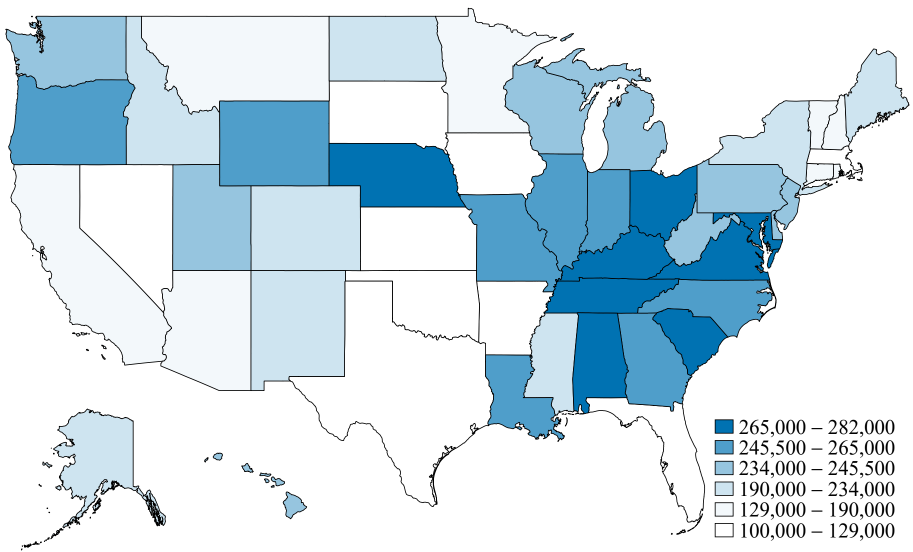


Panel B: 2007 Homestead Exemption vs. 1920 Homestead Exemption



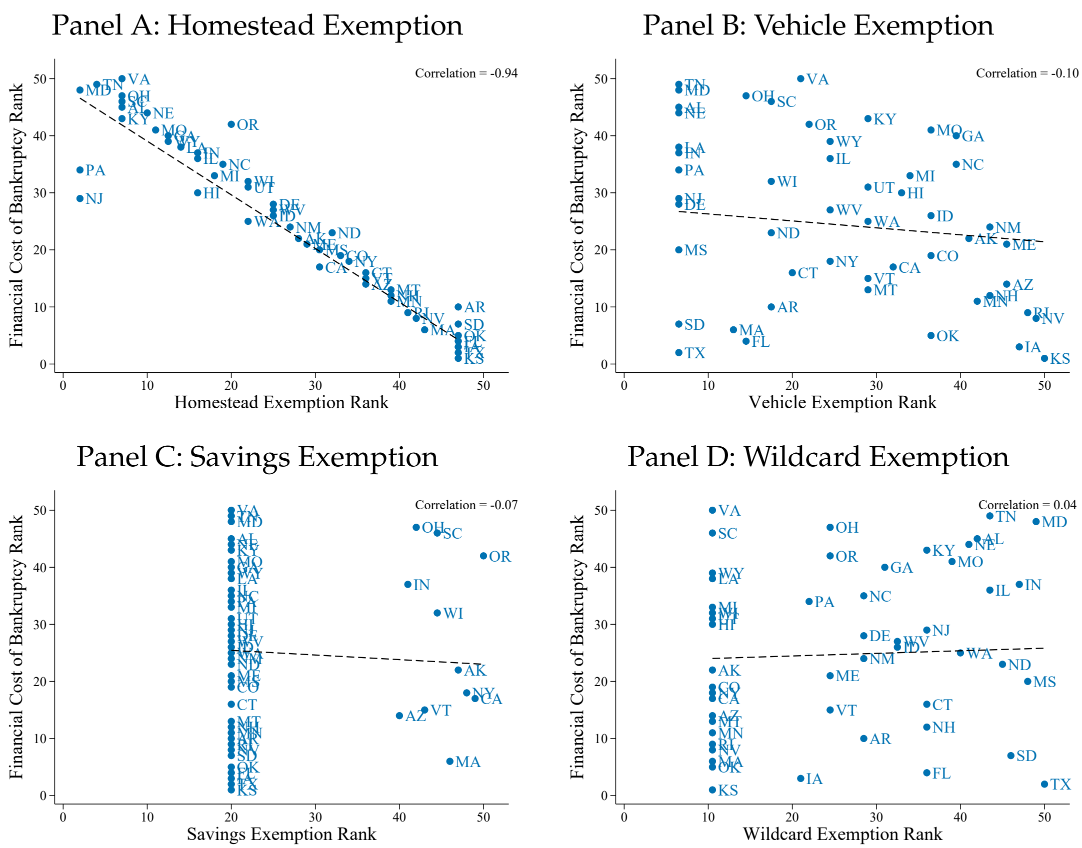
Note: This figure shows the stability of the Chapter 7 bankruptcy exemptions over time. Panel A plots 2007 homestead exemption ranks against 1991 homestead exemption ranks for all 50 states. Panel B plots 2007 homestead exemption ranks against 1920 homestead exemption ranks, excluding states that did not exist in 1920 and states with acre-based homestead exemptions. We use state populations in 2007 as weights and assign a value of $1,000,000 to states with unlimited 2007 homestead exemptions.

Appendix Figure A2: Geography of Bankruptcy Exemptions



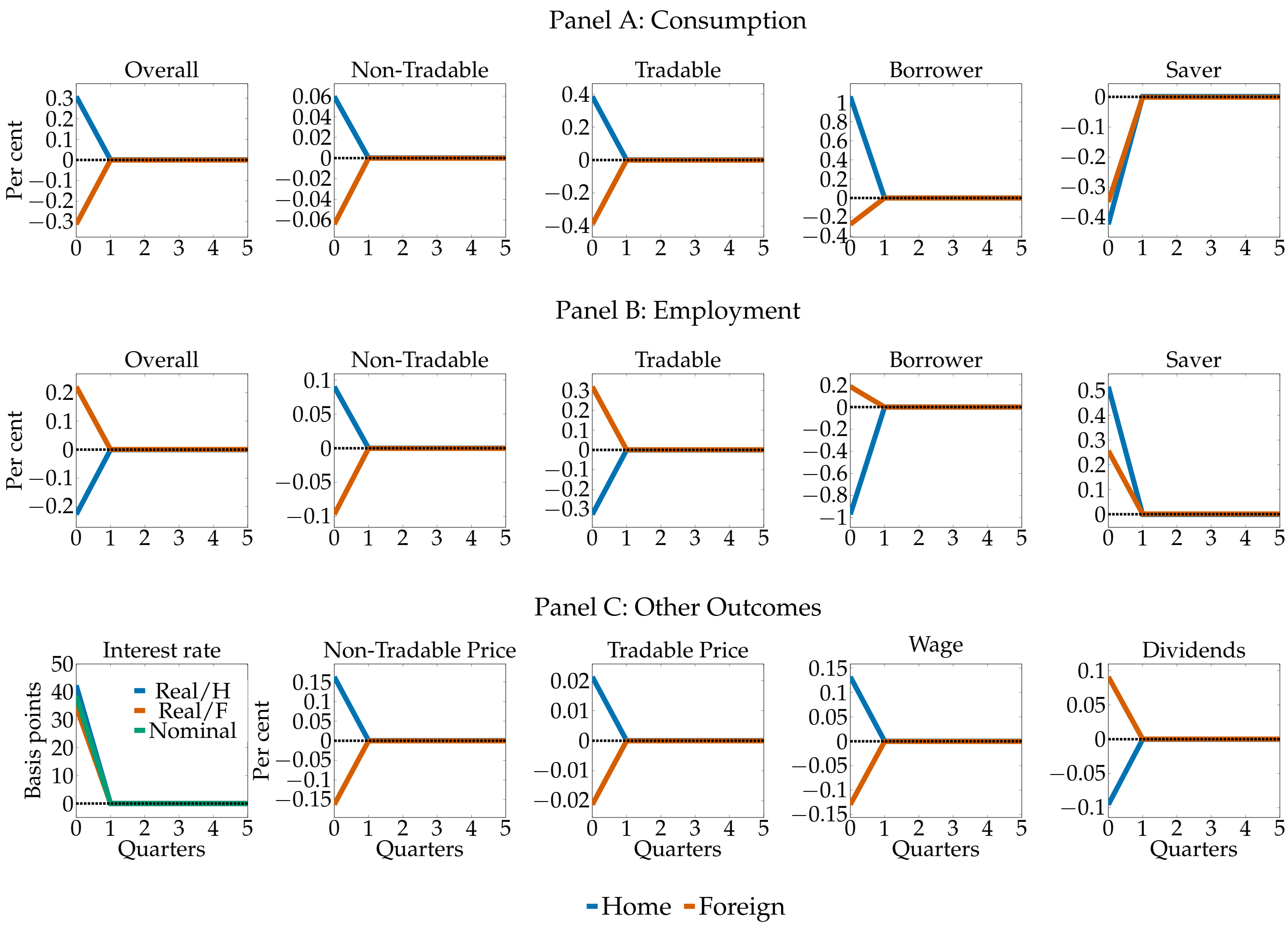
Note: These maps show the geographic distribution of cross-state bankruptcy protections. Panel A shows the map of financial cost of filing for Chapter 7 bankruptcy protection in 2007. Panel B shows the bankruptcy homestead exemptions in 2007. See the text for additional details on the instrument construction and Appendix Table A1 for a list of the homestead exemptions.

Appendix Figure A3: Correlation of Exemptions and Financial Cost of Bankruptcy



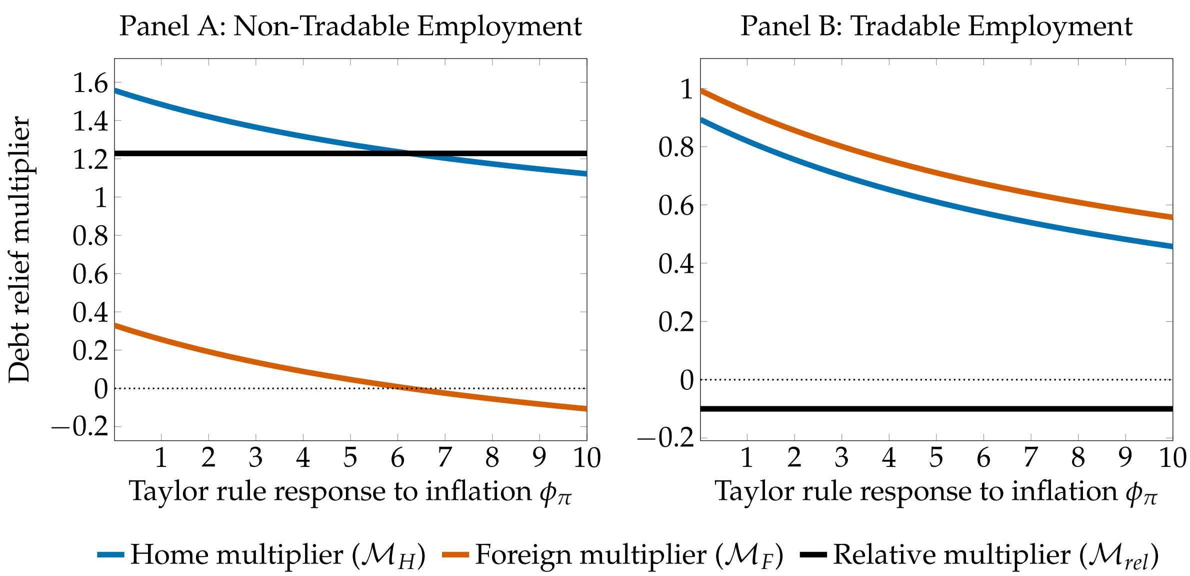
Note: This figure shows the correlation of the Chapter 7 bankruptcy exemptions and the financial cost of bankruptcy measure described in the text. Each panel plots the state-specific financial cost of bankruptcy against the state-specific rank for each Chapter 7 asset exemption category. We also plot the line of best fit, weighted by states' population. In Panel A, we see that Homestead exemption rank is very strongly related to the financial cost of bankruptcy rank, with almost all states lining up close to the line of best fit. Kansas and Texas have some of the lowest financial cost of bankruptcy, and the most generous homestead exemption rank. The line of best fit has an R^2 of 0.88 in this figure. In Panel B, we plot the same figure, but with vehicle exmeptions, and see very little correlation. This figure's line of best fit has an R^2 of 0.002. In Panel C, we repeat the exercise for savings exemption, and see slightly more correlation in the line of best fit, but a much more scatter picture. The R^2 for the line of best fit is 0.11. Finally, in Panel D, we see a correlation in the wrong direction and a minimal R^2 of 0.0048. In sum, we see strong evidence that our bankruptcy risk measure is driven by Homestead exemptions.

Appendix Figure A4: Impulse Response to a Debt Relief Shock under Flexible Prices



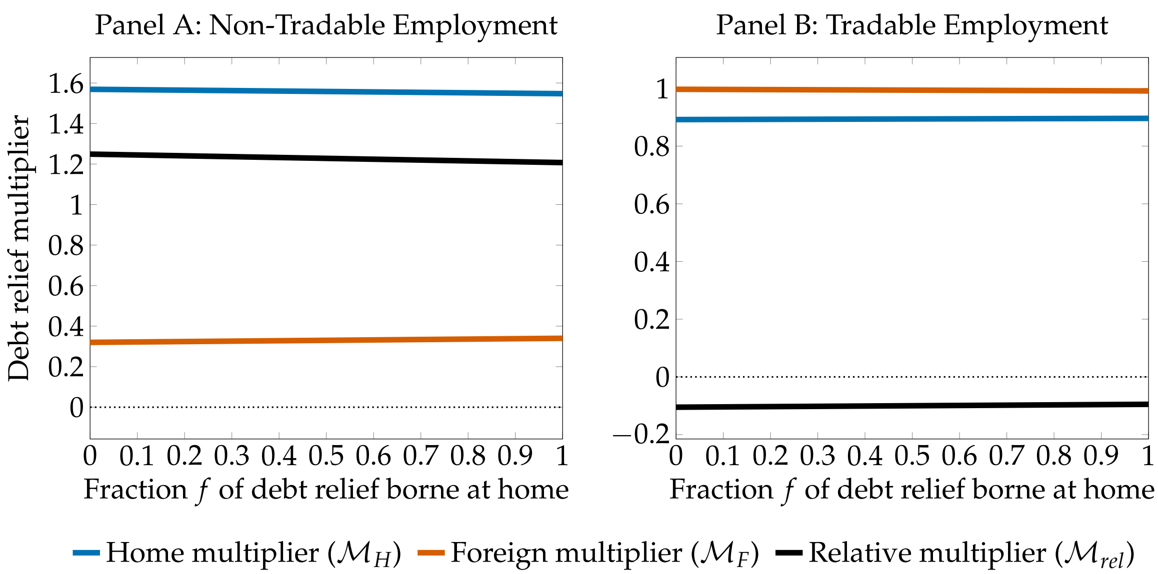
Note: This figure plots the effect, in our model, of a debt relief shock that reduces borrower debts in the high exemptions regions by 1 percent of GDP on aggregate outcomes under the assumption that prices are flexible ($\theta = 0$) instead of sticky ($\theta = 0.8$) as in our baseline parameterization shown in Figure 4. The blue line represents outcomes in the home region ("high-exemption"), and the red line is outcomes in the foreign region ("low-exemption"). Panel A displays consumption outcomes, where the first column displays aggregate consumption, the second and third columns display non-tradable and tradable consumption, and the fourth and fifth columns display borrower and saver consumption. Panel B displays employment outcomes, where the first column again displays aggregate employment, the second and third columns display non-tradable and tradable employment, and the fourth and fifth columns display borrower and saver employment. Panel C displays price outcomes, where the first column displays nominal and real interest rates, the second and third columns display non-tradable and tradable prices, the fourth column displays nominal wages, and the fifth column displays aggregate dividends from firms.

Appendix Figure A5: Debt Relief Multiplier as a Function of Monetary Policy Responsiveness



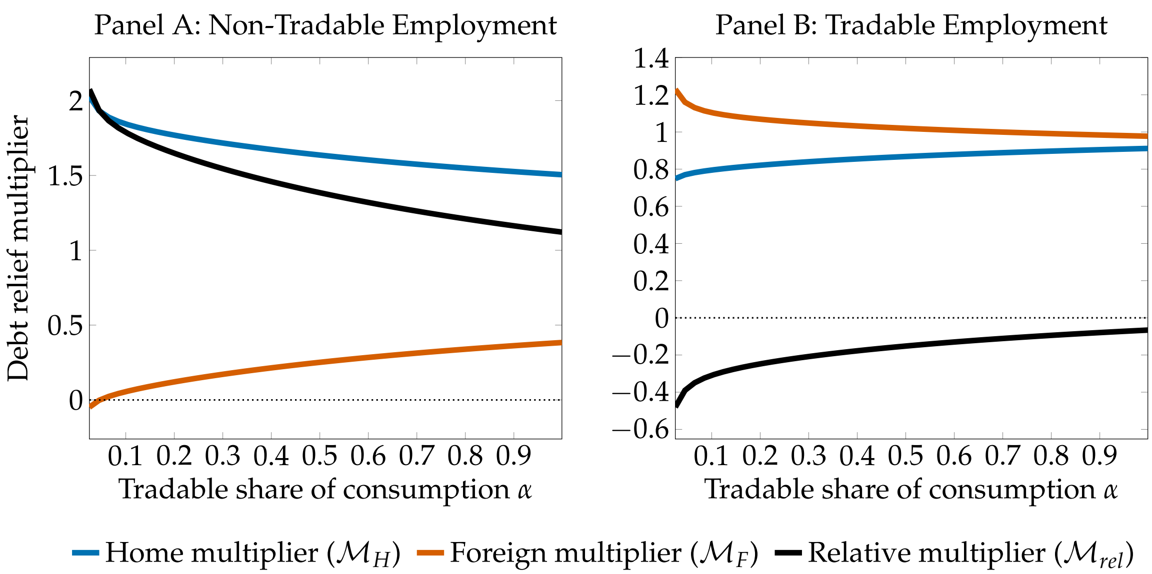
Note: This figure shows the debt relief multiplier, in our model, for non-tradable and tradable employment in high- and low-exemption regions as a function of the degree of responsiveness of monetary policy to inflation ϕ_π. The blue line is the debt relief multiplier in the home region ("high-exemption"), the red line the debt relief multiplier in the foreign region ("low-exemption"), and the black line represents the difference between the home and the foreign regions. Zero responsiveness ($\phi_\pi = 0$) corresponds to the zero lower bound, where nominal interest rates are unchanged as debt relief changes. The figures show that the level effect of debt relief on employment is decreasing in ϕ_π, while the relative multiplier is independent of the monetary policy response, as in Nakamura and Steinsson (2014).

Appendix Figure A6: Debt Relief Multiplier as a Function of the Degree of Local Financing



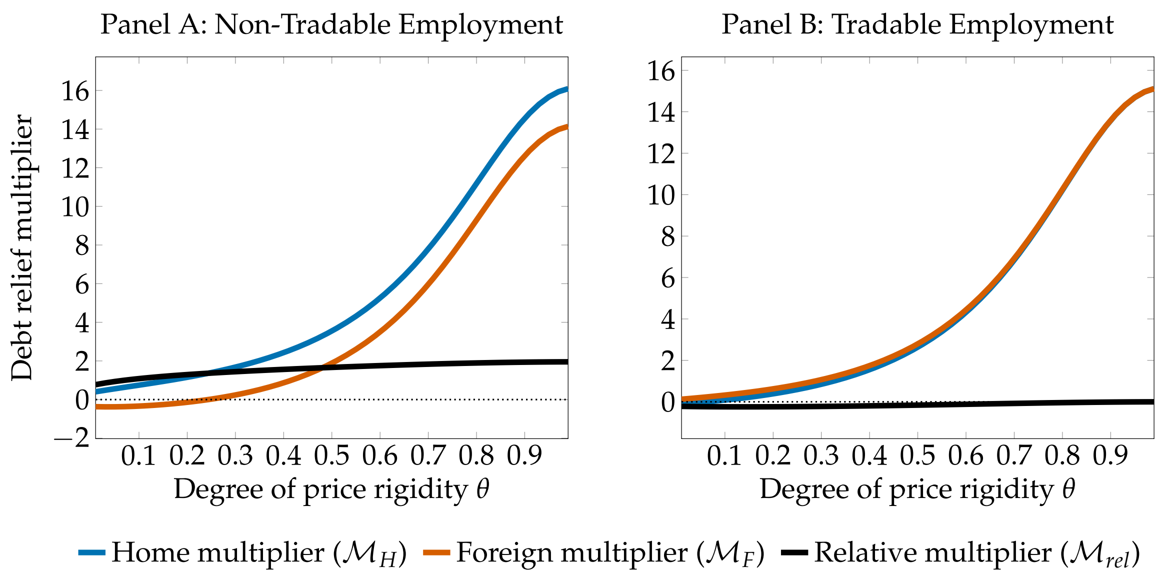
Note: This figure shows the debt relief multiplier, in our model, for non-tradable and tradable employment in the home and the foreign regions as a function of the fraction f of debt relief that is paid for by savers in the high exemption region. The blue line is the debt relief multiplier in the home region ("high-exemption"), the red line the debt relief multiplier in the foreign region ("low-exemption"), and the black line represents the difference between the multipliers in the home and the foreign regions. The figures show that the incidence of debt relief has little impact on either the aggregate or relative debt relief multipliers.

Appendix Figure A7: Debt Relief Multiplier as a Function of Openness to Trade



Note: This figure shows the debt relief multiplier, in our model, for non-tradable and tradable employment in the home and the foreign regions as a function of the degree of openness to trade α. The blue line is the debt relief multiplier in the home region ("high-exemption"), the red line the debt relief multiplier in the foreign region ("low-exemption"), and the black line represents the difference between the multipliers in the home and the foreign regions. The figures show that more home bias reduces the amount of foreign demand "leakage," increasing the local nontradable multiplier and lowering the foreign nontradable multiplier, so that the relative nontradable multiplier goes up.

Appendix Figure A8: Debt Relief Multiplier as a Function of the Degree of Price Rigidity θ for GHH preferences



Note: This figure shows the home, foreign and relative debt relief multipliers, in our model, for non-tradable and tradable employment as a function of the degree of price rigidity, under the assumption of GHH preferences $u^h(C, N) = \log\left(C - \chi_h N^2\right)$. The blue line is the response of log employment in the home region ("high-exemption") to a reduction in home borrowers' debts of 1 percent of GDP. The red line is the response of log employment in the foreign region ("low-exemption") to the same shock. The black line is the difference between the responses in the home and the foreign region ("relative multiplier"), which corresponds to the debt relief multiplier identified by our difference-in-differences research design. To draw this figure, we assume that monetary policy follows a Taylor rule with a coefficient $\phi_\pi = 0.8$ that is sufficient to guarantee determinacy. This guarantees that the outcome converges to flexible prices as $\theta \to 0$. As we show in Section IVE, the relative multipliers are independent of monetary policy. This figure shows that the GHH model is able to generate a relative multiplier for nontradable employment $\mathcal{M}_{NT,rel}$ that is as that observed in the data when θ is sufficiently large, but that such a relative multiplier masks very large home and foreign multipliers for both nontradable and tradable employment.

Appendix B. Employment Data Construction

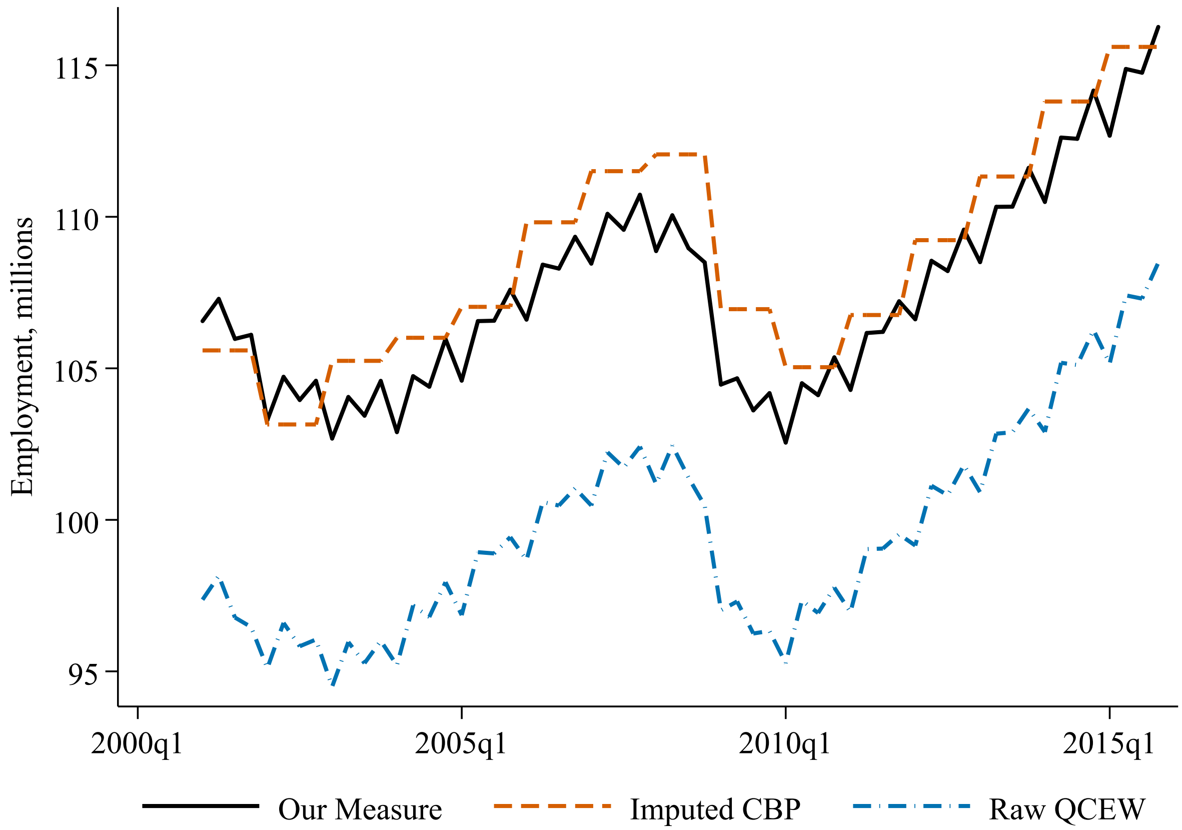
This section includes additional details on how we construct quarterly employment outcomes between 2001 and 2013 using county-level data from the Quarterly Census of Employment and Wages (QCEW) published by the Bureau of Labor Statistics (BLS). We use these data to construct a panel dataset across counties and year-quarters with observations for non-tradable employment, tradable and other employment, and total employment.

There are two important challenges when constructing consistent employment measures over our sample period using the QCEW data. First, as in Mian and Sufi (2014*b*), there are cases where employment data is suppressed in certain county-industry-year-quarter bins for reasons of confidentiality. We minimize the importance of this missing data problem in two ways. First, following Mian and Sufi (2014*b*), we form our industry groupings using 3-digit NAICs codes, not the more detailed 4-digit NAICs codes. Second, also following Mian and Sufi (2014*b*), we impute employment values in the suppressed county-industry-year-quarter bins using employment data from the County Business Patterns (CBP) data, a dataset published by the U.S. Census Bureau. The CBP data report a range of employment values in cases when the data is suppressed due to confidentiality concerns, allowing us to use the midpoint of the reported range in the CBP data whenever the QCEW employment data are suppressed. Following this imputation procedure, only 40.24 of the cells in the QCEW dataset are missing, roughly 8.4 percent of total employment, whereas 48.26 of the cells in the CBP dataset require interpolation, or roughly 11 percent of total employment. We compare the three series in Appendix Figure B1.

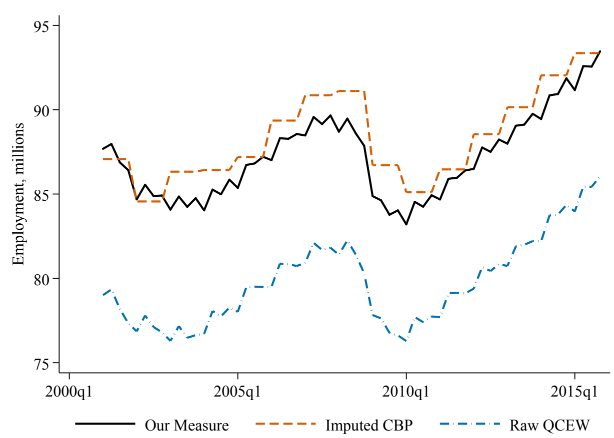
The second challenge when constructing consistent employment measures is harmonizing industry codes over the entire sample period. The NAICs codes we use to group industries changed in 2002, 2007, and 2012, and the available data crosswalks lack an exact one-to-one mapping of NAICs codes across years. To address this issue, we first construct the Mian and Sufi (2014*b*) industry definitions of non-tradable, tradable, and other industries in each set of NAICs codes. We then map the definitions backwards to 2002 and 2012 in all cases where the definitions perfectly align. Then, when the mappings disagree, we choose an industry definition in cases when the definitions disagree. This mapping is made slightly more difficult in that we need to do this harmonization for both the CBP and QCEW datasets, which use different NAICs codings in different years. A version of this data crosswalk is available upon request.

Appendix Figure B1: Comparison of QCEW and CBP Time Series by Industry Type

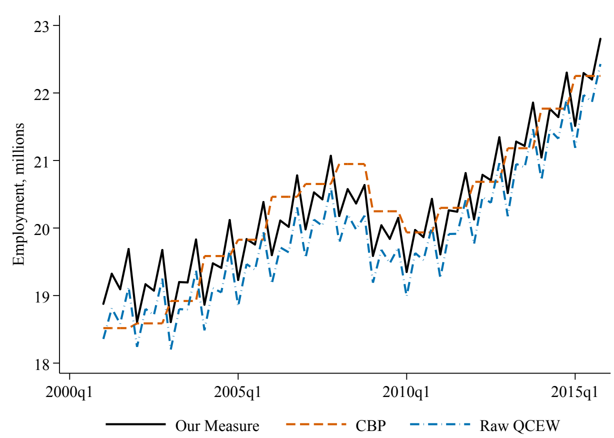
Panel A: All Employment



Panel B: Tradable and Other Employment



Panel C: Non-Tradable Employment



Appendix C. Model details

This appendix derives our model, details our calibration strategy and explains our solution method. Here, we allow for a slightly more general version of the model in which:

1. The size of the home region can be an arbitrary number $n \in (0,1)$ (with $n = \frac{1}{2}$ in the main text).
2. Borrowers and savers may own different shares in firms; we denote these shares by v^B, v^S (with $v^B = v^S = 1$ in the main text).
3. Tradable and non-tradable goods firms may have different degrees of diminishing returns to production γ_T, γ_{NT} (with $\gamma_T = \gamma_{NT} = \gamma$ in the main text).

A. Derivation of Equations

Households. As described in Section IV, our general household problem is

$$\begin{aligned} \max \quad & \mathbb{E}\sum_{t=0}^{\infty}(\beta^h)^t u^h\left(C^h_{i,t}, N^h_{i,t}\right) \\ \text{s.t.} \quad & P_{i,t}C^h_{i,t} + B^h_{i,t-1} - \Delta^h_{i,t} \leq \frac{B^h_{i,t}}{1+I_t} + W_{i,t}N^h_{i,t} + v^h D_{i,t}, \\ & B^h_{i,t} \leq \bar{b}P_{T,t} \end{aligned}$$

This yields standard first-order conditions: a labor supply decision

$$\frac{W_{i,t}}{P_{i,t}} = \frac{u^h_N\left(C^h_{i,t}, N^h_{i,t}\right)}{u^h_C\left(C^h_{i,t}, N^h_{i,t}\right)} \tag{C.1}$$

and an intertemporal Euler equation

$$\beta\frac{u^h_C\left(C^h_{i,t+1}, N^h_{i,t+1}\right)}{u^h_C\left(C^h_{i,t}, N^h_{i,t}\right)} = \frac{P_{i,t+1}}{P_{i,t}}\frac{1}{1+I_t}\left(1-(1+I_t)\mu^h_{i,t}\right) \tag{C.2}$$

where $\mu_{i,t}$ is the Lagrange multiplier on the borrowing constraint; when $\mu^h_{i,t} > 0$ this constraint binds and

$$B^h_{i,t} = \bar{b}P_{T,t} \tag{C.3}$$

Static maximization of the allocation of consumption across goods also yields standard first-order conditions: for both $h \in \{S, B\}$,

$$\begin{aligned} \frac{C^h_{T,H,j,t}}{C^h_{H,t}} &= \alpha\left(\frac{P_{T,j,t}}{P_{T,t}}\right)^{-\epsilon}\left(\frac{P_{T,t}}{P_{H,t}}\right)^{-\eta} && \text{(C.4)} \\ \frac{C^h_{NT,H,j,t}}{C^h_{H,t}} &= (1-\alpha)\left(\frac{P_{NT,H,j,t}}{P_{NT,H,t}}\right)^{-\epsilon}\left(\frac{P_{NT,H,t}}{P_{H,t}}\right)^{-\eta} && \text{(C.5)} \end{aligned}$$

$$\begin{aligned} \frac{C^h_{T,F,j,t}}{C^h_{F,t}} &= \alpha\left(\frac{P_{T,j,t}}{P_{T,t}}\right)^{-\epsilon}\left(\frac{P_{T,t}}{P_{F,t}}\right)^{-\eta} && \text{(C.6)} \\ \frac{C^h_{NT,F,j,t}}{C^h_{F,t}} &= (1-\alpha)\left(\frac{P_{NT,F,j,t}}{P_{NT,F,t}}\right)^{-\epsilon}\left(\frac{P_{NT,F,t}}{P_{F,t}}\right)^{-\eta} && \text{(C.7)} \end{aligned}$$

Separable preferences. Under separable preferences, $u^h(C,N) = \frac{C^{1-\sigma}}{1-\sigma} - \chi^h \frac{N^{1+\psi}}{1+\psi}$, (C.1) reads

$$\frac{\chi^h (N^h_{i,t})^\psi}{(C^h_{i,t})^{-\sigma}} = \frac{W_{i,t}}{P_{i,t}} \tag{C.8}$$

and (C.2) reads

$$\beta \frac{\left(C^h_{i,t+1}\right)^{-\sigma}}{\left(C^h_{i,t}\right)^{-\sigma}} = \frac{P_{i,t+1}}{P_{i,t}} \frac{1}{1+I_t} \left(1 - (1+I_t)\mu^h_{i,t}\right) \tag{C.9}$$

GHH preferences. Under GHH preferences, $u^h(C,N) = \frac{1}{1-\sigma}\left(C - \chi^h \frac{N^{1+\psi}}{1+\psi}\right)^{1-\sigma}$, instead, (C.1) reads

$$\chi^h (N^h_{i,t})^\psi = \frac{W_{i,t}}{P_{i,t}} \tag{C.10}$$

and (C.2) reads

$$\beta \frac{\left(C_{i,t+1} - \chi \frac{N_{it+1}^{1+\psi}}{1+\psi}\right)^{-\sigma}}{\left(C_{i,t} - \chi \frac{N_{it}^{1+\varphi}}{1+\varphi}\right)^{-\sigma}} = \frac{P_{i,t+1}}{P_{i,t}} \frac{1}{1+I_t} \left(1 - (1+I_t)\mu^h_{i,t}\right) \tag{C.11}$$

Generic firm problem. A generic firm has monopoly power; its maximization problem is

$$\max_{p(i)} D(i) \equiv p(i)y(i) - Wn(i)$$

where W is the local wage it faces, $p(i)$ is its price, $n(i)$ is its employment, $y(i) = An(i)^\gamma$ is its production function. The firm faces a demand constraint of the form

$$p(i) = PY^{\frac{1}{\epsilon}} y(i)^{-\frac{1}{\epsilon}}$$

Under fully flexible prices each period, the firm sets $n(i)$ optimally to maximize static profits, this yields

$$PY^{\frac{1}{\epsilon}} \gamma \frac{\epsilon - 1}{\epsilon} \left[An(i)^\gamma\right]^{\frac{\epsilon-1}{\epsilon}} \frac{1}{n(i)} - W = 0$$

where $n(i) = \left(\frac{y(i)}{A}\right)^{\frac{1}{\gamma}}$; hence

$$\frac{W}{P} = \gamma \frac{\epsilon-1}{\epsilon} A^{\frac{1}{\gamma}} Y^{\frac{1}{\epsilon}} y(i)^{1-\frac{1}{\epsilon}-\frac{1}{\gamma}}$$

All firms in the same industry therefore produce the same amount, so $y(i) = Y$ and every period

$$\frac{W_t}{P_t} = \gamma \frac{\epsilon-1}{\epsilon} A_t^{\frac{1}{\gamma}} Y_t^{1-\frac{1}{\gamma}} \tag{C.12}$$

Under sticky Calvo prices, a standard derivation yields a firm's optimal reset price P_t^* at time t, relative to its industry's price index P_t, as

$$\left(\frac{P_t^*}{P_t}\right)^{1+\frac{\varepsilon(1-\gamma)}{\gamma}} = \frac{\varepsilon}{\varepsilon-1}\frac{\sum_{k=0}^{\infty}\theta^k E\left[\left(\beta^S\right)^k u_{C,t+k}^S Y_{t+k}\left(\frac{P_{t+k}}{P_t}\right)^{\varepsilon+\frac{\varepsilon(1-\gamma)}{\gamma}}\overline{MC}_t^r\right]}{\sum_{k=0}^{\infty}\theta^k E\left[\left(\beta^S\right)^k u_{C,t+k}^S Y_{t+k}\left(\frac{P_{t+k}}{P_t}\right)^{\varepsilon-1}\right]} \tag{C.13}$$

where the firm discount future real flows using the saver's stochastic discount factor $\left(\beta^S\right)^k u_{C,t+k}^S$ since the saver is always on his Euler equation, Y_t is industry demand, and $\overline{MC}_t^r$ are average real marginal costs at time t, defined as

$$\overline{MC}_t^r \equiv \frac{W_t}{P_t}\frac{1}{\gamma A_t^{\frac{1}{\gamma}} Y_t^{1-\frac{1}{\gamma}}} \tag{C.14}$$

note that in the limit of flexible prices, $\theta = 0$, $P_t = P_t^*$ and we recover (C.12). Linearization for inflation $\Pi_t = \frac{P_t}{P_{t-1}}$ around a steady-state with zero inflation results in the standard New Keynesian Phillips curve

$$\hat{\pi}_t = \beta^S E\left[\hat{\pi}_{t+1}\right] + \frac{(1-\theta)\left(1-\theta\beta^S\right)}{\theta}\frac{1}{1+\frac{\varepsilon(1-\gamma)}{\gamma}}\hat{mc}_t^r$$

where

$$\hat{mc}_t^r = \hat{w}_t - \hat{p}_t + \frac{1-\gamma}{\gamma}\hat{y}_t$$

We now specify this generic problem to non-traded and traded goods firms in the home and the foreign region.

Non-tradable goods firm problem. A firm j in the non-tradable sector of region $i \in \{H, F\}$ operates its technology subject to a demand constraint

$$\left(\frac{p_{NT,i,j,t}}{P_{NT,i,t}}\right)^{-\epsilon} C_{NT,i,t} = y_{NT,i,j,t} = A_{NT,t}\left(n_{NT,i,j,t}\right)^{\gamma_{NT}} \tag{C.15}$$

where

$$C_{NT,i,t} = (1-\alpha)\left(\frac{P_{NT,i,t}}{P_{i,t}}\right)^{-\eta} C_{i,t}^h$$

is non-traded goods demand in region i, taken as exogenous by the firm. Write $N_{NT,i,t}$ for aggregate employment in the non-tradable sector of region i at time t. Market clearing for each input $N_{NT,i,t} = \int_{j=0}^1 n_{NT,i,j,t}dj$ implies

$$N_{NT,i,t} = \int_j \left(\frac{p_{NT,i,j,t}}{P_{NT,i,t}}\right)^{-\frac{\epsilon}{\gamma_{NT}}} dj \cdot \left(\frac{C_{NT,i,t}}{A_{NT,t}}\right)^{\frac{1}{\gamma_{NT}}}$$

Hence, at the aggregate level, consumption and employment are related via

$$C_{NT,i,t} = \frac{A_{NT,t}}{\triangle_{NT,i,t}}\left(N_{NT,i,t}\right)^{\gamma_{NT}}$$

where $\Delta_{NT,i,t} = \left[\int_{j=0}^1 \left(\frac{p_{NT,i,j,t}}{P_{NT,i,t}}\right)^{-\frac{\epsilon}{\gamma_{NT}}} dj\right]^{\gamma_{NT}} \geq 1$.

This has the form of the generic problem described above. Under flexible prices $\Delta_{NT,i,t} = 1$ and we obtain

$$\frac{W_{i,t}}{P_{NT,i,t}} = \gamma_{NT}\frac{\epsilon-1}{\epsilon}A_{NT,t}^{\frac{1}{\gamma_{NT}}} Y_{NT,i,t}^{1-\frac{1}{\gamma_{NT}}} = \gamma_{NT}\frac{\epsilon-1}{\epsilon}A_{NT,t}N_{NT,i,t}^{\gamma_{NT}-1} \tag{C.16}$$

Under sticky prices, the Phillips curves are

$$\hat{\pi}_{NT,i,t} = \beta^S E\left[\hat{\pi}_{NT,i,t+1}\right] + \kappa_{NT}\left(\hat{w}_{i,t} - \hat{p}_{NT,i,t} + \frac{1-\gamma}{\gamma}\hat{y}_{NT,i,t}\right)$$

where $\kappa_{NT} \equiv \frac{(1-\theta)\left(1-\theta\beta^S\right)}{\theta}\frac{1}{\left(1+\frac{\varepsilon(1-\gamma_{NT})}{\gamma_{NT}}\right)}$.

Tradable goods firm problem. A firm j in the tradable sector of region $i \in \{H, F\}$ operates its technology subject to a demand constraint

$$\left(\frac{p_{T,i,j,t}}{P_{T,i,t}}\right)^{-\epsilon}\left(\frac{P_{T,i,t}}{P_{T,t}}\right)^{-\epsilon} C_{T,t} = y_{T,i,j,t} = A_{T,t}\left(n_{T,i,j,t}\right)^{\gamma_{NT}} \tag{C.17}$$

The difference with (C.15) is that goods demand is global, namely,

$$C_{T,t} = n\cdot\alpha\left(\frac{P_{T,t}}{P_{H,t}}\right)^{-\eta} C_{H,t} + (1-n)\cdot\alpha\left(\frac{P_{T,t}}{P_{F,t}}\right)^{-\eta} C_{F,t}$$

Write $N_{T,i,t}$ for aggregate employment in the tradable sector of region i at time t. Market clearing at home and abroad, $N_{T,H,t} = \int_{j=0}^{n} n_{T,i,j} dj$ and $N_{T,F,t} = \int_{j=n}^{1} n_{T,i,j} dj$, implies

$$N_{T,H,t} = \int_{j=0}^{n}\left(\frac{p_{T,i,j,t}}{P_{T,H,t}}\right)^{-\frac{\epsilon}{\gamma_T}} dj\left(\frac{\left(\frac{P_{T,H,t}}{P_{T,t}}\right)^{-\epsilon} C_{T,t}}{A_{T,t}}\right)^{\frac{1}{\gamma_T}}$$

$$\begin{aligned}\left(\frac{P_{T,H,t}}{P_{T,t}}\right)^{-\epsilon} C_{T,t} &= \frac{A_{T,t}}{\triangle_{T,H,t}}\left(N_{T,H,t}\right)^{\gamma_T} \\ \left(\frac{P_{T,F,t}}{P_{T,t}}\right)^{-\epsilon} C_{T,t} &= \frac{A_{T,t}}{\triangle_{T,F,t}}\left(N_{T,F,t}\right)^{\gamma_T}\end{aligned}$$

where $\Delta_{T,H,t} = \left[\int_{j=0}^{n}\left(\frac{p_{T,H,j,t}}{P_{T,H,t}}\right)^{-\frac{\epsilon}{\gamma_T}} dj\right]^{\gamma_T} \geq 1$ and $\Delta_{T,H,t} = \left[\int_{j=n}^{1}\left(\frac{p_{T,F,j,t}}{P^F_{T,F,t}}\right)^{-\frac{\epsilon}{\gamma_T}} dj\right]^{\gamma_T} \geq 1$.[25]

This problem also has the form of the generic problem described above. Under flexible prices $\Delta_{T,i,t} = 1$ and we obtain

$$\frac{W_{i,t}}{P_{T,i,t}} = \gamma_T\frac{\epsilon-1}{\epsilon}A_{T,t}^{\frac{1}{\gamma_T}}Y_{T,i,t}^{1-\frac{1}{\gamma_T}} = \gamma_T\frac{\epsilon-1}{\epsilon}A_{T,t}N_{T,i,t}^{\gamma_T-1} \tag{C.18}$$

in particular, combining with (C.16), we obtain relative labor demand as

$$\frac{P_{NT,i,t}}{P_{T,i,t}} = \frac{\gamma_T}{\gamma_{NT}}\frac{A_{T,t}}{A_{NT,t}}\frac{\left(N_{NT,i,t}\right)^{1-\gamma_{NT}}}{\left(N_{T,i,t}\right)^{1-\gamma_T}}$$

Under sticky prices, the Phillips curves are

$$\hat{\pi}_{T,i,t} = \beta^S E\left[\hat{\pi}_{T,i,t+1}\right] + \kappa_T\left(\hat{w}_{i,t} - \hat{p}_{T,i,t} + \frac{1-\gamma}{\gamma}\hat{y}_{T,i,t}\right)$$

[25] We have defined the local tradable price indices as $\left(P_{T,H}\right)^{1-\epsilon} = \frac{1}{n}\int_{j=0}^{n}\left(p_{j,T}\right)^{1-\epsilon} dj$ and $\left(P_{T,F}\right)^{1-\epsilon} = \frac{1}{1-n}\int_{j=n}^{1}\left(p_{j,T}\right)^{1-\epsilon} dj$ so that the overall traded goods price index is $P_T^{1-\epsilon} = n\left(P_{T,H}\right)^{1-\epsilon} + (1-n)\left(P_{T,F}\right)^{1-\epsilon}$.

where $\kappa_T \equiv \frac{(1-\theta)\left(1-\theta\beta^S\right)}{\theta} \frac{1}{\left(1+\frac{\epsilon(1-\gamma_{NT})}{\gamma_{NT}}\right)}$.

B. Steady state

Our flexible-price steady state has 29 equations, as detailed below:

1) Our numeraire is the price index for tradables, which we normalize to $P_T = 1$

2) The definition of the tradable price index P_T implies

$$\frac{P_{TH}}{P_T} = \left[n + (1-n)\left(\frac{P_{TF}}{P_{TH}}\right)^{1-\epsilon}\right]^{\frac{-1}{1-\epsilon}}$$

where recall that n denotes the size of the home region; in the main text $n = \frac{1}{2}$.

3-4) Consumer price indices at home and foreign:

$$\begin{aligned} P_H &= \left[\alpha\left(P_T\right)^{1-\eta} + (1-\alpha)\left(P_{NT,H}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}} \\ P_F &= \left[\alpha\left(P_T\right)^{1-\eta} + (1-\alpha)\left(P_{NT,F}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}} \end{aligned}$$

5-8) Household intratemporal first-order conditions: in the case of separable preferences this is given by (C.8)

$$\begin{aligned} \chi^B\left(C_H^B\right)^{\sigma}\left(N_H^B\right)^{\psi} &= \frac{W_H}{P_H} \\ \chi^B\left(C_F^B\right)^{\sigma}\left(N_F^B\right)^{\psi} &= \frac{W_F}{P_F} \end{aligned}$$

$$\begin{aligned} \chi^S\left(C_H^S\right)^{\sigma}\left(N_H^S\right)^{\psi} &= \frac{W_H}{P_H} \\ \chi^S\left(C_F^S\right)^{\sigma}\left(N_F^S\right)^{\psi} &= \frac{W_F}{P_F} \end{aligned}$$

in the case of GHH preferences, replace with (C.10) instead.

9-10) Labor market clearing conditions at Home and in Foreign, exploiting $\Delta_{T,i} = \Delta_{NT,i} = 1$ at steady state:

$$\begin{aligned} \varphi^B N_H^B + \varphi^S N_H^S &= N_{T,H} + N_{NT,H} = \left(\frac{Y_{T,H}}{A_T}\right)^{\frac{1}{\gamma_T}} + \left(\frac{Y_{NT,H}}{A_{NT}}\right)^{\frac{1}{\gamma_{NT}}} \\ \varphi^B N_F^B + \varphi^S N_F^S &= N_{T,H} + N_{NT,F} = \left(\frac{Y_{T,F}}{A_T}\right)^{\frac{1}{\gamma_T}} + \left(\frac{Y_{NT,F}}{A_{NT}}\right)^{\frac{1}{\gamma_{NT}}} \end{aligned}$$

11-14) Goods market clearing conditions for tradables and non-tradables at Home and in Foreign:

$$Y_{T,H} = \left(\frac{P_{T,H}}{P_T}\right)^{-\epsilon}\left(nC_{T,H} + (1-n)\,C_{T,F}\right) \tag{C.19}$$

$$Y_{T,F} = \left(\frac{P_{T,F}}{P_T}\right)^{-\epsilon}\left(nC_{T,H} + (1-n)\,C_{T,F}\right) \tag{C.20}$$

$$\begin{aligned} Y_{NT,H} &= C_{NT,H} \\ Y_{NT,F} &= C_{NT,F} \end{aligned}$$

15-18) Consumer demand at Home and in Foreign, (C.4)–(C.7):

$$\begin{aligned}
\frac{C_{T,H}}{C_H} &= \alpha\left(\frac{P_T}{P_H}\right)^{-\eta}\\
\frac{C_{NT,H}}{C_H} &= (1-\alpha)\left(\frac{P_{NT,H}}{P_H}\right)^{-\eta}
\end{aligned}$$

$$\begin{aligned}
\frac{C_{T,F}}{C_F} &= \alpha\left(\frac{P_T}{P_F}\right)^{-\eta}\\
\frac{C_{NT,F}}{C_F} &= (1-\alpha)\left(\frac{P_{NT,F}}{P_F}\right)^{-\eta}
\end{aligned}$$

19-20) Aggregate demand at Home and in Foreign:

$$\begin{aligned}
C_H &= \varphi_B C_H^B + (1-\varphi_B)\, C_H^S\\
C_F &= \varphi_B C_F^B + (1-\varphi_B)\, C_F^S
\end{aligned}$$

21-24) Tradable and non-tradable goods firms FOCs, at Home and in Foreign, (C.16) and (C.18):

$$\begin{aligned}
\frac{W_H}{P_{T,H}} &= \frac{\epsilon-1}{\epsilon}\gamma_T A_T^{\frac{1}{\gamma_T}}\left(Y_{T,H}\right)^{-\frac{(1-\gamma)}{\gamma}}\\
\frac{W_F}{P_{T,F}} &= \frac{\epsilon-1}{\epsilon}\gamma_T A_T^{\frac{1}{\gamma_T}}\left(Y_{T,F}\right)^{-\frac{(1-\gamma)}{\gamma}}\\
\frac{W_H}{P_{NT,H}} &= \frac{\epsilon-1}{\epsilon}\gamma_{NT} A_{NT}^{\frac{1}{\gamma_{NT}}}\left(Y_{NT,H}\right)^{-\frac{(1-\gamma)}{\gamma}}\\
\frac{W_F}{P_{NT,F}} &= \frac{\epsilon-1}{\epsilon}\gamma_{NT} A_{NT}^{\frac{1}{\gamma_{NT}}}\left(Y_{NT,F}\right)^{-\frac{(1-\gamma)}{\gamma}}
\end{aligned}$$

25-26) Total firm dividends, at Home and in Foreign

$$\begin{aligned}
D_H &= (P_{T,H}Y_{T,H} - W_H N_{T,H}) + (P_{NT,H}Y_{NT,H} - W_H N_{NT,H})\\
D_F &= (P_{T,F}Y_{T,F} - W_F N_{T,F}) + (P_{NT,F}Y_{NT,F} - W_F N_{NT,F})
\end{aligned}$$

27-29) Three budget constraints for Home and Foreign borrower and Home saver,

$$\begin{aligned}
P_H C_H^B &= W_H N_H^B + v^B D_H - (I-1)\,\bar{b} P_H\\
P_H C_H^S &= W_H N_H^S + v^S D_H - (I-1)\,B_H^S\\
P_F C_F^B &= W_F N_F^B + v^B D_F - (I-1)\,\bar{b} P_F
\end{aligned}$$

The Foreign saver's budget constraint follows by Walras's law.

Calibration. Our primitives are n (country size), φ^B (fraction of borrowers), v^B (number of shares per borrower), the preference parameters α, σ, ψ, ϵ, η, β^S and β^B, the production elasticities γ_T and γ_{NT}, as well as a normalization for total PCE C, and the debt-to-GDP ratio $\frac{B}{PC}$. Given these, we now solve for A_T, A_{NT}, χ^S and χ^B to reach a symmetric steady state with all relative prices equal to 1 and hours worked for savers and borrowers in both regions equal to 1.

Given our normalization of $P_T = 1$, our restriction of unit relative prices implies

$$P_{NT,H} = P_{NT,F} = P_{T,H} = P_{T,F} = P_H = P_F = 1$$

In the symmetric steady state, per capita consumption in each region is the same,

$$C_H = C_F = C$$

given (C.4)–(C.7), this implies

$$C_T = \alpha C \quad C_{NT} = (1-\alpha)\, C$$

as well as

$$Y_T = \alpha C \quad Y_{NT} = (1-\alpha)\, C \tag{C.21}$$

Our normalization for hours implies

$$N_H^B = N_H^S = N_F^B = N_F^S = 1$$

Given (C.16) and (C.18), this implies equalization of the value of the marginal product of labor within in both regions

$$P_T \gamma_T A_T N_T^{\gamma_T - 1} = P_{NT} \gamma_{NT} A_{NT} N_{NT}^{\gamma_{NT}-1} \tag{C.22}$$

Together with

$$N_{NT} + N_T = 1 \tag{C.23}$$

this equation pins down relative employment in each sector as a function of the degree of decreasing returns and technology.

Next, production implies

$$Y_T = A_T N_T^{\gamma_T} \quad Y_{NT} = A_{NT} N_{NT}^{\gamma_{NT}}$$

Combining with (C.21) and (C.22), we obtain

$$\frac{\alpha}{1-\alpha} = \frac{A_T}{A_{NT}} \frac{N_T^{\gamma_T}}{N_{NT}^{\gamma_{NT}}} = \frac{\gamma_{NT}}{\gamma_T} \frac{N_T^{1-\gamma_T}}{N_{NT}^{1-\gamma_{NT}}} \frac{N_T^{\gamma_T}}{N_{NT}^{\gamma_{NT}}} = \frac{\gamma_{NT}}{\gamma_T} \frac{N_T}{N_{NT}}$$

hence, given (C.23), tradable goods employment N_T in either region solves

$$\frac{N_T}{N_{NT}} = \frac{\alpha}{1-\alpha} \frac{\gamma_T}{\gamma_{NT}} = \frac{N_T}{1-N_T}$$

Solving for N_T and N_{NT}, we obtain

$$N_T = \frac{\alpha \gamma_T}{(1-\alpha)\, \gamma_{NT} + \alpha \gamma_T}$$

$$N_{NT} = \frac{(1-\alpha)\, \gamma_{NT}}{(1-\alpha)\, \gamma_{NT} + \alpha \gamma_T}$$

This delivers A_T and A_{NT}, as desired:

$$A_T = \frac{\alpha C}{N_T^{\gamma_T}} \qquad A_{NT} = \frac{(1-\alpha)\, C}{N_{NT}^{\gamma_{NT}}} \tag{C.24}$$

Symmetry also implies that relative wages are equated across regions

$$W_H = W_F = W$$

The labor share in the tradable sector and non-tradable sectors are, respectively,

$$\frac{WN_T}{PC} = \frac{P_T}{P}\frac{\epsilon-1}{\epsilon}\gamma_T\alpha = \frac{\epsilon-1}{\epsilon}\gamma_T\alpha$$

$$\frac{WN_{NT}}{PC} = \frac{\epsilon-1}{\epsilon}\gamma_{NT}\left(1-\alpha\right)$$

This implies that the level of the wage must be

$$W = \frac{\epsilon-1}{\epsilon}\left(\gamma_T\alpha + \gamma_{NT}\left(1-\alpha\right)\right)C = \omega C$$

where $\omega \equiv \frac{\epsilon-1}{\epsilon}\left(\gamma_T\alpha + \gamma_{NT}\left(1-\alpha\right)\right)$, and that dividends are

$$\begin{aligned}\frac{D}{P} &= Y_T + Y_{NT} - WN \\ &= C - WN \\ &= C\left(1-\omega\right)\end{aligned}$$

Finally, budget constraints together with a binding borrowing constraint for borrowers, $B^B = \bar{b}$, imply

$$\begin{aligned}C_H^B &= W + v^B D - \left(I-1\right)\bar{b} \\ C_H^S &= W + v^S D - \left(I-1\right)B^S \\ C_F^S &= W + v^S D - \left(I-1\right)B^S\end{aligned}$$

Market clearing for domestic debt implies

$$\varphi^B\frac{\bar{b}}{C} + \left(1-\varphi^B\right)\frac{B^S}{C} = 0$$

so

$$\frac{B^S}{C} = -\frac{\varphi^B}{1-\varphi^B}\frac{\bar{b}}{C}$$

We finally obtain χ^B and χ^S to our normalization for hours worked by setting

$$\chi^B = \frac{W}{\left(C^B\right)^\sigma} = \frac{\omega C}{\left[\left(\omega + v^B\left(1-\omega\right) - \left(I-1\right)\frac{\bar{b}}{C}\right)C\right]^\sigma} \tag{C.25}$$

$$\chi^S = \frac{W}{\left(C^S\right)^\sigma} = \frac{\omega C}{\left[\left(\omega + v^S\left(1-\omega\right) + \left(I-1\right)\frac{\varphi^B}{1-\varphi^B}\frac{\bar{b}}{C}\right)C\right]^\sigma} \tag{C.26}$$

Note that aggregate household debt, as a share of aggregate consumption, is $\frac{\varphi^B\bar{b}}{C}$.

C. Impulse responses

Our model admits two regimes depending on the set of constraints that binds. When all agents are unconstrained,

$$u_{C,H,t}^B = \beta^B\left(1+I_t\right)\frac{P_{H,t}}{P_{H,t+1}}u_{C,H,t+1}^B \tag{C.27}$$

$$u^S_{C,H,t} = \beta^S \left(1 + I_t\right) \frac{P_{H,t}}{P_{H,t+1}} u^S_{C,H,t+1} \tag{C.28}$$

$$u^B_{C,F,t} = \beta^B \left(1 + I_t\right) \frac{P_{F,t}}{P_{F,t+1}} u^B_{C,F,t+1} \tag{C.29}$$

$$u^S_{C,F,t} = \beta^S \left(1 + I_t\right) \frac{P_{F,t}}{P_{F,t+1}} u^S_{C,F,t+1} \tag{C.30}$$

and all agents are on their budget constraints

$$P_{i,t}C^h_{i,t} + B^h_{i,t-1} - \Delta^h_{i,t} = \frac{B^h_{i,t}}{1+I_t} + W_{i,t}N^h_{i,t} + v^h D_{i,t}$$

When home borrowers are constrained, (C.27) is replaced by

$$B^B_{H,t} = \bar{b}P_{T,t}$$

and similarly when foreign borrowers are constrained (C.29) is replaced by

$$B^B_{F,t} = \bar{b}P_{T,t}$$

D. Loglinearization

Assuming separable preferences, loglinearization of our model around the steady state defined above results in the following equations holding at every time t:

$$\begin{aligned}
p_{TH} - p_T &= (1-n)(p_{TH} - p_{TF}) \\
p_H &= \alpha p_T + (1-\alpha) p_{NT,H} \\
p_F &= \alpha p_T + (1-\alpha) p_{NT,F} \\
\sigma c^B_H + \psi n^B_H &= w_H - p_H \\
\sigma c^B_F + \psi n^B_F &= w_F - p_F \\
\sigma c^S_H + \psi n^S_H &= w_H - p_H \\
\sigma c^S_F + \psi n^S_F &= w_F - p_F \\
n_H &= \frac{N_{T,H}}{\gamma_T} y_{T,H} + \frac{N_{NT,H}}{\gamma_{NT}} y_{NT,H} \\
n_F &= \frac{N_{T,F}}{\gamma_T} y_{T,F} + \frac{N_{NT,F}}{\gamma_{NT}} y_{NT,F} \\
n_H &= \varphi^B n^B_H + \varphi^S n^S_H \\
n_F &= \varphi^B n^B_F + \varphi^S n^S_F \\
y_{T,H} &= -\epsilon(p_{T,H} - p_T) + n c_{T,H} + (1-n) c_{T,F} \\
y_{T,F} &= -\epsilon(p_{T,F} - p_T) + n c_{T,H} + (1-n) c_{T,F} \\
y_{NT,H} &= c_{NT,H} \\
y_{NT,F} &= c_{NT,F} \\
c_{T,H} - c_H &= -\eta(p_T - p_H) \\
c_{T,F} - c_F &= -\eta(p_T - p_F) \\
c_{NT,H} - c_H &= -\eta(p_{NT,H} - p_H) \\
c_{NT,F} - c_F &= -\eta(p_{NT,F} - p_F)
\end{aligned}$$

$$
\begin{aligned}
c_H &= \varphi^B \frac{C^B}{C} c_H^B + \frac{C^S}{C} \varphi^S c_H^S \\
c_F &= \varphi^B \frac{C^B}{C} c_F^B + \varphi^S \frac{C^S}{C} c_F^S \\
w_H - p_{T,H} &= -\frac{1-\gamma_T}{\gamma_T} y_{T,H} \\
w_H - p_{NT,H} &= -\frac{1-\gamma_{NT}}{\gamma_{NT}} y_{NT,H} \\
w_F - p_{T,F} &= -\frac{1-\gamma_T}{\gamma_{NT}} y_{T,F} \\
w_F - p_{NT,F} &= -\frac{1-\gamma_T}{\gamma_{NT}} y_{NT,F} \\
d_H &= \frac{P_T Y_T}{D} (p_{TH} + y_{TH}) + \frac{P_{NT} Y_{NT}}{D} (p_{NTH} + y_{NTH}) - \frac{WN}{D} (w_H + n_H) \\
d_F &= \frac{P_T Y_T}{D} (p_{TF} + y_{TF}) + \frac{P_{NT} Y_{NT}}{D} (p_{NTF} + y_{NTF}) - \frac{WN}{D} (w_F + n_F)
\end{aligned}
$$

This completes the static equations. In addition we have, when both borrowers are constrained (reference regime)

$$
\begin{aligned}
c_{Ht}^S &= c_{Ht+1}^S - \frac{1}{\sigma} (i_t - \pi_{H,t+1}) \\
c_{Ft}^S &= c_{Ft+1}^S - \frac{1}{\sigma} (i_t - \pi_{F,t+1})
\end{aligned}
$$

together with the budget constraints

$$
\begin{aligned}
p_{Ht} + c_{Ht}^S &= \frac{B^S}{PC^S} b_{Ht}^S - \frac{RB^S}{PC^S} \left(b_{Ht-1}^S + i_{t-1} \right) + \frac{WN}{PC^S} \left(w_{Ht} + n_{Ht}^S \right) + v^S \frac{D}{PC^S} d_{Ht} \\
p_{Ft} + c_{Ft}^S &= \frac{B^S}{PC^S} b_{Ft}^S - \frac{RB^S}{PC^S} \left(b_{Ft-1}^S + i_{t-1} \right) + \frac{WN}{PC^S} \left(w_{Ft} + n_{Ft}^S \right) + v^S \frac{D}{PC^S} d_{Ft}
\end{aligned}
$$

and

$$
\begin{aligned}
p_{Ht} + c_{Ht}^B &= \frac{B^B}{PC^B} p_{T,t} - \frac{RB^B}{PC^S} (p_{T,t-1} + i_{t-1}) + \frac{WN}{PC^B} \left(w_{Ht} + n_{Ht}^B \right) + v^B \frac{D}{PC^B} d_{Ht} \\
p_{Ft} + c_{Ft}^B &= \frac{B^B}{PC^B} p_{T,t} - \frac{RB^B}{PC^S} (p_{T,t-1} + i_{t-1}) + \frac{WN}{PC^B} \left(w_{Ft} + n_{Ft}^B \right) + v^B \frac{D}{PC^B} d_{Ft}
\end{aligned}
$$

When both borrowers are unconstrained, instead we have

$$
\begin{aligned}
c_{Ht}^B &= c_{Ht+1}^B - \frac{1}{\sigma} (i_t - \pi_{H,t+1}) \\
c_{Ft}^B &= c_{Ft+1}^B - \frac{1}{\sigma} (i_t - \pi_{F,t+1})
\end{aligned}
$$

The dynamics are completed by a description of the evolution of inflation in both regions

$$
\hat{\pi}_{HT,t} = \beta^S E \left[\hat{\pi}_{HT,t+1} \right] + \frac{(1-\theta)\left(1-\theta\beta^S\right)}{\theta} \frac{1}{\left(1 + \frac{\varepsilon(1-\gamma)}{\gamma}\right)} \left(\hat{w}_{HT,t} - \hat{p}_{HT,t} + \frac{1-\gamma}{\gamma} \hat{y}_{HT,t} \right)
$$

$$
\hat{\pi}_{HNT,t} = \beta^S E \left[\hat{\pi}_{HNT,t+1} \right] + \frac{(1-\theta)\left(1-\theta\beta^S\right)}{\theta} \frac{1}{\left(1 + \frac{\varepsilon(1-\gamma)}{\gamma}\right)} \left(\hat{w}_{HNT,t} - \hat{p}_{HNT,t} + \frac{1-\gamma}{\gamma} \hat{y}_{HNT,t} \right)
$$

$$\hat{\pi}_{FT,t} = \beta^S E\left[\hat{\pi}_{FT,t+1}\right] + \frac{(1-\theta)\left(1-\theta\beta^S\right)}{\theta}\frac{1}{\left(1+\frac{\varepsilon(1-\gamma)}{\gamma}\right)}\left(\hat{w}_{FT,t} - \hat{p}_{FT,t} + \frac{1-\gamma}{\gamma}\hat{y}_{FT,t}\right)$$

$$\hat{\pi}_{FNT,t} = \beta^S E\left[\hat{\pi}_{FNT,t+1}\right] + \frac{(1-\theta)\left(1-\theta\beta^S\right)}{\theta}\frac{1}{\left(1+\frac{\varepsilon(1-\gamma)}{\gamma}\right)}\left(\hat{w}_{FNT,t} - \hat{p}_{FNT,t} + \frac{1-\gamma}{\gamma}\hat{y}_{FNT,t}\right)$$

together with the monetary policy rule: either

$$i_t = 0$$

at the ZLB, or:

$$i_t = \phi_\pi\left(\pi_{H,t} + \pi_{F,t}\right)$$

when monetary policy follows at Taylor rule.

E. Solution method

Since our model has occasionally binding borrowing constraints, we solve our model the Dynare "OccBin" package developed by Matteo Iacoviello and Luca Guerrieri (Guerrieri and Iacoviello 2015).

Whenever the model is in the indeterminacy region (with low ϕ_π, as in our main case of the zero lower bound), we resolve this indeterminacy by assuming that the economy returns to steady state by the end of horizon τ of our impulse responses. Practically, since there is a single dimension of indeterminacy, this involves parametrizing the expectation error in one of the Phillips curves with one "sunspot" shock. We set

$$\hat{\pi}_{HT,t+1} = \mathbb{E}_t\left[\hat{\pi}_{HT,t+1}\right] + \epsilon_{t+1}$$

and simulate the model twice. We first obtain the full set of impulse responses to a debt relief shock assuming that the initial expectational error in inflation is $\epsilon_0 = 0$ (call this $\mathbb{I}^0$, where $\mathbb{I}^0(X,t)$ is the impulse response of variable X at time t). We then obtain the full set of impulse responses to a zero debt relief shock, assuming that the expectational error in inflation is $\epsilon_0 = 1$ (call this $\mathbb{I}^1$). We then find the scalar λ such that the impulse response of inflation is exactly zero at date τ, ie $\mathbb{I}^0(\pi_{HT},\tau) + \lambda\mathbb{I}^1(\pi_{HT},\tau) = 0$. Our impulse responses to all shocks are then simply $\mathbb{I}^0 + \lambda\mathbb{I}^1$. We verify that this delivers continuity at the boundary of indeterminacy (see for example figure A5).

F. MPCs out of debt relief

Here we show why the consumption function out of debt relief is concave and highlight the determinants of MPCs out of debt relief. The analysis is complementary to Achdou et al. (2017), who provide an alternative and very elegant derivation, and extend it to a case where borrowers face idiosyncratic income risk.

For this section, we work in continuous time. An impatient agent faces the real interest rate r and has discount rate $\rho < r$

$$\begin{aligned} \max \quad & \int e^{-\rho t}\left\{u\left(c_t\right) - v\left(n_t\right)\right\} dt \\ \text{s.t.} \quad & \dot{b_t} = rb_t + wn_t + y - c_t \\ & b_t \geq -d \end{aligned} \tag{C.31}$$

where $u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}$ and $v(n) = \chi\frac{n^{1+\psi}}{1+\psi}$. Her wage w, nonlabor income y and the real interest rate r are all constants.

Steady state. In a steady-state the constraint binds: the agent is at his borrowing limit $b = -d$. Consumption is equal to income from labor and nonlabor income net of interest payments

$$c = wn + y - rd \tag{C.32}$$

The steady-state levels of consumption c and labor supply n solve (C.32) jointly with the optimality condition for labor vs consumption,

$$c^{\sigma} n^{\psi} = \frac{w}{\chi} \tag{C.33}$$

write this solution (c^*, n^*).

Debt relief. Debt relief for this agent means restarting her at level $b_0 = -d_0$, in other words, forgiving the amount $D = d_0 - d$. The agent will plan to return to the constraint at time T. In the meantime, her consumption solves the Euler equation

$$\frac{\dot{c}_t}{c_t} = \frac{1}{\sigma}(r - \rho)$$

implying

$$c_t = c_0 e^{-\frac{1}{\sigma}(\rho - r)t} \tag{C.34}$$

Along, the way the intratemporal condition

$$c_t^{\sigma} n_t^{\psi} = w \tag{C.35}$$

holds at all time, implying in particular

$$n_t = n_0 e^{\frac{1}{\psi}(\rho - r)t} \tag{C.36}$$

Hence consumption decays exponentially and labor supply increases exponentially back towards their steady-state level. Moreover, by continuity

$$c_T = c_0 e^{-\frac{1}{\sigma}(\rho - r)T} = c^*$$

which relates the time it takes to hit the constraint to the initial level of consumption c_0

$$\frac{1}{\sigma}(\rho - r)T = \ln\left(\frac{c_0}{c^*}\right) \tag{C.37}$$

and similarly

$$-\frac{1}{\psi}(\rho - r)T = \ln\left(\frac{n_0}{n^*}\right)$$

The integrated version of the budget constraint (C.31) between $t = 0$ and $t = T$ (where their asset level is back at the constraint $b_T = -d$) reads

$$d_0 + \int_0^T c_t e^{-rt} dt = \int_0^T y e^{-rt} dt + \int_0^T w n_t e^{-rt} dt + d e^{-rT}$$

Define

$$a \equiv \frac{1}{\sigma}(\rho - r) \quad b \equiv \frac{1}{\psi}(\rho - r)$$

Using (C.34) and (C.36)

$$d_0 + \frac{c_0}{r + a}\left(1 - e^{-(r+a)T}\right) = \frac{y}{r}\left(1 - e^{-rT}\right) + \frac{w n_0}{r - b}\left(1 - e^{-(r-b)T}\right) + d e^{-rT} \tag{C.38}$$

recognizing that $de^{-rT} = d - \frac{rd}{r}\left(1-e^{-rT}\right)$ we obtain

$$\frac{c_0}{r+a}\left(1-e^{-(r+a)T}\right) - \frac{y-rd}{r}\left(1-e^{-rT}\right) - \frac{wn_0}{r-b}\left(1-e^{-(r-b)T}\right) = d - d_0$$

noting that $c_0^{\sigma} n_0^{\psi} = w$, this gives us a second relation between c_0 and T. Solving for both gives us the full solution to our dynamic optimization problem.

Approximation. We first solve out for c_0 and n_0 as functions of T,

$$\frac{c^* e^{aT}}{r+a}\left(1-e^{-(r+a)T}\right) - \frac{y-rd}{r}\left(1-e^{-rT}\right) - \frac{wn^* e^{-bT}}{r-b}\left(1-e^{-(r-b)T}\right) = d - d_0$$

and use the steady state budget constraint $y - rd = c^* - wn^*$ to rewrite this as

$$c^*\left[\frac{e^{aT}}{r+a}\left(1-e^{-(r+a)T}\right) - \frac{1}{r}\left(1-e^{-rT}\right)\right] + wn^*\left[\frac{1}{r}\left(1-e^{-rT}\right) - \frac{e^{-bT}}{r-b}\left(1-e^{-(r-b)T}\right)\right] = d - d_0$$

And note that, to a second-order approximation

$$\begin{aligned}
\frac{e^{aT}}{r+a}\left(1-e^{-(r+a)T}\right) - \frac{1}{r}\left(1-e^{-rT}\right) &= \left(1 + aT + \frac{a^2T^2}{2} + O\left(T^3\right)\right)\left(T - \frac{(a+r)\,T^2}{2} + O\left(T^3\right)\right) - \left(T - \frac{rT^2}{2}\right) \\
&= \frac{aT^2}{2} + O\left(T^3\right)
\end{aligned}$$

and symmetrically for labor supply by substituting $a = -b$. We obtain

$$\left(ac^* + bwn^*\right)\frac{T^2}{2} + O\left(T^3\right) = d - d_0 \equiv D$$

In other words

$$\frac{1}{2}\left(\frac{1}{\sigma}\left(\rho - r\right) + \frac{1}{\psi}\left(\rho - r\right)\frac{wn^*}{c^*}\right)T^2 \simeq \frac{D}{c^*}$$

so that the solution for T is

$$T \simeq \sqrt{\frac{2}{\rho - r}\left(\frac{1}{\sigma} + \frac{1}{\psi}\frac{wn^*}{c^*}\right)^{-1}\frac{D}{c^*}} \tag{C.39}$$

and hence we obtain two approximations for the consumption effect of a given amount of debt relief $D = d - d_0$. Our first approximation is in logs,

$$\ln\left(\frac{c_0}{c^*}\right) = \frac{1}{\sigma}\left(\rho - r\right)T \simeq \sqrt{2\frac{\rho - r}{\sigma^*}\frac{D}{c^*}} \tag{C.40}$$

with effective risk aversion

$$\sigma^* \equiv \sigma\left(1 + \frac{\sigma}{\psi}\frac{wn^*}{c^*}\right)$$

We can also obtain a (less accurate) expression in percentage terms

$$\frac{c_0 - c^*}{c^*} \simeq \sqrt{2\frac{\rho - r}{\sigma^*}\frac{D}{c^*}} \tag{C.41}$$

Equations C.40 and C.41 show that the log change in borrower consumption (or its approximation as a percent change $\frac{c_0-c^*}{c^*}$) is proportional to the square root of the ratio of debt relief to consumption $\frac{D}{c^*}$. As is intuitive, the more impatient the borrower is relative to the risk-free rate and the higher the effective elasticity of intertemporal substitution $\frac{1}{\sigma^*}$, the higher the slope of this relationship.

In addition, the labor supply response is negative and proportional to square root of the ratio of debt relief to labor income:

$$\frac{n_0 - n^*}{n^*} \simeq \ln\left(\frac{n_0}{n^*}\right) \simeq -\sqrt{2\frac{\rho - r}{\psi^*}\frac{D}{wn^*}} \tag{C.42}$$

where we similarly have defined effective ψ as

$$\psi^* \equiv \psi\left(1 + \frac{\psi}{\sigma}\frac{c^*}{wn^*}\right)$$

which is larger, the larger the Frisch elasticity ψ^{-1}.

MPCs out of debt relief in discrete time. In discrete time, debt relief D leads borrowers to go back to their borrowing constraints in a number of discrete periods T, instead of a continuous T approximated by C.39. When D is low enough, the continuous-time T is small and the discrete T equals 1. In this case, the discrete time MPC and the MPN solve

$$MPC = wMPN + 1$$

as well as (differentiating C.35)

$$wMPN = -\frac{wn}{c}\frac{\psi}{\sigma}MPC$$

so that, for small enough, the MPC out of debt relief is simply

$$MPC = \frac{1}{1 + \frac{wn}{c}\frac{\psi}{\sigma}}$$

This number is constant for D sufficiently small that $T = 1$, explaining the flat part of figure 7. Equation (C.39) shows that the lenght of this flat part, as a function of D, depends on several of our parameter values, chiefly the borrower discount factor ρ relative to the interest rate r.