

Klein, Mathias; Krause, Christopher

Conference Paper

Technology-Labor and Fiscal Spending Crowding-in Puzzles: The Role of Interpersonal Comparison

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2015: Ökonomische Entwicklung -
Theorie und Politik - Session: Forecasting, No. C05-V3

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Klein, Mathias; Krause, Christopher (2015) : Technology-Labor and
Fiscal Spending Crowding-in Puzzles: The Role of Interpersonal Comparison, Beiträge
zur Jahrestagung des Vereins für Socialpolitik 2015: Ökonomische Entwicklung - Theorie
und Politik - Session: Forecasting, No. C05-V3, ZBW - Deutsche Zentralbibliothek für
Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft

This Version is available at:

<http://hdl.handle.net/10419/113075>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen
Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle
Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich
machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen
(insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten,
gelten abweichend von diesen Nutzungsbedingungen die in der dort
genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

*Documents in EconStor may be saved and copied for your
personal and scholarly purposes.*

*You are not to copy documents for public or commercial
purposes, to exhibit the documents publicly, to make them
publicly available on the internet, or to distribute or otherwise
use the documents in public.*

*If the documents have been made available under an Open
Content Licence (especially Creative Commons Licences), you
may exercise further usage rights as specified in the indicated
licence.*

Technology Shocks and Employment: The Role of Interpersonal Consumption Comparison

February 24, 2015

Preliminary Version

ABSTRACT

Standard real business cycle models predict a rise in employment following a technology shock. In contrast, numerous empirical studies show that a technology shock leads to a decline in labor input. In this paper, we demonstrate that a flexible price model enriched with interpersonal comparison of consumption expenditures is able to generate a fall in employment in response to a technology shock. The negative labor response is robust to different values assigned to the inverse Frisch elasticity of labor supply and integrating capital adjustment cost into the model.

JEL Codes: D62, E24, E32.

Keywords: Technology shock; Employment; Interpersonal comparison.

1 Introduction

The seminal contribution of Galí (1999) finds that a positive technology shock leads to a decline in labor input. This result stands in contrast to employment dynamics induced by standard real business cycle (RBC) models which predict a positive labor response, following an exogenous productivity increase. The theoretical logic behind this employment increase is straightforward. As productivity rises, the marginal product of labor and the wage rate increase which makes leisure relatively more expensive. Therefore households supply more labor, when a technology shock occurs.

These considerations make clear that the consumption-leisure trade-off is of central importance for theoretically studying employment dynamics. Recent empirical work (Bertrand and Morse, 2013; Maurer and Meier, 2008) confirms that interpersonal comparison between different income groups significantly affect individuals' consumption choices. Moreover, Bowles and Park (2005) find that also labor outcomes are influenced by emulation incentives. We take these findings as motivation to integrate such a mechanism into an otherwise basic RBC model to study the employment response after a technology shock, as upward-looking consumption comparison might be an important driver here. Our results suggest that if the relative consumption motive is present, the model is able to generate the negative response of employment, as found by Galí (1999). To the best of our knowledge, this is the first paper studying the dynamic effects of a technology shock in a model enriched with a mechanism of this kind.¹

Our theoretical set-up is mainly based on Kumhof and Rancière (2010) and Kumhof, Rancière, and Winant (2013) (KRW, henceforth). In contrast to KRW, who study the long-run effects of increasing inequality on household leverage, we focus on the model dynamics following a positive technology shock. Similar to KRW, our model economy consists of two different household groups. *Investors*, who hold the economy's entire stock of capital, own firms and supply deposits, and *workers*, who supply labor and demand loans to finance their desired level of consumption. While KRW assume that working households inelastically supply one unit of labor, optimal labor supply is endogenously determined in our model. Moreover, we extend their framework by a mechanism through which workers value their own level of consumption relative to the investor's level of consumption. In modeling this relative consumption motive, we closely follow the theoretical literature on "keeping up with the Joneses" as initiated by Abel (1990) and Galí (1994).

We illustrate the circumstances under which the employment effect becomes contractionary in detail now. A positive technology shock leads to a higher interest rate on capital such that investment rises significantly. Since working households receive a higher wage rate, they expand labor supply as long as the relative consumption motive is absent.

¹Studies using interpersonal comparison in other contexts are Al-Hussami and Remesal (2012), Alvarez-Cuadrado and El-Attar (2012), Airaudo and Bossi (2014), and Klein and Krause (2014).

In addition, working households reduce loans demand sharply such that financial income and consumption expenditures by investors is reduced. On the contrary, because labor income goes up strongly, workers increase their consumption expenditures. Thus, the substitution effect between consumption and leisure dominates in this case, in line with the prediction of the standard RBC model. However, if the relative consumption motive is present, investors' consumption path influences the workers' consumption decision in such a way that workers seek to minimize the difference between both consumption levels. Since investors reduce their consumption slightly, working households increase consumption expenditures by a smaller amount compared to the former case. Consequently, they consume more leisure, such that employment falls. Although the substitution effect still dominates, the wealth effect is amplified, resulting in a less significant increase in consumption and a negative labor supply response. This fall in employment is robust to different values assigned to the inverse Frisch elasticity of labor supply and integrating a capital adjustment cost into the model.

Including the relative consumption motive into our model is backed by recent empirical studies. In particular, Heffetz (2011) studies the importance of conspicuous consumption between different income groups. He finds that among the whole income distribution, income elasticities can mainly be explained by status consumption motives of individuals. In addition, Bertrand and Morse (2013) find empirical evidence for so-called "trickle-down-consumption", meaning that consumption patterns of the top income households are emulated by households in the lower parts of the income distribution. Moreover, Maurer and Meier (2008) show that peer-group effects are an important factor for explaining intertemporal consumption choices in the US. Bowles and Park (2005) empirically investigate whether individuals' allocation of time between leisure and labor is influenced by emulation incentives. Their results suggest that upward comparison significantly affect work hours in developed economies.

Before proceeding with our theoretical set-up, we relate this work to the broader context of the literature. Building on the empirical results of Galí (1999), a rapidly growing literature has emerged to determine the response of hours worked to a neutral technology shock. One strand of literature takes the negative effect on hours as given and provides several mechanisms that generate Galí's results in theoretical models. While Galí (1999) proposes a model with monopolistic competition, sticky prices and variable labor effort, there have been various attempts to reproduce the contractionary employment effect in a RBC framework.

Mandelman and Zanetti (2014) and Andrés, Boscá, and Ferri (2013) introduce labor market frictions into a standard RBC model and generate a negative response of employment to a technology shock. In related work, Michelacci and López-Salido (2007) use a Solow growth model with search frictions in the labor market, and conclude that a neutral technology shock increases job destruction and reduces aggregate employment. Francis

and Ramey (2005) suggest two different model specifications, both able to generate the negative response of hours. On the one hand, they include habit formation in consumption and an investment adjustment cost. In their second specification, the firm sector is characterized by a Leontief production function with variable utilization. Wang and Wen (2011) suggest a model with firm entry and exit, where firms face a time-to-build lag. Their otherwise standard RBC model is then able to generate the observed negative impulse response of employment. Rebei (2014) estimates all of these model specifications with Bayesian methods and summarizes that the model with habit formation and investment adjustment cost, as proposed by Francis and Ramey (2005), is favored by the data. Collard and Dellas (2007) show that an open economy model with flexible prices and low trade elasticities is able to account for the findings of Galí (1999). Recently, Cantore et al. (2014) introduce CES production technologies and demonstrate that the response of hours crucially depends on the factor-augmenting nature of shocks and the capital-labor substitution elasticity.

A second line of research tests the empirical validation of Galí's results. Christiano, Eichenbaum, and Vigfusson (2003, 2004) use the same long-run restrictions as Galí and find a positive response of hours worked when using the hours data in levels instead of in first differences. With the use of sign restrictions to identify technology shocks, Dedola and Neri (2007), Peersman and Straub (2009) as well as Mumtaz and Zanetti (2012) find a positive response of hours with a hump-shaped pattern. On the other hand, Basu, Fernald, and Kimball (2006) construct a more sophisticated measure of total factor productivity by controlling for non-technological effects and resume that these technology shocks induce a sharp decline of labor. Francis and Ramey (2005) validate the use of Galí's long-run restrictions by applying numerous robustness tests and alternative specifications. Fernald (2007) notes that after allowing for trend breaks in total factor productivity, the response of hours worked remains negative regardless of using the variable in levels or differences. Whelan (2009) assesses the specifications of both Galí (1999) and Christiano, Eichenbaum, and Vigfusson (2004), and finds support for the former in terms of sensitivity to changes in data definitions and lag length. Finally, Canova, López-Salido, and Michelacci (2010) remove long cycles in hours and find a robust negative employment response for a number of alternative specifications.

The remainder of the paper is organized as follows. Section 2 lays out the theoretical model used for our analysis. Section 3 describes the functional forms of the models' equations and the calibration strategy. In Section 4, we present impulse responses to a positive technology shock and investigate the role of interpersonal comparison on the employment dynamics. Moreover, we show that the induced negative labor response is robust to different values assigned to the inverse Frisch elasticity of labor supply and integrating a capital adjustment cost into the proposed set-up. Finally, Section 5 concludes.

2 A simple model

The theoretical framework presented in this study is a modified version of the model proposed by Klein and Krause (2014) with a simplified firm sector. Our model economy is populated by a continuum of infinitely lived households, indexed on the unit interval. A fraction χ of households, termed as *investors* (subscript i), holds the entire stock of physical capital and owns the firms, while the remaining fraction $1 - \chi$, termed as *workers* (subscript w), makes up the entire labor force. Moreover, investors issue deposits to workers. In addition, working households face a relative consumption motive which is modeled as a consumption externality, following the (theoretical) literature on “keeping up with the Joneses” initiated by Abel (1990), Galí (1994) and the subsequent works built upon these two studies. The respective shares of households are fixed. In a perfectly competitive firm sector, inputs provided by investors and workers are combined to produce aggregate output.

2.1 Investors

Investors maximize their lifetime utility function

$$E_0 \sum_{t=0}^{\infty} \beta_i^t U_i(C_{i,t}), \quad (1)$$

where E_0 denotes the expectations operator conditioned on time 0 information, $\beta_i \in (0, 1)$ is the specific discount factor of investors, $U_i(\cdot)$ is a twice continuously differentiable, strictly increasing and concave utility function that satisfies the Inada conditions, and $C_{i,t}$ is the investors’ level of consumption.

The investors’ budget constraint is given by

$$C_{i,t} + I_{i,t} + Q_t D_{i,t} \leq D_{i,t-1} + R_t K_{i,t-1} + \frac{\Pi_t}{\chi}, \quad (2)$$

where $I_{i,t}$ denotes investors’ investment, $D_{i,t}$ deposits issued to workers, $K_{i,t-1}$ is the beginning-of-the-period capital stock of investors, Q_t is the time t price of a deposit that yields one unit of output in $t + 1$, R_t is the rental rate of capital, and Π_t/χ is the individual share of profits from ownership of firms. However, as firms operate in a perfectly competitive market, profits are zero in equilibrium. The law of motion for physical capital is

$$K_{i,t} = (1 - \delta)K_{i,t-1} + I_{i,t}, \quad (3)$$

where δ is the depreciation rate. Investors maximize (1) subject to (2) and (3) so that the first order conditions for consumption, capital, and deposits are given by

$$\Lambda_{i,t} = U'_i(C_{i,t}), \quad (4)$$

$$\Lambda_{i,t} = \beta_i E_t \Lambda_{i,t+1} (R_{t+1} + 1 - \delta), \quad (5)$$

$$\Lambda_{i,t} Q_t = \beta_i E_t \Lambda_{i,t+1}, \quad (6)$$

where $U'_i(\cdot)$ denotes the first derivative with respect to the argument in brackets and $\Lambda_{i,t}$ is the Lagrange multiplier associated with (2). The no-Ponzi-game constraint is

$$\lim_{j \rightarrow \infty} E_t \frac{D_{i,t+j}}{\prod_{s=0}^j \frac{1}{Q_{t+s}}} \leq 0. \quad (7)$$

2.2 Workers

Workers maximize their lifetime utility function

$$E_0 \sum_{t=0}^{\infty} \beta_w^t U_w(C_{w,t}, X_t, N_{w,t}). \quad (8)$$

where $\beta_w \in (0, 1)$ denotes the workers' discount factor, $C_{w,t}$ is the workers' consumption, X_t is a consumption externality that workers take as given, $N_{w,t}$ is hours worked, and $U_w(\cdot)$ is the period utility function.²

Definition 1 (Worker's utility function). *We impose the following assumptions on the workers' utility function U_w .*

- (i) $\frac{\partial U_w}{\partial C_w} > 0$, $\frac{\partial^2 U_w}{(\partial C_w)^2} < 0$, $\frac{\partial U_w}{\partial N_w} < 0$, $\frac{\partial^2 U_w}{(\partial N_w)^2} < 0$,
- (ii) $\frac{\partial^2 U_w}{(\partial C_w)^2} \frac{\partial^2 U_w}{(\partial N_w)^2} - \frac{\partial^2 U_w}{\partial C_w \partial N_w} > 0$,
- (iii) $\lim_{c \rightarrow \infty} \frac{\partial U_w}{\partial C_w} = 0$, $\lim_{c \rightarrow 0} \frac{\partial U_w}{\partial C_w} = \infty$,
- (iv) $\frac{\partial U_w}{\partial X} < 0$, $\frac{\partial^2 U_w}{\partial C_w \partial X} > 0$.

Assumptions (i), (ii), and (iii) refer to the standard properties of utility functions, namely that they are twice differentiable, strictly increasing in consumption, strictly decreasing in labor, strictly concave and that the Inada conditions are satisfied. The first part of (iv) asserts that workers derive disutility from an increase in the consumption

²While Abel (1990) and Galí (1994) abstract from endogenous labor supply in their specification, Dupor and Liu (2003) and Alonso-Carrera, Caballé, and Raurich (2008), among others, include endogenous labor supply in the household's maximization problem.

externality. The second part states that the marginal utility of workers' consumption is increasing with respect to the consumption externality, implying that if this externality rises, workers wish to consume more since their marginal utility of consumption increases.

Workers face the following budget constraint,

$$C_{w,t} + D_{w,t-1} \leq W_t N_{w,t} + Q_t D_{w,t} - \frac{\phi}{2} (D_{w,t} - \bar{D}_w)^2, \quad (9)$$

where $D_{w,t}$ denotes received loans at price Q_t , and W_t is the wage rate. The last term represents a quadratic cost of holding a quantity of loans different from the steady state value \bar{D}_w . Letting $\Lambda_{w,t}$ be the workers' Lagrange multiplier on their budget constraint, the optimal choices for consumption, labor and loans are determined by

$$\Lambda_{w,t} = U'_w(C_w), \quad (10)$$

$$\Lambda_{w,t} W_t = U'_w(N_w), \quad (11)$$

$$\Lambda_{w,t} [Q_t - \phi (D_{w,t} - \bar{D}_w)] = \beta_w E_t \Lambda_{w,t+1}, \quad (12)$$

where $U'_w(\cdot)$ denotes the first derivative with respect to the argument in brackets.

2.3 Technology

The economy's aggregate production is given by the following function

$$Y_t = F(z_t, N_t, K_{t-1}), \quad (13)$$

where we assume that F is strictly increasing, twice differentiable in both arguments, exhibits constant returns to scale, and satisfies the Inada conditions. K_{t-1} and N_t denote the quantity of capital and labor services utilized to produce final output good Y_t , while z_t is the technology level which follows an exogenous stochastic process around its steady state value \bar{z} ,

$$\log z_t = (1 - \rho_z) \log \bar{z} + \rho_z \log z_{t-1} + \varepsilon_{z,t}, \quad (14)$$

where $\varepsilon_{z,t}$ is an i.i.d. technology shock with variance σ_z^2 , and $0 < \rho_z < 1$. Firms are perfectly competitive such that factor prices equal their marginal products

$$W_t = F_N(z_t, N_t, K_{t-1}), \quad (15)$$

$$R_t = F_K(z_t, N_t, K_{t-1}), \quad (16)$$

where F_x denotes the first derivative of F with respect to input factor x .

2.4 Aggregation and market clearing

Aggregates are defined as the weighted average of the respective variables for each household type. Hence, we get

$$C_t = \chi C_{i,t} + (1 - \chi) C_{w,t}, \quad (17)$$

$$K_t = \chi K_{i,t}, \quad (18)$$

$$I_t = \chi I_{i,t}, \quad (19)$$

$$N_t = (1 - \chi) N_{w,t}. \quad (20)$$

Financial market clearing requires that

$$(1 - \chi) D_{w,t} = \chi D_{i,t}, \quad (21)$$

while the aggregate resource constraint is given by

$$Y_t = C_t + I_t + (1 - \chi) \frac{\phi}{2} (D_{w,t} - \bar{D}_w)^2. \quad (22)$$

A competitive rational expectations equilibrium is a stochastic set of sequences $\{C_t, C_{i,t}, C_{w,t}, D_{i,t}, D_{w,t}, I_t, I_{i,t}, K_t, K_{i,t}, \Lambda_{i,t}, \Lambda_{w,t}, N_t, N_{w,t}, \Pi_t, Q_t, R_t, W_t, Y_t\}_{t=0}^{\infty}$ satisfying the households' and firms' first-order conditions, as well as aggregation identities, market clearing conditions, and no-Ponzi-game constraints, given the exogenous realizations of $\{z_t\}_{t=0}^{\infty}$. The model is solved by a log-linear approximation around its deterministic steady state.

3 Calibration

3.1 Functional forms

Investors' preferences are given by the constant relative risk aversion (CRRA) utility function

$$U_i(C_i) = \frac{C_i^{1-\sigma}}{1-\sigma}, \quad (23)$$

where $\sigma > 0$ is the inverse of the elasticity of intertemporal substitution. We assume the workers' utility function to be of the form

$$U_w(C_w, X, N_w) = \frac{C_w^{1-\sigma}}{1-\sigma} X^{b\sigma} - \gamma \frac{N_w^{1+\eta}}{1+\eta}, \quad (24)$$

Table 1: Model calibration

	Parameter	Value
Preferences		
Discount factor	β	0.99
Inverse substitution elasticity	σ	2
Inverse Frisch elasticity	η	1
Relative consumption motive	b	$\{0, 1, 2\}$
Fraction of investors	χ	0.05
Production		
Capital income share	α	0.33
Capital depreciation rate	δ	0.025
Debt adjustment cost	ϕ	0.0002
Steady state		
Labor	\bar{N}	0.33
Loans-to-labor income	$\bar{D}_w/(\bar{W}\bar{N}_w)$	0.92
Shock characteristics		
Technology	\bar{z}	1
AR-coefficient	ρ_z	0.90

where b indicates the strength of the consumption externality, γ is a scaling parameter, and η is the inverse Frisch elasticity of labor supply. This utility function satisfies all assumptions imposed by Definition 1.

X is assumed to be the contemporaneous consumption level of investors relative to the contemporaneous consumption level of workers ($X_t = C_{i,t}/C_{w,t}$). This specification of X is based on microeconomic studies, which find that intertemporal consumption choices are significantly influenced by interpersonal comparison.³ Besides increasing their own consumption, working households seek to minimize the difference between both consumption levels.⁴

Following Dupor and Liu (2003), we model b as a jealousy parameter (i.e. $b > 0$), implying that an increase in the investors' consumption level leads to a decrease in the workers' utility level.

We assume that aggregate technology is given by a Cobb-Douglas production function

$$F(z_t, N_t, K_{t-1}) = z_t N_t^{1-\alpha} K_{t-1}^\alpha, \quad (25)$$

³See e.g. Bertrand and Morse (2013) and Maurer and Meier (2008).

⁴Similar specifications of relative consumption motives are used by Alvarez-Cuadrado and El-Attar (2012), Al-Hussami and Remesal (2012) and Airaudo and Bossi (2014).

where $\alpha \in [0, 1]$ measures the capital income share.

3.2 Parameterization

Table 1 reports the parameter values used for the models' calibration, where an upper bar denotes the steady state value of the respective variable. The simulated data of the model are at a quarterly frequency. The depreciation rate of capital, δ , equals 0.025, which corresponds to an annual depreciation rate on capital equal to 10 percent. The inverse elasticity of intertemporal substitution equals 2. For the discount factors, we set $\beta_i = \beta_w = \beta$ to 0.99. In combination with δ , this guarantees a steady state annual real interest rate on capital of 3.5%. We calibrate the leisure preference parameter, γ , so that the steady state level of labor is equal to 0.33 and set the inverse Frisch elasticity, η , to 1. The capital share parameter, α , equals 0.33. As in KRW, investors make up 5% of the overall population. In addition, we assume a steady-state loans-to-income ratio of 92%, which corresponds to the average value in the US for the period from 1952Q1 to 2008Q2.⁵ Similar as in Iacoviello (2008), the debt adjustment cost parameter, ϕ , is set to 0.0002. Steady state technology is normalized to 1 and the parameter measuring the persistence of the technology shock, ρ_z , is set to 0.9.

In what follows, we examine the models' responses to a technology shock for a set of three different choices for b , $\{0, 1, 2\}$.

4 Model dynamics

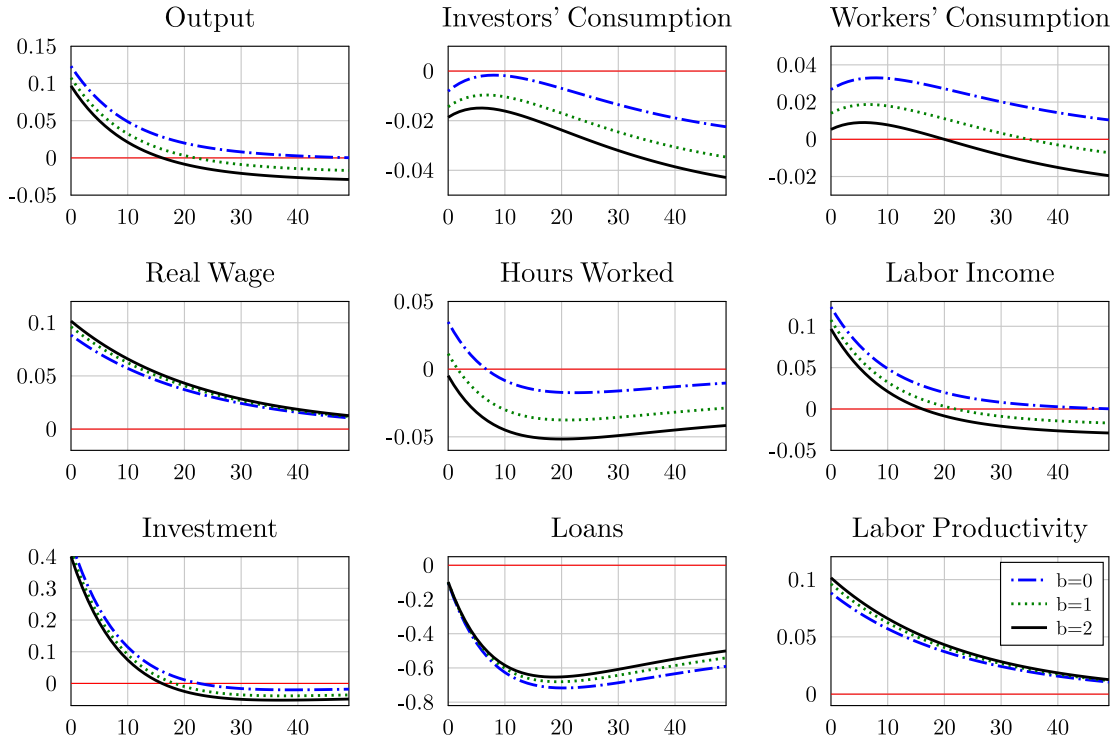
In this section, we demonstrate that by integrating interpersonal consumption comparison, our proposed model is able to generate a fall in employment in response to a technology shock. First, we discuss how the effect on labor in our baseline calibration changes if we vary the strength of the relative consumption motive. It turns out that employment falls when consumption externalities are present. We show that this negative employment response is robust to (i) different values assigned to the inverse Frisch elasticity and (ii) including a capital adjustment cost into the model.

4.1 Baseline

Figure 1 shows the effects of a positive, one standard deviation technology shock to the model economy. All parameter values are chosen as reported in Table 1. We first discuss the results for $b = 0$ (dash-dotted lines), i.e. we abstract from any interpersonal comparison. An increase in z_t causes output to go up immediately. As a result of the

⁵We measure the loans-to-income ratio as the share of credit market liabilities held by households and non-profit organizations divided by total compensation of employees. Both series are deflated by the price index of personal consumption expenditures. Data are obtained from FRED database.

Figure 1: Impulse responses to a one standard deviation technology shock.

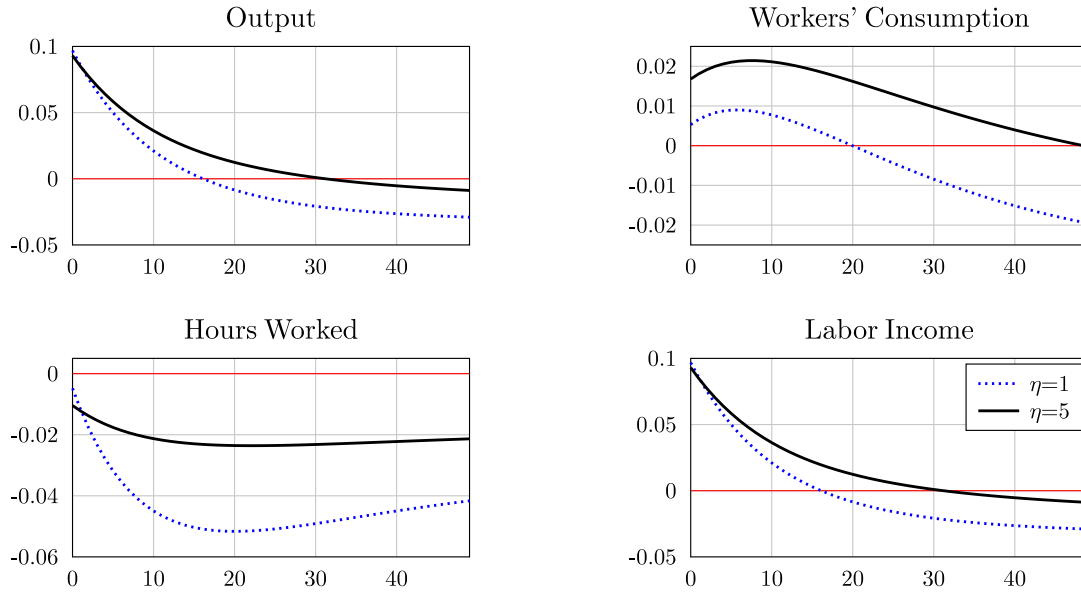


Note: Responses are measured in percentage deviations from steady state. Horizontal axes measure time in quarters.

productivity rise, the marginal products of labor and capital increase, leading to a higher wage rate and interest rate on capital. Investors invest more and workers increase their labor supply such that labor productivity rises less compared to output. Consequently, labor income increases more strongly than the wage rate. A higher labor income leads to a strong decrease in workers' demand for loans. Therefore, financial income falls and finally investors consumption level is lower than in the steady state. Contrary, working households use their part of their additional labor income for increasing consumption expenditures. Given that the relative consumption motive is switched off, the model produces an increase in employment in response to a technology shock in line with standard RBC models.

This result changes if we incorporate the relative consumption motive ($b > 0$), i.e. working households partially adapt their consumption level to the investors' consumption level. Again, the increase in z_t results in an increase in output, and subsequently, increases in wages and the interest rate. The crucial difference now is the workers decision making. The reduced consumption level of investors alters the consumption choice of workers immediately, entailing a lower optimal consumption level of workers compared to the case of $b = 0$. Thus, workers are able to reduce their labor supply but still gain in terms of labor income and consumption expenditures.

Figure 2: Impulse responses to a one standard deviation technology shock.



Note: Responses are measured in percentage deviations from steady state. Horizontal axes measure time in quarters.

The size of the relative consumption motive determines the impact response of hours worked. For $b = 1$ (dotted lines), the smaller increase in workers' consumption induces just a slight rise in hours worked. However, labor supply is reduced below the steady state level in the following periods. Raising the strength of the relative consumption motive to $b = 2$ (solid lines) implies a stronger adaption to the investors' consumption choice and thus, a further reduction of workers' consumption. This results in an impact decrease of hours worked, and consequently, in an even further drop in the succeeding periods compared to the other two cases. Thus, besides hours worked also output and labor income are negatively related to the strength of the relative consumption motive.

4.2 Robustness

As stated by Hall (2009), the range of values typically assigned to the inverse Frisch elasticity lies between 1 and 5. While the lower value is frequently used in business cycle models, $\eta = 5$ refers to values that many microeconomic studies consider as plausible. Figure 2 compares the model dynamics to a technology shock of our baseline calibration ($\eta = 1$) to the case of a high inverse Frisch elasticity ($\eta = 5$). The relative consumption motive parameter, b , is 2 for both model constellations. The remaining parameters are set as in the baseline calibration, documented in Table 1, and again, we simulate a one standard deviation technology shock.

When assuming a high inverse Frisch elasticity (solid lines), the immediate fall in hours worked is larger compared to the baseline scenario (dotted lines). In addition, workers

reduce labor supply less strongly in the following periods. Nevertheless, even for high values of the inverse Frisch elasticity, the model produces a labor reduction in response to a technology shock. As labor income is slightly higher than in the baseline case, workers consume more when $\eta = 5$. Similar to labor income, output increases more in the high inverse Frisch elasticity scenario.

Next, we demonstrate that the negative employment response still holds when integrating a capital adjustment cost into the set up. In modeling the capital adjustment cost, we follow King and Wolman (1996), such that the investors' budget constraint becomes

$$C_{i,t} + I_{i,t} + \Psi(I_{i,t}/K_{i,t-1})K_{i,t-1} + Q_t D_{i,t} \leq D_{i,t-1} + R_t K_{i,t-1} + \frac{\Pi_t}{\chi}, \quad (26)$$

here $\Psi(\cdot)$ is a positive, increasing, and convex function measuring the investors' cost associated with adjusting the capital stock. We assume $\Psi(x) = \kappa(x - \delta)^2/2$, where κ measures the size of the adjustment cost.

While the investors' first order conditions for consumption and deposits stay unchanged, there is a new condition concerning Tobin's q and a modified consumption Euler equation, given by

$$q_t = 1 + \kappa \left(\frac{I_{i,t}}{K_{i,t-1}} - \delta \right), \quad (27)$$

$$q_t = \beta_i E_t \left\{ \frac{\lambda_{i,t+1}}{\lambda_{i,t}} \left(R_{t+1} - \frac{\kappa}{2} \left(\frac{I_{i,t+1}}{K_{i,t}} - \delta \right)^2 + \kappa \frac{I_{i,t+1}}{K_{i,t}} \left(\frac{I_{i,t+1}}{K_{i,t}} - \delta \right) + (1 - \delta) q_{t+1} \right) \right\}. \quad (28)$$

The aggregate resource constraint now reads

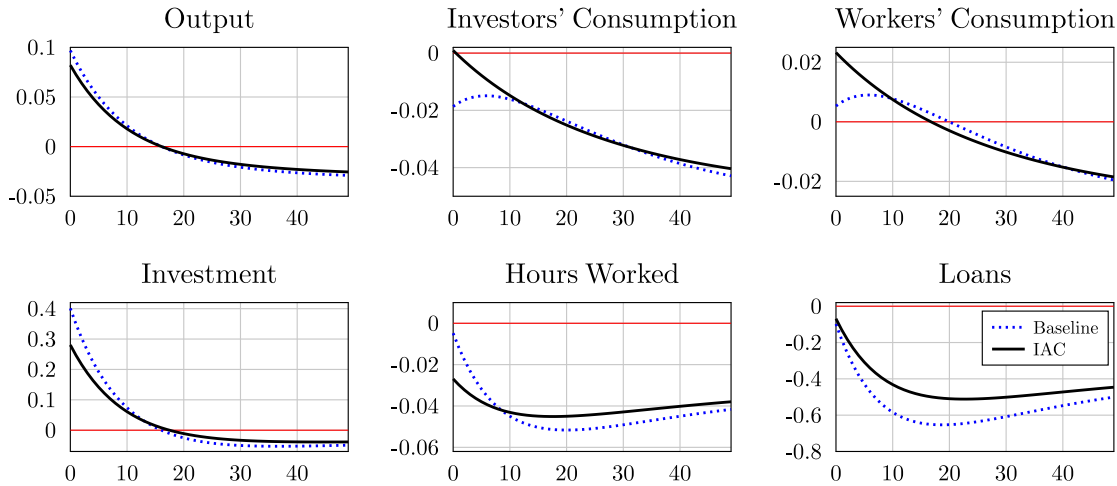
$$Y_t = C_t + I_t + (1 - \chi)\phi(D_{w,t} - \bar{D}_w)^2 + \chi \frac{\kappa}{2} \left(\frac{I_{i,t}}{K_{i,t-1}} - \delta \right)^2 K_{i,t-1}. \quad (29)$$

All remaining first-order conditions are identically equal to the baseline model.

Figure 3 shows impulse responses to a one standard deviation technology shock for the baseline model (dotted lines) and the setting including capital adjustment cost (solid lines). Following Erceg and Levin (2003), the capital adjustment cost parameter, κ , is set to 5.6, and b is 2 for both model constellations. All remaining parameters are set as documented in Table 1.

As adjusting the capital stock becomes costly, investment rises less when including capital adjustment cost. Consequently, investors use the additional resources for consumption, such that expenditures are reduced by a smaller amount compared to the baseline scenario. As workers seek to minimize the difference between both consumption levels, they also consume more when integrating capital adjustment cost. Interestingly,

Figure 3: Impulse responses to a one standard deviation technology shock.



Note: Responses are measured in percentage deviations from steady state. Horizontal axes measure time in quarters.

to obtain this higher consumption level, workers do not reduce hours worked less but decrease loans demand by a smaller amount. Although both consumption levels are higher than in the baseline case, a technology shock still leads to a negative employment response when incorporating capital adjustment cost into the model. Concerning aggregate output, there are no significant difference between the baseline and the capital adjustment cost scenario.

5 Conclusion

Standard RBC models predict a rise in employment following a technology shock. This theoretical result stands in sharp contrast to empirical studies, which find that a positive technology shock leads to a fall in hours worked (e.g. Galí (1999), Basu, Fernald, and Kimball (2006), Canova, López-Salido, and Michelacci (2010)). This paper shows that a flexible price model enriched with interpersonal consumption comparison is able to produce a negative employment response to an exogenous productivity increase. Incorporating such a mechanism into an otherwise standard macroeconomic model is backed by recent empirical evidence (e.g. Bertrand and Morse (2013), Maurer and Meier (2008), Bowles and Park (2005)). Our model economy is populated by two different types of agents, investors who hold the economy's entire stock of capital and workers who make up the entire labor force. In addition, working households seek to minimize the difference between both agents' consumption levels. When the technology shock hits the economy, the marginal products of labor and capital increase immediately. Therefore, investors invest more but decrease consumption expenditures as working households reduce loans demand sharply. As workers' optimal consumption level decreases with the strength of

the relative consumption motive, they are able to reduce hours worked but still gain in terms of a higher labor income. This negative employment response is robust to different values assigned to inverse Frisch elasticity, allowing for capital adjustment cost in the model and the functional specification used for the relative consumption motive in the workers' utility function.

References

- Abel, Andrew B. (1990). “Asset Prices under Habit Formation and Catching up with the Joneses”. *American Economic Review (Papers and Proceedings)* 80 (2), 38–42.
- Airaudo, Marco and Luca Bossi (2014). “Trickle-Down Consumption, Monetary Policy, and Inequality”. mimeo.
- Al-Hussami, Fares and Alvaro Martín Remesal (2012). “Current Account Imbalances and Income Inequality: Theory and Evidence”. Kiel Advanced Studies Working Papers 459.
- Alonso-Carrera, Jaime, Jordi Caballé, and Xavier Raurich (2008). “Can consumption spillovers be a source of equilibrium indeterminacy?” *Journal of Economic Dynamics & Control* 32 (9), 2883–2902.
- Alvarez-Cuadrado, Francisco and Mayssun El-Attar (2012). “Income Inequality and Saving”. IZA Discussion Papers 7083.
- Andrés, Javier, José E. Boscá, and Javier Ferri (2013). “Household debt and labor market fluctuations”. *Journal of Economic Dynamics & Control* 37 (9), 1771–1795.
- Basu, Susanto, John G. Fernald, and Miles S. Kimball (2006). “Are Technology Improvements Contractionary?” *American Economic Review* 96 (5), 1418–1448.
- Bertrand, Marianne and Adair Morse (2013). “Trickle-Down Consumption”. NBER Working Papers 18883.
- Bowles, Samuel and Yongjin Park (2005). “Emulation, Inequality, and Work Hours: Was Thorsten Veblen Right?” *Economic Journal* 115 (507), F397–F412.
- Canova, Fabio, J. David López-Salido, and Claudio Michelacci (2010). “The Effects of Technology Shocks on Hours and Output: A Robustness Analysis”. *Journal of Applied Econometrics* 25 (5), 755–773.
- Cantore, Cristiano, Miguel León-Ledesma, Peter McAdam, and Alpo Willman (2014). “Shocking Stuff: Technology, Hours, and Factor Substitution”. *Journal of the European Economic Association* 12 (1), 108–128.
- Christiano, Lawrence J., Martin Eichenbaum, and Robert Vigfusson (2003). “What Happens After a Technology Shock?” NBER Working Papers 9819.
- (2004). “The Response of Hours to a Technology Shock: Evidence Based on Direct Measures of Technology”. *Journal of the European Economic Association* 2 (2-3), 381–395.
- Collard, Fabrice and Harris Dellas (2007). “Technology Shocks and Employment”. *Economic Journal* 117 (523), 1436–1459.
- Dedola, Luca and Stefano Neri (2007). “What does a technology shock do? A VAR analysis with model-based sign restrictions”. *Journal of Monetary Economics* 54 (2), 512–549.
- Dupor, Bill and Wen-Fang Liu (2003). “Jealousy and Equilibrium Overconsumption”. *American Economic Review* 93 (1), 423–428.

- Fernald, John G. (2007). “Trend breaks, long-run restrictions, and contractionary technology improvements”. *Journal of Monetary Economics* 54 (8), 2467–2485.
- Francis, Neville and Valerie A. Ramey (2005). “Is the technology-driven real business cycle hypothesis dead? Shocks and aggregate fluctuations revisited”. *Journal of Monetary Economics* 52 (8), 1379–1399.
- Galí, Jordi (1994). “Keeping Up with the Joneses: Consumption Externalities, Portfolio Choice, and Asset Prices”. *Journal of Money, Credit, and Banking* 26 (1), 1–8.
- (1999). “Technology, Employment, and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations?” *American Economic Review* 37 (4), 1661–1707.
- Hall, Robert E. (2009). “Reconciling Cyclical Movements in the Marginal Value of Time and the Marginal Product of Labor”. *Journal of Political Economy* 117 (2), 281–323.
- Heffetz, Ori (2011). “A Test of Conspicuous Consumption: Visibility and Income Elasticities”. *The Review of Economics and Statistics* 93 (4), 1101–1117.
- Iacoviello, Matteo (2008). “Household Debt and Income Inequality, 1963-2003”. *Journal of Money, Credit and Banking* 40 (5), 929–965.
- Klein, Mathias and Christopher Krause (2014). “Income Redistribution, Consumer Credit, and Keeping up with the Riches”. Ruhr Economic Papers 0509.
- Kumhof, Michael and Romain Rancière (2010). “Inequality, Leverage and Crises”. IMF Working Papers 10/268.
- Kumhof, Michael, Romain Rancière, and Pablo Winant (2013). “Inequality, Leverage and Crises: The Case of Endogenous Default”. IMF Working Papers 13/249.
- Mandelman, Federico S. and Francesco Zanetti (2014). “Flexible prices, labor market frictions and the response of employment to technology shocks”. *Labour Economics* 26 (C), 94–102.
- Maurer, Jürgen and André Meier (2008). “Smooth it Like the ‘Joneses’? Estimating Peer-Group Effects in Intertemporal Consumption Choice”. *Economic Journal* 118 (527), 454–476.
- Michelacci, Claudio and J. David López-Salido (2007). “Technology Shocks and Job Flows”. *Review of Economic Studies* 74 (4), 1195–1227.
- Mumtaz, Haroon and Francesco Zanetti (2012). “Neutral Technology Shocks and the Dynamics of Labor Input: Results from an Agnostic Identification”. *International Economic Review* 53 (1), 235–254.
- Peersman, Gert and Roland Straub (2009). “Technology Shocks and Robust Sign Restrictions in a Euro Area SVAR”. *International Economic Review* 50 (3), 727–750.
- Rebei, Nooman (2014). “What (really) accounts for the fall in hours after a technology shock?” *Journal of Economic Dynamics & Control* 45, 330–352.
- Wang, Pengfei and Yi Wen (2011). “Understanding the effects of technology shocks”. *Review of Economic Dynamics* 14 (4), 705–724.

Whelan, Karl T. (2009). “Technology shocks and hours worked: Checking for robust conclusions”. *Journal of Macroeconomics* 31 (2), 231–239.