

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 and 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.

We set up an open economy, multi-sector, general equilibrium model to illustrate our mechanism. Using a calibrated version of the model, we find that our mechanism can account for a sizable part of the observed increased comovement between manufacturing and services employment. Importantly, the quantitative relevance of our mechanism holds even considering key alternative factors which have potentially driven the increased sectoral synchronization (for instance, sectoral input-output linkages, and the process of structural change from manufacturing to services). 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

¹Ben 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

to increases in price of housing. Mian, Rao, and Sufi (2013) and Mian and Sufi (2014) 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 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

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."

²There 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.

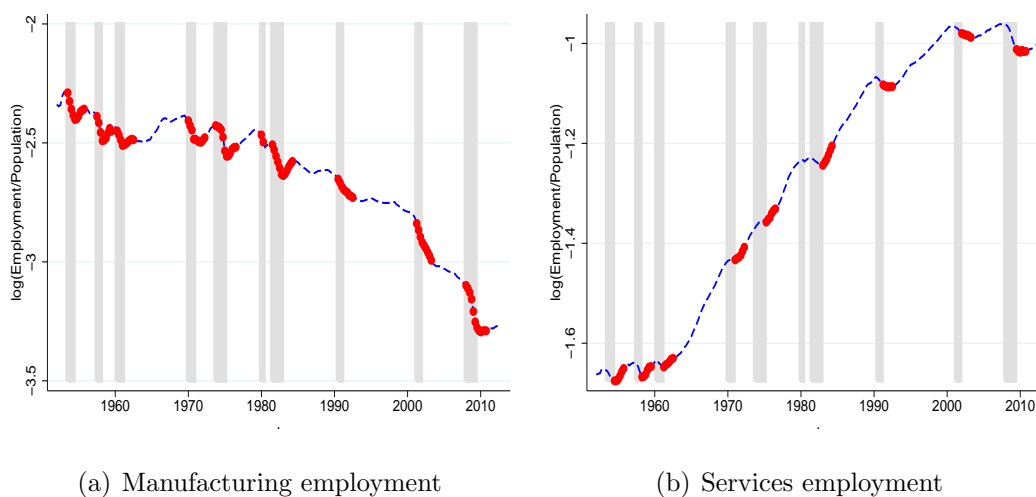
(2010), Bianchi (2011) and Mendoza and Yue (2012) argue that sudden stops are due to domestic agents who are financially constrained. This literature has typically emphasized an overborrowing externality, since households do not fully internalize the risk of entering a financial crisis. Our framework 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).

Figure 1: Structural transformation over the US business cycle



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

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 3.3 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 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.

Table 1: US business cycle correlations (quarterly data)

	Growth rates			HP $\lambda = 1600$		
	<i>Pre-1990</i>	<i>Post-1990</i>	diff	<i>Pre-1990</i>	<i>Post-1990</i>	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

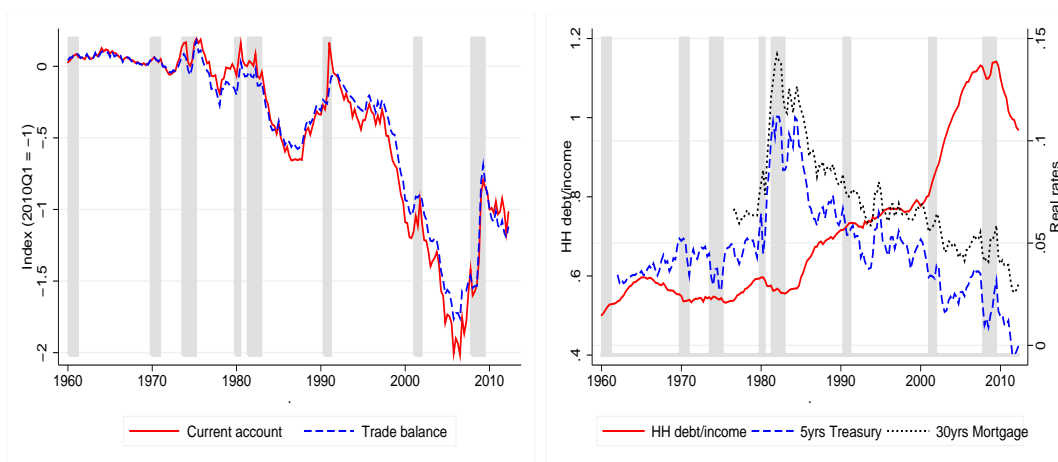
Notes: *Pre-1990* refers to the period 1952Q1-1989Q4; *Post-1990* refers to 1990Q1-2012Q4. 'm' stands for Manufacturing, 's' for Total Services. Test of difference between the correlation coefficients using Fisher z-transformation. * indicates significance at 5 percent level.

Further, Figure 3.3 reports the current account and trade balance in panel (a), and the

⁴There 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 percent. We address this issue by varying the window used for indicating recovery periods, results do not change.

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.⁵ Table 5 in Appendix shows the correlation of net exports over GDP with other macroeconomic aggregates using detrended data. The US trade balance has become more countercyclical than before, a typical feature of emerging economies business cycles, see for example Aguiar and Gopinath (2007) 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

⁵Mendoza (2010) defines Sudden Stops as events which feature three main empirical regularities: (i) reversals of international capital flows, reflected in sudden increases in net exports and the current account, (ii) declines in production and absorption, and (iii) corrections in asset prices.

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 those services which are typically nontradable. In this respect, following Mian and Sufi (2014), we identify *Retail Trade* and *Accommodation and Food Services* as two particularly non-tradable services sectors, while *Information* is a tradable services sector

(similarly to FIRE activities).⁶ We conduct regressions using the changes in employments of these sub-sectors as dependent variable, and we find large estimated elasticities for the non-tradable services, while no significant effects for the tradable ones, see Table 6 in Appendix.

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 (2014), and results do not change. Table 7 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.

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

$$y_{st} = A_{st} e_{st}^{\nu_s} (s_{st}^{\varepsilon_s} m_{st}^{1-\varepsilon_s})^{1-\nu_s} \quad (1)$$

while manufacturing firms produce goods according to

$$y_{mt} = A_{mt} e_{mt}^{\nu_m} (m_{mt}^{\varepsilon_m} s_{mt}^{1-\varepsilon_m})^{1-\nu_m} \quad (2)$$

where for each sector $j = \{m, s\}$, $0 < \nu_j < 1$, $0 < \varepsilon_j < 1$, y_j denotes gross output, e_j is employment, m_j is the manufactured intermediate good, s_j are intermediate services,

⁶Specifically, Mian and Sufi (2014) identify the following services industries as non-tradable (NAICS codes are in parentheses): Grocery stores (4451), Health and personal care stores (4461), Gasoline stations (4471), Clothing stores (4481), Sporting goods hobby and music stores (4511), Department stores (4521), Other general merchandise stores (4529), Full-service restaurants (7221), Limited-service eating places (7222), Special food services (7223). Those industries belong either to Retail Trade (44-45) or Accommodation and Food Services (72) sectors. Conversely, Software publishers (5112) is identified as tradable, and belongs to the Information (51) sector.

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

	<i>Total services</i>				<i>Total services excl. FIRE</i>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Manufacturing employment	.087*** [.015]	.091*** [.013]	.190*** [.058]	.237*** [.047]	.086*** [.014]	.097*** [.014]	.166*** [.061]	.248*** [.050]
Δ M. empl \times Debt/income in 2007	.184*** [.023]	.193*** [.022]	.214*** [.028]	.201*** [.030]	.215*** [.028]	.222*** [.026]	.236*** [.029]	.230*** [.032]
Δ House prices	.053** [.026]	.035 [.033]	.041 [.028]	.036 [.033]	.044 [.027]	.027 [.032]	.037 [.028]	.032 [.033]
Δ House prices \times Debt/income in 2007	-.043 [.053]	.072 [.077]	-.026 [.057]	.082 [.072]	-.041 [.052]	.055 [.082]	-.033 [.054]	.060 [.078]
Debt/income ratio in 2007	-.010*** [.026]		-.006** [.002]		-.009*** [.003]		-.005* [.002]	
Manufacturing empl. Share in 2007	.001 [.001]		.000 [.002]		.000 [.001]		.001 [.002]	
House prices in 2007	.011*** [.002]		.009*** [.002]		.011*** [.002]		.009*** [.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.

and A_j represent the sector-specific level of productivity.⁷ We assume that productivities evolve according to the following law of motion

$$\ln A_{it} = (1 - \rho_i) \ln \bar{A}_i + \rho_i \ln A_{it-1} + z_{it} \quad (3)$$

where for each sector $i = \{m, s\}$, \bar{A}_i is a constant, $0 < \rho_i < 1$ is the autocorrelation coefficient and z_{it} are serially uncorrelated zero-mean identically distributed shocks with variance σ_i^2 .

The economy is characterized by an infinitely-lived representative household with utility

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta^t U(c_{mt}, c_{st}, n_t)$$

with

$$U(c_m, c_s, n) = \ln [\gamma c_m^{-\epsilon} + (1 - \gamma) c_s^{-\epsilon}]^{-\frac{1}{\epsilon}} - \psi \frac{n^{1+\sigma}}{1 + \sigma}$$

where c_m and c_s respectively denote consumption units of manufacturing goods and services. 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 $\epsilon \geq 0$. The household elastically supplies labor n earning a wage rate w , where $\sigma > 0$ is the inverse Frisch elasticity and $\psi > 0$ is a labor disutility parameter.⁸

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

⁷Intermediate inputs are an unnecessary ingredient for our mechanism but they allow for reproducing the positive correlation between manufacturing and services as shown for example in Davis and Heathcote (2005). In fact, the inclusion of intermediate inputs allows us to test and verify that changes in sectoral input-output linkages could not be the key reason behind the increased sectoral synchronization. We develop further this argument in our quantitative exercise in Section 3.3.

⁸We think of the household as composed by a continuum of workers of measure one. The household can reallocate workers across sectors without cost. 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. Importantly, 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.

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

$$d_t = Rd_{t-1} - \tau_t \quad (4)$$

We assume a cost of adjusting debt in terms of the tradable (manufacturing) good. Specifically we assume the following cost function,

$$D(d_t) = \frac{\omega}{2}(d_t - \bar{d})^2 \quad (5)$$

where ω is a parameter strictly greater than zero and \bar{d} is some long-run level of debt. Too much leveraging (or deleveraging) is costly to the household, since the function is increasing and convex in the discrepancy between the current level of foreign debt and its steady-state value.⁹

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

$$w_t n_t + \pi_{mt} + \pi_{st} = c_{mt} + p_{st} c_{st} + Rd_{t-1} - d_t + D(d_t) \quad (6)$$

where the left hand side represents household's income. The household obtains income from supplying labor and from receiving firms' profits, and uses this income to purchase consumption of goods and services, as well as to repay debt.

The household is subject to the following financial constraint:

$$\xi y_t \geq Rd_{t-1} + \theta w_t n_t \quad (7)$$

where y_t is the total value of production in the economy net of intermediates (i.e. GDP),

$$y_t = y_{mt} + p_{st} y_{st} - (m_{mt} + m_{st}) - p_{st}(s_{mt} + s_{st}) \quad (8)$$

and ξ defines the amount of collateralizable income. The household borrows intertemporally for consumption smoothing (d), but also for working capital that she provides

⁹We borrow this formulation of the adjustment cost from Neumeyer and Perri (2005). Such adjustment cost allows to ensure stationarity of our economy when the (to-be-defined) financial constraint does not bind. To this end, we could have alternatively introduced an endogenous discount factor (Uzawa-type preferences) or debt-elastic interest-rate premium, however Schmitt-Grohé and Uribe (2003) have shown that regardless of how stationarity is induced in the small open economy RBC model, the model's predictions regarding second moments are virtually identical.

to firms as in Mendoza (2010).¹⁰ In particular, the parameter $\theta \in (0,1)$ denotes the amount of liquidity which firms need to finance labor in advance of sales. Higher value of θ implies that a tighter financial constraint restricts job creation and increases job destruction by making firm investment more costly, which acts as 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. 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 (7).

The constraint in (7) 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 (7) by showing that *current* income is a major determinant of credit market access in the US.

The financial constraint in (7) 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

¹⁰In principle, the parameter ξ can stochastically evolve over time as in Jermann and Quadrini (2012). We consider this extension in Section xx, to study the role of financial shocks in determining the increased sectoral synchronization.

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.

3.2 Equilibrium

The representative household maximizes the expected present value of its instantaneous utility subject to the per period budget constraint (6) and the financial constraint (7). The problem of the household can be characterized by the following Bellman equation:

$$V_t(d_{t-1}, \mathbf{u}_t) = \max_{c_{mt}, c_{st}, d_t, n_t} U(c_{mt}, c_{st}, n_t) + \beta E_t [V_{t+1}(d_t, \mathbf{u}_{t+1})] \quad (9)$$

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 technology levels in manufacturing and services, A_{mt} and A_{st}). The problem is subject to the budget constraint in (6) and the financial constraint in (7). The Lagrange multiplier on the budget constraint (6) is denoted by λ_t , while the Lagrange multiplier on the financial constraint (7) is denoted by $\lambda_t \eta_t$. The Lagrangian of the problem can then be written as equal to

$$\begin{aligned} L = & E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \ln [\gamma c_{mt}^{-\epsilon} + (1 - \gamma) c_{st}^{-\epsilon}]^{-\frac{1}{\epsilon}} - \psi \frac{n_t^{1+\sigma}}{1 + \sigma} \right\} \\ & + \sum_{t=0}^{\infty} \beta^t \lambda_t \left\{ w_t n_t + \pi_{mt} + \pi_{st} - c_{mt} - p_{st} c_{st} - R d_{t-1} + d_t - \frac{\omega}{2} (d_t - \bar{d})^2 \right\} \\ & + \sum_{t=0}^{\infty} \beta^t \lambda_t \eta_t \left\{ \xi y_t - R d_{t-1} - \theta w_t n_t \right\} \end{aligned}$$

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

$$\frac{\gamma c_{mt}^{-(1+\epsilon)}}{\gamma c_{mt}^{-\epsilon} + (1-\gamma) c_{st}^{-\epsilon}} = \lambda_t \quad (10)$$

$$\frac{(1-\gamma) c_{st}^{-(1+\epsilon)}}{\gamma c_{mt}^{-\epsilon} + (1-\gamma) c_{st}^{-\epsilon}} = \lambda_t p_{st} \quad (11)$$

After dividing side by side (10) and (11), we also obtain

$$p_{st} = \frac{1-\gamma}{\gamma} \left(\frac{c_{mt}}{c_{st}} \right)^{1+\epsilon}, \quad (12)$$

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

$$\lambda_t (1 - \omega(d_t - \bar{d})) = \beta RE_t [\lambda_{t+1} (1 + \eta_{t+1})] \quad (13)$$

The first order conditions with respect to n_t reads as follows

$$(1 - \theta \eta_t) w_t = \frac{\psi}{\lambda_t} n_t^\sigma \quad (14)$$

The representative firm in sector $i = \{m, s\}$ takes as given prices and chooses the amounts of labor and intermediates to employ in production so to maximize profits. The first-order conditions for the manufacturing firm are given by

$$\nu_m A_{mt} e_{mt}^{\nu_m - 1} (m_{mt}^{\varepsilon_m} s_{mt}^{1-\varepsilon_m})^{1-\nu_m} = w_t (1 + \theta \eta_t) \quad (15)$$

$$(1 - \nu_m) \varepsilon_m A_{mt} e_{mt}^{\nu_m} (m_{mt}^{\varepsilon_m} s_{mt}^{1-\varepsilon_m})^{1-\nu_m} m_{mt}^{-1} = 1 \quad (16)$$

$$(1 - \nu_m) (1 - \varepsilon_m) A_{mt} e_{mt}^{\nu_m} (m_{mt}^{\varepsilon_m} s_{mt}^{1-\varepsilon_m})^{1-\nu_m} s_{mt}^{-1} = p_{st} \quad (17)$$

The first-order conditions for the services firm are given by

$$\nu_s p_{st} A_{st} e_{st}^{\nu_s - 1} (m_{st}^{1-\varepsilon_s} s_{st}^{\varepsilon_s})^{1-\nu_s} = w_t (1 + \theta \eta_t) \quad (18)$$

$$(1 - \nu_s) (1 - \varepsilon_s) p_{st} A_{st} e_{st}^{\nu_s} (m_{st}^{1-\varepsilon_s} s_{st}^{\varepsilon_s})^{1-\nu_s} m_{st}^{-1} = 1 \quad (19)$$

$$(1 - \nu_s) \varepsilon_s A_{st} e_{st}^{\nu_s} (m_{st}^{1-\varepsilon_s} s_{st}^{\varepsilon_s})^{1-\nu_s} s_{st}^{-1} = 1 \quad (20)$$

These conditions equate the marginal product of each factor to its marginal cost in each sector.

For given sequence of the exogenous states \mathbf{u}_t , an equilibrium in this economy consists of a tuple

$$\left(c_{mt}, c_{st}, d_t, n_t, \tau_t, \lambda_t, \eta_t, y_t, y_{mt}, y_{st}, e_{mt}, e_{st}, m_{mt}, m_{st}, s_{mt}, s_{st}, p_{st} \right)$$

The elements of the tuple should satisfy the following conditions:

1. The sequence $\{c_{mt}, c_{st}, d_t, n_t\}$ solves the problem of the household.
2. The sequence $\{e_{it}, m_{it}, s_{it}\}$ solves the problem of the firm in each sector $i = m, s$.
3. The market for manufactured goods clears

$$c_{mt} + \tau_t + \frac{\omega}{2}(d_t - \bar{d})^2 = y_{mt} - m_{mt} - m_{st} \quad (21)$$

4. The market for services clears

$$c_{st} = y_{st} - s_{mt} - s_{st} \quad (22)$$

5. The labor market clears

$$e_{mt} + e_{st} = n_t \quad (23)$$

and the laws of motion of debt hold, as well as the financial constraint.

3.3 Quantitative analysis

In this section we use a calibrated version of the model to quantify the role of our mechanism in increasing the synchronization between manufacturing and services employment in the US. To this end, we study the cyclical properties of linearized versions of the model around two steady-states that differ on whether the financial constraint is binding or not.¹¹ Our experiment works as follows. First, we employ pre-1990s data to calibrate the model to the first steady-state, over which the financial constraint does not bind. Then,

¹¹Our model, as typical models of structural change, does not display a balanced growth path unless specific assumptions are imposed, see for example Kongsamut, Rebelo, and Xie (2001) and Ngai and Pissarides (2007). In principle, one could compute the complete unbalanced growth path between steady states, but such approach becomes untractable when the path is stochastic. Our approach, which follows Da-Rocha and Restuccia (2006) and Moro (2012), represents a simpler and more tractable way to assess the relevance of our mechanism.

we consider a financially-constrained version of our calibrated economy by lowering the interest rate to match the average level over the period 1990-2012. Finally, we employ model-generated data to compute and compare the correlations of manufacturing and services employment over the two economies.

The model is calibrated at quarterly frequency. For the unconstrained economy, we set a subjective discount rate $\beta = 0.9875$ which implies a yearly real interest rate equal to 5 percent over the deterministic steady-state. Given the Cobb-Douglas assumption of the sectoral production functions, the parameters defining the shares of labor and intermediates are computed from sectoral EUKLEMS data over the period 1952-1989, $\nu_m = 0.2983$, $\nu_s = 0.5174$, $\varepsilon_m = 0.7464$, $\varepsilon_s = 0.7442$. Time series for sectoral productivities are computed using the equilibrium conditions (see Appendix for details), and once normalizing the values of A_{mt} and A_{st} to one in 1952Q1, the average levels of productivities in manufacturing and services are respectively $\bar{A}_m = 1.4562$ and $\bar{A}_s = 1.1287$ over the period 1952Q1-1989Q4. The resulting estimated autoregressive parameters of the stochastic components of sectoral productivities are $\rho_m = 0.7511$ and $\rho_s = 0.7948$, while the estimated standard deviations of the idiosyncratic innovations are $\sigma_m = 0.0065$ and $\sigma_s = 0.0034$. The weight of manufactured goods in the consumption bundle γ is calibrated to match the share of manufacturing in the total value added of the economy over the period 1952-1989, which averages 35.7 percent, so to get $\gamma = 0.2242$. We set the complementarity parameter in consuming goods and services ϵ equal to 1.5, which is consistent with Rogerson (2008), Duarte and Restuccia (2010), and Moro (2012). The scale parameter ψ is set to normalize the sum of manufacturing and services employment to one in the nonstochastic steady state, which yields $\psi = 1.0001$. We set the inverse Frisch elasticity equal to $\sigma = 1$ following Kimball and Shapiro (2008). We set the parameter which governs the cost of adjusting debt, ω , equal to 0.00335 so to match the volatility of the goods-trade-balance-to-GDP ratio over the pre-1990's period (about 0.4 percent), as debt in our model is adjusted via imports/exports of manufactured goods. Finally, as the steady-state level of foreign debt is not defined, so we set it to match the level implied by the financially constrained.¹²

¹²However, we also show that by calibrating this level to target the almost zero net foreign debt over

Our alternative economy features a lower interest rate which leads the economy to be financially constrained. Specifically, we set the yearly real interest rate equal to 2 percent to mimic the post-1990s level, close to the value employed in Boz and Mendoza (2014). This implies that $\beta R < 1$ so that in equilibrium the economy is financially constrained. We calibrate the ξ parameter to match the net foreign debt over GDP of about 15 % over the period 1990-2012. We follow Schmitt-Grohé and Uribe (2007) and Bianchi and Mendoza (2010) in taking M1 money balances in possession of firms as a proxy for working capital. Given that about two thirds of M1 are held by firms (see Mulligan (1997)), and that M1 was on average about 12 percent of annual GDP over the period 1990-2012, we calibrate the working capital-GDP ratio to be $(2/3)0.12=0.08$, which implies that $\theta = 0.33$. Table 3 summarizes the calibration.

Table 3: Parameters

	Definition	Source, Target	Value
R	Gross real interest rate	Data (1990-2012)	1.02
β	Discount factor	5% annual rate in unconstrained (1952-1989)	0.987
ν_m	Share of labor in manufacturing	Data (1952-1989)	0.2983
ν_s	Share of labor in services	Data (1952-1989)	0.5174
ε_m	Share of goods in manufacturing intermediates	Data (1952-1989)	0.7464
ε_s	Share of services in services intermediates	Data (1952-1989)	0.7442
A_m	Level of manufacturing productivity	Data (1952-1989)	1.4562
A_s	Level of services productivity	Data (1952-1989)	1.1287
γ	Weight of goods in consumption	35.7% manufacturing share (1952-1989)	0.2242
ϵ	Elasticity parameter in preferences	Literature	1.5
σ	Inverse Frisch elasticity	Literature	1
ψ	Labor disutility parameter	Steady-state total employment = 1	1.0001
ξ	Financial parameter	15% net foreign debt over GDP (1990-2012)	0.48
θ	Share of working capital	9% working capital over GDP (1990-2012)	0.33
ω	Adjustment cost of debt	$std(NX/GDP) = 0.4\%$ (1952-1989)	0.00335
ρ_m	Autocorrelation of manufacturing shock	Data (1952-1989)	0.7511
ρ_s	Autocorrelation of services shock	Data (1952-1989)	0.7948
σ_m	Std. dev. of manufacturing shock	Data (1952-1989)	0.0065
σ_s	Std. dev. of services shock	Data (1952-1989)	0.0034

Table 4 compares the results of the exercise with the data. In the data, the correlation between manufacturing and services employment over the period 1952-1989 is about 86 percent, and the model is able to reproduce this pattern (the correlation is about 85 percent).

the pre-1990s period, results do not change.

percent).¹³ Conversely, over the period 1990-2012 this correlation is about 93 percent in the data, and the financially constrained version of the model predicts a correlation of about 94 percent. Overall, the increase in sectoral comovement is about 7 percent, while in the model is about 9 percent. We also show that this result does not rely on the presence of costs of adjusting debt: the correlation in the unconstrained economy is about 88 percent, while it averages 94 percent in the financially constrained economy. Similarly, changing the steady-state level of foreign debt (by matching it to a level of about zero net foreign assets over the period 1960-1989) does not change results, both qualitatively and quantitatively. Further, we allow sectoral productivities to vary so that, following the mechanism emphasized in Ngai and Pissarides (2007), imply a lower share of manufacturing in the economy (about 27 percent in the model, versus 23 percent in the data over the period 1990-2012). However, the increase in sectoral comovement increases only slightly (about 10 percent increase).¹⁴

Table 4: Manufacturing and Services Employment Synchronization: Data and Model

Data (HP $\lambda = 1600$)	<i>Pre-1990</i>	<i>Post-1990</i>	difference
$\rho(n_m, n_s)$	.86	.93	.07
Model	<i>Unconstrained</i>	<i>Constrained</i>	difference
<i>Benchmark</i>	.85	.94	.09
<i>No debt adjustment costs</i>	.88	.94	.06
<i>Unconstrained with (almost)zero foreign debt</i>	.84	.94	.10
<i>Allow for structural change</i>	.85	.95	.10

Notes: *Pre-1990* refers to the period 1952Q1-1989Q4; *Post-1990* refers to 1990Q1-2012Q4. Model statistics are averages over 1000 simulations, each of length 152 periods, the length of our data sample over the pre-1990's period.

Figures 4 and 5 plot the impulse responses to a one percent fall in services and manufacturing productivities. In the constrained economy, negative shock to productivities

¹³A necessary ingredient to obtain this result is the presence of sectoral input-output linkages. In absence of intermediates, the correlation is negative. *Maybe show results of economy where production employs just labor.*

¹⁴*To do: allow for change in autocorrelations and variances of technology shocks; allow for changes in sectoral input-output parameters; allow for presence of financial shocks, ξ stochastic.*

(in manufacturing or services) lead to synchronized falls in manufacturing and services employment, which cannot be reproduced by the same shocks in the unconstrained economy. A negative 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. 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. In fact, 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 smaller relatively to the financially constrained case.¹⁵

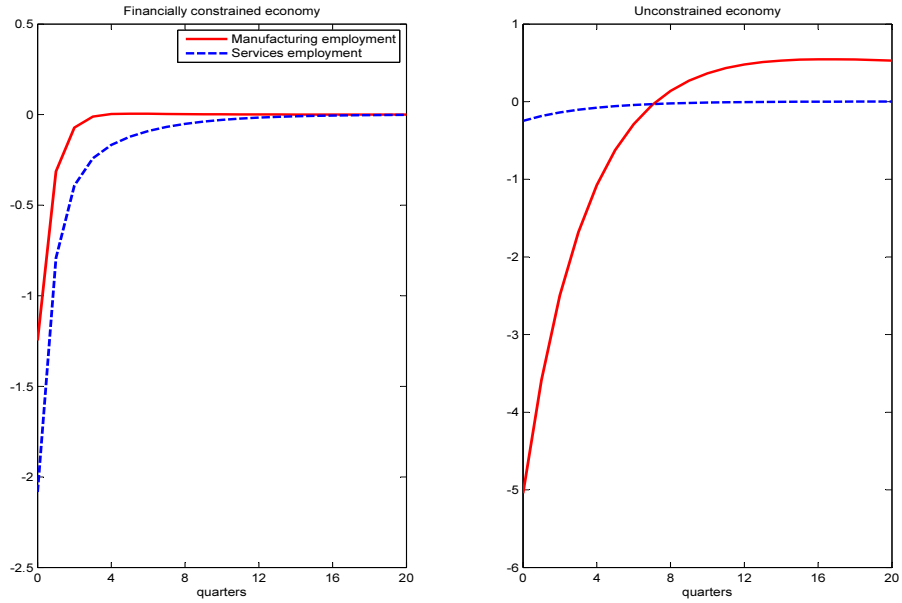
4 Conclusions

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.

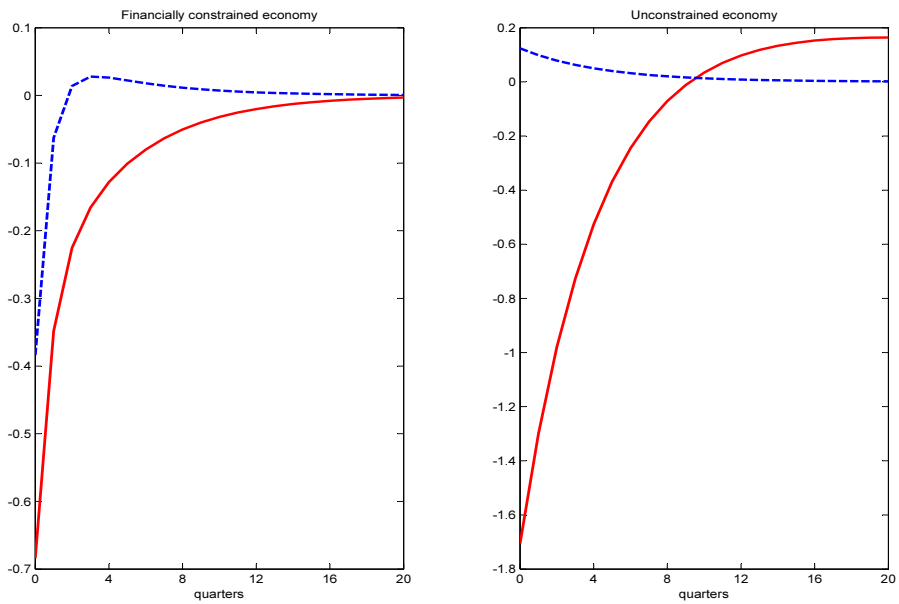
We argue that this increased synchronization is due to the interaction between the financial conditions of the households and the aggregate demand for services. When households are financially constrained, manufacturing output matters for the demand in

¹⁵The 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.

Figure 3: Responses of Sectoral Employments to Manufacturing and Services Productivity Shocks



(a) Negative manufacturing productivity shock



(b) Negative services productivity shock

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.

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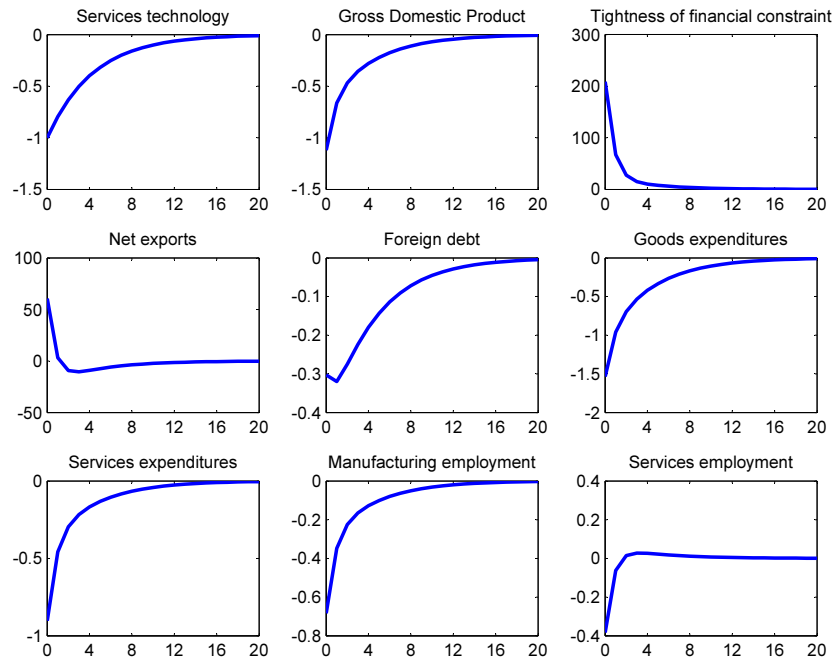
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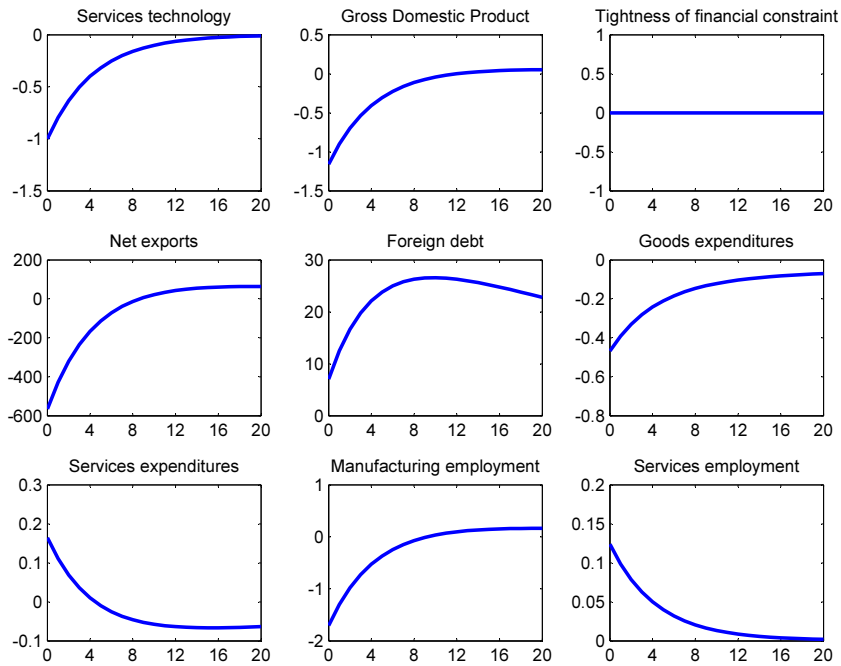
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A Figures and Tables

Figure 4: Responses to a Negative Services Productivity Shock

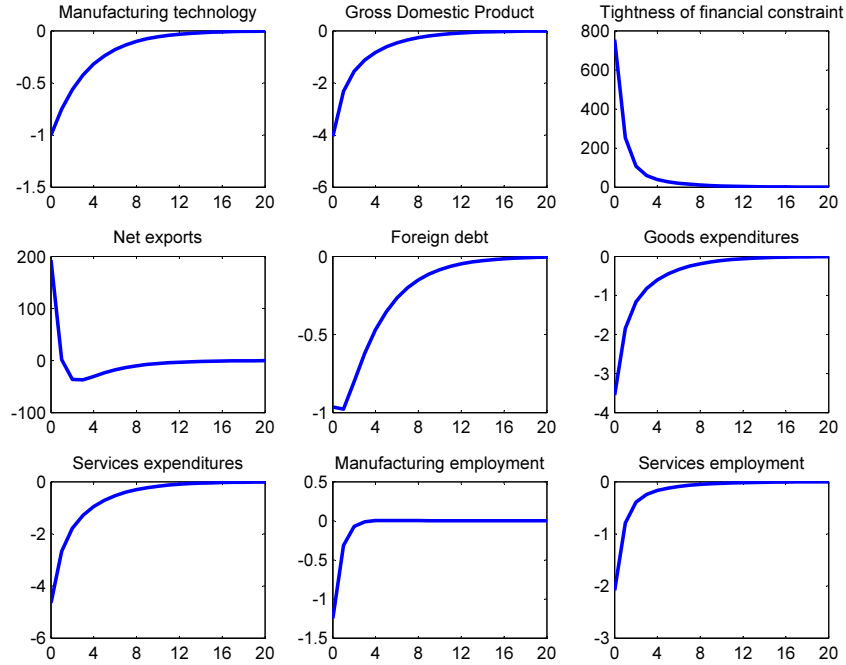


(a) Financially constrained economy

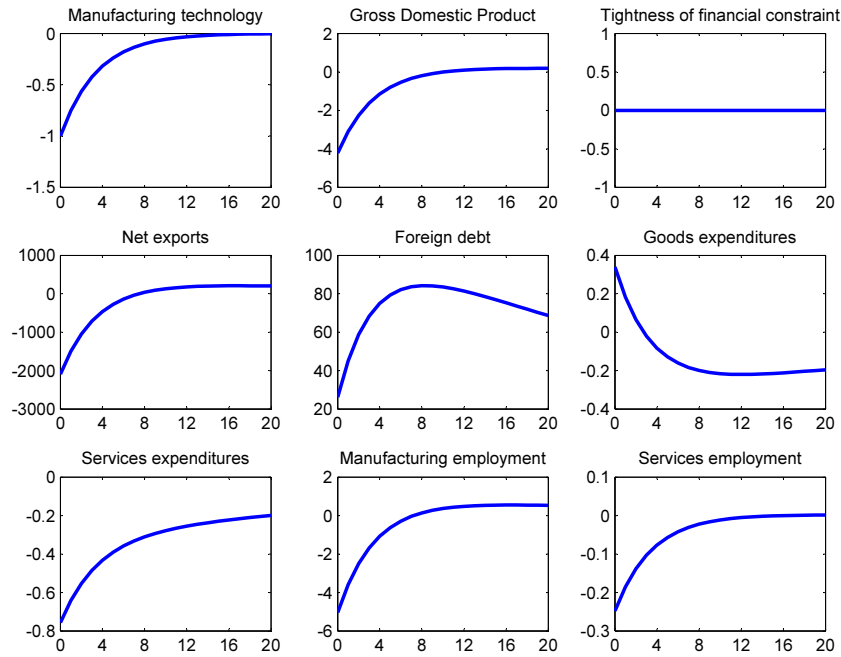


(b) Unconstrained economy

Figure 5: Responses to a Negative Manufacturing Productivity Shock



(a) Financially constrained economy



(b) Unconstrained economy

Figure 6: A negative financial shock

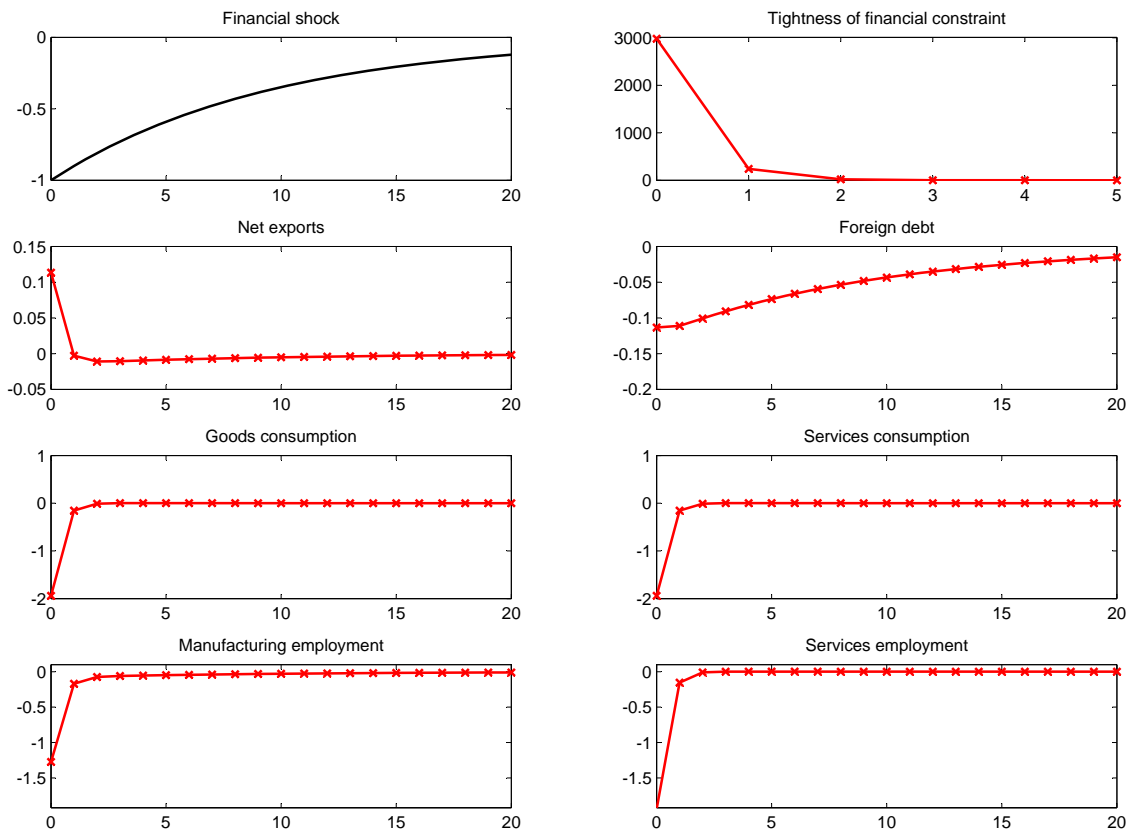


Table 5: US business cycle correlations (quarterly data)

	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
$\rho(\text{Net Exports / GDP, GDP})$	-.09	-.32	-.24	-.33	-.70	-.37*
$\rho(\text{Net Exports / GDP, Total employment})$	-.15	-.45	-.29*	-.20	-.54	-.34*
$\rho(\text{Net Exports / GDP, Goods consumption})$	-.15	-.28	-.13	-.46	-.70	-.24*
$\rho(\text{Net Exports / GDP, Services consumption})$	-.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 6: Panel state level evidence on sensitivity of service employment to manufacturing employment: selected services sectors

	Non-tradable services							
	<i>Retail Trade</i>				<i>Accommodation and Food Services</i>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Manufacturing employment	.069***	.079***	.173**	.312***	.038	.070*	.311**	.355***
	[.024]	[.028]	[.086]	[.104]	[.038]	[.038]	[.140]	[.115]
Δ M. empl \times Debt/income ratio in 2007	.305***	.307***	.355***	.326***	.338***	.352***	.375***	.346***
	[.035]	[.040]	[.045]	[.060]	[.070]	[.064]	[.088]	[.088]
Δ House prices	.070*	.072	.071	.139**	.092*	.133**	.065	.167**
	[.041]	[.061]	[.046]	[.069]	[.050]	[.064]	[.061]	[.066]
Δ House prices \times Debt/income ratio in 2007	-.114	.050	-.137	-.038	-.189**	-.152	-.146	-.182
	[.092]	[.121]	[.116]	[.138]	[.082]	[.143]	[.099]	[.150]
Debt/income ratio in 2007	-.015***		-.011**		-.024***		-.016**	
	[.004]		[.005]		[.007]		[.007]	
Manufacturing empl. Share in 2007	-.001		.000		-.002		-.004	
	[.002]		[.004]		[.002]		[.005]	
House prices in 2007	.016***		.015***		.024***		.022***	
	[.003]		[.003]		[.005]		[.005]	
Observations	204	204	192	192	204	204	192	192
R-squared	.81	.85	.82	.82	.77	.83	.73	.79
J-test			20.77	17.71			19.39	17.29
p-value			.01	.01			.02	.02
State fixed effects	N	Y	N	Y	N	Y	N	Y
IV	N	N	Y	Y	N	N	Y	Y
Tradable services								
	<i>Information</i>				<i>FIRE activities</i>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Manufacturing employment	-.034	-.104	.026	.086	.083***	.042	.301***	.110
	[.063]	[.073]	[.208]	[.228]	[.029]	[.031]	[.099]	[.117]
Δ M. empl \times Debt/income ratio in 2007	.123	.101	.132	.118	.019	.034	.104	.050
	[.167]	[.164]	[.155]	[.137]	[.056]	[.060]	[.076]	[.062]
Δ House prices	.076	-.052	.052	-.113	.155***	.132	.107***	.102
	[.070]	[.123]	[.073]	[.119]	[.046]	[.087]	[.039]	[.085]
Δ House prices \times Debt/income ratio in 2007	.005	.326	.095	.527**	-.119	.114	-.042	.161
	[.134]	[.244]	[.135]	[.255]	[.117]	[.157]	[.114]	[.153]
Debt/income ratio in 2007	.011		.014		-.022***		-.016**	
	[.013]		[.013]		[.005]		[.006]	
Manufacturing empl. Share in 2007	.008**		.002		.002		-.003	
	[.003]		[.006]		[.002]		[.003]	
House prices in 2007	.013		.012		.011***		.009**	
	[.009]		[.010]		[.004]		[.004]	
Observations	204	204	192	192	204	204	192	192
R-squared	.39	.48	.45	.57	.54	.52	.52	.54
J-test			4.53	2.24			12.18	15.84
p-value			.87	.95			.20	.04
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 51 US States. All variables are in logs. Debt/income is calculated in 2007 at the start of the recession. All regressions include Year fixed effects, standard errors are clustered at the State level. *FIRE activities* include finance, insurance, real estate, rental, and leasing. Coefficients of the constant and year dummies are not reported. ***, **, *: indicates significance at the 1, 5, and 10 percent level respectively.

Table 7: Panel MSA level evidence on sensitivity of service employment to manufacturing employment (yearly data, 2007-2011 period)

	<i>Total services</i>				<i>Total services excl. FIRE</i>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Manufacturing employment	.024 [.016]	.015 [.021]	.143 [.106]	.097 [.130]	.021 [.018]	.013 [.022]	.167 [.119]	.090 [.139]
Δ M. empl \times Debt/income ratio in 2007	.029* [.016]	.029* [.017]	.061*** [.022]	.060*** [.022]	.037* [.019]	.035* [.021]	.070*** [.026]	.067*** [.025]
Δ House prices	.059*** [.016]	.069 [.043]	.048** [.022]	.073 [.045]	.051*** [.017]	.059 [.043]	.036 [.022]	.064 [.044]
Δ House prices \times Debt/income ratio in 2007	-.022 [.016]	-.062 [.038]	-.023 [.022]	-.069 [.042]	-.018 [.016]	-.059 [.039]	-.018 [.023]	-.066 [.042]
Debt/income ratio in 2007	.001 [.001]		.003* [.002]		.001 [.001]		.004** [.002]	
Manufacturing empl. Share in 2007	.001 [.001]		.001 [.002]		.001 [.001]		.001 [.002]	
House prices in 2007	-.005 [.004]		-.008 [.005]		-.005 [.004]		-.008 [.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 Firms demand liquidity to finance labor in advance of sales. Firms' demand for liquidity is equal to $\varkappa_s w(e_m + e_s)$. 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.¹⁶ 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} . So the household beginning of period demand for liquidity is equal to $\varkappa_h Rd_{t-1} + \varkappa_s w(e_{mt} + e_{st})$ —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's current income y_t . In equilibrium no debt renegotiation occurs provided that

$$\varkappa_f y_t \geq \varkappa_h Rd_{t-1} + \varkappa_s w_t(e_{mt} + e_{st}) \quad (24)$$

Equation (24) is equivalent to

$$\xi y_t \geq Rd_{t-1} + \theta w_t(e_{mt} + e_{st})$$

¹⁶For 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).

where $\xi \equiv \frac{z_f}{z_h}$ and $\theta \equiv \frac{z_s}{z_h}$. 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 constrained economy is characterized by the following conditions:

$$\lambda = \frac{\gamma c_m^{-(1+\varepsilon)}}{\gamma c_m^{-\varepsilon} + (1-\gamma)c_s^{-\varepsilon}} \quad (25)$$

$$p_s = \frac{1-\gamma}{\gamma} \left(\frac{c_m}{c_s} \right)^{1+\varepsilon} \quad (26)$$

$$\eta = \frac{1-\beta R}{\beta R} \quad (27)$$

$$(1-\theta\eta)w = \frac{\psi}{\lambda} n^\sigma \quad (28)$$

$$c_m + \tau = y_m - m_m - m_s \quad (29)$$

$$c_s = y_s - s_m - s_s \quad (30)$$

$$e_m + e_s = n \quad (31)$$

$$\bar{\xi}y = Rd + \theta w(e_m + e_s) \quad (32)$$

$$\nu_m \frac{y_m}{e_m} = w(1 + \theta\eta) \quad (33)$$

$$(1 - \nu_m)\varepsilon_m \frac{y_m}{m_m} = 1 \quad (34)$$

$$(1 - \nu_m)(1 - \varepsilon_m) \frac{y_m}{s_m} = p_s \quad (35)$$

$$\nu_s \frac{p_s y_s}{e_s} = w(1 + \theta\eta) \quad (36)$$

$$(1 - \nu_s)(1 - \varepsilon_s) \frac{p_s y_s}{m_s} = 1 \quad (37)$$

$$(1 - \nu_s)\varepsilon_s \frac{y_s}{s_s} = 1 \quad (38)$$

$$y_m = A_m e_m^{\nu_m} (m_m^{\varepsilon_m} s_m^{1-\varepsilon_m})^{1-\nu_m} \quad (39)$$

$$y_s = A_s e_s^{\nu_s} (m_s^{1-\varepsilon_s} s_s^{\varepsilon_s})^{1-\nu_s} \quad (40)$$

$$\tau = (R - 1) d \quad (41)$$

$$q = y_m + p_s y_s - (m_m + m_s) - p_s (s_m + s_s) \quad (42)$$

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

state is one

$$e_m + e_s = 1 \tag{43}$$

In practice we choose ψ such that (43) is satisfied. We first solve for the steady state level of manufacturing employment e_m and then choose ψ to guarantee that (43) is satisfied. We start writing all equilibrium quantities as a function of e_m and we iterate over (26) to guarantee that the initial guess of e_m is consistent with an equilibrium. *TO BE COMPLETED*