Job Destruction without Job Creation: Structural Transformation in the Overborrowed America *

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Abstract

In recent US business cycle episodes the correlation between manufacturing and service employment has increased, and more so in recessions and US states where households are highly indebted. We argue that this is because manufacturing output matters for the demand in services when households are financially constrained. While manufacturing produces tradable goods whose demand is determined internationally, most services are non-tradable with their demand set just by local economic conditions. When manufacturing employment falls, households disposable income falls which, due to the binding financial constraint, forces households to deleverage. This leads to a contraction in manufacturing consumption that due to complementarity in consumption between manufacturing and services makes the aggregate demand for services fall. As a result economic activity falls more, households become even more constrained, and this further contracts demand for services. This prevents job creation in services and comovement increases. So we have job destruction in manufacturing without job creation in services.

JEL Codes: E32, E44, F16, F32, F41, G01
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1 Introduction

Over time, advanced economies reallocate resources from manufacturing to services, see Herrendorf, Rogerson, and Valentinyi (2013). This reallocation process has cyclical features, see for example Rogerson (1991). In the United States (i) job destruction in manufacturing mostly occurs in recessions, (ii) job creation in services is concentrated in expansions, (iii) recessions typically start with a contraction in manufacturing employment followed by an increase in service employment.

Since the early 90's, this cyclical pattern has changed. We find that: (i) job destruction in manufacturing has accelerated in recessions (and in recoveries), (ii) job creation in services has slowed down in recoveries, (iii) overall, manufacturing and service employment have become more synchronized (and more so in US states with higher household debt). We provide evidence of the increased comovement between manufacturing ad services employment. The increased comovement is stronger in states where households were more indebted. We also show that net exports have become more countercyclical. In fact, latest US recessions feature sharp reversals of the current account and trade balance, which are typical in Sudden Stops emphasized in the emerging economies literature, see for example Mendoza (2010). Hence the US business cycle now resembles the one of a standard emerging economy.

Why has synchronization increased? We argue this is because current income matters for the aggregate demand for services when households are financially constrained. Household debt has increased substantially since the 90's (due to low borrowing real interest rates and/or increased world supply of savings). This makes households more prone to become financially constrained. While manufacturing produces tradable goods whose demand is determined internationally, most services are non-tradable with their demand set just by local economic conditions. When manufacturing employment falls, households disposable income falls which, due to the binding financial constraint, forces households to deleverage. This leads to a contraction in manufacturing consumption that due to complementarity in consumption between manufacturing and services makes the aggregate demand for services fall. As a result economic activity falls more, households become even more constrained, and this further contracts demand for services. This prevents job creation in services and comovement increases. So we have job destruction in manufacturing without job creation in services. This mechanism is mostly important in (severe) recessions and in recoveries, which is when households are more likely to become financially constrained.

Work in progress: We are currently investigating on whether our mechanism could account for the observed increased comovement between manufacturing and services employment by estimating the model with US data. Specifically, we log-linearize the model around two steady states: one in which the borrowing constraint is binding and another in which the constraint is slack. We fit the log-linearized models to quarterly US time series on manufacturing and services employment levels, goods and services consumption, and net trade balance. The models are estimated over the full sample, 1952Q1:2012Q4, as well as over the pre- and post-90's samples. Estimation is conducted via Bayesian methods and models are compared following An and Schorfheide (2007) via posterior odds ratios. Consistently with our story, Charles, Hurst, and Notowidigdo (2013) provide evidence that job destruction in manufacturing employment and the implied lack of job creation in services have contributed substantially to the sluggish recovery in the US.

Relation to the literature. *The role of demand over the business cycle.* There is theoretical debate on the modeling of aggregate demand in business cycle fluctuations. Demand shocks might be due to expectational errors as in Lorenzoni (2009), to changes in search behavior of consumers as in Bai, Storesletten, and Ríos-Rull (2012), or to changes in the price of collateral or job uncertainty that affect aggregate demand in sticky price models as in Monacelli (2009) and Sterk and Ravn (2012). Here demand plays a role in a neoclassical model without sticky prices because one sector (services) is non-tradable.

Role of aggregate demand over the great recession. There is debate about why high unemployment persists after latest US recessions. According to the mismatch hypothesis, high unemployment is due to mismatch between workers' skills and employers' requirements. But Sahin, Song, Topa, and Violante (2012) find that mismatch accounts for only 1/3 of recent rise in unemployment. The US FED supports the alternative view that demand plays a role.[1] Mian and Sufi (2011) provide evidence that debt has contributed to increases in price of housing. Mian and Sufi (2012) and Mian, Rao, and Sufi (2013) provide direct evidence that high household debt has contributed to a fall in consumption and aggregate demand, with direct implications for the high level of unemployment observed in the great recession. The fact that relative prices of services have fallen relatively to trend in last recession provides another piece of evidence in support for the existence of a demand channel. In our theory, jobless recovery is due to lack of households' demand as in Philippon and Midrigan (2011).[2]

Macroeconomic consequences of US deleveraging. Some recent papers address the question of what are the macro consequences in the US of first leveraging and then deleveraging. Justiniano, Primiceri, and Tambalotti (2012) find that the households' deleveraging has little macro consequences in a closed economy where effects of domestic lenders and borrowers wash out in aggregate. Justiniano, Primiceri, and Tambalotti (2013) argue that dynamics of foreign capital flows account for between one fourth and one third of the recent cycle in US house prices and household debt. Kehoe, Ruhl, and Steinberg (2013) quantitatively predict that if the global savings glut ends, US would run a trade surplus entirely originated by services exports, while continuing to import more goods than services. Here we emphasize the special role of the tradable sector during a deleveraging phase where households are financially constrained, i.e. during a financial crisis.

Sudden stops and emerging economies. Sudden Stops in emerging economies are characterized by large falls in output and consumption, and reversal of the current account and

[1] Ben S. Bernanke, in *Recent Developments in the Labor Market*, NABE Meeting March 26, 2012. *"Is the current high level of long-term unemployment primarily the result of cyclical factors, such as insufficient aggregate demand, or of structural changes, such as worsening mismatch between workers' skills and employers' requirements? If cyclical factors predominate, then policies that support a broader economic recovery should be effective in addressing long-term unemployment as well; if the causes are structural, then other policy tools will be needed. I will argue today that, while both cyclical and structural forces have doubtless contributed to the increase in long-term unemployed, the continued weakness in aggregate demand is likely the predominant factor. Consequently, the Federal Reserve's accommodative monetary policies, by providing support for demand and for the recovery, should help, over time, to reduce long-term unemployment as well."*

[2] There are alternative theories about the US jobless recovery: in Schaal (2012), firms do not hire due to increased uncertainty; for Jaimovich and Siu (2012) jobless recovery is due to job polarization.

trade balance. Aguiar and Gopinath (2007) argue that sudden stops are consistent with a conventional RBC model were shocks to the trend drives the cycle. This explanation has been questioned by the evidence by García-Cicco, Pancrazi, and Uribe (2010). Mendoza (2010), Bianchi (2011) and Mendoza and Yue (2012) argue that sudden stops are due to domestic agents who are financially constrained. This literature has typically emphasized an overborrowing externality, since households do not fully internalize the risk of entering a financial crisis. Our framework builds on Bianchi (2011) with one departure: the supply of tradables (manufacturing) and nontradables (services) is endogenous. Overall, here we emphasize the special role of the tradable sector in periods of financial crisis.

The structure of the paper is as follows. Section 2 contains some motivating evidence. Section 3 describes our DSGE model. Section 4 concludes.

2 Motivating Evidence

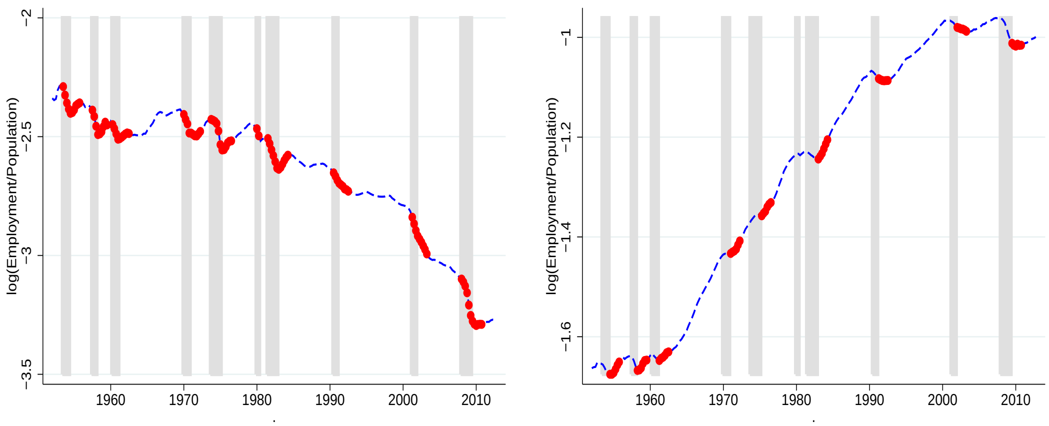
Figure 1 reports the time series of employment in manufacturing and services, normalized by total population, from 1952 to 2012.[3] Over the full sample, manufacturing employment falls while services employment rises, that is the structural transformation occurring in the US. The pace of the structural transformation interacts with the business cycle. Job destruction in manufacturing mostly occurs in recessions, while there is creation of jobs in services during expansions. This has yet been emphasized in the literature, see Rogerson (1991).

However the pattern has changed. We define recoveries as 6-quarters periods after the through of each recession as defined by the NBER indicator. For services employment, we highlight with red points the time observations belonging to a recession. For manufacturing employment, we highlight the points which relate to recessions and recoveries. Figure 2 shows a break which starts with the recession of the 1991. Before this date, employment in manufacturing rebounds during recoveries (V-shaped behavior) while starting with the 1991 recession employment continues to fall even during recoveries.[4] So since the 90's, job

[3]Normalizing by the aggregate labor force does not change the results.

[4]There is current debate about how to correctly identify recession and recoveries in the data. Hall (2011) defines *slump* a period in which employment over labor force is less than its normal level of 95.5

Figure 1: Structural transformation over the US business cycle



(a) Manufacturing employment

(b) Services employment

destruction in manufacturing accelerates. This is possibly due to the increased competition from foreign countries, see Autor, Dorn, and Hanson (2013) and Pierce and Schott (2012). At the same time jobs in services slowly recover after recessions. We compute the correlations between manufacturing and services employment using detrended data (growth rates or Hodrick-Prescott filtered data). Table 2 reports an overall increase in the correlations at all lags and leads. So manufacturing and services tend to be more synchronized over time.

Further, Figure 2 reports the current account and trade balance in panel (a), and the US households' debt-income ratio and the 5-years Treasury Bill and the 30-years mortgage (real) rates in panel (b). Over the last decades the US economy has had access to an unprecedented low cost of borrowing. The Americans massively borrowed from abroad and this has been reflected in the dramatic deterioration of the US current account, see panel (a). In the recessions of the 1970, 1975 and 1980-1982, current account and trade balance deteriorate. After the 90's, recessions feature reversals of the current account and trade balance with respect to trend. The post-90's US recessions look like Sudden Stops of a standard emerging economy. Table 4 in Appendix shows the correlation of net exports over GDP with other macroeconomic aggregates using detrended data. The US

percent. We address this issue by varying the window used for indicating recovery periods, results do not change.

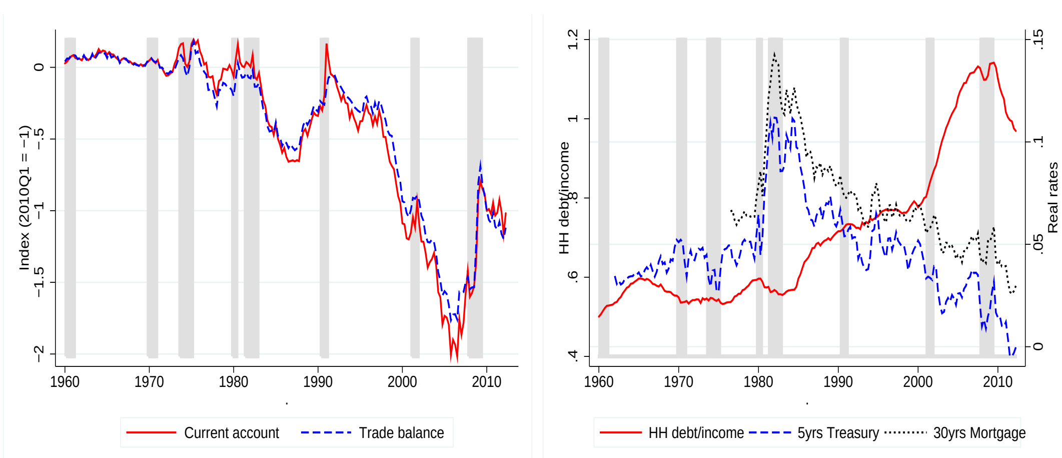
Table 1: US business cycle correlations (quarterly data)

	Growth rates			HP $\lambda = 1600$		
	Pre-1990	*Post-1990*	diff	*Pre-1990*	*Post-1990*	diff
$\rho(n_m, n_s)$	.76	.84	.08	.86	.93	.07*
$\rho(n_{mt-1}, n_{st})$	.63	.75	.13	.83	.92	.09*
$\rho(n_{mt-2}, n_{st})$	.36	.62	.26*	.69	.83	.14*
$\rho(n_{mt-4}, n_{st})$	.04	.34	.30*	.30	.50	.19
$\rho(n_{mt}, n_{st-1})$	.53	.76	.23*	.75	.86	.11*
$\rho(n_{mt}, n_{st-2})$	.27	.56	.30*	.54	.71	.17*
$\rho(n_{mt}, n_{st-4})$	-.08	.19	.27*	.06	.30	.24

Notes: *Pre-1990* refers to the period 1952Q1-1989Q4; *Post-1990* refers to 1990Q1-2012Q4. 'm' stands for Manufacturing, 's' for Total Services. Test of difference between the correlation coefficients using Fisher z-transformation. * indicates significance at 5 percent level.

trade balance has become more countercyclical than before, a typical feature of emerging economies business cycles, see for example Aguiar and Gopinath (2006) and Mendoza (2010).

Figure 2: US current account and trade balance reversals, and households' leveraging



(a) Net export and current account

(b) Household debt and interest rates

At the same time, debt of US households reached unprecedented levels, see panel (b). We ask whether this dramatic leveraging is responsible for the increased comovement between manufacturing and services jobs. We test whether, in the last US recession, services employment has responded more to (exogenous) changes in manufacturing employment in US states where households were more indebted (at the beginning of the crisis). We use annual data (2007-2011) at the US state level to estimate:

$$\Delta n_{S,i,t} = \beta \Delta n_{M,i,t} * HHleverage_{2007} + \gamma' X_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t}$$

where i indexes states, t time. $\Delta n_{S,i,t}$ and $\Delta n_{M,i,t}$ are the annual changes in services and manufacturing employments per capita, $HHleverage_{2007}$ is the households debt over disposable personal income for the year 2007, α_i and δ_t are respectively state and fixed effects. To identify some causal effects of changes in manufacturing employment on serviced employment we borrow from Autor, Dorn, and Hanson (2013) the idea that the emergence of China is a shock to manufacturing employment with varying impact across US states. We use their index of penetration of Chinese imports in US state i over the period 2000-2007 as IV.

Table 2 reports results. Columns (1) to (4) use as dependent variable the change in employment in total services, while columns (5) to (8) use the change in employment in total services without financial and real estate activities (FIRE). Since in practice most of FIRE services can be internationally traded, we expect that by excluding these sectors the effects of our mechanism are amplified. The estimated coefficients associated to the change in manufacturing employment are positive and significant in all regressions. That is, a fall in manufacturing employment leads to a fall in services employment. This is consistent with the high sectoral synchronization that we previously documented. Also the estimates for the interaction between the change in manufacturing employment and the pre-crisis level of debt, which is our regressor of interest, are positive in all specifications. Hence falls in manufacturing employment lead to falls in services employment, and the effect is stronger in those states in which the households are more leveraged. The effects are more pronounced in regressions which exclude the FIRE sectors (columns (5) to (8)), and this finding supports the idea that our mechanism particularly mostly affects nontradable services.

We also experimented with a specification where we instrument households' debt over income using the Saiz (2010) index of housing supply elasticity, as in Mian and Sufi

(2012), and results do not change. Table 5 in Appendix reports similar regressions using 183 Metropolitan Statistical Areas (MSAs). The estimates for the interaction term are positive and significant in all regressions, and are larger when excluding FIRE sectors from the dependent variable. This confirms previous findings of US States level regressions.

Table 2: Panel state level evidence on sensitivity of service employment growth to manufacturing employment growth (yearly data, 2007-2011 period)

	Total services				*Total services excl. FIRE*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Δ Manufacturing employment	.087***	.091***	.190***	.237***	.086***	.097***	.166***	.248***
	[.015]	[.013]	[.058]	[.047]	[.014]	[.014]	[.061]	[.050]
Δ M. empl × Debt/income in 2007	.184***	.193***	.214***	.201***	.215***	.222***	.236***	.230***
	[.023]	[.022]	[.028]	[.030]	[.028]	[.026]	[.029]	[.032]
Δ House prices	.053**	.035	.041	.036	.044	.027	.037	.032
	[.026]	[.033]	[.028]	[.033]	[.027]	[.032]	[.028]	[.033]
Δ House prices × Debt/income in 2007	-.043	.072	-.026	.082	-.041	.055	-.033	.060
	[.053]	[.077]	[.057]	[.072]	[.052]	[.082]	[.054]	[.078]
Debt/income ratio in 2007	-.010***		-.006**		-.009***		-.005*	
	[.026]		[.002]		[.003]		[.002]	
Manufacturing empl. Share in 2007	.001		.000		.000		.001	
	[.001]		[.002]		[.001]		[.002]	
House prices in 2007	.011***		.009***		.011***		.009***	
	[.002]		[.002]		[.002]		[.002]	
Observations	204	204	192	192	204	204	192	192
R-squared	.86	.90	.86	.87	.86	.90	.87	.87
J-test			10.00	10.96			13.94	11.61
p-value			.35	.14			.12	.11
State fixed effects	N	Y	N	Y	N	Y	N	Y
IV	N	N	Y	Y	N	N	Y	Y

Notes: annual data (2007-2011) for 50 US States plus District of Columbia. All variables are in logs. Dependent variable in columns *(1)-(4)* is the change in log total private service employment, in columns *(5)-(8)* is the change in log total private service employment excluding financial and real estate activities (FIRE). Debt/income is calculated in 2007 at the start of the recession and it is measured in logs. All regressions include year fixed effects, standard errors are clustered at the state level. Coefficients of the constant and year dummies are not reported. ***,**,*: indicates significance at the 1, 5, and 10 percent level respectively. Bottom and top decile of sample log-change in total services employment are {-2.5%, .6%}; of log-change in total services employment minus FIRE are {-2.8%, .5%}; of log-change in manufacturing employment are {-12.1%, 1.4%}; of logged debt over income in 2007 are {-.24, .38}. The analogous number for quartiles are {-1.5%, 0%}, {-1.7%, 0%}, {-7.3%, .1%} and {-.14, .27}, respectively.

3 The Model

3.1 Assumptions

We represent the US as a small open economy with two sectors $i = m, s$. The manufacturing sector $i = m$ produces tradable goods which we set as the numeraire. The service sector $i = s$ produces non-tradable goods which can be consumed just locally. Manufacturing goods and services are produced by perfectly competitive firms. Services firms produce services according to the following production function

$$y_{st} = A_t \min \{e_{st}, k\} \tag{1}$$

while manufacturing firms produce goods according to

$$y_{mt} = ZA_t \min \{e_{mt}, k\} \tag{2}$$

where y_i and e_i respectively denote output and employment in sector i, $Z > 0$ is a (time-invariant) parameter which governs the level of productivity of manufacturing relative to services, A_t represents the (stochastic) level of productivity of all market activities (both manufacturing and services), and $k > 0$ is a parameter which measures the units of capital required for each unit of labor employed.[5] For simplicity, we assume k is common across sectors. Capital is priced in terms of the tradable good (say the cost of buying a machine). We assume that the market technology A_t evolves as

$$a_t \equiv \ln A_t = \rho_a a_{t-1} + \varepsilon_{at} \tag{3}$$

where we normalize to one the steady state level. Following Schmitt-Grohe and Uribe (2012), we assume that market-wide technology is subject to anticipated as well as unanticipated innovations. Specifically, we impose the following structure on the error term ε_{at}:

$$\varepsilon_{at} = u^0_{at} + u^1_{at-1} + u^2_{at-2} + u^3_{at-3} \tag{4}$$

[5]The assumption that labor and capital enter in a Leontief production function greatly simplifies the solution of the model. Alternatively we could assume a more standard Cobb-Douglas production function without changing the qualitative implications of our mechanism.

where u_{at}^{j} for $j = 0, 1, 2, 3$ denote j-period anticipated innovations in the level of A_t. For example, u_{xt-2}^{2} is an innovation to the level of A_t that materializes in period t, but that agents learn about in period $t-2$. The innovation u_{xt}^{j} has zero mean, standard deviation σ_a^j and is uncorrelated across time and across anticipation horizon.[6]

The economy is characterized by a representative household with preferences over the utility obtained by consuming c_m units of the manufacturing goods and c_s units of services. The instantaneous utility from consumption is $\ln u(c_{mt}, c_{st})$ where

$$u(c_m, c_s) = \left[\gamma c_m^{-\epsilon} + (1-\gamma)\, c_s^{-\epsilon}\right]^{-\frac{1}{\epsilon}} \tag{5}$$

The assumption of log preferences would guarantee the existence of a steady state with structural transformation in the presence of ongoing technological progress in manufacturing productivity, see Herrendorf, Rogerson, and Valentinyi (2013). Following the structural transformation literature we assume $\epsilon \geq 0$. We assume that there are no movements in and out of the labor force. We think of the household as composed by a continuum of workers of measure one. The household can reallocate workers across sectors without cost. Workers elastically supply labor. The household chooses the effort levels e_m and e_s respectively in manufacturing and services. We assume the following effort cost function

$$E(e_m, e_s) = \frac{\psi}{1+\sigma}\left(e_m + e_s\right)^{1+\sigma} \tag{6}$$

with $\sigma > 0$ is the inverse Frisch elasticity and $\psi > 0$ is a labor disutility parameter.[7] As in Andolfatto (1996) and Den-Haan, Ramey, and Watson (2000) workers pool their income at the end of the period and choose consumption and effort costs to maximize the sum of the expected utility of the household's members. The utility obtained by the representative household in period t is given by:

$$\ln u(c_{mt}, c_{st}) - E(e_{mt}, e_{st}) \tag{7}$$

[6]News shocks are an unnecessary ingredient for our mechanism but they are useful in estimating the model. The model is estimated using five observables (manufacturing and services employments, goods and services consumption, and net trade balance) and two shocks (technology and financial), and the presence of news shocks allows for having as many observables as unobservables, in order to avoid stochastic singularity.

[7]The assumption of elastic labor supply is a necessary ingredient for our model to generate positive comovement in sectoral employments: with fixed labor supply, sectoral employments mechanically move in opposite direction.

where the functions u and E are defined respectively in (5) and (6).

The household is infinitely lived and discounts utility streams at rate β. The household can borrow from the rest of the world at an internationally determined fixed interest rate R which satisfies

$$\beta R < 1.$$

That is, the household in our economy is relatively more impatient than foreigners as in Boz and Mendoza (2014). This assumption captures in a simple way the idea of a *global saving glut* following Bernanke (2005). We assume that the household inherits a stock of debt $d_{t-1} > 0$ from the previous period. She has to decide how much debt to repay τ_t, which determines next period debt as equal to

$$d_t = Rd_{t-1} - \tau_t \tag{8}$$

We assume there is a cost in terms of the tradable good for adjusting the level of foreign debt, $D_t = D(d_t - d_{t-1})$. Specifically we assume

$$D(d_t - d_{t-1}) = \frac{\omega}{2}(d_t - d_{t-1})^2 \tag{9}$$

where ω is a parameter strictly greater than zero. Too much leveraging (or deleveraging) is costly to the household, since the function is increasing and convex in the change of stock of foreign debt.

The household owns firms in both sectors. The per period budget constraint of the household reads

$$c_{mt} + p_{st}c_{st} + Rd_{t-1} + D(d_t - d_{t-1}) = ZA_te_{mt} + p_{st}A_te_{st} - k(e_{mt} + e_{st}) + d_t \tag{10}$$

The household is subject to the following financial constraint:

$$\xi_t\beta E_t\left(q_{t+1}\right) \geq Rd_{t-1} + D(d_t - d_{t-1}) + \theta k(e_{mt} + e_{st}) \tag{11}$$

where q_t is the market value of production in the economy, which is defined by its Bellman equation as

$$q_t = y_{mt} + p_{st}y_{st} + \beta E_t\left(\frac{\lambda_{t+1}}{\lambda_t}q_{t+1}\right) \tag{12}$$

where λ measures the marginal utility of income. $\theta \in (0, 1)$ denotes the amount of liquidity needed to finance firms' capital investment (i.e. working capital). Higher value of θ implies that a tighter financial constraint restricts job creation and increases job destruction by making firm investment more costly, which is a conventional investment channel of financial constraint, see for example Bernanke and Gertler (1989) and Cooley, Marimon, and Quadrini (2004). The market value of production in the economy enters in the collateral as in Mendoza (2002), Korinek (2010), and Bianchi (2011). This formulation is particularly convenient to study the relation between manufacturing and service employment in an economy where households are financially constrained.

In the Appendix we provide a simple microfoundation for the constraint that builds on Mendoza (2002). The idea is that, at the beginning of each period, households need liquidity to repay long term debt and the costs of adjusting debt. This liquidity is provided by external financiers through intraperiod loans that should be repaid at the end of the period when the household receives her income. If the household reneges her debt, external financiers retaliate and destroy a fraction of household future income. This sets a limit on the financial capacity of households, which justifies (11).

The constraint in (11) is consistent with standard practices in the US mortgage market which effectively require borrowers to keep their total debt service payments below 1/3 of their income. Also, Jappelli (1990) provides empirical support for the relevance of the constraint in (11) by showing that *current* income is a major determinant of credit market access in the US.

The financial constraint in (11) has two key properties that are satisfied by a large class of models where the borrowing limit is endogenously determined. The first is that the financial capacity and the value of debt are expressed in the same unit, here the units of tradable goods. The second is that the borrowing financial capacity depends on the general level of economic activity and so on the value of production both in the tradable and in the nontradable sector of the economy. This is a property of any model where financial capacity depends on the value of some collateralizable assets (say physical capital, housing or the value of firms' equities) whose value increases with the general level of local economic activity, see Kiyotaki and Moore (1997) and Mendoza (2010) for example of models where the financial constraints depends on the price of capital and Iacoviello (2005), Philippon and Midrigan (2011), Heathcote and Perri (2012), and Justiniano, Primiceri, and Tambalotti (2012) for example where the constraints depends on the price of housing. All results of the paper hold provided that the financial constraint satisfies these two properties.

The amount of collateralizable income evolves as

$$\ln \xi_t = (1 - \rho_\xi) \ln \bar{\xi} + \rho_\xi \ln \xi_{t-1} + \varepsilon_{\xi t}. \tag{13}$$

As in Jermann and Quadrini (2012) this is how we formalize the notion of a financial shock. As for technology, we assume that the financial shock is a composition of anticipated as well as unanticipated innovations by imposing the following structure on the error term $\varepsilon_{\xi t}$:

$$\varepsilon_{\xi t} = u^0_{\xi t} + u^1_{\xi t-1} + u^2_{\xi t-2} + u^3_{\xi t-3} \tag{14}$$

where $u^j_{\xi t}$ for $j = 0, 1, 2, 3$ denote j-period anticipated innovations in the level of ξ_t, which have zero mean, standard deviation σ^j_ξ and are uncorrelated across time and across anticipation horizon.

3.2 Equilibrium

The representative household maximizes the expected present value of its instantaneous utility (7), subject to the per period budget constraint (10) and the financial constraint (11). The problem of the household can be characterized by the following Bellman equation:

$$V_t(d_{t-1}, \mathbf{u}_t) = \max_{\substack{c_{mt}, c_{st}, d_t, \\ e_{mt}, e_{st}}} \ln u(c_{mt}, c_{st}) - E(e_{mt}, e_{st}) + \beta E_t \left[V_{t+1}(d_t, \mathbf{u}_{t+1}) \right] \tag{15}$$

where V_t is the value of being a household at time t with debt d_{t-1} inherited from previous period, conditional on the current exogenous states $\mathbf{u}_t$ (namely the market-wide technology level A_t and the financial shock ξ_t). The problem is subject to the budget constraint in (10) and the financial constraint in (11). The Lagrange multiplier on the budget constraint (10) is denoted by λ_t, while the Lagrange multiplier on the financial constraint (11) is denoted by $\lambda_t \eta_t$. The Lagrangian of the problem can then be written as equal to

$$
\begin{aligned}
L = \quad & E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \ln u(c_{mt}, c_{st}) - E(e_{mt}, e_{st}) \right\} \\
& + \sum_{t=0}^{\infty} \beta^t \lambda_t \left\{ Z A_t e_{mt} + p_{st} A_t e_{st} - k(e_{mt} + e_{st}) + d_t - R d_{t-1} - D(d_t - d_{t-1}) - c_{mt} - p_{st} c_{st} \right\} \\
& + \sum_{t=0}^{\infty} \beta^t \lambda_t \eta_t \left\{ \xi_t \beta q_{t+1} - R d_{t-1} - D(d_t - d_{t-1}) - \theta k(e_{mt} + e_{st}) \right\}
\end{aligned}
$$

The first order conditions with respect to c_{mt} and c_{st} read as follows

$$
\frac{\gamma c_{mt}^{-(1+\epsilon)}}{\gamma c_{mt}^{-\epsilon} + (1-\gamma)\, c_{st}^{-\epsilon}} = \lambda_t \tag{16}
$$

$$
\frac{(1-\gamma)\, c_{st}^{-(1+\epsilon)}}{\gamma c_{mt}^{-\epsilon} + (1-\gamma)\, c_{st}^{-\epsilon}} = \lambda_t p_{st} \tag{17}
$$

After dividing side by side (16) and (17), we also obtain

$$
p_{st} = \frac{1-\gamma}{\gamma} \left(\frac{c_{mt}}{c_{st}} \right)^{1+\epsilon}, \tag{18}
$$

which equates the marginal rate of substitution between consumption of services and manufacturing goods to the relative price of services. The first order condition with respect to d_t reads

$$
\lambda_t = \beta R E_t \left[\lambda_{t+1}(1+\eta_{t+1}) \right] + \omega \left\{ \lambda_t (d_t - d_{t-1})(1+\eta_t) - \beta E_t \left[\lambda_{t+1}(d_{t+1} - d_t)(1+\eta_{t+1}) \right] \right\} \tag{19}
$$

The first order conditions with respect to e_{mt} and e_{st} read as follows

$$
Z A_t - k(1+\theta\eta_t) = \frac{\psi}{\lambda_t} (e_{mt} + e_{st})^{\sigma} \tag{20}
$$

$$
p_{st} A_t - k(1+\theta\eta_t) = \frac{\psi}{\lambda_t} (e_{mt} + e_{st})^{\sigma} \tag{21}
$$

These conditions equate the marginal cost of a job to the marginal increase in income respectively in manufacturing and services. Market clearing in the services sector at time t implies that

$$
c_{st} = A_t e_{st} \tag{22}
$$

while market clearing in the manufacturing sector requires that

$$
c_{mt} + \tau_t + \frac{\omega}{2}(d_t - d_{t-1})^2 = Z A_t e_{mt} - k(e_{mt} + e_{st}) \tag{23}
$$

where τ_t are debt repayments defined in (8).

The equilibrium consists of a tuple

$$\left(\ a_t, \xi_t, d_t, c_{mt}, c_{st}, e_{mt}, e_{st}, \tau_t, p_{st}, q_t, \lambda_t, \eta_t \ \right)$$

The elements of the tuple should satisfy the following conditions:

1. The vector of shocks (a_t, ξ_t) satisfies the laws of motion (3) and (13).

2. The values for sectoral efforts e_{mt} and e_{st} should satisfy the first order conditions in (20) and (21):

$$\begin{aligned} ZA_t - k(1+\theta\eta_t) &= \frac{\psi}{\lambda_t}\left(e_{mt}+e_{st}\right)^{\sigma} \\ p_{st}A_t - k(1+\theta\eta_t) &= \frac{\psi}{\lambda_t}\left(e_{mt}+e_{st}\right)^{\sigma} \end{aligned} \tag{24}$$

3. Consumption expenditure levels c_{mt} and c_{st} should satisfy the market clearing conditions (16) and (17):

$$\begin{aligned} c_{mt} + \tau_t + \frac{\omega}{2}(d_t - d_{t-1})^2 &= ZA_te_{mt} - k(e_{mt}+e_{st}) \\ c_{st} &= A_te_{st} \end{aligned}$$

4. The value of debt d_t should satisfy the first order condition in (19):

$$\lambda_t = \beta RE_t\left[\lambda_{t+1}(1+\eta_{t+1})\right] + \omega\left\{\lambda_t(d_t-d_{t-1})(1+\eta_t) - \beta E_t\left[\lambda_{t+1}(d_{t+1}-d_t)(1+\eta_{t+1})\right]\right\}$$

5. The value of debt repayments τ_t should satisfy the law of motion of debt in (8)

$$d_t = Rd_{t-1} - \tau_t$$

6. The relative price of services p_{st} should satisfy the optimality condition in (18)

$$p_{st} = \frac{1-\gamma}{\gamma}\left(\frac{c_{mt}}{c_{st}}\right)^{1+\epsilon}$$

7. The Lagrange multiplier on the household budget constraint λ_t should satisfy (16):

$$\frac{\gamma c_{mt}^{-(1+\epsilon)}}{\gamma c_{mt}^{-\epsilon} + (1-\gamma)\, c_{st}^{-\epsilon}} = \lambda_t$$

8. The financial constraint Lagrange multiplier η_t should satisfy (11) as an equality:

$$\xi_t \beta E_t (q_{t+1}) = Rd_{t-1} + D(d_t - d_{t-1}) + \theta k(e_{mt} + e_{st})$$

9. The market value of production in the economy q_t is defined by its Bellman equation

$$q_t = Ze_{mt} + p_{st}e_{st} + \beta E_t \left(\frac{\lambda_{t+1}}{\lambda_t} q_{t+1} \right)$$

3.3 Model properties

The mechanism of the model works as follows. When the economy is financially constrained, any shock which reduces the households' disposable income leads to a drop in the value of the collateral and forces households to deleverage. Debt repayments crowd out manufacturing consumption that, due to complementarity in consumption between manufacturing and services, make the aggregate demand for services fall. As a result economic activity falls more, households become even more constrained, and this further contracts demand for services. This mechanism is absent when the economy is financially unconstrained, as households borrow to smooth their consumption when bad shocks hit.

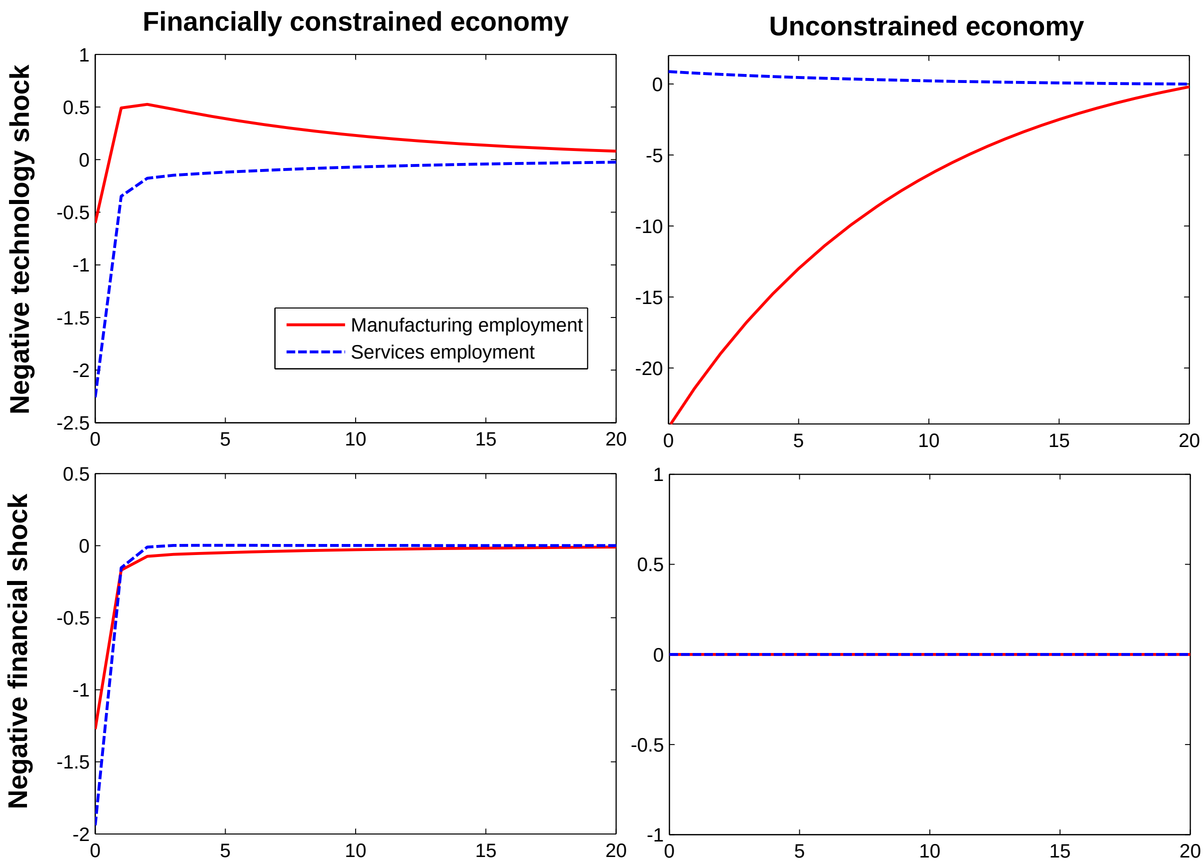
We show this mechanism by comparing the responses to negative productivity and financial shocks when the economy is financially constrained and unconstrained. Regarding the calibration, we set values of selected parameters by targeting selected aggregates of the US economy over the period 1990Q1-2012Q4, while other parameters are set by relying on previous literature. For the remaining set of parameters which will be estimated in next section, we assign arbitrary values for illustration. We set the yearly real interest rate equal to 2 percent for the financially constrained economy which is close to the value in Boz and Mendoza (2014). Then we set a subjective discount rate $\beta = 0.9875$ which implies a yearly real interest rate in the unconstrained economy equal to 5 percent. The share of manufactured goods in consumption is $\gamma = 0.2$ following the literature. We set the inverse Frisch elasticity equal to $\sigma = 1/2$ following Hall (2009). We follow Buera and Kaboski (2009) in setting the manufacturing-services complementarity parameter equal to $\varepsilon = 1$. We jointly set the steady state level of relative productivity in manufacturing Z and the capital content per labor unit k to match 11.6 % share of employment in manufacturing and 16.2 % of investment over GDP. We follow Bianchi and Mendoza (2010) in setting the liquidity parameter $\theta = 0.56$ so to match a working capital over GDP of about 9 %. We set the steady state level of the financial shock $\bar{\xi}$ to match the net foreign debt over GDP of about 14.1 %. Regarding the other parameters which we expect to estimate, we set for illustration zero adjustment costs of debt ($\omega = 0$), the autocorrelation coefficients of the shocks are all equal to 0.7 and the variances of their innovations are normalized to one. In the following we abstract from news shocks, which are inessential for the mechanism but will be added in estimating the model. Table 3 in Appendix summarizes the values of model's parameters.

Table 3: Parameters

	Definition	Source, Target	Value
R	Gross real interest rate	Boz and Mendoza (2014)	1.02
β	Discount factor	5 % annual rate in unconstrained	0.987
k	Capital per labor unit	16.2 % investment over GDP	14.92
Z	Manufacturing productivity	11.6 % share in manufacturing	92.08
A	Economy-wide productivity	Normalization	1
γ	Share goods in consumption	Literature	0.2
ε	Complementarity parameter	Buera and Kaboski (2009)	1
σ	Inverse Frisch elasticity	Hall (2009)	1
ψ	Labor disutility parameter	Steady-state total employment = 1	0.90
$\bar{\xi}$	Financial parameter	14.1 % net foreign debt over GDP	0.0025
θ	Share of working capital	9 % working capital over GDP	0.56
ω	Adjustment cost of debt	No costs (for illustration)	0
ρ_a	Autocorrelation of productivity shock	Arbitrary (for illustration)	0.70
ρ_ξ	Autocorrelation of financial shock	Arbitrary (for illustration)	0.70

Figure 3 plots the responses of manufacturing and services employments to negative technology and financial shocks. The first column refers to responses in the financially constrained economy, while second column corresponds to the unconstrained economy. First row refers to responses of a negative technology shock (fall in A), and responses to a negative financial shock (fall in ξ) are in second row. In the constrained economy, a negative technology shock leads to falls in manufacturing and services employment, hence generates higher synchronization between sectoral employments. Conversely in the unconstrained economy, the same shock implies a fall in manufacturing employment, while services employment slightly increases. A negative financial shock generates falls in sectoral employments in the constrained economy, while it has no effect on sectoral employments of the unconstrained economy given that the collateral constraint does not bind.

Figure 3: Responses of Sectoral Employments to Technology and Financial Shocks



To better understand these results, Figure 4 in Appendix plot the responses to a negative technology shock in the financially constrained economy. Anegative technology shock reduces the households' disposable income (the value of the collateral), the financial constraint is tighter, and households deleverage. The rise in debt repayments implies a fall in manufacturing consumption that, due to the complementarity in consumption between manufacturing and services, makes the aggregate demand for services fall. As a result manufacturing and services employment fall.

Figure 5 in Appendix plots the responses of the negative technology shock in the unconstrained economy. In this case the negative shock induces households to borrow so to smooth their consumption. The increase in borrowing (that is, a worsening of the trade balance) leads to a fall in manufacturing activity because imported and domestically produced goods are perfect substitutes, so manufacturing employment falls. Due to consumption smoothing, the fall in services employment is negligible relatively to the financially constrained case.

The mechanism works similarly with a negative financial shock. Figure 6 in Appendix plots the responses to a negative financial shock for the constrained economy. Due to the shock, the financial constraint gets tighter, households deleverage by increasing their debt repayments. Consumption of manufactured goods falls, and by complementarity also the consumption of services falls. Sectoral employments eventually fall. Responses for the unconstrained economy are not reported, because the financial shock does not affect the economy as long as the collateral constraint is slack.

3.4 Estimation (*in progress*)

4 Conclusions

In the United States the process of structural transformation, that is the reallocation of resources from manufacturing to services, interacts with the business cycle. We document that in recent US business cycle episodes the correlation between manufacturing and services employment has increased, and more so in recessions and US states where households are highly indebted.

We argue that this increased synchronization is due to the interaction between the financial conditions of the households and the aggregate demand for services. When households are financially constrained, manufacturing output matters for the demand in services. This is because most services are non-tradable with their demand set just by local economic conditions. Hence a fall in manufacturing employment reduces the disposable income and forces households to deleverage. Debt repayments crowd out manufacturing consumption, and due to complementarity in consumption of goods and services, consumption of services contracts. Since services are non-tradable, activity in services falls. As a result economic activity falls more, households become even more constrained, and this further contracts demand for services. This prevents job creation in services and sectoral comovement increases. So we have job destruction in manufacturing without job creation in services.

We are currently investigating on whether our mechanism could account for part of the observed increased comovement between manufacturing and services employment by estimating our DSGE model with US data.

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A Figures and Tables

Figure 4: A negative technology shock: financially constrained economy

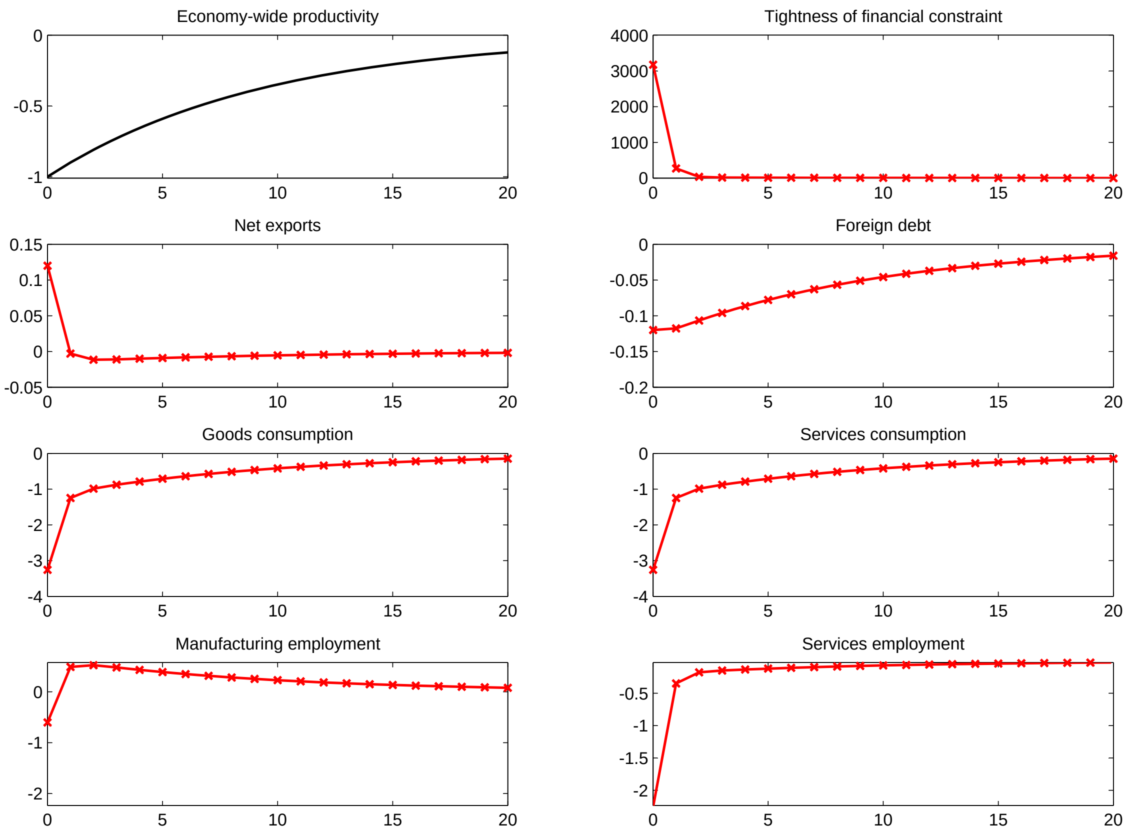

Figure 5: A negative technology shock: unconstrained economy

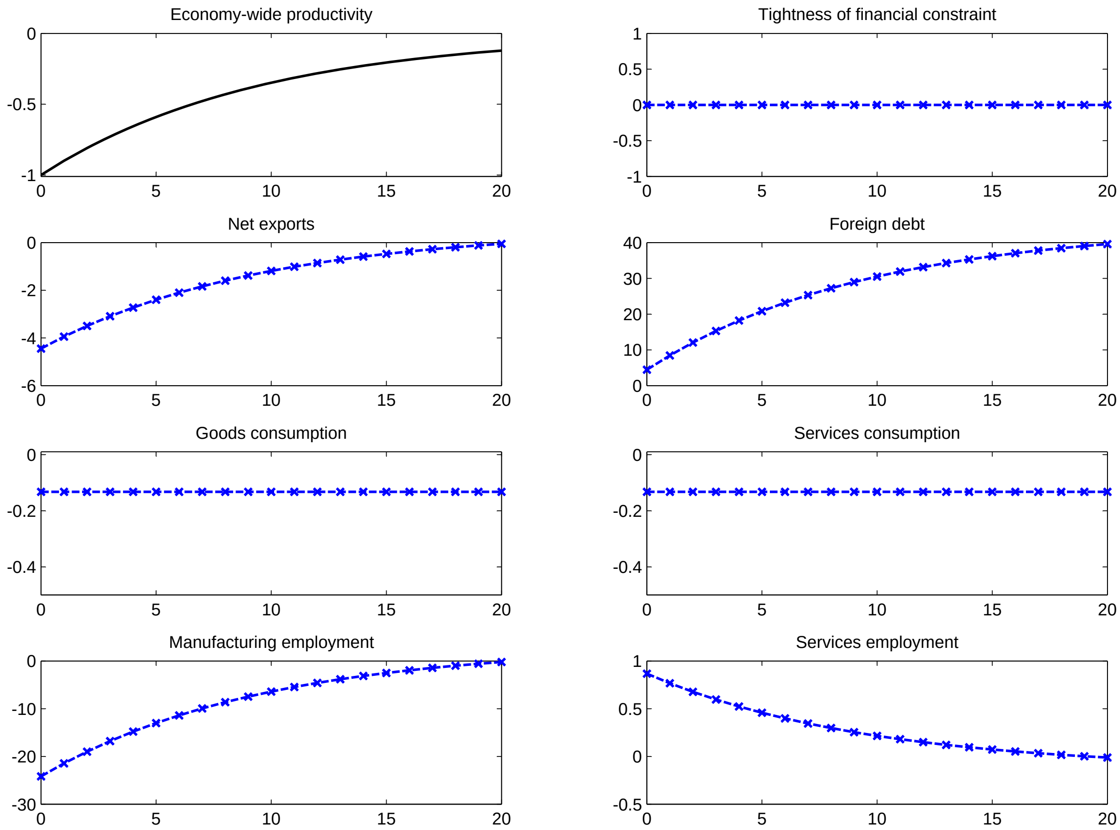

Figure 6: A negative financial shock

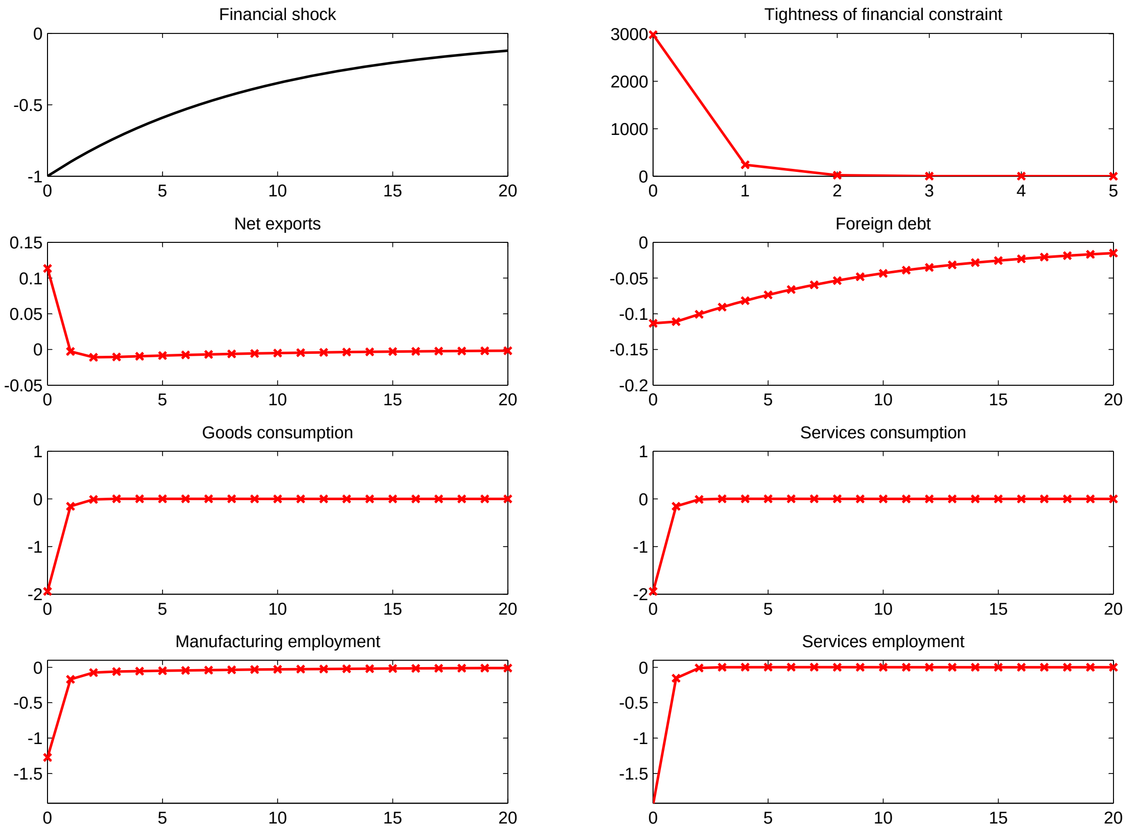

Table 4: US business cycle correlations (quarterly data)

	Growth rates			HP $\lambda = 1600$		
	(i)	(ii)	diff	(i)	(ii)	diff
$\rho(n_m, n_s)$	.76	.84	.08	.86	.93	.07*
$\rho(n_{mt-1}, n_{st})$	.63	.75	.13	.83	.92	.09*
$\rho(n_{mt-2}, n_{st})$	.36	.62	.26*	.69	.83	.14*
$\rho(n_{mt-4}, n_{st})$	.04	.34	.30*	.30	.50	.19
$\rho(n_{mt}, n_{st-1})$	.53	.76	.23*	.75	.86	.11*
$\rho(n_{mt}, n_{st-2})$	.27	.56	.30*	.54	.71	.17*
$\rho(n_{mt}, n_{st-4})$	-.08	.19	.27*	.06	.30	.24
$\rho(n_m, n_r)$	.64	.72	.08	.82	.90	.08*
$\rho(n_{mt-1}, n_{rt})$	.41	.59	.18	.67	.82	.16*
$\rho(n_{mt-2}, n_{rt})$	.19	.49	.30*	.44	.69	.25*
$\rho(n_{mt-4}, n_{rt})$	-.16	.22	.39*	-.04	.30	.34*
$\rho(n_{mt}, n_{rt-1})$	.60	.77	.16*	.83	.90	.07*
$\rho(n_{mt}, n_{rt-2})$	.33	.64	.31*	.71	.81	.09
$\rho(n_{mt}, n_{rt-4})$	.11	.34	.23	.34	.46	.12
$\rho(n_m, n_{nf})$	.76	.84	.08	.87	.92	.06
$\rho(n_{mt-1}, n_{nft})$	.63	.75	.12	.83	.91	.08*
$\rho(n_{mt-2}, n_{nft})$	.36	.62	.26*	.69	.83	.14*
$\rho(n_{mt-4}, n_{nft})$	.04	.33	.30*	.30	.50	.21
$\rho(n_{mt}, n_{nft-1})$	.53	.76	.23*	.75	.85	.09*
$\rho(n_{mt}, n_{nft-2})$	.27	.56	.29*	.54	.69	.15
$\rho(n_{mt}, n_{nft-4})$	-.08	.18	.26	.05	.28	.23
ρ(Net Exports / GDP, GDP)	-.09	-.32	-.24	-.33	-.70	-.37*
ρ(Net Exports / GDP, Total employment)	-.15	-.45	-.29*	-.20	-.54	-.34*
ρ(Net Exports / GDP, Goods consumption)	-.15	-.28	-.13	-.46	-.70	-.24*
ρ(Net Exports / GDP, Services consumption)	-.01	-.38	-.37*	-.32	-.65	-.33*

Notes: (i) 1952Q1-1989Q4; (ii) 1990Q1-2012Q4. US Manufacturing, 's' stands for 'Total Services', 'r' for 'Retail Trade', 'nf' for 'Services without Financial services'. Test of difference between the correlation coefficients using Fisher z-transformation. * indicates significance at 5 percent level.

Table 5: Panel MSA level evidence on sensitivity of service employment to manufacturing employment (yearly data, 2007-2011 period)

	Total services				*Total services excl. FIRE*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Δ Manufacturing employment	.024	.015	.143	.097	.021	.013	.167	.090
	[.016]	[.021]	[.106]	[.130]	[.018]	[.022]	[.119]	[.139]
Δ M. empl × Debt/income ratio in 2007	.029*	.029*	.061***	.060***	.037*	.035*	.070***	.067***
	[.016]	[.017]	[.022]	[.022]	[.019]	[.021]	[.026]	[.025]
Δ House prices	.059***	.069	.048**	.073	.051***	.059	.036	.064
	[.016]	[.043]	[.022]	[.045]	[.017]	[.043]	[.022]	[.044]
Δ House prices × Debt/income ratio in 2007	-.022	-.062	-.023	-.069	-.018	-.059	-.018	-.066
	[.016]	[.038]	[.022]	[.042]	[.016]	[.039]	[.023]	[.042]
Debt/income ratio in 2007	.001		.003*		.001		.004**	
	[.001]		[.002]		[.001]		[.002]	
Manufacturing empl. Share in 2007	.001		.001		.001		.001	
	[.001]		[.002]		[.001]		[.002]	
House prices in 2007	-.005		-.008		-.005		-.008	
	[.004]		[.005]		[.004]		[.006]	
Observations	445	446	445	416	445	446	445	416
R-squared	.44	.52	.28	.46	.48	.58	.29	.54
J-test			9.11	9.04			9.73	9.88
p-value			.43	.17			.37	.13
Commuting zone fixed effects	N	Y	N	Y	N	Y	N	Y
IV	N	N	Y	Y	N	N	Y	Y

Notes: annual data (2007-2011) for 183 Metropolitan Statistical Areas (MSAs). All variables are in logs. Dependent variable in columns *(1)-(4)* is the change in log total private services employment, in columns *(5)-(8)* is the change in log total private services employment without financial and real estate activities (FIRE). Debt/income is calculated in 2007 at the start of the recession. All regressions include Year fixed effects, standard errors are clustered at the Commuting Zone level. Coefficients of the constant and year dummies are not reported. ***,**,*: indicates significance at the 1, 5, and 10 percent level respectively. Bottom and top decile of sample log-change in total services employment are {-3.9%, .5%}; of log-change in total services employment minus FIRE are {-4.4%, .3%}; of log-change in manufacturing employment are {-14.2%, -.0%}; of logged debt over income in 2007 are {-.24, 1.68}. The analogous number for quartiles are {-2.6%, -.3%}, {-2.9%, -.4.1%}, {-10.0%, -2.8%} and {.01, 1.11}, respectively.

B Microfoundations for the financial constraint

The microfoundation builds on Mendoza (2002). There are short term (intraperiod) loans and long term (one period) loans. Financial market are competitive: intraperiod period loans demand a zero interest rate while the interest rate on long term loans is equal to R. Short terms loans are needed to finance beginning of period liquidity needs of households to repay long term loans contracted in the previous period and the costs of adjusting debt. Firms demand liquidity to finance capital needed for production. Firms' demand for liquidity is equal to $\varkappa_s k(e_m+e_s)$. We think that this liquidity is provided by households to firms. Lenders and firms can commit to deliver their goods. We think of liquidity as a technology that, by paying $\varkappa_h$ in advance for each unit value, allows the household to commit to pay the remaining amount due $1-\varkappa_h$ upon delivery of the good.[8] We assume that the household can not divert any liquidity demanded to repay long term loans because the external financiers who provide short term liquidity are also the financiers who have to be reimbursed for their long term loans. This guarantees that external financiers can control that the liquidity they provide is used to repay their long term loans. Liquidity needs are a fraction $\varkappa_h$ of the beginning of period expenditures of the household which are equal to the sum of the amount of long term debts that have to be reimbursed Rd_{t-1} and the cost of adjusting debt $D(d_t - d_{t-1})$. So the household beginning of period demand for liquidity is equal to $\varkappa_h\left(Rd_{t-1} + D(d_t - d_{t-1})\right) + \varkappa_s k(e_{mt} + e_{st})$—which also incorporates firms demand for liquidity. Intraperiod loans have to be repaid to external financiers at the end of the period when the household receives his income. If the household reneges his intraperiod loans, external financiers are able to destroy a fraction $\varkappa_f > \varkappa_h$ of household expected discounted next-period income $\beta E_t\left(q_{t+1}\right)$— alternatively we can assume that the external financier can also destroy fraction of current income. In equilibrium no debt renegotiation occurs provided that

$$\varkappa_f \beta E_t\left(q_{t+1}\right) \geq \varkappa_h\left(Rd_{t-1} + D(d_t - d_{t-1})\right) + \varkappa_s k(e_{mt} + e_{st}) \tag{25}$$

[8] For example, one can think that the purchase of a unit value of a good involves two types of transfers: one part can be easily diverted by the household, say the part in cash, while the other can be committed in advance by the household, say through a prespecified bank transfers. $\varkappa_h$ is the fraction in cash. By paying in advance all the amount that the household could divert, the household can then commit in advance to fully pay the entire value of the good (provided all income is delivered in the bank account).

Equation (25) is equivalent to

$$\xi\beta E_t\left(q_{t+1}\right) \geq Rd_{t-1} + D(d_t - d_{t-1}) + \theta k(e_{mt} + e_{st})$$

where $\xi \equiv \frac{\varkappa_f}{\varkappa_h}$ and $\theta \equiv \frac{\varkappa_s}{\varkappa_h}$. This corresponds to the formulation of the financial constraint used in the paper.

C Solving for the steady state of the model

The steady state of the model is characterized by the following conditions:

$$A = 1$$

$$\xi = \bar{\xi}$$

$$\lambda = \frac{\gamma c_m^{-(1+\varepsilon)}}{\gamma c_m^{-\varepsilon} + (1-\gamma)c_s^{-\varepsilon}} \tag{26}$$

$$p_s = \frac{1-\gamma}{\gamma}\left(\frac{c_m}{c_s}\right)^{1+\epsilon} \tag{27}$$

$$c_m + \tau = y_m - k(e_m + e_s) \tag{28}$$

$$c_s = y_s \tag{29}$$

$$\eta = \frac{1-\beta R}{\beta R} \tag{30}$$

$$\bar{\xi}\beta q = Rd + \theta k(e_m + e_s) \tag{31}$$

$$Z - k(1+\theta\eta) = \frac{\psi}{\lambda}\left(e_m + e_s\right)^{\sigma} \tag{32}$$

$$p_s - k(1+\theta\eta) = \frac{\psi}{\lambda}\left(e_m + e_s\right)^{\sigma} \tag{33}$$

$$y_m = Ze_m \tag{34}$$

$$y_s = e_s \tag{35}$$

$$\tau = (R-1)\,d \tag{36}$$

$$q = \frac{Ze_m + p_s e_s}{1-\beta} \tag{37}$$

We solve for the steady state under the assumption that total employment in steady state is one

$$e_m + e_s = 1 \tag{38}$$

In practice we choose ψ such that (38) is satisfied. We first solve for the steady state level of manufacturing employment e_m and then choose ψ to guarantee that (38) is satisfied. We start writing all equilibrium quantities as a function of e_m and we iterate over (27) to guarantee that the initial guess of e_m is consistent with an equilibrium. Output in manufacturing and services are equal to

$$y_m = Ze_m \tag{39}$$

$$y_s = 1 - e_m \tag{40}$$

Moreover (32) and (33) imply that p_s should be such that

$$p_s = Z \tag{41}$$

Hence the market value of production in the economy is given by

$$q = \frac{Z}{1-\beta} \tag{42}$$

Now we can use (31) together with (39), (40), (41), (37) and the normalization condition (38) to solve for d:

$$d = \frac{\bar{\xi}Z}{(1-\beta)R} - \frac{\theta k}{R}$$

which also determines τ, which is given by $\tau = (R-1)d$. So we now have that

$$c_m = y_m - \tau \tag{43}$$

$$c_s = y_s \tag{44}$$

which are also expressed just as a function of e_m. The equilibrium value of e_m should be such that the implied value of c_m and c_s in (43) and (44) generates a value for p_s given by (27)

$$p_s = \frac{1-\gamma}{\gamma}\left(\frac{c_m}{c_s}\right)^{1+\epsilon}$$

which is consistent with the value of p_s in (41). Once e_m is determined, the value of λ is obtained using (26). Given λ, the value of ψ is determined using (32):

$$\psi = \lambda\left[Z - k(1+\theta\eta)\right]$$

This completely characterizes our steady state.