Cross-region transfers in a monetary union

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This version: 6 November 2014. First draft: August 2013

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Abstract

Transfers to individuals from the federal government vary greatly across states in the US, but are largely absent across countries in the European Monetary Union (EMU). I use exogenous cross-state variation in transfers from recent temporary stimulus packages and from permanent social security increases around 1970 to identify the effect of a federal transfers shock on state economies. I find an extra dollar of temporary transfer boosts labor income in a state by around \$0.2-\$0.5 on impact, while a \$1 permanent transfer boosts labor income by around \$1-1.5 after a quarter. The results are consistent with a multi-region New Keynesian (NK) model where around a third of households consume all their income each period. The NK model suggests demand effects (which are sensitive to home bias) are short-lived, and in the long term neoclassical wealth effects dominate. I use the calibrated model to compare the response of the economy to regional shocks in a US-style fiscal union (which has counter-cyclical cross-region transfers) and an EMU-style system without cross-region transfers. While cross-region transfers in the US-style system can help to smooth shocks, their effects are often modest.

"Some economists...argue that [the] regional insurance scheme provided by the federal government is one of the key reasons why the system of fixed exchange rates within the United States has survived without major problems." Sali-i-Martin & Sachs (1991) p20

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1 Introduction

Transfers to individuals from the federal government vary greatly across states in the US, but are largely absent across countries in the European Monetary Union (EMU). In the US, a $1 decrease in per capita income in a US state/region over time is associated with around a $0.20-0.40 net transfer from the federal government to the residents of that state/region, with the bulk of the adjustment occurring through the tax system (Feyrer and Sacerdote 2013, Sali-i-Martin and Sachs 1991, Bayoumi and Masson 1995). In contrast, the European Commission's budget is only about 1% of EU GDP and so the variation in comparable cross-country transfers within the EMU is negligible, almost by definition. Transfers between the US federal government and individuals represent the majority of US federal spending, the majority of recent stimulus packages (Oh and Reis 2012).[1] The Federal bailout of Texan banks during the Savings and Loans crisis of the late 1980s reached 20% of Texan GDP (see Appendix).

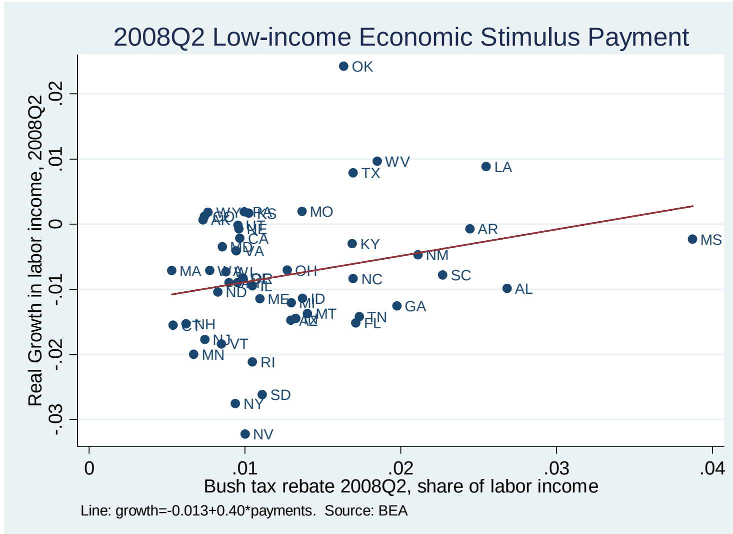
Recent recessions in countries on the European periphery have been severe, perhaps made deeper by the inability of those countries to independently loosen monetary policy and devalue their exchange rates. While the experience of these countries has called into question the viability of the EMU, the US monetary union remains solid. Part of the difference might be due to fiscal policy. The United States has long been seen as an example of risk sharing across states — largely through cross-region transfers — as the opening quotation from Sali-i-Martin and Sachs (1991) more than 20 years ago indicates. But this hypothesis hinges on the effects of cross-region transfers on the regions receiving them.

This paper investigates the effects of cross-region transfers on income in the data (Section 2) and in a New Keynesian (NK) model (Section 3). I use the model to perform counterfactual simulations comparing the US and EMU fiscal systems. In Section 4, I ask whether a recession in a country in the EMU, similar to the one experienced by Spain in 2008-09, would be less severe with cross-region transfers as part of a US-style fiscal union. The different components are connected by the multi-region NK model, which is consistent with the short run cross-sectional effects of transfers on labor income in the data and is used for the analysis of US vs EU fiscal systems. As the model is linear, the *difference* between the response to a shock in the EU and US fiscal systems is the effect of the counter-cyclical cross-region transfer driven by the shock.

Transfers to individuals are typically endogenous to state level income growth (e.g. unemployment benefits). I identify the causal effect of cross-region transfers on state income growth using permanent changes in US social security (aged pension) payments around 1970, and temporary transfers as part of recent stimulus packages.[2] As the policy change is at the aggregate level, the

[1] Transfers between federal and state governments are much smaller. For example in FY2010, transfers to individuals from the federal government (Retirement/Disability Payments and other direct payments) where $1734bn, whereas grants to state and local governments were less than half the size ($680bn). Traditional government spending — salaries and procurement — accounted for about $870bn (Source: CFFR 2010)

[2] Wilcox (1989) and Parker et al (2013) (among others) investigates the effect of these programs on aggregate



Note: I match the slope of the line in the model.

Figure 1: Refundable (low income) Component of the 2008 Economic Stimulus Payment

total size of the transfer cannot be driven by differential state growth rates. The share of the aggregate payment going to each state is based on largely preexisting demographic characteristics of states — such as the number of social security recipients or the number of people in different parts of the income distribution — making the size of the transfer to each state exogenous to contemporaneous state-level income growth. In general, only the aggregate size of the transfer is available from official sources, and so I have to construct the cross-state allocation manually. I focus on the effect of transfers on labor income ($W \times L$) because alternatives like GDP or employment are not available quarterly for states over the whole sample.

An example of a specific temporary transfer is the low-income component of the 2008 Bush Economic stimulus package, which paid out \$300 in 2008Q2 to those who paid no taxes (but had some other income). Figure 1 shows that states which received larger transfers (as a share of labor income) tended to grow faster in the quarter, with a "relative multiplier" (line slope) of about 0.4. These payments were a much larger share of income in poorer states like Mississippi (MS) than richer states like Connecticut (CT). As the *relative* income distribution of Mississippi (MS) and Connecticut (CT) is effectively fixed quarter-to-quarter, it unlikely that differences in growth in labor income could be driving differences in transfers.

To control for other factors which might be correlated with both the transfer and growth in labor income, I estimate a range of regression models which control for state-specific trends (state fixed effects) and aggregate variation (time fixed effects). For robustness, I also pool over a range of similar temporary transfers that were part of the 2001, 2008 and 2009 stimulus packages. The estimated multipliers suggest that an extra dollar of *temporary* transfers to a state boosts

consumption, but no-one (to my knowledge) has examined their effects on incomes at the state level.

contemporaneous labor income in that state by \$0.2-0.5 (*relative* to states that did not receive the extra dollar of transfers).

I estimate the effect of *permanent* cross-region transfers using a similar methodology applied to a range of ad-hoc social security rate increases in late 1960s and early 1970s (partly in compensation for inflation). Typically, monthly benefits would increase *permanently* by 10-20%, and were a much larger share of labor income in states like Florida with more retirees. I find that states which received an extra \$1 in social security payments increased their labor income by around \$1-1.5 after a quarter.

Relative transfer multipliers of this size can be rationalized by a multi-region New Keynesian model (described in Section 3) but are inconsistent with the simplest neoclassical model. In the model, one of the regions is small and represents a state in the US or a country in the EMU, and with the rest of the monetary union combined into another region. Each region produces its own variety of a tradeable good, prices are sticky, and unconstrained households trade a non-contingent bond. In addition to this baseline, the model needs two additional features to be consistent with the data. First, home bias in consumption is needed to localize the effects of demand in the region receiving the transfer. I show analytically that without home bias, the fall in the demand from the region paying for the transfer exactly cancels out the extra demand from the region receiving the transfer, removing any stimulatory effect — even if prices are perfectly sticky. Second, a fraction of the population must consume their income hand-to-mouth to prevent temporary transfers from being saved (I calibrate the fraction to about 1/3). In the model, transfers stimulate demand in the short term, but cross-region transfers can *reduce* output in the long term due to neoclassical wealth effects which reduce labor supply. I also consider an extension with sticky nominal wages, which increases the size and persistence of demand effects.

Would countries in the EMU have had shallower recessions if they were part of a US-style fiscal union with counter-cyclical cross-region transfers?[3] Following Farhi et al (2013), I shock one region of the model economy with a large and persistent increase in borrowing costs that generates a large recession, similar to that experienced in Spain in 2008-09.[4] Under the EU fiscal system (without cross-region transfers), I match the fall in output (peak-to-trough) of 4.96% in the data and a *path* of output similar to that forecast by the IMF in early 2009 (before the European sovereign debt crisis hit in 2010-11). The fall in output and consumption under the US fiscal system is about 10% smaller than under the EU fiscal system, assuming the Spanish government cannot borrow to

[3] In the Appendix, I consider the opposite counterfactual by asking how much worse the Texan recession of the mid-1980s would have been if the residents of Texas had to fund their own bank bailout (as they would have done if they were a country in the EMU). I find Texan GDP would fall by around 2-3 percentage points, and consumption be 3-5 percentage points lower. The gains for Texas from countercyclical transfer are about 5 times larger than for Spain as considered in Section 4, largely because the cross-region transfers are much larger. Moreover, these estimates do not include spillover effects of a banking union to the regional government's risk premium or "financial accelerator" effects.

[4] I modify the calibration slightly to more closely match the facts for Spain such as introducing sticky wages, and increasing the size of the region and its home bias.

offset the shock (for example if it is constrained by EU deficit rules or financial markets). If the Spanish government is able to borrow, the gains under the US fiscal system are about half as large. The relatively small gap in the effectiveness of Spanish-funded and EMU-funded countercyclical fiscal policy is because hand-to-mouth households (who tend to spend temporary transfers) do not respond to future taxes. In other words, the hand-to-mouth households respond identically in the short term to a deficit-financed transfer coming from Madrid (which results in higher future taxes) and a transfers from Brussels (which is mostly paid for by other members of the EMU).

In sum, cross-region transfers do seem to be stimulatory in the US, which can be rationalized by a New Keynesian model where demand effects are strengthened by home bias and hand-to-mouth households. However, the model suggests that demand effects are likely to be short-lived, giving way to wealth effects which reduce output in the long term. While a US-style fiscal system with counter-cyclical cross-regional transfers can help smooth regional business cycles, the gains over a EU-style fiscal system are modest — especially if countries in the EMU are able to self-insure by running budget deficits during recessions. The gains from a "banking union", however, can be sizable because the magnitude of cross-region transfers during a banking crisis can be much larger.

Related Literature Despite the size and policy importance of cross-region transfers, there has been little empirical or theoretical academic research on whether transfers across regions actually stimulate incomes in the regions receiving them (and why that might be). The existing empirical literature has largely focused on whether transfers are *consumed*, rather than whether transfers boost *incomes* as investigated there (eg Parker et al (2013), Johnson et al (2006), Wilcox (1989), Hausman (2013)). Very little of this analysis is at a regional level. Another strand of the empirical literature focuses on the effects of *other* types of government expenditure across states (e.g. Nakamura and Steinsson 2013, Suarez and Wingender 2012, Cohen et al 2012), or the effect of spending by state and local governments (Clemens and Miron 2012, Shoag 2011, Chodorow-Reich et al 2012). Theoretical work on fiscal policy within a monetary union has generally been focused on government purchases rather than transfers (e.g. Gali and Monacelli 2008, Nakamura and Steinsson 2013, Farhi and Werning 2012), though both of the latter papers include a brief discussion of the financing of government purchases. Farhi and Werning (2013) examine optimal cross-region transfers, but are restricted to some special cases for tractability. Other theoretical work on the effect of transfers on incomes has mostly been in closed economy settings (Oh and Ries 2012, Giambattista and Pennings 2014, Mehrota 2013).

2 Empirical Evidence

Estimating the effect of transfers on economic activity is difficult because causality can run in both directions. Even if federal transfers stimulated incomes in the regions receiving them, regions with low levels of growth *for other reasons* might attract higher levels of federal transfers (such as unemployment benefits), biasing the estimates. My identification strategy addresses this problem by studying federal transfers that stem from aggregate policy changes which affect all states, such as temporary federal stimulus packages, and permanent increases in social security payments. As the policy change is at the aggregate level, by definition it cannot be driven by differences in conditions in one state vis-a-vis another.

In order to estimate the cross-region federal transfer multiplier, there needs to be variation in the share of the aggregate transfer received by each state. They key identification assumption is that the allocation of transfers across states is unrelated to contemporaneous income growth in that state. For the policies examined here, the allocation of spending is based on largely *predetermined* state characteristics, such as the number of social security recipients in each state, or the number of people in different parts of the income distribution. Conceptually, the *levels* of these variables will not change much from quarter to quarter, eliminating any reverse causality running growth to transfers. In reality, identification is even stronger because policymakers used lagged information — such as those from the previous year's income tax reports — to allocated transfer across states.

While the identification strategy is well suited to measuring the short-term cross-sectional response of growth to a transfer shock, it is ill-suited to answering other seemingly-related empirical questions. First, it cannot identify the medium-long run effects of a cross-region transfer policy, because there are likely to be other policy changes in the intervening period, making identification difficult. For example, there is only around half a year between the last payments of the 2008 Bush Stimulus, and the first payments of 2009 Obama stimulus — so it is difficult to know which policy would be driving long run movements. Accordingly, I concentrate on the first 3-6 months (up to a one quarter lag) after first payments are made, which means I am more likely to be picking up short-run demand-side effects rather than long-run supply side effects. It also rules out the use of state-level GDP, which are only available at an annual frequency. Second, the empirical approach is cross-sectional by nature, which rules out any identification of the aggregate multiplier.

I focus on two episodes of exogenous increases in transfers to match in the model in the Section 3 — a temporary increase (from the 2008 stimulus package) and a permanent increase (from ad-hoc Social Security increases around 1970). Although I have many other examples of transfers (which are discussed in Section 2.3) these two are some of most robust and well-measured, and are classified as transfers (rather than tax cuts) by the Bureau of Economic Analysis (BEA). To my knowledge, this is the first time the effect of these transfers has been analyzed on state-level economic activity, although many papers have examined the effect of these transfers on consumption as part of tests of the permanent income hypothesis or Ricardian Equivalence (Parker et al 2013 and Wilcox 1989, Romer and Romer 2014 among others). In general, I had to manually construct the cross-state allocation of these transfers using information on eligibility criteria.

I investigate the effect of transfers on the growth rate of real quarterly labor income (equivalent to the wage bill) $\Delta WL_{i,t} \equiv (WL_{i,t} - WL_{i,t-1})/WL_{i,t-1}$.[5] Labor income data come from the Bureau

[5] All variables are deflated by the Quarterly Personal Consumption Expenditures Chain-type Price Index (PCE) from the BEA and St Louis FRED Database.

of Economic Analysis under the official title of “Earnings by place of work” and mostly consist of Wage and Salary Disbursements (70%) but also include non-wage payments by employers that which contribute to labor costs such as employer contributions for pensions and social insurance (12%) and social insurance taxes (5%).[6] The data are available since 1949 quarterly by state, mostly come from high-quality administrative data, and make up 73%-83% of Personal Income before taxes.[7] State-level quarterly seasonally adjusted data are not available for many alternative series such as GDP, consumption or hours worked, with heads-based employment only available since 1990.[8]

Specification and interpretation Variables in the literature are usually defined as a “multiplier” — i.e. \$1 of government spending/transfers is associated with \$$x$ increase in economic output. As I investigate the effect of transfers on the growth rate of labor income, I also scale transfers by lagged of labor income to retain the “multiplier” interpretation of coefficients i.e. $\Delta tr_{i,t} \equiv (tr_{i,t} - tr_{i,t-1})/WL_{i,t-1}$. The scaled transfer variable reflects how important the transfers are to the economy of the particular state. Scaling by other variables, such as disposable personal income, yields similar results.

There are myriad of state-specific factors that could be spuriously correlated with transfers and labor income growth — biasing the results in small samples. For example, the “sun belt” states tend to have higher trend growth than other areas in the US, but they are also initially poorer, making transfers a larger share of personal income in the sunbelt than elsewhere. I control for this in most regressions by including state fixed effects (μ_i) which will capture all state-level trends. Because of the state fixed effects, the regressions themselves can estimated in a parsimonious way with no controls other than (sometimes) a lagged dependent variable and other contemporaneous transfers that are interesting in their own right. I also typically add a quarterly dummy variable γ_t to control for the aggregate business cycle and other aggregate shocks. The estimated equation is:

$$\Delta WL_{i,t} = \sum_{j=0}^{N} \beta_j \Delta tr_{i,t+j} + \delta \Delta WL_{i,t-1} + \gamma_t + \mu_i + e_{it} \tag{1}$$

Finally, care needs to be taken with outliers/influential observations, as economic conditions in many states — particular the smaller states — are quite volatile.[9] I also drop the District of

[6]Earnings by place of work also include partnership and sole trader income (12%) of the total (all figures from 2011).

[7]The BEA gets most of its data on labor income from the BLS’s Quarterly Census of Employment and Wages (CEW) program, which is administrative data collected on 98% of non-farm employees as part of the state’s unemployment insurance programs. Earnings by place of work are 73% of personal income in 2011 and 83% of personal income in 1970 (as the share of transfers in personal income has risen).

[8]There is some evidence that transfers boost GDP, but as state-level GDP is only available annually the identification assumption is strong, standard errors are wide and the estimated coefficients are difficult to rationalize.

[9]I drop observations where the quarterly growth rate of labor income growth is more than 3 SD (or 6 percentage

Columbia from the estimation, given the large number of commuters across state boundaries.

2.1 Temporary Transfers

2.1.1 2008 low-income Economic Stimulus Payments (ESP)

Around $100bn was transferred to households as one-time payments in the 2008Q2-Q3 as part of the Bush administration's Economic Stimulus plan. There were two components of the package, $600 per capita payments made to those paying net taxes (with a phaseout for those earning over $75,000) comprising 2/3 of the total —which I call the *middle-income* component — and $300 per capita payments made to those paying no net taxes but with at least $3000 in eligible income (1/3 of total). I focus on the effects of the second component — which I call the *2008 low-income rebate* — which turns out to drive the results (the package is included in the pooled specification or as a control).[10] The 2008 low-income ESP is better measured than other transfers at the state-level because it counts as a transfer (according to the BEA definition) towards state-level personal income. I use the cross-state allocation from the BEA (2009), which is primarily based on the geographic distribution of recipients of refundable Earned Income Tax Credits (EITCs).[11] According to the BEA's allocation, about 95% of the refundable 2008 low-income ESP were paid out in 2008Q2 (as against 15% of the whole package). This is consistent with a high percentage of recipients receiving their ESP by direct deposit, which is faster than by check. IRS data show that around 80% of those with refundable EITCs filed electronically. Direct deposit payment were made in the first half of May 2008, giving plenty of time for economic activity to be affected in 2008Q2. [12]

points) from the mean in a quarter. This is typically for states for like North/South Dakota, which can be very influential.

[10]According to the BEA (2008) the middle-income component was $50bn (in dollar terms) in 2008Q2. Parker et al (2013) reports $15bn in payouts in 2008Q3 in total, leaving around $14bn once the refundable component has been subtracted. This is allocated across states using IRS data on 2007 Income tax returns (Tax Year 2007: Historical Table 2 (SOI Bulletin) http://www.irs.gov/uac/SOI-Tax-Stats—Historic-Table-2), using eligibility rules for the tax rebate. This involves quite a few assumptions given the aggregated nature of the data. My allocation adds to about $75bn, which is slightly larger than $65bn middle-income component of the package. I allocate the $50bn in 2008Q2 and $14bn in 2008Q2 across states in proportion to their share of $75bn allocation. The results are almost identical when the cross-state allocation is done using IRS Microdata from individual tax returns. Note that the microdata are not necessarily more accurate because around 50% of respondents in the microdata have their state identifier missing.

[11]Refundable EITCs are where the tax credit is larger than the tax due and so the beneficiaries receive a net payment from the federal government. The payouts of the refundable components (in dollar terms) were $28bn in 2008Q2 and $1.35bn in 2008Q3 (BEA 2009). For the allocations see:

BEA (2008): State Personal Income (October 2008) http://www.bea.gov/scb/pdf/2008/10%20October/spi_text.pdf#esabox and

BEA (2009): Regional Quarterly Report (Jan 2009) http://www.bea.gov/scb/pdf/2009/01%20January/0109_regqtrlyreport.p

[12]Eligibility for the 2008 stimulus payment was made based on 2007 income as the level of 2008AY income is not known in 2008Q2. There was a facility the 2008 tax forms (the "Recovery Rebate Credit") for people filing 2008 taxes in 2009 to claim an additional credit if their income had changed and this increased the size of their stimulus payment. http://www.irs.gov/uac/Questions-and-Answers-about-the-Recovery-Rebate-Credit

Figure 1 shows the relation between transfers as a share of labor income on the x-axis, and the growth of labor income on the y-axis. The cross-state variation in transfers is striking: the 2008 low-income ESP ranges from around than 0.5% of quarterly labor income in Connecticut (CT) , to almost 4% of quarterly labor income in Mississippi (MS). Two factors are at play here: first, the level of per capita labor income is much lower in MS than CT and so fixed dollar payments are mechanically more important. Second, as the 2008 low-income ESP only goes to those who pay no net taxes, the payments in dollar-per-capita terms are focused towards the poorer states. Figure 1 shows that states which received larger transfers (as a share of labor income) tended to grow faster contemporaneously, with a "relative multiplier" (line slope) of about 0.4. Note that this is not due to higher *trend* labor income growth in states that received a larger transfer. Figure 8 (in the Appendix) displays a placebo test which has the same x-axis (transfers as a share of labor income), but on the y-axis plots labor income growth in the previous quarter (2008Q1) and shows no relation between prior labor income growth and transfers.[13]

I investigate the effects of the 2008 ESP on labor income using a variety of specifications, but they all suggest a multiplier of 0.2-0.5 that is significant at the 5% level (and often the 1% level). The simplest is a cross-sectional regression of growth in labor income on the change in transfers as share of labor income in 2008Q2, as reported in Table 1 Column A and in Figure 1 (Equation 1 without lags or state fixed effect). Here a 1% of labor income transfer boosts labor earnings by about 0.4% and is significant at the 5% level. In Columns B and C, I run a regression with quarter and state-level fixed effects over 2008 or 2005-09 (respectively) to control for state-level trends. The regression coefficient is around 0.35, and is significant at the 1% level.

In Column D I switch to an instrumental variables (IV) specification, with the my measure of the rebate being the instrument for changes in general (endogenous) BEA transfers. The coefficient is 0.45 and significant at the 1% level. The IV first stage of the regression is strongly significant, with the estimated coefficient of 0.75 (se=0.08) on the 2008 low-income rebate (not reported).

These estimates are broadly consistent with other evidence on the 2008 ESP. Parker et al (2013) exploited randomization in the timing that checks were sent out to find that (for the whole package) about 12-30% was spend on non-durables in the months they were received, or 50-90% including durables. Hence, both estimates are suggestive of a fast and sizable response of economic activity to the ESP. One might be concerned that many of the non-durables purchases would be tradeable, disconnecting the state receiving the transfer from the state benefiting from higher goods demand. However as Burstein et al (2005) point out, the distribution margin on traded goods is around 50% and so sales of traded non-durables can still stimulate local demand.

[13] As the package was enacted in February 2008, the placebo test (combined with Figure 1) suggests the package had an effect on implementation rather than announcement.

Table 1: The effect of temporary transfers on labor income

Dep variable:	Growth in Labor Income					
	(A) OLS	(B) OLS	(C) OLS	(D) IV^	(E) OLS	(F) OLS
Sample	2008Q2	2008	2005-09	2008	2001-09	2001-09
Temporary Transfer measure	2008 Low income rebate			BEA Transfers	Pooled transfers	
(t)	0.40**	0.33***	0.38***	0.45***	0.20**	0.29**
	(0.17)	(0.10)	(0.14)	(0.13)	(0.09)	(0.12)
(t-1)			0.17			0.10
			(0.19)			(0.15)
(t-2)			0.30			0.33*
			(0.23)			(0.18)
(t-3)			0.23			0.27
			(0.24)			(0.17)
Controls						
2008 Middle Income refund (t)		-0.13	-0.06	-0.15		
		(0.30)	(0.43)	(0.27)		
			(extra 3 lags insig)			
Dependant Vble (t-1)			-0.01			-0.04
			(0.05)			(0.03)
Quarter FE		Y	Y	Y	Y	Y
State FE		Y	Y	Y	Y	Y
Obs	50	198	990	198	1,795	1,790

Notes: Robust Std Errors in Brackets. ***,** and * reflect significance at the 1% 5% and 10% levels. Transfer variables are defined as (tr(t)-tr(t-1))/WL(t-1) All Variables are real (deflationed by PCE). Outliers dropped (quarterly growth rate more than 3sd/6% above/below mean). ^First stage IV coefficent on 2008 Low income rebate 0.75 (se=0.08)

2.1.2 Pooled Temporary Transfers

In this section I examine the *general* effect of temporary transfers on labor income by pooling across transfers from 2001 and 2009 stimulus packages, in addition to 2008 ESP discussed above. None of these packages included permanent transfers.

In 2001Q3, the Bush administration transferred $38bn to households in a one-off payment. Individuals paying net taxes mostly received $300 per capita, though unlike the 2008 stimulus there was no payment for those with no tax liability, and no phaseout for those on high incomes. I allocate the transfers across states using IRS state-level data on individual tax returns for the 2000 tax year.[14] Exploiting randomization of payment dates, Johnson et al (2006) found that 20-40% of the payment was spend on non-durables in the months that it was received, with higher MPC for the poor and credit constrained, and no response of durables.

The 2009 American Recovery and Reinvestment Act included a $250 once-off payment to social security recipients (total payments of about $13bn in 2009Q2) and a $400 refundable "Making Work Pay" (MWP) tax credit for 2009 and 2010 (with a phase-out for those on high incomes). For those paying net taxes, the MWP tax credit was implemented through lower withholding rates, which took effect (mostly) in 2009Q2 and lasted until the end of 2010, resulting in lower taxes by

[14] The source is the same as the for the 2008 ESP. My cross-state allocation adds to around $45bn, which is slightly larger than the $38bn of payouts according to official data. The final estimate is each state's share × $38bn.

around \$40bn per tax year (\$13bn per quarter in 2009Q2-Q4 and \$10bn per quarter in 2010).[15] The refundable component (for those not paying taxes) was claimed back via tax refunds in the following year, and due to this delay between eligibility and payment is dropped from the analysis (this has little effect on the results). I allocate the \$250 payments across states using data on the number of beneficiaries from the Social Security Administration, and I allocate the MWP tax cuts across states using state-level tax statistics from the IRS.[16]

Column E and F of Table 1 show that a *general* \$1 temporary transfer increases labor income by about \$0.2-0.3 contemporaneously with no lags (Column E) or 3 lags (Column F). There is also some evidence of a lagged effect after two quarters (Column F), though it is not very robust. The effects of individual policies are generally not robust to changes in specification (such as the number of lags, of the type fixed effects) and are not presented here.[17]

2.2 Permanent Transfers — ad-hoc increases in social security payments

Between 1965-1974 social security payments (largely the old age pension) were increased by act of Congress on an ad-hoc basis (Wilcox 1989). The increases were typically large and varied in size and timing — for example, a 10% increase in June 1971, a 20% increase in October 1972 and no increase in 1973 (full list of adjustments in Table 1 of Wilcox 1989). From 1975 onwards, social security payments were indexed to the CPI and were adjusted annually.[18] The variation in size and timing means that payments before 1975 would not be subsumed into seasonal patterns in the data. Unlike the transfers in the previous section, these were *permanent* increases in the monthly stipend received by the elderly and their dependents, and so are more likely to be spent even by unconstrained optimizing consumers (unless they anticipated higher future taxes).

The focus of my analysis is the effect of *cross-state* variation in these transfers on *cross-state*

[15] The time series of the transfer is much like a small semi-permanent transfer in 2009Q2 lasting until the end of the 2010 tax year.

[16] Data on the number of OASDI recipients is taken from www.ssa.gov/policy/docs/statcomps/oasdi_sc/2008/ and number of SSI beneficiaries from http://www.socialsecurity.gov/policy/docs/statcomps/ssi_asr/2008 removing double counting. The MWP tax cut component is allocated using the same 2007 state-level tax data as the 2008 ESP, though with adjustments for the difference between policies. My cross-state allocation adds to about \$50bn, which is slightly larger than the \$40bn official aggregate figure. The quarterly figure is each state's share × \$13bn (for 2009Q2-Q4). I ignore the small fall in withholding rates in 2010Q1, and the small effect at the end of 2009Q1 (which was less than \$1bn).

[17] In other results (not reported), I regress the growth rate of total non-farm employment (from Current Employment Statistics program http://www.bls.gov/sae/) on pooled temporary transfers. Although there is some evidence that a 1% of labor income transfer tends to increase employment (head count) by 0.1% after two quarters, this not very robust across specifications/estimation methods. Given the frictions/adjustment costs in hiring, one might expect to see the effect of temporary transfers in hours rather than heads-based employment. Unfortunately, the BLS does not release seasonally adjusted hours per worker so this hypothesis is difficult to test.

[18] From 1975-1982 the annual adjustment was on 1 July and from 1984 onwards it was from 1 January. Romer and Romer (2014) argue that changes in inflation over 1975-91 (as well as the July-to-January timing switch) lead to sufficient random volatility in social security increases over 1975-91. I take a more conservative approach and exclude adjustments during this period because they are much easier to anticipate that ad-hoc legislation by Congress.

variation in labor income growth (time dummies remove all aggregate-level variation). In contrast, Wilcox (1989) and, more recently Romer and Romer (2014) examine the effect of social security increase of *aggregate* US variables. Romer and Romer extend Wilcox's sample of ad-hoc SS increases back to 1952. The benefit increases 1965-74 were almost three times larger on average than those from 1952-64 so I discuss the 1965-74 Wilcox (1989) sample first before extending the analysis to the 1952-64 from Romer and Romer (2014) in Section 2.2.2.

2.2.1 Ad-hoc social security increases over 1965-74 (Wilcox 1989 sample)

In order to generate a state-level series of social-security increases by state, I need (i) the dollar size of payouts (in addition to their % increase reported in Wilcox 1989) and (ii) their cross-state variation. I downloaded data from the Social Security Administration (SSA) on number of beneficiaries and average monthly payment for Old-Age and Survivor's Insurance (OASI) and Disability Insurance (DI).[19] I spread the adjustments over two quarters if the increase in payments occurred mid-quarter.[20] I allocate the increases across states in proportion to each state's share of total social security benefits at the end of the previous year using hand-entered data from Social Security Bulletins in the 1960s and 1970s.[21]

The mean quarterly increase in payments (among those quarters with increases) is modest, about 0.4% of state quarterly labor income, though this masks very large differences across states. The largest quarterly increases were in 1972Q4 (a 20% increase in benefits) of around 1.7% of quarterly labor income in West Virginia, Arkansas and Florida, in contrast with an increase of 0.2% in Alaska in the same quarter. Figure 9 (in the Appendix) plots the size of the increase in transfers (as share of labor income) for each state in 1972Q4 on y-axis against the increase in 1970Q2 (a 15% increase) on the x-axis. The points almost form a straight line, indicating the size of the transfer in 1970Q2 for each state is proportional to the size of the increase in 1972Q4. This is consistent with the transfers being largely exogenous — the distribution of transfers across states doesn't change much year-to-year because they are driven by largely predetermined demographic state characteristics.[22]

[19]Data Source: http://www.ssa.gov/cgi-bin/currentpay.cgi This category is broader than the "OASI Benefits in Current Payment Status" series used by Wilcox (1989) because it includes disability insurance beneficiaries. However, DI benefits increased generally concurrently with OASI and so excluding them would bias up estimates of the multiplier. The dates of payment increases reported on the ssa.gov vary slightly from those reported by Wilcox (1989) — for example a 15.7% increase in February 1968 for OASI (15.4% including DI), as against 15% increase in March 1968 reported in Wilcox (1989) . The lead is one month for four of the 1968-74 increases, with 3m and 2m delays in 1971 and 1972 respectively. I go with Wilcox (1989)'s dates and percentage increases. Romer and Romer (2014) also report that in social security publications, if a benefit change is effective for a given month, it is reflected in the checks received early the following month (which explains much of the discrepancy).

[20]eg A $1 increase starting on 1 June will become a $0.33 increase in Q2 and a $0.66 increase in Q3.

[21]These data are taken from Annual Statistical Supplement of the Social Security Bulletin 1964 (Table 97), 1967 (Table 120), 1969 (Table 124), 1970 (Table 122), 1971 (Table 127), 1973 (Table 115), for Total (OASI +DI) benefits for those in current status.

[22]In other words, the size of increase in 1972Q4 can be closely approximated by the cross-state allocation of transfers in 1970Q2 and the relative aggregate size of transfer increases in 1970Q2 and 1970Q4. The slope of the

The first 3 columns of Table 2 analyze the effect of the social security increases listed in Wilcox (1989) over 1965-74, and show that on average a $1 permanent increase in transfers leads to about a $1-1.5 increase in labor income, with a lag of around a quarter (perhaps due to implementation delays). Column A shows my preferred specification, with quarterly and state-level fixed effects, and a lagged dependent variable as controls. The estimate of 1.1 suggests that a $1 increase in transfers boosts labor income by about $1.1 after a quarter (and is significant at the 5% level). An alternative specification is in Column (B), which restricts the sample to years with social security changes (and drops 1965 due to some implementation difficulties in that year), but finds a very similar estimate of 1.32 after a quarter.[23] Column C uses the full 1965-74 sample, but adds additional lags at t-1 and t-2. The estimated coefficient on the first lag is very similar to before. While the later lags are positive and significant, the identification assumptions are stronger with longer lags and so I don't place much weight on those estimates.[24]

2.2.2 Ad-hoc social security increases over 1952-74 (Romer and Romer 2014 sample)

Romer and Romer's (2014) sample of aggregate social security increases is (unsurprisingly) very similar to that of Wilcox (1989) over the common period. However, there are some differences: (i) Romer and Romer (2014) include temporary SS payments (three payments over 1965-74), and (ii) they extended the period of ad-hoc adjustments to 1952-64. As for the analysis for the Wilcox (1989) sample, I construct the cross-state allocation of payments using hand-entered data from the Social Security Bulletin from the previous year (1952-1990).

The final three Columns of Table 2 analyze the effect of permanent social security increases using the sample of Romer and Romer's (2014) ad hoc adjustments. In column D, I estimate over the 1965-74 sample and (unsurprisingly) get a similar coefficient on lagged permanent transfers as using Wilcox's sample (Column A). The main addition, temporary SS increases, are always insignificant and imprecisely estimated — I fail to reject the hypothesis that the contemporaneous temporary transfer multiplier is 0.2-0.5 as estimated in Section 2.1. In Column E I extend the sample to include the small social security increases over 1952-64, which increases size of the coefficient on lagged transfers slightly, but also leads to a marginally significant contemporaneous effect. In Column F, I add two extra lags of permanent increase, and get very similar results as

line is 1.6 (rather than 1.33) because social security payments increased faster than labor income in the intervening years.

[23]The sample here is 1968,1970-1973Q1 (to allow for a lag) and 1974. Table M5 of the July 1966 Social Security Bulletin states "The decline in the number and amount of monthly benefits in August and the resulting increase in September can be attributed to temporary modifications of the usual administrative procedures during the conversion of benefits from existing rates to new rates provided by the Social Security Amendments of 1965".

[24]An alternative specification (not reported) is to instrument all transfer increases with the exogenous social security increases here. If I do this for the full sample (1965-74), the first lag estimate is the same size as in Table 2, but the standard errors are more than twice as large (and so the coefficient is insignificant). If I use year dummies (rather than quarter dummies), both OLS and IV estimates have a significant coefficients of about 0.7 (contemporaneous) and 1 (first lag) which yields a similar cumulative increase over the first two quarters.

Table 2: The effect of permanent SS transfers on labor income

Dep variable:	Growth in Labor Income					
	(A)	(B)	(C)	(D)	(E)	(F)
Years	1965-74	1968-74 ΔSS yr	1965-74	1965-74	1952-74	1965-74
Source SS Narrative		Wilcox (1989)			Romer and Romer (2014)	
Permanent (t)	-0.30	-0.12	0.11	-0.33	1.15*	0.08
transfer	(0.55)	(0.65)	(0.56)	(0.62)	(0.63)	(0.63)
(t-1)	1.10**	1.32**	1.39***	1.35**	1.61***	1.43**
	(0.51)	(0.61)	(0.52)	(0.60)	(0.58)	(0.61)
(t-2)			1.52**			1.71**
			(0.72)			(0.81)
(t-3)			1.15**			0.94*
			(0.48)			(0.56)
Controls						
Tempory Transfer				-0.24	-0.33	-0.04
increases (t)				(0.58)	(0.58)	(0.60)
(t-1)				0.33	0.05	0.70
				(0.74)	(0.74)	(0.78)
Dependant Vble (t-1)	0.01	-0.07	0.02***	0.01	0.07***	0.01
	(0.03)	(0.05)	(0.00)	(0.03)	(0.02)	(0.03)
Quarter FE	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Obs	1,960	1,020	1,960	1,960	4,465	1,960

Notes: Robust Std Errors in Brackets. ***,** and * reflect significance at the 1% 5% and 10% levels. Transfer variables are defined as (tr(t)-tr(t-1))/WL(t-1) All Variables are real (deflationed by PCE). Outliers dropped (quarterly growth rate more than 3sd/6% above/below mean).

with the Wilcox sample (Column C).[25]

These estimates are broadly consistent with the other evidence on the effects of social security increases. Wilcox (1989) finds that each $1 increase in social security payments leads to more than a $2 increase in aggregate retail sales over the following two months, with around 2/3 of the increase concentrated in durables (particularly autos).[26] Romer and Romer (2014) also find 1% of personal income increase in permanent social security payments increases consumption by 1.2% contemporaneously, an effect which lasts 5 months (with stronger results using the 1952-74 sample). They also find a positive (though insignificant) effect on industrial production, no effect on employment and a sizable increase in the Fed Funds rate — which they argue drives the mixed results on industrial production and employment. These findings are entirely consistent with estimated cross-sectional effect in Table 2 — the monetary policy response dampens employment/IP

[25] Permanent transfers are insignificant using the 1952-1991 sample, which is consistent with transfers have a smaller effect after annual indexation in 1975.

[26] As (i) retail sales cover only 60% of consumption in 1970, (ii) the estimated response is 50% larger in the pre-1975 sample I use, and (iii) consumption could increase after the two month window examined by Wilcox (1989), it is likely that the total consumption response could be even larger.

increase for all states, but still allows states receiving larger (smaller) transfers to have above (below) average labor income growth.[27]

3 Model and Mechanisms

To explain the empirical results and perform counter-factual simulations, I examine transfers in a multi-region New Keynesian model of a monetary union. Section 3.1 describes the model and calibration, Section 3.2 describes the drivers of the transfer multiplier in a simplified model, and Section 3.3 compares the full model to data and presents impulse responses.

3.1 Model Description

Consider a monetary union with N regions, each with a fraction $n = 1/N$ of the population. Region A is one of these regions with a fraction n of the total population, and represents a state within the US or a country within the European Monetary Union (EMU). Region B represents the aggregate of the rest of US or EMU, which are assumed identical (size $1-n$). Each region produces their own variety of good, named h (produced by region A) or f (produced by region B). Both goods are perfectly traded and are imperfect substitutes, with constant elasticity of substitution θ_T. The relative price of the two goods (the terms of trade) is $s_t = P_{f,t}/P_{h,t}$, and $P_{f,t}$ and $P_{h,t}$ are sticky in the Calvo sense. Good h has a weight of α in the utility function of region A's consumer, with home bias if $\alpha > n$.[28] In the full model, a fraction ω of households consume their income hand-to-mouth, with the remaining $1 - \omega$ fraction being unconstrained and are able to trade a non-contingent bond. In the simple model discussed in Section 3.2, I set $\omega = 0$ so there are only optimizing households. I solve the model by log-linearizing around the non-stochastic steady state using Dynare, where variables with a hat $\hat{x}$ reflect log-deviations from steady-state values (except for transfers, which are expressed as share-of-GDP deviation from steady state values).

3.1.1 Unconstrained Household's Problem (Region A) (share $1 - \omega_A$)

The unconstrained household in region A chooses aggregate consumption ($c^{un}_{A,t}$), labor supply ($L^{un}_{A,t}$) and real bond holdings ($b_{A,t}$) (all defined in per capita terms) to maximize utility:

[27] As suggested by theory, there is some evidence of a larger effect of transfers in states that were more closed (as proxied by land area). I was unable to test for a larger effect in states with a higher share of credit constrained households due to (i) missing state identifiers in the Survey of Consumer Finance dataset and (ii) missing checking account data (entirely) for 30% of states in the Consumer Expenditure Survey. I find no evidence of differential effects in states with unemployment above their state-specific average. Controlling for state-specific sensitives to US GDP growth (adding 50 state dummy X GDP growth interaction terms) does not affect the results.

[28] When $s_t = 1$, region A consumes a share α of their own variety. An alternative assumption (which yields very similar results) is that there is no home bias, but a non-traded goods sector with perfectly mobile labor across sectors.

$$max_{\{c^{un}_{A,t}, B^{un}_{A,t}, L^{un}_{A,t}\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{c^{un\,1-\sigma}_{A,t}}{1-\sigma} - \frac{L^{un\,\eta}_{A,t}}{\eta} \right])$$

subject to the budget constraint (written in nominal terms):

.

$$P^C_{A,t} c^{un}_{A,t} = P_{H,t} b^{un}_{A,t} - R_{t-1} P_{H,t-1} b^{un}_{A,t-1} + (1-\tau_A) W_{A,t} L^{un}_{A,t} + P_{H,t,} \frac{1}{1-\omega_A} ((1-\tau_A)\Pi_{A,t} + Tr^{un}_{A,t})$$

The unconstrained households receives net transfers from the national government ($T^{un}_{A,t}$), receives profits from firms ($\Pi_{A,t}$) and receives labor income $W_{A,t} L^{un}_{A,t}$. In the model in Section 4, the household pays taxes on labor income and profits at rate τ_A (allowing net transfers to respond to output), but in this section they are set to zero.[29] The problem of the unconstrained HH in region B is analogous.

3.1.2 Hand-to-mouth Household's Problem (Region A) (share ω_A)

The hand-to-mouth household's problem in region A is very similar to the unconstrained household's problem, except that household consumes its whole income hand-to-mouth. Although I don't take a stand on the reason the household behaves this way, for ease of exposition I label the household CC for "credit constrained". Intratemporally, the household chooses aggregate consumption ($c^{cc}_{A,t}$) and labor supply ($L^{cc}_{A,t}$) to maximize utility:

$$max_{\{c^{cc}_{A,t,}, L^{cc}_{A,t}\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{c^{cc\,1-\sigma}_{A,t}}{1-\sigma} - \frac{L^{cc\,\eta}_{A,t}}{\eta} \right])$$

subject to the budget constraint (written in nominal terms)

.

$$P^C_{A,t} c^{cc}_{A,t} = (1-\tau_A) W_{A,t} L^{cc}_{A,t} + \frac{1}{\omega_A} P_{h,t,} Tr^{cc}_{A,t}$$

The constrained households consumes its entire income which consists of net transfers from the national government, $T^{cc}_{A,t}$ and after tax labor income $(1-\tau_A) W_{A,t} L^{cc}_{A,t}$ ($\tau_A = 0$ here but are positive in Section 4). The problem of the credit constrained HH in region B is analogous.

[29] The unconstrained household owns the retailers. Steady state profits as are share of GDP are $(X_{ss}-1)/X_{ss} = 0.0476$ (where $X_{ss} = 1.05$, the steady state markup). All variables are defined in per capita term for the unconstrained HH, except profits $\Pi_{A,t}$and transfers $T^{un}_{A,t}$ which are defined as a share of region A GDP. There is a small steady-state transfer from the unconstrained household to the constrained household of $\omega_A \Pi_A$ to make sure that per capita income of the two households is identical.

3.1.3 Goods demand and the aggregate resource constraint

Aggregate consumption by household in Region A ($c^{un}_{A,t}$ and $c^{cc}_{A,t}$) is a constant elasticity of substitution (CES) index of varieties h and f produced by regions A and B respectively.

$$c^i_{A,t} = \left[\alpha^{1/\theta_T} c_{A,h,i,t}^{\frac{\theta_T - 1}{\theta_T}} + (1-\alpha)^{1/\theta_T} c_{A,f,i,t}^{\frac{\theta_T - 1}{\theta_T}}\right]^{\frac{\theta_T}{\theta_T - 1}} \qquad i = un, cc$$

This results in the following standard demand equations for $c_{A,h,i,t}$ and $c_{A,f,i,t}$ and the consumer price index.[30]

$$c^h_{A,i,t} = \alpha \left[\frac{P_{h,t}}{P^C_{A,t}}\right]^{-\theta_T} c_{A,i,t} \qquad i = cc, un \tag{2}$$

$$c^f_{A,i,t} = (1-\alpha) \left[\frac{P_{f,t}}{P^C_{A,t}}\right]^{-\theta_T} c_{A,i,t}$$

$$P^C_{A,t} = \left[\alpha P_{h,t}^{1-\theta_T} + (1-\alpha) P_{f,t}^{1-\theta_T}\right]^{1/(1-\theta_T)}$$

Output of good h is consumed at home or abroad (an analogous condition for f). $g_{h,t}$ is a government purchases. This can be either self-funded by increases in lump sum taxation on the household in region A, or funded by per-capita lump-sum taxation across the whole monetary union, though unless otherwise stated I set $g_{h,t} = 0$. The aggregate resource constraint, adjusting for different population sizes, is:

$$Y_{h,t} = \left[\omega_A c^h_{A,cc,t} + (1-\omega_A) c^h_{A,un,t}\right] + \frac{(1-n)}{n}\left[\omega_B c^h_{B,cc,t} + (1-\omega_B) c^h_{B,un,t}\right] + g_{h,t}$$

3.1.4 Production and Price Setting

Labor of the two households is perfectly substitutes, which means nominal wage rates will be equalized $W_{h,cc,t} = W_{h,un,t}$ and total labor supply is a populated-weighted sum of the output of the two varieties (Equation 3).

$$L_{h,t} = \omega_A L_{h,cc,t} + (1-\omega_A) L_{h,un,t} \tag{3}$$

As is standard in New Keynesian models (eg Gali and Monacelli 2005, 2008), final output in each region is produced by a unit continuum of monopolistically competitive firms in each region $Y_{h,t} = \left(\int_0^1 Y_{h,i,t}^{\frac{\sigma_X - 1}{\sigma_X}} \, di\right)^{\frac{\sigma_X}{\sigma_X - 1}}$. Each firm uses labor as their only input such that for each firm

[30] Log linearizing, the consumption demands can be expressed in terms log terms of trade $\hat{s}_t = \hat{p}_{f,t} - \hat{p}_{h,t}$ yields $\hat{c}_{A,h,i,t} = \hat{c}_{A,i,t} + \theta_T(1-\alpha)\hat{s}_t$ and $\hat{c}_{A,f,i,t} = \hat{c}_{A,i,t} - \theta_T \alpha \hat{s}_t$. Note $\gamma = 1 - n(1-\alpha)/(1-n)$ is the weight on f goods in Region B's utility function which sets per capital income equal in steady state across countries with $S_{ss} = 1$.

$Y_{h,i,t} = L_{A,h,i,t}$ and $L_{h,t} = \int_0^1 L_{A,h,i,t}.di$. As the marginal product of labor is unity, (i) aggregate real marginal cost is the real product wage $MC_{h,t} = w_{h,t} = W_{h,t}/P_{h,t}$ and (ii) the markup is the inverse of the real product wage $X_t = 1/w_{h,i,t}$. Taking the log-linear approximation around the steady state: $\hat{mc}_{h,t} = \hat{w}_{h,t} = -\hat{X}_t$ and $\hat{Y}_{h,t} = \hat{L}_{h,t}$.[31]

Firms face a downward-sloping demand curve for their variety, and must choose a nominal price, taking into consideration the Calvo probability θ_p that they may not be able to change their price each quarter in the future. As shown in Gali and Monacelli (2005,2008) and elsewhere, this price setting problem leads to a standard New Keynesian Philips curve (Equation 4), where $\hat{\pi}_{h,t} = lnP_{h,t} - lnP_{h,t-1}$ is price inflation.

$$\hat{\pi}_{h,t} = \beta E_t \hat{\pi}_{h,t+1} + \kappa \hat{mc}_{h,t} \tag{4}$$

An increase in demand has two effects. First, firms that are unable to adjust their prices have to provide higher levels of output at the same price, which involves hiring more labor at higher wages rates (higher MC). As the final price is fixed, this results in a fall in the firm's markup. Second, other firms who can increase their prices do so. In sum an increase in demand results in both higher MC (higher real product wages) and higher price inflation. The parameter $\kappa = (1-\theta_p)(1-\beta\theta_p)/\theta_p$ is the "slope" of the Phillips curve — the higher κ, the more responsive inflation (and less responsive output) is to a given shift in demand. With more sticky prices (higher θ_p, lower κ) most firms are unable to change their prices to move markups towards the desired level. With flexible prices ($\kappa \to \infty$), markups, real product wages and markups are constant $\hat{X}_{h,t} = \hat{mc}_{h,t} = \hat{w}_{h,t} = 0$.

3.1.5 Monetary Policy

The central bank of the monetary union follows a Taylor Rule, where $\hat{R}_t = lnR_t - lnR$ is the log deviation of the nominal interest rate from its steady state level. With a mandate for the whole union, it responds to union-wide average inflation $\hat{\pi}_{AGG,t} = n\hat{\pi}_{h,t} + (1-n)\hat{\pi}_{f,t}$ (As per capita incomes are identical, n and $1-n$ are population, GDP and consumption weights).

$$\hat{R}_t = \phi_\pi \hat{\pi}_t^{AGG}$$

As the nominal interest rate is fixed across regions, it is natural to draw parallels between Zero Lower Bound in a closed economy (which increases fiscal multipliers), and fiscal policy in a small region of a monetary union. However, they are very different, because in the monetary union model the lagged terms of trade is an *endogenous state variable* (Equation 5) whereas the simple new Keynesian model considered by Christiano et al (2011) and Giambattista and Pennings (2013) has no endogenous state variables. Inflation in the closed-economy New Keynesian model when the ZLB binds pushes down the real interest rate, increasing consumption demand, generating more

[31] The steady state markup is the $X = \sigma_X/(\sigma_X - 1)$. Firms are identical apart from their ability to re-optimize prices each period. Deviations from these aggregates are second-order.

inflation. Regional inflation also reduces real interest rates and boosts consumption in the open economy model, but it has a second effect: it reduces $\hat{s}_t$ (the terms of trade) which makes region A's products more expensive and encourages expenditure switching towards Region B's products. Farhi and Werning (2012) show that if government spending in a small region of the monetary union is combined with a once-off devaluation such that the path of $\hat{\pi}_{h,t}$ is identical in the small region and in a closed economy model, the multipliers in the closed economy and open economy models are identical. Nakamura and Steinsson (2013) show that because relative price changes are only temporary (in response to a temporary fiscal shock), long term real rates don't change, limiting the boost to consumption from regional spending.

$$\hat{s}_t = \hat{\pi}_{f,t} - \hat{\pi}_{h,t} + \hat{s}_{t-1} \tag{5}$$

3.1.6 Extension: Sticky Wages

As an extension to the baseline model, I add sticky nominal wages. Sticky wages prevent large jumps in the nominal wage rate which are not seen in the data. Moreover, they also increase the response of output to a transfers shock. I model wage stickiness as in Erceg, Henderson, and Levin (2000) and Galí (2008). The production function is the same ($Y_{h,i,t} = L_{h,i,t}$ for firm i), but $L_{h,i,t}$ is now a CES composites differentiated labor inputs (indexed by j):

$L_{h,i,t} = [\int_0^1 L_{h,i,t}(j)^{1-\frac{1}{\epsilon_w}} dj]^{\frac{\epsilon_w}{\epsilon_w - 1}}$ where $j \in [0, \omega)$ represent the hand-to-mouth household, and $j \in [\omega, 1]$ represent unconstrained households.

The wage index are defined as follows:

$W_{h,t} = [\int_0^1 W_{h,t}(j)^{1-\epsilon_w} dj]^{\frac{1}{1-\epsilon_w}}$.

As the labor income of the constrained and unconstrained households is perfect substitutes, there is only one sticky nominal wage for both types. As such, one can think of the different types of households selling their labor to a union who acts in their interests but treats all members identically, that is $\hat{L}_{un,h,t} = \hat{L}_{cc,h,t}$. As with Calvo pricing, each member of the union can reset its nominal wage with constant probability $1 - \theta_w$ in each period. Since households posses market power in their labor supply decisions, they are able to set their wage at a markup above their marginal rate of substitution. Given the wage-setting decisions by households that do re-optimize, and the fact that households that do not re-optimize must keep their nominal wages at last period's value, there is an analogue of a Phillips curve for each type of household. In particular, nominal wage inflation for each household $\hat{\pi}^w_{h,t} = logW_{h,t} - logW_{h,t-1}$ will be a function of expected wage inflation tomorrow and the deviations of each type of household's marginal rate of substitution from their steady state level.

$$\hat{\pi}^w_{h,t} = \beta \mathbb{E}_t \hat{\pi}^w_{h,t+1} - \lambda(\omega \hat{\mu}^w_{cc,t} + (1-\omega)\hat{\mu}^w_{un,t})$$

$$\hat{\mu}^w_{i,t} = \hat{w}_{i,t} - (\eta - 1)\hat{L}_{i,t} - \sigma\hat{c}_{i,t} - (1-\alpha)\hat{s}_t, \quad i = cc, un$$

where $\lambda = \frac{(1-\theta_w)(1-\theta_w\beta)}{\theta_w(1+(\eta-1)\varepsilon_w)}$, and $\hat{w}_{h,t} = \hat{w}_{h,t-1} + \hat{\pi}^w_{h,t} - \hat{\pi}_{h,t}$ is the real product wage. The set up in the region B is analogous.

3.1.7 Fiscal Policy

Fiscal policy in Section 3 consists of balanced-budget exogenous lump-sum transfers from the unconstrained household in region B to both households in region A in proportion to their population shares (that is, the hand-to-mouth household receives a fraction ω of transfers) . Transfers are expressed as a share of GDP in Region A, and follow a first order autoregressive process with persistence ρ. In Section 4 and 5 transfers can be endogenous (for example proportional to output), and the government can run a budget deficit — see these sections for a more detailed discussion.

3.1.8 Solution method

I log-linearize around a zero-debt symmetric non-stochastic steady state with equal per capita income (with $s_t = 1$). Typically, this type of model will exhibit hysteresis because changes in debt across households in the two regions will be permanent. To ensure stationary, I add a small debt-elastic interest spread as in Schmitt-Grohe and Uribe (2005), which slowly moves the model back to steady state.

3.1.9 Calibration

In Section 3.2 and 3.3 I perform numerical simulations which depend on particular parameters. Most of the parameters such as risk aversion, price stickiness and the CES H-F elasticity come from Nakamura and Steinsson (2013) who have a similar multi-region model and examine a related question (see Table 3). I discuss some important parameters below. The baseline parameters are used in most of the paper, though I change the calibration slightly to match the recession in Spain 2008-09 discussed in Section 4.

I choose a lower levels of home bias ($\alpha = 0.56$) than Nakamura and Steinsson (2013) ($\alpha = 0.7$), as I calibrate to a US state ($n = 0.02$) rather than a region ($n = 0.1$). Purchases of the home variety can be thought to represent non-traded services, which according to Nakamura and Steinsson (2013) are 70% of GDP of which 80% are non-traded. Midrigan and Philippon (2011) calibrate $\alpha = 0.75$ for non-durable goods. As the effect of cross-region transfers increase with home bias, my calibration can be viewed as conservative.[32]

[32] I choose the same Frisch elasticity of labor supply as estimated in Smets and Wouters (2007), and close to the average of the values use Bernanke *et al* (1999) and Christiano *et al* (2005). It is also in the middle of the range of a number of macro studies (2.8) and micro studies (0.8) surveyed by Chetty et al (2011), but it slightly higher than the value of unity used by Nakamura and Steinsson (2013). Lower Frisch elasticities tend to increase the labor

Table 3: Parameters

	Value	Source/Target
CC HH share ω_A	0.35	SCF 2010 (<\$1000 in liquid assets)*
Home Bias (α)	0.56 (Baseline) 0.7 (Spain) 0.7 (Texas)	Services 70% GDP; 80% are Non-tradeable (1-exports/GDP) Spain 2011** Nakamura & Steinsson (2013) (US region)
Country Size - small region (n)	0.02 (Baseline) 0.1 (Spain) 0.065 (Texas)	Average Size of US State Spain GDP/Euro Area GDP (2011)*** Texas GDP/US GDP (1987) (BEA)
Frisch Labor Elasticity ($\nu = \frac{1}{\eta-1}$)	2	Smets and Wouters (2007)
Debt-elastic interest spread (ψ)	0.00005	Schmitt-Grohe and Uribe (2003)^
Calvo prob not change wage (θ_w)	0.75 (US)	Barattieri et al (2010)/Christiano et. al. (2005)
	0.90 (Spain)	Du Caju et al (2008)^^
CES Labor (Sticky Wages) (ε_w)	21	Christiano et al (2005)
Tax rate (τ)	0 (Baseline)	Lump-sum taxes only
	0.3 (Spain)	Total Tax to GDP (Eurostat, 2009)
Risk Aversion (σ)	1	Nakamura & Steinsson (2013)
Calvo prob not change price (θ_p)	0.75	Nakamura & Steinsson (2013)
Discount rate (β)	0.99	Nakamura & Steinsson (2013)
CES H-F Elasticity (θ_T)	2	Nakamura & Steinsson (2013)

* Liquid assets: average of two measures: checking accounts (40%) and transactions accounts (29%). ** Source: World Bank World Development Indicators *** Source: OECD ^Annual figure of 0.00074/16 to convert to quarterly figure. ^^Spanish wage contracts last 2.5yrs on average.

The other key parameter in the model is the share of credit constrained households, ω. I assume that households are credit constrained if they have less than \$1000 in liquid assets. I average across two definitions from the 2010 Survey of Consumer Finances: the proportion of households with less than \$1000 in checking accounts (40%), or less than \$1000 in "transaction accounts" which also include savings accounts, money market accounts and call accounts at brokerages (29%). The average of 35% is similar to the value in Giambattistia and Pennings (2013), the value estimated by Iacoviello (2005) and in the middle of the range in the literature, such as 0.5 from Hall (2011) and Campbell and Mankiw (1989), and 0.26 from Cogan et al (2010). Kaplan and Violante (2013) find that between 18-37% of households are hand-to-mouth in the US.

income transfers multiplier.

3.2 Simple model: intuition and analytical results

In this section, I present some analytical expressions in a simplified model, which (i) shows how cross-regional transfers break Ricardian Equivalence, and (ii) shows the multiplier in polar cases when prices are perfectly fixed or perfectly flexible. Because the lagged terms of trade s_{t-1} is an endogenous state variable, there are no simple analytical expressions for the intermediate case when prices are are sticky as in the standard New Keynesian model. To simplify the model, I remove credit constrained households ($\omega = 0$), distortionary taxes ($\tau = 0$) and debt-elastic interest spread (and assume log preferences ($\sigma = 1$)).

3.2.1 The cross-region transfer multiplier in a simplified model

Assume a *permanent* transfer from the residents of region B to residents of region A. This transfer allows me to simplify the model in couple of key ways to get an analytical solution. First, a cross-section transfer in the simple model has *symmetric effects* on Region A and Region B variables after adjusting for region size $\hat{x}_{B,t} = -\frac{n}{1-n}\hat{x}_{A,t}\ \forall \hat{x}$, i.e if labor supply in region A fell by 1 unit, in region B it would rise by $\frac{n}{1-n}$ units. This means that I only need solve for the allocation of one region. An immediate implication of this is that cross-region transfers have no effect on nominal interest rates (though as explained above, this does mean multipliers increase like the ZLB because s_{t-1} is a state variable). Second, I assume that either prices are perfectly rigid ($\theta_p \to 1, \kappa \to 0$) or perfectly flexible ($\theta_p \to 0, \kappa \to \infty$), with the New Keynesian model being an intermediate case. Using a permanent transfer removes dynamics from the exogenous state variable, and assuming fixed or flexible prices removes the dynamics from the endogenous state variable s_{t-1}. Hence, the model in these polar cases is *static* and so the path of output (or any other variable) is a constant faction of the perpetuity value of the transfer (defined as $\bar{tr} \equiv (1-\beta)tr^{PV}$). I use the overbar to represent these comparative static deviations from steady state.

3.2.2 Fixed prices

If prices are fixed ($\pi_h = \pi_f = 0$ and $\hat{s}_t = 0$), then output is entirely demand-determined, with markups and hence wages ($\hat{w}_A = -\hat{X}_{A,t} = \hat{mc}_{A,t}$) adjusting to make sure labor supply adjusts to labor demand. In this demand-determined world, home bias ($\alpha > n$) is key for a positive response of GDP to a transfer, as seen in Equation 6. If there is no home bias $\alpha = n$, then the increase in demand for home goods from region A (receiving the transfer) is perfectly offset by the fall in demand from residents of region B (paying the transfer) leaving no effect on allocations. In contrast, if home bias is large, then the stimulatory effects of transfers can be sizable as residents of region A increase their demand for home-produced goods.

$$\bar{y_A}^{FIX} = \bar{L}^{FIX} = \frac{\alpha - n}{1-\alpha}\bar{tr} \geq 0 \tag{6}$$

As $\alpha \rightarrow 1$ (the economy becomes closed) the cross-region transfer multiplier goes to infinity. In the first instance, demand for y_h is boosted by $\alpha - n$, which is the difference between the increase in local demand for home goods (α), and the fall in demand for home goods from the residents of Region B (n). But of this higher income, a share α is spent locally (the local MPC), increasing income by a factor of α. Of the second round increase α^2 is spend locally and so forth, summing to the "Old Keynesian" multiplier of $1/(1-\alpha)$.

How does this compare to self-financed wasteful government spending in Region A? In the simple model where output is demand determined, the locally-financed government spending multiplier is 1 (as demand increases by the amount of the government spending). As such, the transfer multiplier will be greater than the purchase multiplier if Equation 7 holds, which it does with my parametrization ($n = 0.02$, $\alpha = 0.56$, implying a cross-region output multiplier of about 1.2).

$$\alpha > \frac{n}{2} + \frac{1}{2} \tag{7}$$

In the empirical analysis in Section 2, I estimated the effect of a permanent transfer on real labor income. The analogous variable in the model is Equation 8, with the relative price term appearing because labor income is deflated by national inflation, not inflation in Region A (there are no inflation data for US states).[33] Labor income when prices are fixed is shown in Equation 9. Even if there is no home bias ($\alpha = n$) and so GDP is unchanged, labor income still rises because higher wages are needed to induce the wealthier household to work the same number of hours. The "labor income multiplier" increases with home bias, but decreases with the Frisch elasticity of labor supply $\nu = 1/(\eta - 1)$, because a more elastic labor supply means a smaller increase in wages for a given increase in hours. With the default parameters for $\eta = 1.5$, $\alpha = 0.56$ and $n = 0.02$, the "labor income multiplier" is about 2.5, which is higher than my estimate in for permanent transfers in the data. Note that even with fixed prices, the implied multiplier for temporary transfers is $(1 - \beta) = 0.01$ times the expression in Equation 9 because the annuity value of a one off transfer is around 1% of its face value. Hence, we need to introduce hand-to-mouth households into the model to match the response of labor income to a temporary transfer shock.

$$\hat{WL}_{BEA} = \hat{w}_A + \hat{L}_A - (1-n)\hat{s} \tag{8}$$

$$\bar{WL}^{FIX}_{BEA} = \left[1 + (\eta + 1)\frac{\alpha - n}{1 - \alpha}\right] \bar{tr} > 0 \tag{9}$$

[33] $\hat{w}_A$ is the real product wage (i.e. in terms of home goods), $\hat{L}_A$is labor supply and $-(1-n)\hat{s}$ reflects relative prices. Note that this expression is in terms of deviation from steady state, whereas in the data I look at growth rates. As I assume the model is initially in steady state, the deviation from steady state and the growth rate are the same in the first period, which is the one considered in the empirical analysis.

3.2.3 Flexible prices

When prices are flexible, markups, real marginal costs and real product wages are constant. The only effects on labor supply (and hence output) are through (i) wealth effects (an increase in consumption reduces labor supply), and (ii) relative prices, where the consumption wage can rise if the terms of trade improves. In equilibrium, the households in region A splits their increased wealth between lower labor and higher consumption, with labor and output *falling* (Equation 10).[34] Note that this is the *negative* of the self-funded government purchase multiplier in the flex-price model.

$$\bar{Y_h}^{FLEX} = \bar{L_A}^{FLEX} = -\frac{1}{\eta}\bar{tr} < 0 \tag{10}$$

The increase in demand for Region A's variety (and reduced supply of that variety due to wealth effects) will cause the relative price of Region A's variety to rise (a fall in s) as in Equation 11 (written with $n \to 0$ to simplify the algebra). The size of price adjustment is increasing in α (larger localization of demand), and decreasing in θ_T (varieties are more substitutable).

$$\bar{s} = -\frac{1 + \frac{\alpha\eta}{1-\alpha}}{\eta\left[(\theta_T - 1)(1+\alpha) + 1\right]}\bar{Tr} \tag{11}$$

As labor income depends relative prices as well as hours (Equation 8), ex-ante we can't tell whether labor income will rise or fall in the flex price model — we need a detailed quantitative comparison (see Section 3.3). The expression for labor income is shown in Equation 12 (with $n \to 0$ to simplify the algebra), which has an ambiguous sign. For my default parametrization $\hat{WL}_{BEA}^{FLEX}$ it is close to zero, which is a long way below the estimates in the data.

$$\bar{WL}_{BEA}^{FLEX} = \frac{1}{\eta}\left[\frac{1 + \frac{\alpha\eta}{1-\alpha}}{\left[(\theta_T - 1)(1+\alpha) + 1\right]} - 1\right]\bar{tr} \lesseqgtr 0 \tag{12}$$

3.2.4 Impulse responses in the simple model

The simple New Keynesian model is a hybrid of the fixed price model (in the short term) and the neoclassical flex price model (in the long term). Figure 2 presents impulse responses to a *permanent* 1% GDP cross-region transfer in the simple model. While the long run effects are very close to the flex price case above, the short-run effect is much less stimulatory that the fixed price model. One can see why in the bottom LHS panel: s_t falls substantially on impact (increase in p_h increases relative to p_f), with around half of the total adjustment happening in the first quarter.

The output volume ($\hat{Y_h}$) increases on impact due to demand effects, but quickly becomes negative due to wealth effects (red dashed line, top LHS). The initial increase of 0.19 is less than a tenth of the fixed price model, though the final multiplier of -0.67 is almost exactly the flex-price

[34] More specifically, the household in Region A works less and ships fewer goods to region B. The household in region B works harder and ships more goods to region A. Both consume the same amount of their own variety.

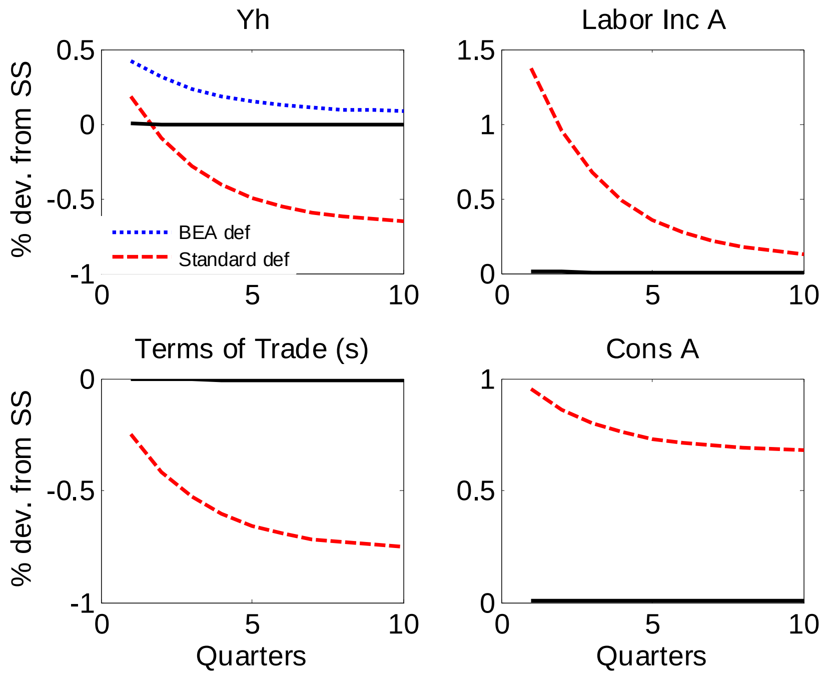


Figure 2: Impulse response to a *permanent* 1% GDP cross-region transfer in the *simple* model

multiplier of $-1/\eta$. Labor income (top RHS) increases by about 1.4% on impact (reflecting almost a 1% increase in the real product wage), but is still considerably below the labor-income fixed-price multiplier of about 2.5. Initially, consumption increases almost one-for-one with the transfer, but in the long term falls as the household reduces its labor supply.

The BEA definition of state GDP (blue dotted line) is somewhat different from the volume measure because it deflated by the *national* price index, and so relative price movements will affect state-level GDP estimates $(\hat{Y}_h - (1-n)\hat{s}_t)$.[35] Due to sizable movements in prices, this means that the BEA definition of state-level GDP remains positive.

The black line is the impulse response function for a $\rho = 0$ shock, but its visually indistinguishable from the zero axis. Numerically, it is a $1 - \beta = 0.01$ scaled down version of the $\rho = 1$ line and hence is almost flat — reflecting the tiny annuity value of a one-off transfer. Hence in the next section we need to add credit constrained households to give the model give temporary transfers some bite.

3.3 Comparison to data using the full model

3.3.1 Impulse response function — full model

Unlike the simple model, the full model includes credit constrained households, who (i) tend to spend one-off transfers hand-to-mouth as in the data, (ii) amplify the effect of temporary shocks.

[35] Specifically, the BEA deflates nominal GDP in each state with the national prices applied to the industrial composition in that state.

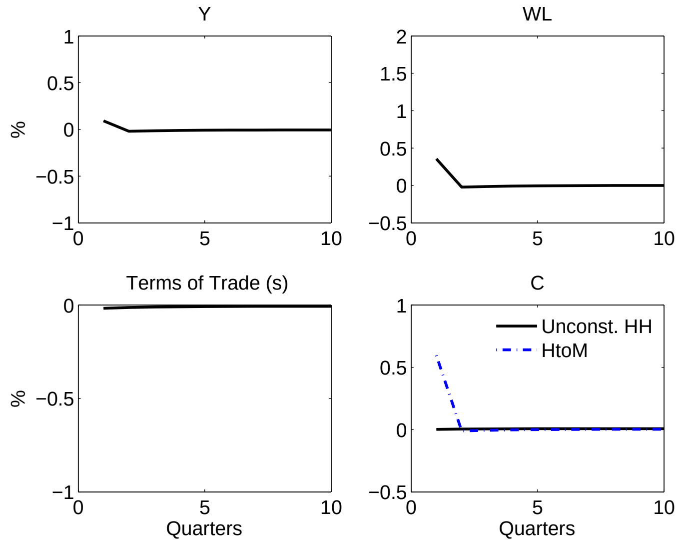


Figure 3: Impulse response to a 1% GDP *temporary* cross-region transfer in the full model

Using the 2010 Survey of Consumer Finances, I find that around 35% of households have less than $1000 in liquid assets, and so set the share of credit-constrained households $\omega = 0.35$ in each region. I examine the effects of a cross-region transfer: the only difference is now the credit constrained households get 35% of the transfers. For simplicity I continue to assume that transfers are paid for by the unconstrained household in Region B, but this does not quantitatively affect the results because region B is so much larger than region A.

The impulse responses to a 1% of GDP cross-section once-off transfers shock are shown in Figure 3 and are much larger than the simple model. Labor income increases by about 0.35% contemporaneously, and GDP increases slightly (the BEA and standard measures are similar because of the limited movement in relative prices). Hand-to-mouth households increase consumption by 0.6% and unconstrained HHs by 0.02%, such that total consumption increases by 0.21%. This is within the range of non-durable consumption multipliers for once-off transfers, such as 20-40% in Johnson et al (2006) and 12-29% for Parker et al (2013).[36] As in the data, the effects of a temporary transfer are mostly confined to the quarter in which they are received.

The effects of *permanent* transfers are slightly stronger in the full model due the general amplification effects of the hand-to-mouth households (Figure 4). A $1 permanent transfer boosts labor income by $1.7 on impact and $1.1 after a quarter, very similar to the data and the analogous cross-sectional experiment in Section 3.3.2.

[36]In steady state GDP, Consumption and Labor Income are the same, so we can interpret these percentages as multipliers.

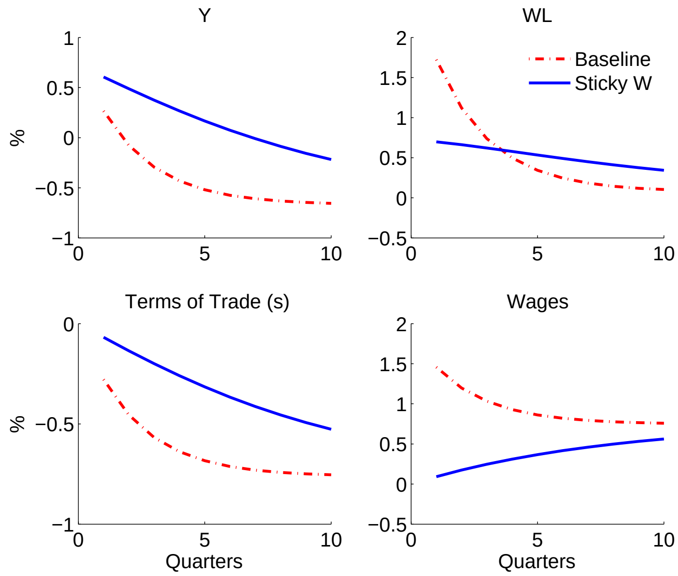


Figure 4: Impulse response to a 1% GDP *permanent* cross-region transfer in the full model

3.3.2 Sticky wages

Figure shows that nominal wages are quite volatile in the baseline model, whereas in the data they are quite sticky (Barattieri et al 2013). Specifically, nominal wages jump about 1.5% in response to a 1% (of regional GDP) *permanent* transfer shock, and then fall rapidly (Figure 4, bottom RHS, dotted lines). The addition of sticky wages (Figure 4, solid line) helps to smooth the nominal wage profile. Sticky wages are important more generally: Christiano et al (2005) find that sticky wages are needed to match the impulse response to a monetary policy shock, and Gali et al (2007) find that wage markups are more volatile than price markups.

Sticky wages have a profound impact on the cross-region transfer output multiplier in the model (Figure 4). Whereas most of the increase in labor income in the baseline New Keynesian model comes from temporary nominal wage increases, with sticky wages most of it comes from increase in employment/output. Not only is the initial increase in output much larger, its also much more persistent. In the baseline NK model, output only increases for a quarter in response to a permanent transfers shock and after that output falls due to wealth effects. With sticky wages the increase in output lasts around two years. The response of key variables to a temporary shock is similar with sticky wages and flexible wages (not reported).

3.3.3 Comparison of model and data

In this section, I compare the response of labor income to a contemporaneous cross-region transfer in model and data. In a sense, this exercise thought of as estimating the slope in Figure 1, where the slope equals the difference in the growth rate of labor income of between states i and j (these are represented as region A in the model), divided in by the difference in the amount of transfers

Table 4: Model vs data

	A. Data (Table 1 & 2)	B. Baseline (NK Model)	C. Neoclassical Model*	D. Sticky W (NK Model)	E. Flexible ER (NK Model)
Panel A: Comparison of Model and Data — Slope Coefficients (Labor Income) on impact					
Temp.	0.2-0.5	0.36	0.002	0.24	0.33
Perm.**	1-1.5^	1.1-1.7	0.07	0.7	0.50-1.1
Panel B: Short Run (Impact) Output Multiplier ($\hat{Y}$)					
Temp.	-	0.1	0	**0.24**	0.08
Perm.	-	0.27	-0.67	**0.6**	-0.07
Panel C: Long Run (10yr) Present Value Output Multiplier ($\hat{Y}$)					
Temp.	-	-0.14	-0.22	0.10	-0.14
Perm.	-	-0.59	-0.67	-0.36	-0.64
* No CC HH or sticky prices/wages. **Range: first two quarters ^After a quarter					

received (Equation 13). For example, in Figure 1 the first state i could be Mississippi (MS) which received 3.9% of quarterly labor income as a transfer in 2008Q2, and the second j could be Alabama (AL) which received 2.7% of quarterly labor income as a transfer (the total size of the package of was about 1.2% of labor income in 2008Q2). I replicate the package by transferring 1.2% of national GDP to the households (funded by lump sum taxes on households in proportion to their population). 35% of the total transfer goes to credit constrained HH (in proportion to their population share). I simulate the model twice: once where the residents of Region A get a 3.9% labor income transfer (as in the case of Mississippi) and the second time when the residents of Region A gets 2.7% of quarterly labor income (as in the case of Alabama). I calculate the slope using Equation 13.

Despite this rigorous approach, in a *linear* model I don't need to follow the details of the policy so closely: the sizes of the total transfer and the absolute size of the state's portion don't matter for the slope. First, the size of the transfer going to the residents in region B (and the tax obligation on the unconstrained agents in region A) difference out in the slope calculation, and second, the effect of the cross-state transfer is normalized by the size of the cross-state transfer in the denominator. The cross-region transfer has no payments going to the residents of region B (or funding of the transfer from Region A) to difference out, and so the *impact* multiplier from Figure 3 is the same as the slope in Equation 13.

$$Slope = (\Delta WL_i - \Delta WL_j)/(\Delta Tr_i - \Delta Tr_j) \tag{13}$$

Table 4 Panel A compares the slope coefficients estimated in Table 1 and Table 2 with the slope coefficient from the baseline New Keynesian model and a range of variants. The baseline NK model fits the evidence well for both temporary and permanent transfers (Column B). For temporary transfers, the first-quarter response in the model is in the middle of the range of coefficients estimated in the data. For permanent transfers, the estimated lagged increase in labor income in the data is slightly lower than the contemporaneous response in the NK model, and slightly higher than the lagged response. Which of these I should match depends on whether the one quarter delay is due to implementation (in which case I should match the impact multiplier) or a noisy contemporaneous response (in which case I should match the second quarter). Either way, the New Keynesian model is fairly consistent with the data. In contrast, transfers have very little effect on labor income when prices are flexible as in Column C for the neoclassical model.

Table 2 Column D adds sticky wages. The boost in labor income in response to a temporary transfer is slightly smaller than in the baseline NK model, but is still in the range estimated in the data. The effect of a permanent transfer on impact is slightly smaller than that in the data, but well within one or two confidence intervals of the reported estimate.

Transfers across states *within* a monetary union are more stimulatory than those across countries with floating exchange rates. Table 4, Column E shows the response of labor income to a cross-regional transfer in the baseline NK model when the two regions have a floating exchange rate (with producer currency pricing; equations listed in the Appendix). Flexible exchange rates allow the relative price of home and foreign varieties to jump on announcement of the shock, aiding price adjustment.However, anticipated future ER movements depend on changes in relative interest rates (and hence relative inflation) by the uncovered interest parity (UIP) condition. For a permanent transfer, an initial exchange rate appreciation aids relative price adjustment and so drastically reduces the labor income multiplier. For one off transfers, future exchange rate movements are limited by UIP, hence the exchange rate does not move much, and the labor income multiplier is similar to that with fixed exchange rates.[37]

3.4 Output multipliers

Policymakers are generally interested in the effect of fiscal policy on GDP rather than the effect on labor income.[38] In the counterfactual in Section 4, I examine the effect of counter-cyclical transfers on GDP in the first quarter — known as impact multipliers, which are presented in Panel B of Table 4. The model used for the counterfactual simulations is similar to the sticky wage model, shown in column D. In the sticky wage model, a \$1 transfer boosts output by \$0.24 on impact if is once-off, or \$0.6 if it is permanent. The multipliers considered in Section 4 are about in the

[37]If the central bank responds to expected inflation $\hat{R}_t = \phi E_t \hat{\pi}_{US,t+1}$ rather than current inflation ($\hat{R}_t = \phi \pi_{US,t}$) as I have otherwise assumed, the economy with floating exchange replicates the flexible price allocation through a once and for all exchange rate appreciation.

[38]In a linear model, the transfer multiplier is the difference between the self-funded government purchase multiplier and the foreign-financed government purchase multiplier. See Appendix D for a discussion.

middle of this range as they reflect a persistent (but not permanent) transfer.

Other models have much smaller impact multipliers. In particular, the impact multiplier for the baseline New Keynesian model is between 0.1 and 0.27, and the multiplier for the neoclassical model is between 0 and -0.67. Interestingly, shock persistence increases the multiplier for the New Keynesian model, but reduces it for the neoclassical model. The wide difference in multipliers between the sticky wage model and the neoclassical model emphasize how important it is to use the data to inform the choice of models. Figure 10 (Appendix) shows how the different multipliers in Table 4 vary with many other parameters in the model (see Appendix C for a discussion).

3.4.1 Long run (Present Value) Output Multiplier

A long-run measure of the effect of fiscal policy is present value output multiplier: this is present value of increases in output relative to the present value of transfer payments.[39] As the long run change in output is not identifiable in the data, I need to use a model to calculate the LR output multiplier. Table 4, Panel C presents long-run present value multipliers: these are negative even for the baseline New Keynesian model. The PV multipliers are negative because over the long term, wealth effects dominate demand effects. The negative PV multiplier is smaller in the sticky wage model but is still sizable. The only case with a positive PV multiplier is in the sticky wage model in response to a temporary transfer. This is consistent with results in Giambattista and Pennings (2013), where the present value transfer multipliers are higher for *temporary* transfers because they cause little price/wage adjustment, and hence are closer to the fixed-price Keynesian benchmark.

4 A US-style fiscal system in Europe? (Spain recession 2008-09)

Given the troubles of the Euro area in recent years, many economists have been encouraging European leaders towards greater fiscal integration. The United States as long been seen as an example of risk sharing across states — largely through cross-region transfers — as the opening quotation from Sali-i-Martin and Sachs (1991) more than 20 years ago indicates. But would Europe be better off with a US-style centralized fiscal system, in terms of its ability to smooth regional shocks? In the last two sections I have produced evidence that cross-regional transfers boost labor income on impact, and my New Keynesian model does a reasonable job of matching the short-run effects of these transfers.

In this section, I model the effect of EU vs US fiscal systems in the context of a deep Spanish recession of 2008-09, when output fell by around 5% from peak-to-trough. To generate such a

[39] $\sum_{i=0}^{40} \beta^i \hat{Y}_{t+i} / \sum_{i=0}^{40} \beta^i \hat{tr}_{t+i}$. I truncate after 10 years (40 quarters).

large recession, I hit the model economy with a large and persistent increase in borrowing costs in region A (representing Spain), similar to that considered by Farhi et al (2013). It turns out that the US fiscal system can smooth consumption and output, but its effects are modest relative to the size of the shock, and depend on the ability of the Spanish government (under the EU fiscal system) to self-insure against negative shocks by borrowing.

4.1 Which counterfactual: balanced budget or countercyclical borrowing?

Bayoumi and Mason (1995) argue that European countries have been able to compensate for a lack of cross-regional transfers by borrowing during recessions and saving during booms. While EMU countries may previously have been able to borrow in response to *new* shocks, in recent years they may have been constrained by (i) the Stability and Growth Pact rules, which are supposed to limit deficits to 3% of GDP,[40] (ii) market pressure during the European debt crisis, which causes countries to consolidate even if in recession. As I am analyzing the case of the EMU fiscal system *in general* rather than during a particular period, I consider both counterfactuals of (i) balanced budgets and (ii) countercyclical within-country fiscal policy.

I introduce the possibility of countercyclical borrowing as in Leeper et al (2010) via a *fiscal rule* (Equation 14). Under the fiscal rule, the net transfer to households responds to lagged government debt, as well as this period's deficit. When $\phi_b = \beta^{-1} - 1 \approx 0.01$ the government just pays interest on their debt, whereas if $\phi_b = 1$, then the regional government runs a balanced budget (as $b_{g,t-1} = 0$ under this rule). I set a default coefficient of $\phi_b = 0.18$ (similar to Leeper et al (2010)), which suggests government debt has a half life of about a year.[41] I assume all transfers are equally allocated across constrained and unconstrained households in per capita terms.

$$Tr_{A,t} = -\phi_b(deficit_{A,t} + b_{A,g,t-1}) \tag{14}$$

Before analyzing endogenous transfers, it is worth considering the effects of an exogenous transfer shock with different levels of countercyclical fiscal policy. Table 5 compares the effect of cross-region transfers (which are mostly invariant to the budget rule in the rest of the monetary union), and the same sized transfer funded by per capita lump sum taxes within the same region (the EU fiscal system). The cross-region transfers under the US fiscal system are the same as those reported in Table 4, and are insensitive to the funding of these transfers. When the budget is balanced under a EU fiscal system, this type of *gross transfer* clearly has no effect as *net* transfers

[40]SGP rules are often broken, but nonetheless apply pressure to politicians not to increase budget deficits. These rules were relaxed during the financial crisis to allow countries to run countercyclical fiscal policy.

[41]Leeper et al (2010)'s fiscal rule is slightly different as transfers not respond to the contemporaneous deficit, but do respond to output. Leeper et al also allow other fiscal instruments to respond to output and debt. The coefficient is calculated as 0.5×0.355, where 0.355 ratio of transfers to debt in steady state needed to convert Leeper et al's elasticity into the share-of-GDP coefficient used here.

Table 5: Exogenous transfers under different fiscal systems

WL Impact Multiplier	US (Federal System)	EU (State)	
	(Either System)	Bal. Budget ($\phi_b = 1$)	Fiscal Rule ($\phi_b = 0.18$)
Temp.	0.36	0	0.29
Perm.	1.1-1.7	0	0.23-0.13

will be zero for each agent. With a fiscal rule, the government can borrow to fund gross transfers to households. For temporary transfers, the effect is very similar to a US fiscal system, because for temporary transfers it is mostly the hand-to-mouth households who respond to transfers, and these HH are indifferent to whether the transfer is funded by debt or comes from another region. However, the results are very different for a permanent transfer. In this case, most of the effect under the US fiscal system is driven by the unconstrained households, who spend the transfer as their permanent income increases. But under the EU fiscal system (with a fiscal rule), the unconstrained household anticipates higher future taxes and so does not respond to the gross transfer, leaving a much smaller impact on labor income.

In sum, the response of the regional economy to a temporary transfer is similar in the US and EU fiscal systems *if* the government can borrow. But a persistent transfer will be much less stimulatory under an EU fiscal system (with a fiscal rule) than under the US fiscal system.

4.2 The 2008-09 Spanish recession (balanced budget) with a US fiscal system

During the financial crisis of 2008-09, Spain entered a deep recession. From the peak in 2008 to trough in 2009, consumption fell 5.5% and output fell 4.96%.[42] *How much shallower would this recession have been if Europe had a federal government, like the US?* To answer this question, I follow Farhi et al (2013) and hit the Spanish economy with a large and persistent rise in borrowing costs, and compare the fall in output and consumption under US vs EU fiscal systems.[43] As mentioned above, the comparison depends crucially on whether the Spanish government borrows to smooth the effects of the shock. In this section, I first assume that Spain runs a balanced budget, and then analyze the case of a fiscal rule in the next subsection.[44]

[42]Source: FRED. Gross Domestic Product by Expenditure in Constant Prices: Total Gross Domestic Product for Spain (NAEXKP01ESQ661S), and Gross Domestic Product by Expenditure in Constant Prices: Private Final Consumption Expenditure for Spain (NAEXKP02ESQ661S)

[43]In reality, the Spanish recession was largely related to a turnout in the construction industry, though the model does not capture this kind of industry-level detail.

[44]In the data, Spain did run a big deficit in 2008-09, but in part this was because the shock was not idiosyncratic as modeled here, but part of a world-wide recession. The European Commission allowed countries to break the

In order to match the data for Spain, I need to make some small changes to the model, which was previously calibrated to a generic US state (see Table 3). In particular, Spain is larger than the average US state and also more closed, so I increase the relative size of the small region to $n = 0.1$ and raise the level of home bias to $\alpha = 0.7$ as Spain accounts for about 1/10th of Euro Area GDP, and has exports/GDP of about 30% (Table 3). As reported in Farhi et al (2013), Spain's net foreign debt is about 75% of GDP, so I set $b_{ss} = 0.75$.[45] I introduce sticky wages as in Erceg et al (2000), in order to help generate a more persistent fall in output ($\theta_w = 0.9$ as wage contracts average 2.5 years in Spain according to Du Caja et al 2008). I calibrate $\tau = 0.3$, which matches the Spanish tax-to-GDP ratio in 2009, and means that a 1% fall in GDP would generate a 0.27% of GDP cross-region fiscal transfer under the US fiscal system (operating through reduced tax payments), adjusting for the fact that Spain is about 10% of Euro Area GDP. This is around middle of the range found in the literature cited in the introduction.

The effect of the borrowing cost shock is shown in Equation 15, with the spread, $\hat{sp}_t$, rising by 0.005 (2% annualized) and with quarterly auto-correlation 0.95. The persistence of the shock is the same as Farhi et al (2013), but the shock is around half the the size because my model has a higher inter-temporal elasticity of substitution/lower risk aversion $(1/\sigma)$, which makes consumption more sensitive to changes in interest rates.

$$\hat{R_{A.t}} = \hat{R}^*_{ECB.t} + \psi(\hat{b}_{A,t} - b_A^{SS}) + \hat{sp}_t \tag{15}$$

The shock has two effects on the economy. First, by increasing interest rates, it causes the unconstrained household to save. This reduces demand for the home variety, and sends the Spanish economy into recession. Spanish unconstrained households save by lending to the rest of the world, which leads to a substantial improvement in the trade balance. The second effect is an income effect: because the Spanish are net debtors, and increase in interest rates reduces their wealth. In the first quarter, the higher spread reduces their income by about 0.4% of quarterly GDP (0.005×0.75).

The shock is calibrated to match the initial fall in GDP (peak to trough) over 2008-09 of 4.96% under the EU fiscal system (balanced budget). The path of output in model vs data is shown in Figure 5. In the data, Spain is hit by a second shock (sovereign debt shock) at the start of 2011, making it almost impossible to match the data with a single shock. Instead, I match the path of the IMF's forecast in April 2009, which were formed before the European debt crisis.

Under the EU fiscal system (with a balanced budget) I match the fall in GDP exactly, but the fall in consumption (at 7.15%) is a bit larger than the 5.5% fall seen in the data (Table 6). With a

deficit limit in the SGP, which was highly unusual.

[45] To keep the model in a symmetric steady state, I introduce a small steady state transfer to the residents of Spain.

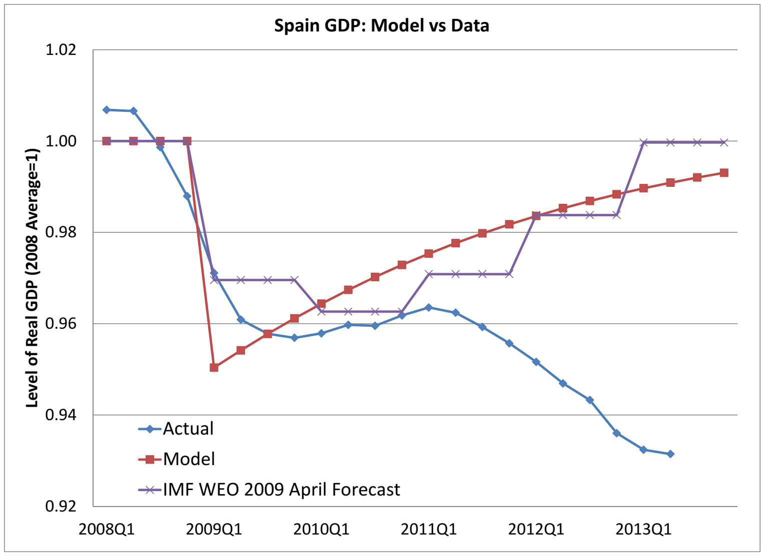


Figure 5: Spread Shock (application to Spain 2008-09)

Table 6: Spread shock and the 2008-09 Spanish Recession

	Spain	Baseline Model (Peak-Trough) (EU balanced budget)			
	2008-09	EU Fiscal System	US Fiscal System	US-EU	(US-EU)/Initial Fall
C	-5.50%	-7.15%	-6.36%	0.8%	11%
Y	-4.96%	-4.96%	-4.44%	0.5%	10%

US fiscal system, the initial fall in consumption would be about 6.36%, or 0.8ppts less than under the EU (balanced budget) system, with the fall in output under the US fiscal system of 4.44%, or 0.5ppts less than under the EU (balanced budget) system. In both cases, the US fiscal system is able to smooth about 10% of the effect of the shock.

The profile of the economy is shown in Figure 6. One can see the rise in consumption and output under the US system (relative to the EU system). With flexible prices, this shock leads to an increase in output, a small decrease in consumption and a fall in the relative price of the Spanish good. In general, the US system helps the economy move towards the flex-price allocation, and reduces the large negative output gap. However, by stimulating home demand it also slows the adjustment of relative prices.

The effect of these counter-cyclical transfers depend on features included in the model to bring the it into line with the data. In Appendix D, I show that the initial boost to output and consumption from the cross-region transfer would be less than half as large if the model had no hand-to-mouth households. In a neoclassical model (without sticky prices/wages), the effect on consumption would be even smaller again, and the effect on output would be negative.

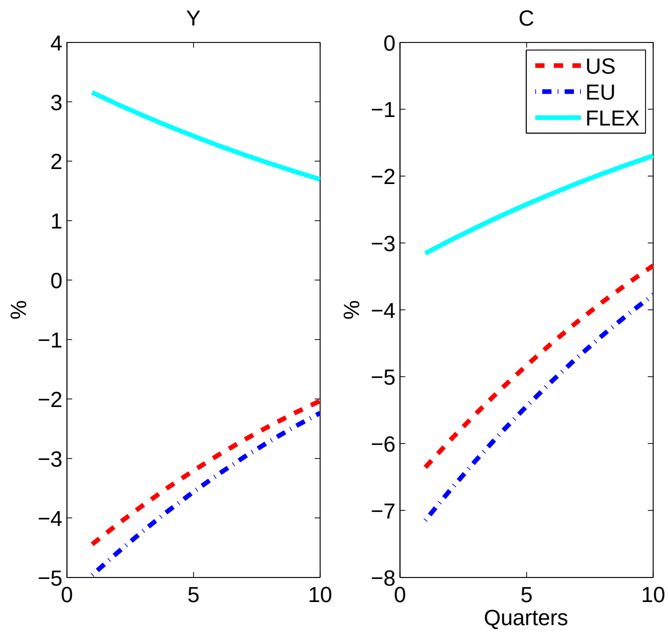


Figure 6: Spread Shock (application to Spain 2008-09): US (with transfers) vs EU (without transfers) fiscal systems

4.3 How are things different when Spain self-insures by borrowing?

To illustrate the sensitivity of the results in Section 4.2 to deficit financing, Figure 7 shows the *difference* in the fall of Spanish GDP and consumption under the two fiscal systems as a function of the coefficient ϕ_b in the fiscal rule. Recall that with $\phi_b = 1$, Spain runs a balanced budget under the EU fiscal system, and so the difference in the fall in Y and C are the same as those reported in Table 6. With $\phi_b = 0.01$, Spain just pays off its interest each period. One can see the gains under the US fiscal system are very sensitive to the degree of countercyclical borrowing. When $\phi_b = 0.18$, as in Leeper et al (2010) for the US, one can see that the fall in GDP is only 0.2ppts lower under the US system, and the fall in consumption is only 0.3ppts lower under the US system. This means that the US fiscal system would smooth about 5% of the fall in output or consumption.[46]

5 Conclusion

Cross-region transfers are a key difference between EMU and US fiscal systems. As the future of the European fiscal system is debated and the United States federal system is put forward as a potential model for the EMU, it is important to have a better estimate of the effects of cross-region transfers in the US and a deeper understanding of the extent to which cross-region transfers can help to smooth regional shocks.

I use exogenous cross-state variation in temporary transfers from recent stimulus packages and

[46]With $\phi_b = 0.18$, the fall in GDP is only slightly smaller at 4.69% and consumption falls by 6.62%

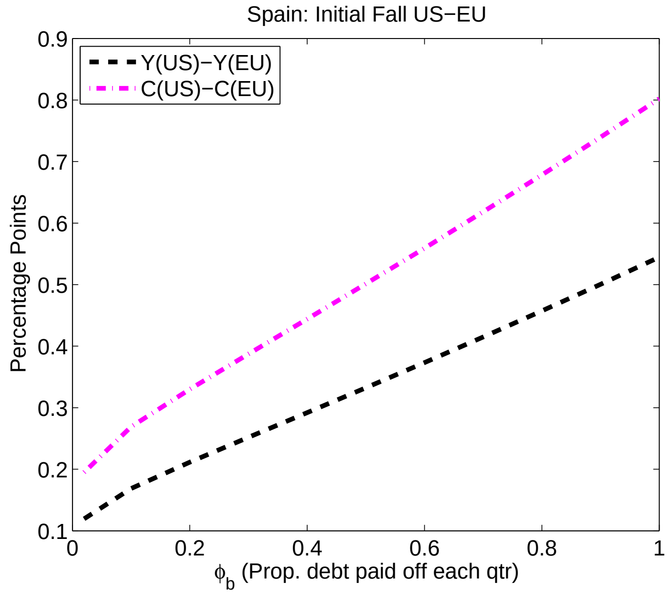


Figure 7: Spread Shock (application to Spain 2008-09)

permanent changes in social security benefits from around 1970 to estimate the effects of transfers on labor income. I find a cross-region transfer multiplier of 0.2-0.5 for temporary transfers on impact, and around 1-1.5 for permanent transfers after a quarter. I develop multi-region New Keynesian model with incomplete markets which is able to replicate the contemporaneous cross-sectional response of labor income to transfer shocks seen in the data. The demand effects in the NK model are strengthened by home bias and hand-to-mouth households but are likely to be short-lived, giving way to neoclassical wealth effects (once prices adjust) which reduce output in the long run in response to a transfer shock.

Given this, are counter-cyclical cross-region transfers useful in Europe for smoothing regional business cycles (as in the US fiscal system)? Using a shock to borrowing costs designed to capture the 2008-09 recession in Spain, I show that although cross-region transfers are beneficial, their effects are fairly modest. If the Spanish government is unable to run domestic countercyclical deficits — constrained, for example, by sovereign debt markets — the US fiscal system is able to smooth about 10% of the effects of the shock. If Spain is able run countercyclical deficits, the gains to stabilization are about half as large. In part, this because credit constrained households don't respond to future taxes, and so will spend all transfers received — whether they come from Madrid (with a higher future tax bill) or Brussels (as pure transfer). In part, the small gains also reflect the modest size of countercyclical transfers generated, even for fairly deep recessions. Much larger cross-region transfers, such as those from regional bank bailouts in a banking union, are likely to have much more sizable effects.

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Appendix A — Flexible Exchange Rates

Flexible exchange rates are implemented by changing four equations. I use the currency of the large region (call it \$) as unit of account, and so all equations are expressed in terms of \$ prices. Goods produced in the small region are priced in the domestic currency (call the small region Mexico, currency = Peso). Define $er = Pesos/\$$. I assume the Law of One Price holds, so $lnp_h^{Pesos} = lnp_h^{\$} + lner$ and hence (taking log differences) $\pi_{h,t}^{peso} = \pi_{h,t}^{\$} + \Delta er_t$. The four extra conditions are

1. The Mexicans have their own central bank, which sets interest rates with reference to the Mexican consumption basket, in Pesos.

$$\hat{R}_t^{Peso} = \phi_\pi \left[\alpha \pi_{h,t}^{peso} + (1-\alpha)\pi_{f,t}^{peso}\right] = \phi_\pi \left[\alpha \pi_{h,t}^{\$} + (1-\alpha)\pi_{f,t}^{\$} + \Delta er_t\right]$$

2. The US central bank now only respond to US inflation in dollars, rather than region-wide inflation.

$$\hat{R}_t^{\$} = \phi_\pi \left[(1-\gamma)\pi_{h,t}^{\$} + \gamma \pi_{f,t}^{\$}\right]$$

3. Uncovered interest parity (UIP) must equalize the return from holding each currency. For example if the dollar interest rate is 0% ($\hat{R}_t^{\$}$) and the Peso is expected to depreciate by 1% ($\Delta er_{t+1} = 1\%$: er_{t+1} from 10 to 10.1), then the Peso interest rate must be 1%

$$\hat{R}_t^{Peso} = \hat{R}_t^{\$} + E_t \Delta er_t$$

4. The prices of Mexican goods are set (and are sticky) in Pesos. $\pi_{h,t}^{Peso} = \beta E_t \pi_{h,t+1}^{Peso} - \kappa \hat{X}_{h,t}$implies that:

$$\pi_{h,t}^{\$} = \beta E_t \pi_{h,t+1}^{\$} - \kappa \hat{X}_{h,t} - [\Delta er_t - \beta E_t \Delta er_{t+1}]$$

Appendix B — Further Empirical Robustness Tests

For description of Figures 7 and 9, see Sections 2.1 and 2.2 (respectively)

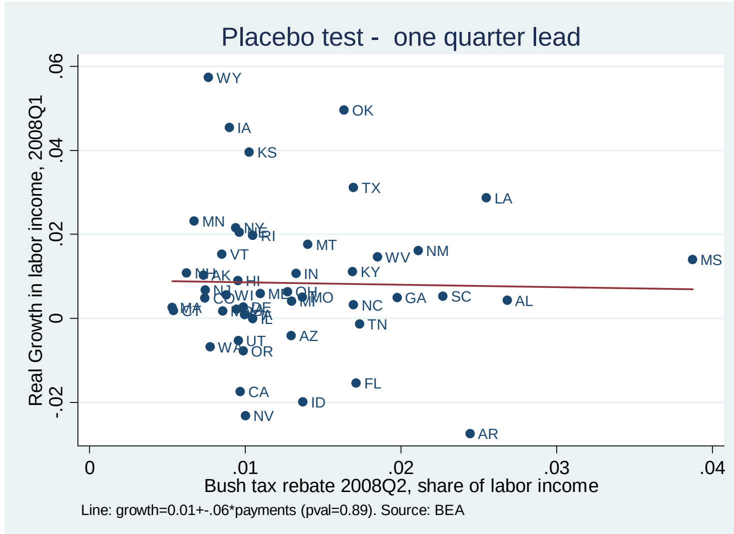


Figure 8: Placebo Test - 2008 Bush Rebate (low income component)

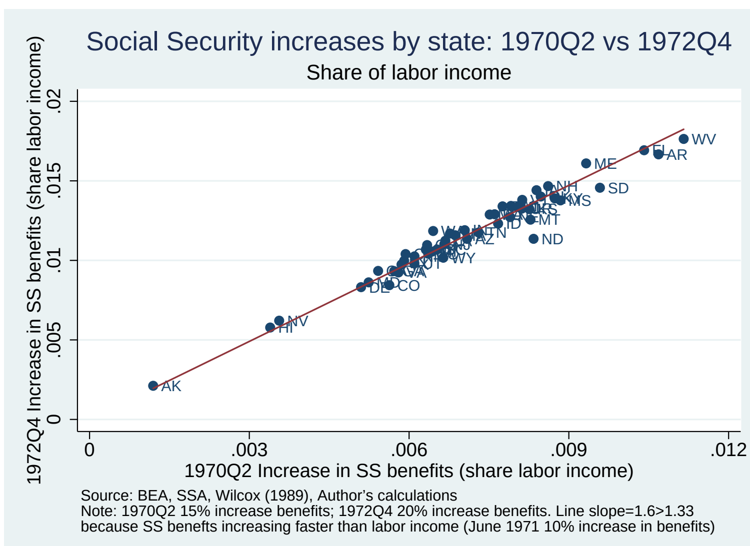


Figure 9: Cross-state allocation of social security transfers mostly predetermined

Appendix C — Transfer multipliers under different parametrizations

Figure 10 shows how three types of multipliers discussed in Table 4 vary with the persistence of the cross-region transfers shock and other parameters of the model. The three multipliers are (i) the impact labor income multiplier (blue dash-dot), (ii) the impact output multiplier (red dash) and (iii) the present value (PV) multiplier (black solid line). The base model here is the sticky price/wage model (subplot A), a variant of which is used in the counterfactual analysis. Starting with this base model, parameters are changed one-by-one in other subplots.

For all models that have sticky wages (all except subplots G, H and I), note that the impact output multiplier and impact labor income multipliers are very similar, which reflect small movements in product wages and relative prices in the short run. In contrast, the baseline NK model (subplot G) has a large increase in product wages, which boosts the labor income multiplier above the output impact multiplier. The flex-price and flex-exchange-rate models (subplot H and I) have larger movements in relative prices, which also increase the labor income multiplier relative to the output multiplier. Note that in all models with sticky prices, the impact output multiplier is increases with transfer persistence but long-run present value (PV) multipliers decrease with transfer persistence.

A larger share of hand-to-mouth households, or the targeting of transfers at hand-to-mouth households, increases the temporary transfer multiplier substantially. Subplot D shows that impact multiplier is around 0.6-0.7 when transfers are targeted at hand-to-mouth households. One gets similar results with a higher share of hand-to-mouth households (subplot E and F).

Overall, the transfer multiplier is the most sensitive to how closed the region is, in terms of preference for locally produced products (α). Moving from a region as closed as a US state ($\alpha = 0.56$) to a region as closed as Spain ($\alpha = 0.7$) increases the size of multipliers by about 50% (subplot J). For an economy that is as closed as Brazil or the US ($\alpha = 0.85$), the transfer multiplier can be very large (subplot K): well above one if the transfer is persistent. Impact transfer multipliers are still sizable if the regional economy is a larger share of the monetary union (subplot L). More sticky wages (subplot B) or a lower Armington elasticity of substitution (subplot C) also increase the impact multiplier, but less dramatically that decreases in openness.

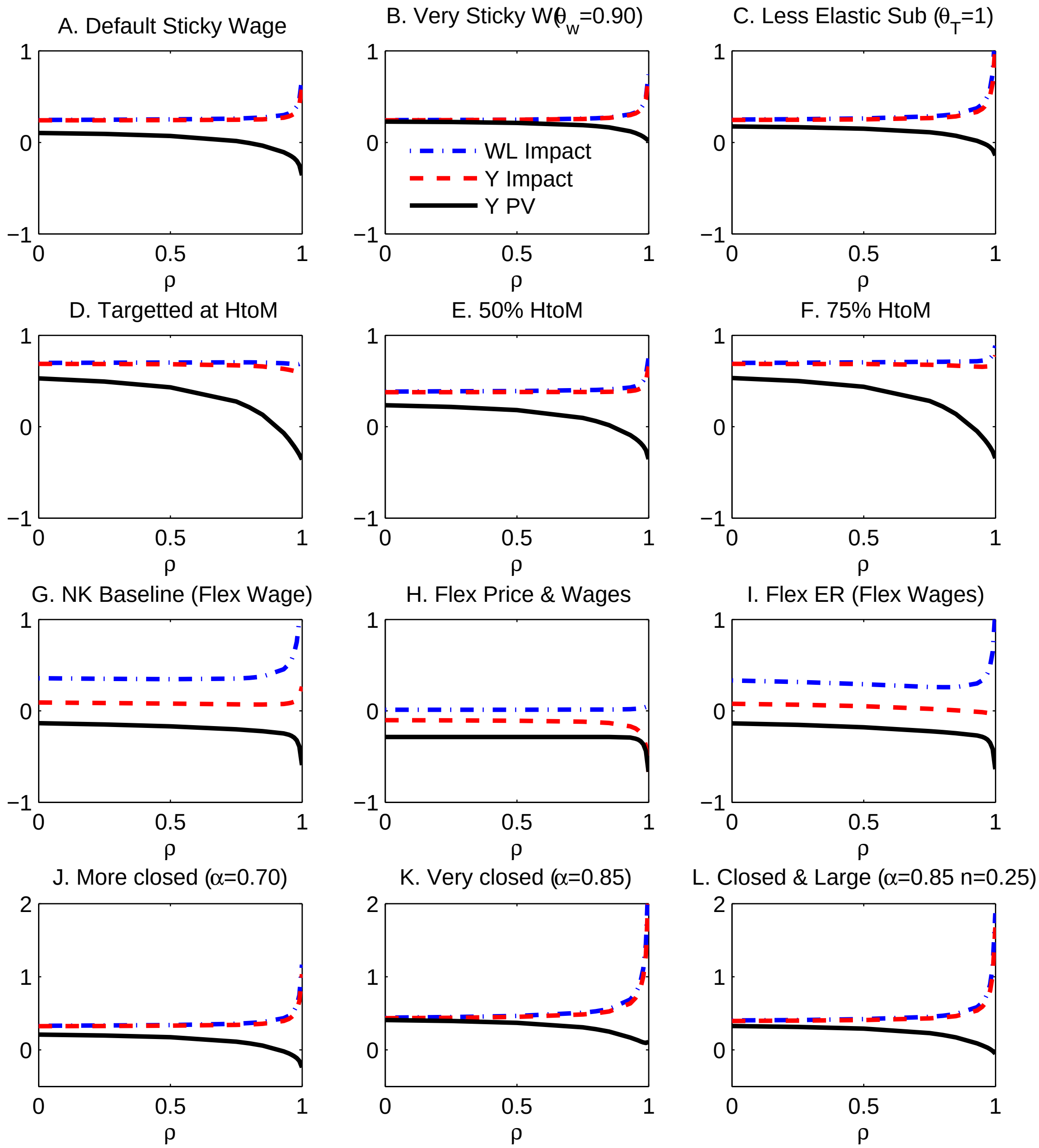


Figure 10: Cross-region transfer multipliers with different parameters as a function of transfer persistence

Appendix D: Difference between Self-funded and Federally-funded Government Purchase Multipliers

A number of papers have examined the effects of *federally-funded* government purchases at the regional level and have found large estimated multipliers. For example, Nakamura and Steinsson

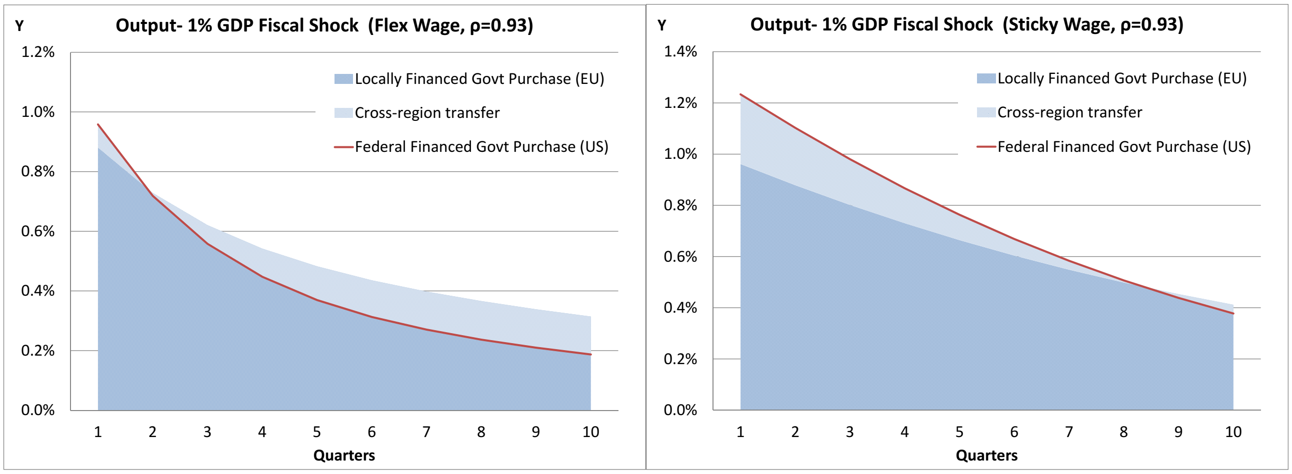


Figure 11: The locally-financed vs federally-financed regional government purchases multipliers in flex-wage NK baseline (LHS) and sticky wage (RHS) models

(2013) find a multiplier on federally-financed defense spending in US regions of about 1.5 and Suarez and Wingender (2012) find a federally-financed regional spending multiplier of about 1.9. In contrast, Clemens and Miron (2012) find a locally-financed spending multiplier of around 0.4 in US states. *Could the difference in the estimates be in the financing of spending?* I find the answer is no. Although federal financing can boost the purchases multiplier in the short term (especially when wages are sticky), the boost is not large enough to explain the differences in the empirical estimates.

As a matter of accounting, the effect of a federally-funded government purchase is equal to the effect of a locally-funded government purchase, *plus* the effects of a cross-region transfer that offsets the costs of local financing. This means that that the cross-region transfer multiplier estimated above is the difference between federally-financed and locally-financed purchase multipliers. I use this decomposition again in the Appendix when analyzing the effects of a self-funded bailout of S&L Banks in Texas in the late 1980s.

To illustrate this decomposition, I hit the regional economy with an exogenous 1% of regional GDP government purchases shock ($g_{h,t}$ in the region's resource constraint), funded by either by lump-sum taxes on the residents of the small region, or the lump-sum taxes on the whole monetary union. The persistence of the shock is 0.93, taken from Nakamura and Steinsson (2013). As we saw in the previous section, a cross-region transfer boosts regional output in the short-run due to Keynesian demand effects, but reduces it in the long-run due to neoclassical wealth effects. This means the federally financed spending multiplier is larger in the short run, but smaller in the long run (Farhi and Werning 2012 have a similar finding). The relative strength and persistence of Keynesian demand effects is much greater when wages are sticky.

The effect of regional government purchase shocks is shown in Figure 11 in the flex-wage (NK baseline, LHS) and sticky wage (RHS) models. One can see that the "wedge" between effect of federally-financed and locally-finance government purchases is equal to the cross-region transfer multiplier. With flexible wages, the boost in output from a federally-funded purchase shock relative to a locally-funded purchase shock is small and ephemeral. In contrast, with sticky wages the impact multiplier of government spending is about 0.25 percentage points higher when federally-financed, though this difference shrinks over time. These results are consistent with Nakamura and Steinsson (2013), who find that the federally-financed multiplier is only marginally greater than the locally-financed multiplier. The difference between federally-financed and locally-financed multipliers is too small to explain the difference between a number of estimated federally-funded and locally-funded government spending multipliers in the data.

Appendix D — Spain counterfactual with alternative models

In Section 4, I compare the severity of a recession similar to that experienced Spain in 2008-09 under a US-style fiscal system (with countercyclical cross-region transfers) and a EU-style fiscal system (without cross-region transfers). The initial boost to output and consumption from cross-region transfers in the US-style system is much smaller without hand-to-mouth household or sticky prices/wages. The comparison between model and data in Table 4 suggests these features are important for helping the model match the size of labor income multipliers seen in the data for the US.

The left-hand side of each panel in Figure 12 shows that the *difference* between the path of the regional economy under the US and EU fiscal systems (dot-dashed line in purple) is well approximated by the response of the economy to an exogenous cross-region transfer of 1.2% of GDP with persistence $\rho = 0.93$ (solid black line).[47] The right-hand side of each panel in Figure 12 shows that the effect of this exogenous cross-region transfer is much smaller in a model with no hand-to-mouth households (orange dot-dash line) or a neoclassical model (flexible prices/wages and no hand-to-mouth households; solid cyan line). Specifically, without hand-to-mouth households, the initial boost to output would be half as large as the baseline model and the initial boost to consumption would be only a third as large. Under a neoclassical model, the cross-region transfer would only generate a very small increase in consumption and regional GDP would actually fall.

Appendix E The Saving and Loans Crisis and bailout of Texas

A specific example of a large cross-region transfer in the US is the federal bailout of regional Savings and Loans (S&L) banks in the late 1980s/early 1990s. Over a thousand banks failed during this

[47] That is: the purple dash-dot line is the difference between the red (US) and blue (EU) lines in Figure 6. As this is a linear model, the path of the economy under the US system is equal to the path under the EU fiscal system, plus the effect of a transfer generated by the shock (the transfer is proportional to the fall in GDP). However, the path for GDP (and hence the path for the transfer) is not AR(1), so I approximate transfer generated by the spread shock with an exogenous AR(1) transfer shock that has the same present value and first-order persistence.

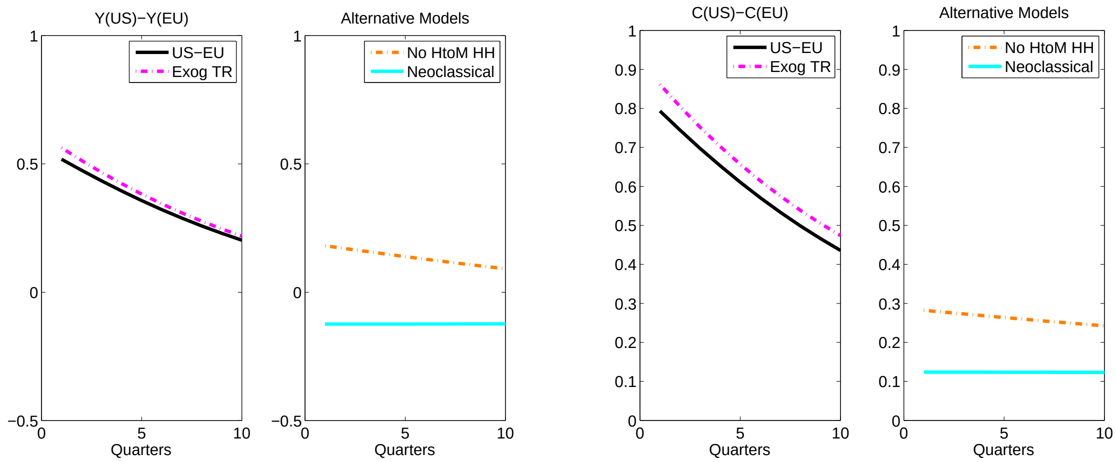
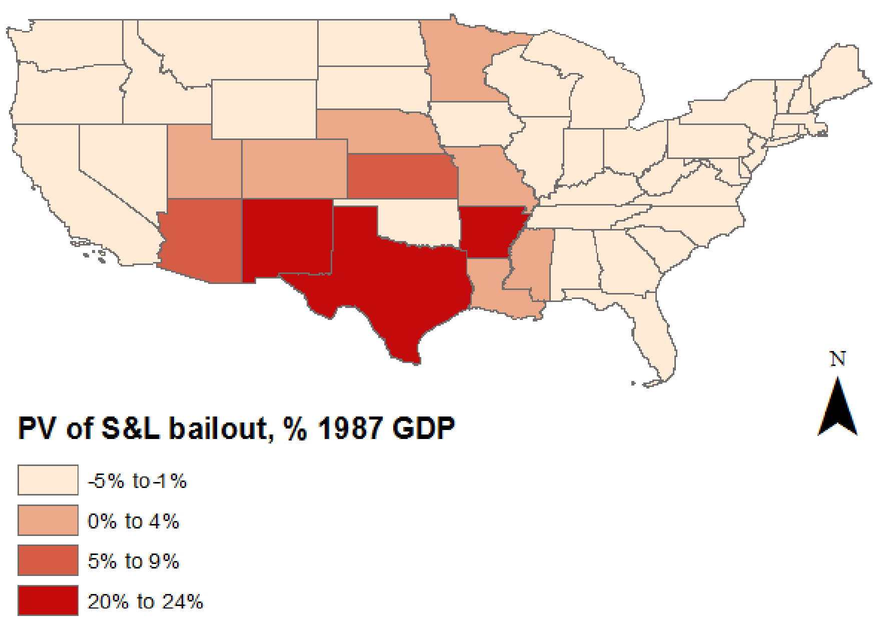


Figure 12: Spain counterfactual: Difference in Output (LHS) or Consumption (RHS) paths with cross-region transfer (US system) or without transfer (EU system) under alternative models.



Source: Hill (1990), BEA and author's calculations. Note: a positive number indicates beneficiaries of a cross-region transfer, a negative number indicates the states paying for the transfer.

Figure 13: Savings and Loans (S&L) Bailout: Present Value by State

period with combined assets of around \$500bn, and the bailout cost totaled about \$150bn (Curry and Shibut 2000, Hill 1990). However, the failed banks were geographically concentrated in Texas and surrounding states, following a deep recession in the mid 1980s in those states (FDIC 1997). Because the bailout was federally funded, it resulted in a large cross-region transfer from the rest of the US (who footed most of the bill) to those states where the banks were based.[48] The net beneficiaries were states like Texas, where the present value of the bailout, less federal taxes and deposit charges paid, was about \$60bn (Hill 1990), or 20% of Texas GDP in 1987 (Figure 13). Given Texas was in a deep recession in the mid-1980s, the bank bailout can be considered counter-cyclical.

The S & L crisis and the recession in Texas The Savings and Loans Crisis unfolded over several years, and parallels to the recent financial crisis are striking — a property crash, constantly revised losses, federal bank bailouts. Although there were S&L bank failures in most US states, the losses were concentrated in the "South West", particularly in Texas.

As the Texan economy deteriorate in the mid-1980s, S & L institutions started making large losses on loans, especially those related to the property and oil industries (FDIC 1997). In the late 1970s and early 1980s, Texas benefited from a large increase in oil prices. This, combined with favorable tax treatment, lead to a construction boom (the number of residential construction permits issued doubled from 1980-83). In the mid-1980s the oil price collapsed, falling from \$30 per barrel in November 1985 to \$10 per barrel in August 1986. The construction market collapsed as developers realized that they had overbuilt — in 1985 Dallas had more unleased office space than total office space in Miami. New residential construction permits in Texas more than halved from 1983-86 and then halved again from 1986-88. Nominal house prices in Houston fell by 23% from 1983-88 (at a time national house prices rose by 27%), and by 1987 one in six homes in Houston were vacant.

During the recession, S&L losses mounted. S&L depositors were not insured by the Federal Deposit Insurance Corporation (FDIC), but by the Federal Savings and Loan Insurance Corporation (FSLIC). On 31 December 1986, the FSLIC became insolvent. In 1987, congress recapitalized the FSLIC through bond sales, though the full scale of the losses in the S&L industry were not known. With limited funds to shut down insolvent S &L banks, the FSLIC allowed them to continue trading, which not only deepened eventually losses, but also obfuscated the size of the crisis. By 1988-89, FSLIC was running out of money again. Under the Financial Reform and Recovery and Enforcement Act of 1989, congress shut down the FSLIC, and created the Resolution Trust Corporation (RTC) to resolve the failed S&L institutions. The RTC was initially capitalized with \$50bn, but had to be topped up multiple times as losses exceeded expectations. Total losses to the

[48] Cross-region transfers are between the residents of one state and the residents of another. In this example, the cost is borne by those in other states paying for the transfers. The beneficiaries are in Texas (and surrounding states) who either (i) do not lose their deposits (relative to a counterfactual of no bailout) or (ii) do not have to pay higher taxes (relative to the counterfactual of a locally-financed bailout).

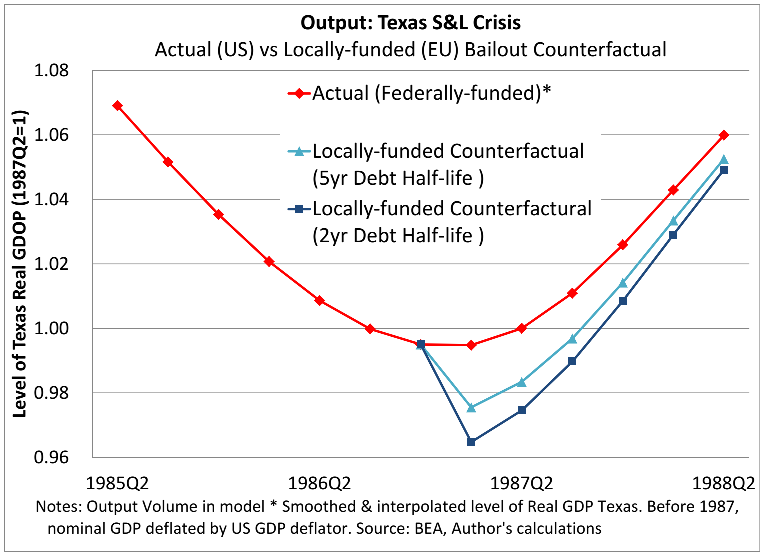


Figure 14: Texas GDP under Federal (US) vs Locally-funded (EU) S&L bank bailout

public sector were about \$125bn, with around another \$25bn funded through federal depositors fees (Hill 1990, Curry and Shibut 2000).

The experiment One reason for relatively modest differences between EMU and US fiscal systems in Section 4 is the small size of the counterfactual cross-region transfer — around 1.35% of GDP for a deep recession with a 5% fall in output. But cross-region transfers stemming from the federal bailouts of regional banks have the potential to be much larger, such as the 20% of Texas GDP cross-region transfer from the bailout of Savings and Loans (S&L) banks in the late 1980s discussed in the introduction (Figure 13). In this section, I consider *opposite* counterfactual from in Section 4: *what would be the affect on the Texas economy if there were* ***no*** *cross-regional transfers to bail out Texan S&L banks (as under the EMU fiscal system)?* That is, what if the bailouts of Texan S&L banks were locally funded (such as the Irish bank bailout) rather than federally funded?

In my linear model, the effect of a locally-funded bailout of Texas S&L banks is just the effect of a federally-funded bailout (as in the data), plus a *negative* cross-regional transfer repaying the taxpayers in the rest of the US for the bailout (funded by lump sum taxes on the residents of Texas). This negative cross-region transfer is very similar to the cross-region transfers examined in Section 3.3 and in the data. As in Section 3, I assume that this cross-region transfer follows an AR(1) process, but with the same present value as the actual bailout .

The baseline is the actual path of the Texas economy with the US [federal] fiscal system.[49] The path of (interpolated) quarterly Texas Real GDP is shown in Figure 14, showing the large

[49]The calibration is exactly the same as the full model in Section 3, except that Texas's economy is much larger than the average US state, and closer to that of a US region. For that reason, I set $n = 0.065$ (Texas GDP is 6.5% of the US total) and set $\alpha = 0.7$, which is the level of home bias used by Nakamura and Steinsson (2013) for US regions. I assume that wages are sticky.

recession which contributed to the S&L crisis.

The counterfactual is a S&L bank bailout funded by the people of Texas. This can be modeled as the same path of the economy as the federal bailout, *plus* the effect of a transfer from the residents of the Texas to the rest of the US (a *negative* cross-region transfer). The transfer is to "undo" the cross-region transfer shown in Figure 13 of 20% of 1987 Texas GDP in present value (from the rest of the US).

As the drawn-out history of the crisis makes clear, the size of the bailout required only became known slowly. These evolving expectations are hard to model. Instead, I start the crisis at 1987Q1 when the Federal Savings and Loan Insurance Corporation (FSLIC) became insolvent, and assume (i) the full size of bailout was known at that stage, (ii) the federal government announced that the residents of Texas would have to repay the cost of its bailout.

The last remaining assumption is how quickly the counterfactual bailout is repaid to the rest of the US (repaying instantly is clearly unrealistic as it would require a transfer of 80% of steady state quarterly GDP). In choosing a repayment rate, I balance a few real-world considerations. First, Texas has a balanced budget amendment (the state legislature must pass a balanced budget), and EMU countries are restricted in their ability to run deficits by EMU rules and, these days, by market pressure. Second, actual bank bailouts tend to be debt funded (eg Ireland) and the Resolution Trust Corporation (RTC) was largely debt funded off-budget.

Due to parameter uncertainty, I consider a range of repayment rates (indexed by ρ, the persistence of the negative cross-region transfer) though in all cases I adjust the initial size of the transfer to keep the present value of the transfer at -20% of Texas GDP. A debt half-life of 2 years corresponds to $\rho = 0.905$ and an initial transfer size of 8% of quarterly GDP. A debt half life of 5 years corresponds to $\rho = 0.965$, and an initial transfer size of 4.76% of quarterly GDP. If the residents of Texas never paid off their debt (just paying interest) this would be equivalent to a 0.8% of quarterly GDP *perpetual* transfer (much like the negative of the social security payment increases considered in section 2).[50]

Results The effect of the *negative* cross-region transfer are shown in Figure 15. Specifically, the fall in output would be around 2-3% larger and the fall in consumption 3-5% larger with reasonable parameters. With 2yr debt half-life ($\rho = 0.905$), output falls 3% on impact (Figure 15 LHS) and consumption falls 4.7% on impact (Figure 15 RHS). With a 5yr debt half-life ($\rho = 0.965$), the effects are a bit smaller: a 1.9% fall in GDP and a 3.1% fall in consumption. The cross-region *impact* multiplier is about 0.35 (i.e the initial size of the transfer is around 3 times larger than the fall in output) with these parameters.[51] The fall in Y and C is larger when the debt is being repaid

[50]The speed of the repayment does not directly affect the rest of the US as I assume that the *negative* cross-region transfer goes to unconstrained households in the rest of the US, who only care about the present value of the payment, rather than its time path.

[51]The impact multiplier increases with the persistence of the transfer (the half-life of the debt), but the present-value multiplier falls with persistence of the transfer.

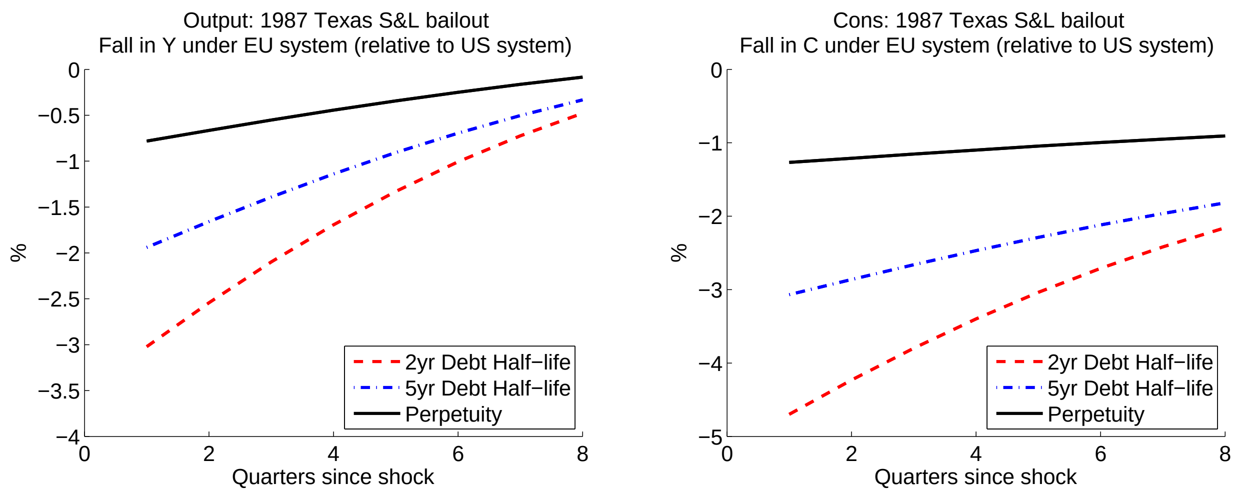


Figure 15: Output (LHS) and Consumption (RHS) —*Negative* cross-region transfer

more quickly because (i) the initial *negative* cross-region transfer is larger and (ii) hand-to-mouth households only respond to current transfers. The initial fall in output and consumption is much smaller with a perpetual transfer (0.75% and 1.25 % respectively).

The path of the economy under the self-funded bailout counterfactual is shown in blue in Figure 14, which is the actual path of output *plus* the effect of the *negative* cross-region transfer from Figure (11).[52] One can see the self-funded S&L bailout would make the mid-1980s recession in Texas much deeper, especially if the residents of Texas has to repay the debt reasonably quickly. I ignore the possibility that a self-funded bank bailout could lead to a sovereign debt crisis in and any amplification due to financial frictions.

[52]The path of GDP deflates by national prices rather than local prices to data availability, though in the model I compare to the *volume* of output.